Book Reviews

Geopollution Surveyed

Man's Impact on the Global Environment. Assessment and Recommendations for Action. Report of the Study of Critical Environmental Problems. M.I.T. Press, Cambridge, Mass., 1970. xxii, 320 pp., illus. Paper, $2.95.

Every time we learn that yet another man-made substance has been found to have distributed itself uniformly throughout the atmosphere, we are reminded that our planet is finite and vulnerable. The skills of atmospheric chemists are such, however, that the threshold for detection of a substance can be well below the level that would have a significant influence on our environment. The determination of what amounts may be significant was the task set for a group of about 50 specialists of various kinds who met last July in Williamstown, Massachusetts, under the sponsorship of the Massachusetts Institute of Technology. This book is their report.

The study was of the problems of geopollution, that is, the contamination by man of the whole atmosphere and ocean system, rather than of the more immediate and well-studied problems of regional pollution. Thus the planet was treated as a container within which it was possible to compute total budgets of material and energy. While some work groups balanced these budgets, others estimated the influence of the predicted concentrations on the climate and on living organisms. One work group specified the kind of physical and biological monitoring necessary to provide warning, and still another considered the social and political implications of attempted remedies.

The first part of the report is a 35-page summary of the findings of the study, with conclusions and recommendations. The second and larger part consists of separate reports of the work groups giving the technical bases for their findings. As is to be expected in such a collective report so rapidly published, there is some overlap in work and contradiction in conclusions. Yet I believe that this contradiction gives the reader a more honest view of the matter and clearly reveals the uncertainties in the estimates made.

What then are the critical environmental problems? Here there are no great surprises. We must worry about heavy metals, oil slicks, phosphates, CO_2, DDT, and the SST. Interesting examples of quite different kinds of problems are provided by DDT and the SST.

The physical aspects of DDT production and distribution are relatively well understood. The report gives figures on production and measured concentrations in rivers and rainwater and on the increase of concentrations in the food chain from plankton to pelicans. There is an impressive array of reports of damage in the reproductive processes of fishes and birds. We are assured that a catastrophic destruction of all plankton by DDT is unlikely because the required amount exceeds by tenfold its solubility in seawater, but, as a disquieting afterthought, we are reminded that DDT is soluble in oil, and a combination of DDT and oil slick might be dangerous.

The complex social aspects of pollution problems become evident in a discussion of the difference in attitude toward DDT of developed and developing nations. A nation still facing hunger and malaria is not yet concerned about the fishing streams, the deer parks, the forest preserves, and other amenities of the well-to-do.

Unlike the measurable problem of DDT, the possibility of climate modification by the SST is a future problem and involves somewhat uncertain theoretical predictions. The report gives the characteristics of the SST engine and its projected traffic and deduces estimates of resulting changes in the composition of the stratosphere. Two of these changes, in water vapor and in particulate matter, are thought to have possible climatic significance. Water vapor might be increased 10 percent globally and be doubled in air lanes with a possible consequent increase in stratospheric cloudiness and a "greenhouse" effect on temperatures. The amount of particulate matter might be doubled over that measured in 1960; but the eruption of Mount Agung in 1963 seems to have increased particulate matter in the stratosphere by an order of magnitude, so that of the amount measured in the late 1960's the projected increase is 10 percent globally and a doubling in air lanes. The Mount Agung eruption has had a measurable but small effect on the climate, having apparently produced a 5°C warming in the lower equatorial stratosphere. These figures have left with me the impression that SST traffic would probably not seriously influence the climate but that the scientific uncertainties involved are large enough that the possibility is not ruled out. The social values and damages associated with SST traffic are not discussed in the report.

The study was a month's work well done, and its report, though it was assembled hurriedly, provides the pertinent facts where known. It also reveals many areas of ignorance within which further research is needed.

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Seeing and Perceiving

The Intelligent Eye. R. L. GREGORY. McGraw-Hill, New York, 1970. 192 pp., illus. $7.95.

Richard L. Gregory, professor of bionics at the University of Edinburgh, delivered the distinguished Royal Institution Christmas Lectures in 1967–68 under the title "The Intelligent Eye." The present book is an essay of the same title rather than a record of the lectures. It is a lively and provocative discussion of the nature of visual perception, with a theory of its relation to the thought processes. The experiments here reported show Gregory to be an unusually talented and ingenious experimenter, and the illustrations and demonstrations with which the book is richly provided enhance it greatly. The stereoscopic drawings, for example, are exceptional (a viewing device for these is provided), and well-chosen engravings, op paintings, and many other

kinds of illustration contribute to the interest of the book.

Quoting a paragraph from Helmholtz which contains the famous doctrine of the role of unconscious inferences in perception, the author comments that his book "may almost be regarded as an extension of this passage from Helmholtz" (p. 31). Perception is considered to be a matter of building up and testing hypotheses; it involves inferences from sensory data to the external objects which gave rise to the sensory pattern. Thus perception, for Gregory, involves a kind of problem solving; it is in this sense that the eye is intelligent.

The identification of the correct object presents a problem because a given retinal image could have been produced by any number of things. Hypotheses about the most likely object are provided by past experience: "Retinal images evidently serve to select from a stored repertoire of objects represented symbolically in the 'visual' brain. Perception must, it seems, be a matter of seeing the present with stored objects from the past" (p. 36). In some cases, the ambiguous figures [see cover], alternative hypotheses are equally likely, and "the brain never makes up its mind" (p. 38).

As with other accounts that assign to previous experience a major part of the responsibility for perception, two questions must be faced: How were the first perceptions possible—that is, before past experiences existed to account for them? and How is this experience itself acquired? Gregory does not deal adequately with either question. In connection with the first, he seems to admit "the possibility that some perceptual organising processes are 'wired in' at birth" (p. 22). This possibility does not figure in his subsequent discussion, however, and, for a reason to be indicated below, will not solve our problem in any case. The author fails to see the problem of how experience is acquired because he does not face the problem of organization. No retinal image can select a memory trace from "a stored repertoire of objects," since the retinal image is not itself organized; it is a mosaic of excitations indifferent to one another, excitations which do not themselves constitute a form. Only an organized process can make contact with the organized memory trace of a previously perceived object; thus organization in the visual cortex is prior to trace selection and must be considered before any use can be made of past experience in accounting for perception. Effects of past experience presuppose, they cannot produce, organization.

Apart from the failure to deal with organization, the author's persistent failure to understand Gestalt psychology is unfortunate in yet other respects. (See also his review of *The Task of Gestalt Psychology* by Wolfgang Köhler, *Science*, 8 May 1970.) While not rejecting the principles of organization formulated by Gestalt psychologists, Gregory attributes them to inductive generalization from instances; he describes the Gestalt view of them as "innate, inherited" (p. 20). But Köhler breaks out of the nativistic-empiristic dichotomy, distinguishing in addition those factors that organisms share with the rest of nature, thus factors independent both of heredity and of individual experience. These are factors concerned with action and include, of course, the cortical events corresponding to perception. It is incorrect to describe Gestalt psychology as nativistic; it takes into account inherited structures, influences of experience, *and* invariant dynamics. Gregory's organizing processes "wired in at birth," on the other hand, presumably refer to innate structures, not to invariant dynamics, and thus could not account for *processes* of perception, any more than wiring arrangements could provide the power that runs the computer.

The eye is intelligent not only in the sense of engaging in problem solving but also because abstract thinking is seen as emerging from vision. In this connection, the problem of the relation of language to thought is given a novel twist by the author, since abstract thinking seems to be derived from *written* language. The progress is one of increasing abstraction from pictures (such as stylized cave paintings) to increasingly simple and abstract pictographs, and finally to cuneiform characters or hieroglyphic or letter symbols, in which only "distant echoes" of the original pictograms remain. "Granted that, with the development of written language, thinking gradually became abstract, freed from perceptual situations, we can only speculate that the symbols were necessary for the thought; that the symbols freed the brain from the tyranny of sensory perception" (p. 147).

It is usual for students of language to regard spoken language as primary, written language as a later and secondary development. Thus it seems more likely that writing became a vehicle for the abstractions first expressed in spoken language than that it led to the development of these very abstractions. In any case, it is hazardous to infer from the contents of early writings —lists of possessions, commercial accounts, and the like—that earlier civilized man was incapable of, or uninterested in, abstractions.

Gregory sees the separation of thought from perceptual experience as culminating in modern science. Science's use of " 'observational data' which can only be 'observed' with instruments" presents a paradox, he says, since "the senses can no longer be said to be the sole source of direct knowledge" (p. 15). But observation with instruments depends ultimately on reading these instruments, thus on sense data. The development of science is further characterized by increasingly abstract theories; perceptual models of reality become inadequate. Thus "perhaps thought in terms of the brain's perceptual hypotheses becomes inadequate as theories become more general and abstract" (p. 152). Or, in other words, "the physicist in a sense cannot trust his own thought" (p. 150).

In these ways Gregory sees science as increasingly distant from man's perception and his thought processes. Since these are the basic tools of the scientist, the whole of science would be undermined if this theory were correct. Indeed the author himself comments: "We are left with a question: how far are human brains capable of functioning with concepts detached from sensory experience?" (p. 154). It is true, of course, that the scientist has no direct access to the physical world. But his inferences about it *are* based on observation, as mentioned above: pointer readings and the like are his link to hidden physical phenomena. These perceptual data are assumed—must be assumed—to share characteristics with the physical facts in question; it is only on this basis that theory building can proceed. And theoretical constructions, in turn, are tested experimentally—that is, against new perceptual facts. A theory of perception and thought that denies the basis on which science proceeds, the only one on which it can proceed, would seem to require revision.

It is only deductive inferences that, according to Gregory, thus become detached from perception. These are the inferences involved in abstract thinking, in communication, and in the hypotheses of formalized science. Deduction,

which requires a formal symbolic language, would thus be a uniquely human possession (or one shared by human beings and computers). Perceptual hypotheses, on the other hand, are essentially inductive. "We may say that deduction is non-biological—for there cannot have been deduction before there was formal language" (p. 161). Again, "it is the incredible invention of deductive thinking . . . which has given unique power to the human brain: allowing us to transcend our biological origin" (p. 162).

A number of issues arise in connection with this view. The author undoubtedly does not mean to say that formalized science is exclusively deductive, so comment here is unnecessary. But it needs to be shown, not merely asserted, what kinds of abstract thinking and communication involve deductions in what ways and to what extent. Nor is it clear why perceptual hypotheses are inductive if the problem to be solved is, "What is the object giving this projection?" (p. 36). Indeed, the author illustrates Helmholtz's doctrine of unconscious inference, of which his own theory of perception is said to be an extension, by way of a deduction (p. 30). Once more, it is difficult to see why a process that depends on language is "non-biological." Has not language a biological basis?

Many particular discussions in this book deserve mention. A single example of special interest is Gregory's treatment of the contrast between pictures and perceptual objects. Although, as he points out, most perceptual experiments have used pictures rather than objects, he shows important functional differences between the two. This discussion needs, of course, to be continued with a focus on similarities as well as differences between pictures and things. Metzger's work on three-dimensional illusions is relevant here, as well as the author's own ingenious "impossible object" constructed after the model of the "impossible triangle" of the Penroses.

The mixture of physiological and psychological terminologies in this book is particularly disturbing to the present reviewer. Such expressions as "pictures in the eye" (p. 15), "the brain never makes up its mind" (p. 38), "colour is transmitted to the brain" (p. 75) can only be confusing. The difficulty is not merely stylistic. To speak of "pictures in the eye" makes it easy to overlook the fact that the retinal image is a mosaic, and thus to bypass the problem of organization, as the author in fact does.

Gregory is obviously in command of the facts of perception, and his experimental contributions are excellent. His major thesis, that perception is intelligent, is an important and interesting one. It deserves better treatment.

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Heredity in Mental Disorders

Genetic Theory and Abnormal Behavior. DAVID ROSENTHAL. McGraw-Hill, New York, 1970. xviii, 318 pp., illus. $9.95. McGraw-Hill Series in Psychology.

Those who do not ignore the possibility of genetic influences on abnormal behavior are rightly cautious of unwarranted claims as to the nature and degree of such influences. A famous physician once reported a pair of identical twins so strikingly similar in their psychoses that both of them "often on the same day roused themselves from their habitual stupor and prostration"; such behavior would occur even when they were some miles apart. Of this report Francis Galton wrote in 1875: "Dr. Moreau (de Tours) ranked as a very considerable medical authority, but I cannot wholly accept this strange story without fuller information. Dr. Moreau writes it in too off-hand a way to carry the conviction that he had investigated the circumstances with the sceptic spirit and scrupulous exactness which so strange a phenomenon would have required."

A similar caution, together with a demand for high standards, pervades this book by David Rosenthal. This is one of its strongest points of recommendation in a climate of opinion in the social sciences where until recently it was widely considered outmoded to attach any weight at all to genetic factors. Rosenthal's conclusion, based on a detailed and thoughtful discussion of a wide range of evidence, that "it has been demonstrated beyond any reasonable doubt that heredity plays an important role indeed in the etiology of schizophrenia," will carry all the more weight, coming as it does from a trenchant but constructive critic of studies using schizophrenic twins and a pioneer of strategies employing adopted children.

The chapter on genetic studies of schizophrenia, over 100 pages long, forms the core of the book. There is a useful account of the methodology and results of recent adoption studies, and an instructive comparison of monogenic-biochemical, diathesis-stress, and life-experience models of the etiology. Much of the chapter is devoted to a discussion of the biological unity and specificity of the schizophrenic genotype, rather than just to whether genetic factors play a part or not.

If there were evidence that all functional behavioral disorders are genetically related, it would "support the popular claim that . . . there is only mental illness of more or less degree." Rosenthal's discussion of manic-depressive psychosis is more condensed, but it gives general support to its being a separate entity from schizophrenia, each illness having its own genetic spectrum. The fact that the author is a psychologist and not a psychiatrist wedded to the medical model will again add weight to his conclusions here. He warns that this basic foundation will crumble if it is not supported by blind diagnostic procedures. In fact, independent blind confirmation of results has already, in his own current work and elsewhere, strengthened conclusions concerning heredity.

In his book Rosenthal places human behavior in an evolutionary setting. The possible effects of both genetic and environmental variation are considered. But however important the genotype or constitutional diathesis may be for the major psychoses, its recognition, its mode of inheritance, and how it interacts with what environments to produce the psychosis are not matters that can be settled from the data at present available. The author wisely does not attempt to "tie all the material into a neat package with a cogent conclusion." Instead he organizes the evidence in such a way as to expose possible sources of error and to allow the reader to see what order can be brought to the data, what research they suggest, or what new theories they generate. He declares his own preference for a diathesis-stress theory of schizophrenia.

Mental retardation, aging, normal personality variation, and the behavioral consequences of disorders such as epilepsy fall outside the scope of the book, but there are excellent chapters on genetic studies of psychopathy, criminality, psychoneurosis, homosexuality, and alcoholism. "In all likelihood,