droxytryptamine, appeared on the scene, and 22 years since its chemical synthesis and competitive distribution by two American drug firms made it widely available to researchers. These two volumes are the fifth (at least) and the most recent collection of papers representing the efforts of many scientists caught in serotonin's web. They contain 82 separate contributions describing various aspects of the biochemistry, physiology, pharmacology, anatomical distribution, and behavioral implications of serotonin.

Although it is only one of a growing number of chemical neurotransmitter substances in the central nervous system (CNS), serotonin has been particularly provocative, enticing neuroscientists to follow its trail in the naive hope of finding simple answers to some questions about CNS function. Despite enormous effort and very considerable progress, the questions have become more complex as more information has been acquired.

What is the function of serotonergic tracts and of tracts utilizing other neurotransmitters such as acetylcholine, norepinephrine, and dopamine? How is behavior modified by interactions of various neural pathways that utilize different neurotransmitters? What is the mechanism of action of hallucinogenic substances, many of which (for example, LSD, bufotenin) are structurally closely related to serotonin? Is physical dependence on drugs (such as morphine) connected with serotonergic pathways? Is there a simple relationship between a disordered metabolism of serotonin (methylation, deamination, turnover) and human behavioral disorders such as depression and schizophrenia?

These two volumes show that scientists engaged in this work are aware of these larger questions but have not yet acquired sufficient information to attack them. Rather, they are concerned with smaller questions that *can* be answered, in the expectation that the smaller answers obtained will shed light on the larger questions of function. These smaller questions mainly concern regulation of concentration and turnover of serotonin in the CNS.

Regulation, which determines how much neurotransmitter reaches the receptor site on the postsynaptic membrane, involves consideration of at least five processes: biosynthesis, breakdown, storage, and release from and reuptake into the nerve endings. With the exception of release, each of these processes receives some consideration in these volumes. Particular attention is given to biosynthesis (activity of the rate-limiting enzyme, tryptophan hydroxylase, is affected by availability of substrate, hormones, feedback inhibition by intermediary and final products, and feedback regulation through neuronal loops), breakdown (multiple forms of monoamine oxidase), and further metabolism (methylation and acetylation).

Much of our progress comes through the discovery of drugs that not only have a selective action on a particular neurotransmitter system, but also preferentially affect only one of the five or six regulatory processes. The newest drugs are the neurotoxic agents 5,6- and 5,7-dihydroxytryptamine, which are useful not only for mapping serotonergic tracts but because their effects force us to a higher level of sophistication in considering the function of such tracts. For example, these agents and *p*-chlorophenylalanine (an inhibitor of tryptophan hydroxylase) lower brain serotonin concentrations, but the enzyme inhibitor produces no obvious changes in behavior, whereas the neurotoxic agents cause bizarre behavioral effects.

One of the assets of a comprehensive review of current studies is that it suggests, by its omissions, kinds of research that are needed. For example, these volumes do not report on: (i) studies of release mechanisms; (ii) development of a peripheral model, perhaps the myenteric plexus, that will play the role that the neuromuscular junction does for cholinergic mechanisms; (iii) determination of which behavioral effect (rapid eye movement sleep, temperature, sexual activity, memory, affective disorders) is most significant for determining selectivity of antiserotonin agents; (iv) studies of the relation of serotonin synthesis in the perikaryon to that in the nerve ending and of the role of axonal transport; (v) studies of storage forms other than synaptic vesicles, whose existence is indicated by new biochemical, morphological, and pharmacological data (for example, the presence of a special compartment for newly synthesized transmitter, the presence of reserpine-resistant stores, the electron microscope evidence for "tubular reticulum-like structures," and the presence of soluble high-affinity binding proteins in nerve ending cytoplasm).

Costa, Gessa, and Sandler have performed a great service in compiling such a comprehensive discussion of the present state of serotonin research and the current hypotheses invoked to explain complex observations. These hypotheses are no longer very simple, but even a touch of insight often requires an enormous number of very small steps.

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Eastern Biota

Ecology and Biogeography in India. M. S. MANI, Ed. Junk, The Hague, 1973. xx, 774 pp., illus. + maps. Dfl. 190. Monographiae Biologicae, vol. 23.

That the biogeographical and geomorphological evolution of the Indian subregion or subcontinent should be considered in an integrated fashion is the purpose of this work edited by M. S. Mani. Mani, whose distinguished work in entomology, particularly on the insect fauna of high altitudes, has been known to the reviewer for over 20 years, has performed a most valuable task in putting together this monumental work. Taking advantage of new information from plate tectonics and continental drift, weather and climatic patterns, and recent revisions in botany and zoology, he and his co-workers have assembled a thorough synthesis of present-day biogeographical evidence.

One of the important points the editor makes is that nothing is static in biogeography. Perhaps this is one of the difficulties of the subject which prompt him to say that "field ecology and biogeographical researches in India often seem to have been looked upon with considerable misgivings as belonging to the realm of speculation." It is true that in the halcyon days of speculative biogeography floating islands, land bridges, and mountain range gaps were created and made to appear and disappear, like conjurors' rabbits, at the whim of biologists. Today patterns are studied with new geomorphological and climatological evidence in mind, and biogeography is becoming bedded in a firm body of documented evidence.

The evolution of distributional patterns of animals and plants, subject as they are to a complex web of circumstances, has indeed tended to confuse

many workers and make the evidence seem a trackless jungle. As Mani says, "The present-day flora and fauna of India [the word is used here in a generic sense to refer to the region] are indubitably the product of such a continual change in the past; they represent the modified descendents of past floras and faunas. The evolution of the flora and fauna must be interpreted in terms of the continual changes in the size, location, configuration, topography, stratigraphy, drainage patterns and other tectonic changes which have taken place in the region in the past." The editor believes, as I do, that, given the evidence of continental drift, the single most important influence on these parameters and hence on biogeographical evolution in the region is the uplift of the Himalayan range.

The book consists of an introduction by Mani and 23 subsequent chapters, 10 of them also by Mani and the remaining 13 by such authorities as the late M. S. Krishnan on geology, L. A. Ramdas on climatology, K. Subramanyam and M. P. Nayar, A. S. Rao, and M. A. Rau on phytogeography, P. Lal on the human hunter-gatherers, and A. K. Mukherjee, whose contribution is a timely and fascinating discussion of recent faunal impoverishment and regression. As an ecologist I regard consideration of the present-day influence of man, as well as of the important role of more aboriginal man in the past, as a necessity in a treatise on biogeography, and I am delighted to see that evolution *in process* in socioeconomic terms has intruded itself between the covers of this work. The sole complaint in this regard is that such information tends to be dated when written, so badly does the world wag these days. The only solution would have been to insert Mukherjee's chapter 12 in loose leaf so that the dismal tale could have been brought up to date at intervals.

Finally, there are a number of chapters on ecology and ecological associations of vertebrates and insects of the Indian region. These are in some ways less valuable, being essentially a tabulation form of ecology reminiscent of the old "Fauna" volumes of the former government of British India series. Holloway's chapter on Indian butterflies takes a broader, less quantitative approach than the others, presumably because of his interests outside the region, in Indochinese and Sunda-land biogeography.

One matter that became of great interest to me in my own work on avian biogeography in this area is the question of Ethiopian affinities, a question that has recently been revived by Moreau in his work on African biogeography. I could wish that more had been said about these affinities or that a more penetrating analysis had been included of the arc of the interchange between Ethiopia and Arabia and the northwest that must have taken place since the end of Miocene times and of the gradual changeover in biota that occurred as the Tethys sea closed. Perhaps this matter is of less interest to these authors, but it remains for a future work to delineate.

At all events this volume should be in every library collecting important source works in that newly reawakened subject, biogeography.

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Physics in the Early 1900's

The History of the Quantum Theory. FRIEDRICH HUND. Translated from the German edition (Mannheim, 1967) by Gordon Reece. Barnes and Noble, New York, 1974. 260 pp., illus. $20.

The development of the quantum theory and its applications in atomic physics from 1900 to about 1930 has had a very special fascination for physicists, historians of physics, and popularizers of various kinds. The history has been repeatedly retold, by Rubinowicz and Guth, by d'Abro, by Whittaker, by Tomonaga, by Jammer, by Hund—to name only those addressing students of physics primarily. In each case, however, the treatment has been at roughly the same physicomathematical level, has offered roughly the same account of what actually happened, and thus has rendered the history at roughly the same length and depth.

Hund's *Geschichte der Quantentheorie* (1967; Hochschultaschenbuch 200/200a* of the Bibliographisches Institut, Mannheim), although generally faithful to the canon, is in several respects the best of this group. Hund goes farther than most in offering chapters on post-1926 developments other than indeterminacy. With an extended range encompassed in considerably less than half the volume of Max Jammer's well-known *Conceptual Development of Quantum Mechanics* (1966), the treatment is necessarily extremely concise. This concision is facilitated by frequent recourse to a logicohypothetic treatment of historical causation. But as Hund is careful not to violate "causality" (temporal sequence) and is usually clear when and where he is representing the development as it might or should or could have been (subjunctive rather than indicative; present rather than imperfect), the historian, though he may find the genre less satisfying, cannot challenge its legitimacy. Neither is Hund's history entirely free of factual errors or wrongheaded contentions, but they do not repose upon those double columns of crenelated footnotes that give Jammer's work the appearance of impregnability. It is, moreover, the best-balanced history of the quantum theory, above all in presenting—as no other history has—the effort to unravel the complex structure of spectral lines in its true historical proportions and perspective, namely, as the avenue "of choice" to the quantum mechanics. Finally it contains rudiments of a social history—which is more than can be said of any of the other histories of the quantum theory. Rather than simply advancing from result to result, Hund regularly stops to look around and characterize the state of the field at a given point in time, in particular pointing up the "crisis" that emerged in 1923 and the "flood of applications" in 1927. This important perspective is belied, however, by the very limited number of original papers and contributors Hund chose to cite. In this respect his account unfortunately caters to the scientists' predilection for a history carried on the shoulders of giants.

The concision of Hund's history and the precision of his choice of words, moods, and tenses—outstanding virtues in the original German—render the book especially vulnerable in translation. The translator was not notably expert or careful in his work. Quite apart from the infelicities and inexactitudes, he has introducd roughly one falsehood or nonsense statement in every two pages. Thus he who takes this translation to hand, though he can learn from it, won't have much pleasure from it.

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