

THE HUMAN BRAIN AS A PREADAPTIVE FACTOR IN THE DEVELOPMENT OF CULTURE

LEO ESTEL

Department of Sociology and Anthropology, The Ohio State University

The central idea of preadaptation is the development of genetically inherited potentials making possible the utilization of a new environment (Huxley, 1943). The term is quite often used in reference to a set of variables present that make possible survival during drastic climatic changes. A classic example would be the presence of rudimentary lungs and lobed fins in the Crossopterygians of the Paleozoic which facilitated the transition of the vertebrates from an aquatic to a terrestrial habitat (Romer, 1945). Preadaptation is most probable in a large, highly variable population. The preadapted segment, small in the beginning, expands rapidly, accompanied by wholesale destruction in the rest of the population (Simpson, 1944). Preadaptation does not oppose natural selection but goes along with it, taking advantage of accumulations of small, relatively unimportant mutations.

The known time of man on earth is accompanied by a series of drastic climatic changes during the fluctuation of the glaciations in the Pleistocene. Our earliest evidence for man coincides rather closely with the initiation of the climatic changes leading to the first glaciation (Zeuner, 1946). However, the appearance of drastic climatic changes are not necessary to the application of the idea of preadaptation. A markedly new and different use of an existing environment could be made possible by the gathering together of an accumulation of small mutations in a small breeding group.

Evolutionary differentials may be structural, such as the differences between lobe fins and ray fins which seem initially to have served the same function. Differentials may be of a more functional nature as in the difference in the functioning of gill and lung. A third differential is in the functioning of the brain and the central nervous system. Differential behavior between contemporary ape and contemporary man is mediated by differences in size, proportionate distribution of tissues, and microscopic structure of the brain (Hooton, 1942). Differences in facial structure among apes and man have no great significance, as far as behavioral patterns are concerned. The post cranial structure of an ape such as the chimpanzee would provide no great bar to the enjoyment of modern civilization if a human head was properly attached.

From our fragmentary evidence the major observable differential between early man and his immediate primate ancestors is in behavioral patterns as evidenced by utilization of the environment. Very early in his career man began to manufacture tools in a continuing pattern passed on from one generation to another. He also utilized fire very early in his career. If we could observe the transition from ape to man, gross morphological and functional changes would be minute and almost undetectable. Major detectable differentials would be in behavior mediated by an accumulation of small mutations affecting the complex structure of the primate brain. One of the foremost proponents of the idea of asymmetrical evolution was Dr. Hooton (Hooton, 1949). Behavioral patterns would indicate that this first human brain persisted through the early part of human existence, probably for about its first two-thirds. In the meantime the facial and postcranial structure of man was undergoing evolutionary modifications.

A major change in behavioral patterns for man appears in Europe with the arrival of the Mousterian culture and Neandertal man (Boule and Vallois, 1957). Intentional burial with grave offerings among the Neandertal type of men indicate an ability to conceptualize far beyond immediate time and place. This dif-

ference in behavioral pattern is accompanied by an enlargement of the brain case and some redistribution of the proportionate constituents of brain tissue. Variant types of man occur in Asia and Africa contemporary with the European Neandertals (Weidenreich, 1943). These seem to fit into a continuum with the Neandertal as regards brain size and behavior. In gross size the Neandertal brain, as evidenced by available brain cases, falls within the range of variability for modern man (McCown and Keith, 1939). The human brain exhibits a large degree of plasticity without alteration of function. Human heads can be deformed artificially without impairment of mental ability. The shape of the Neandertal brain falls within the range of variability for modern man.

A very large discontinuity in cultural development is shown between the Mousterian and Aurignasian cultures in Europe, accompanied by the disappearance of the classic type of Neandertal and the immigration of *Homo sapiens* (Garrod, 1938). The elaboration of culture exhibited by *Homo sapiens* is made possible, in part, by an apparently greater group organization and cooperation. Neandertal man seems to have been an exponent of rugged individualism operating in very small bands.

The human brain is a very complex organ performing many functions. Only a part of the brain is occupied with the conscious reception of stimuli and its sorting and coordination. The reaction to stimuli are only in part determined by logical reasoning and past experience. Brain size and gross structure for the orangutan, chimpanzee and gorilla show an overlapping continuum. Basic inherited intelligence differs very little among these three groups. The inherited temperamental disposition differs markedly among orangutan, chimpanzee and gorilla (Yerkes and Yerkes, 1929). I believe that these temperamental differentials are mediated by subliminal activity in the mid brain.

As in the case of the transition from ape to man, the major differential between Neandertal man and *Homo sapiens* is in behavioral patterns and not in morphological structure. The facial and post cranial structures of the Mt. Carmel type of Neandertal would be quite compatible with participation in modern culture. As in the case of the anthropoid apes, the major differentials between Neandertal and *Homo sapiens* seem to be in the realm of temperamental disposition, not in intellectual capacity.

Differences between prehistoric skeletal remains of *Homo sapiens* and the skeleton of modern *Homo sapiens* do not exhibit biological differences that would show an evolutionary change as regards intelligence. The cultural elaborations of early *Homo sapiens* indicate a cultural capacity equal to that of modern man. The time of *Homo sapiens* is very short from an evolutionary standpoint and neither bones nor culture indicate noticeable important evolutionary changes.

I would summarize three stages in culture preceded and made possible by mutations inducing changes in the structure of the brain. First, the change from ape to man making possible the more efficient use of the environment. Second, the change to the Neandertal type of brain with its ability to conceptualize in time and space. Third, the *Homo sapiens* type of brain with the capacity for cultural elaboration. Each one of these stages made possible the new use of an existing environment. From his inception *Homo sapiens* seems to have had the capacity for cultural elaboration mediated more by a change in temperamental disposition than by an increase in intellectual capacity. The *Homo sapiens* brain contains preadapted factors making possible the development of our way of life.

BIBLIOGRAPHY

- Boule, M. and H. V. Vallois.** 1957. *Fossil Men*. Dryden Press. New York. 535 pp.
Garrod, D. A. E. 1938. *The Upper Paleolithic in the light of recent discovery*. Proceedings of the Prehistoric Society.
Hooton, E. A. 1942. *Man's Poor Relations*. Doubleday, Doran and Co., Inc. Garden City, New York. 412 pp.

- . 1949. *Up From the Ape*. The MacMillan Co. New York. 788 pp.
- Huxley, J. 1943. *Evolution*. Harper & Bros. 645 pp.
- McCown, T. D. and Sir Arthur Keith. 1939. *The Stone Age of Mount Carmel*. Oxford Press. London. 390 pp.
- Romer, A. S. 1945. *Vertebrate Paleontology*. University of Chicago Press. Chicago. 687 pp.
- Simpson, G. G. 1944. *Tempo and Mode in Evolution*. Columbia University Press. New York. 237 pp.
- Weidenreich, F. 1943. *The Skull of Sinanthropus pekinensis*. *Paleon. Sin.* n.s. D. No. 10.
- Yerkes, R. M. and A. W. Yerkes. 1929. Yale University Press. New Haven. 431 pp.
- Zeuner, F. E. 1946. *Dating the Past*. Methuen and Co. Ltd. London. 44 pp.

The Air. *Edgar B. Schieldrop*. Philosophical Library, New York. 1958. 256 pp. \$12.00.

This is one of a series of four independent books on the conquest of space and time undertaken by Edgar Schieldrop, a British Professor of Applied Mathematics. It is a nonmathematical and quite nontechnical presentation of flight from the dreams of mythology to the reality of recent years. The emphasis is on flying rather than on flying machines. The viewpoint is that of a competent person writing in a subject area somewhat divorced from his area of special competence. The most technical portion of this book is devoted to an elementary discussion of lift and why it occurs. Many excellent photographs with copious captions are included.

The story of flight from the days of hot air balloons thru exploratory attempts at gliding and crude powered flight up to the time of jet flight, is unfolded in a rather interesting and popular manner. The author emphasizes the point that man had to learn to fly or learn adequate means of controlling heavier-than-air machines before he could build a successful one. The evolution of the flying machine although chronologically rapid was accomplished thru the small contributions of many, just as is true of most major developments.

The Air should particularly appeal to lay people and others who are not too intimately associated with aviation although it does provide a quite readable semihistorical presentation for those in the field too.

GARVIN L. VON ESCHEN

Species Plantarum. *Carolus Linnaeus*. A facsimile of the first edition, 1753. Vol. I. Printed for the Ray Society, sold by Bernard Quaritch Ltd., 11 Grafton Street, London W1, 1957. 2 pounds, 10 shillings.

It is not often that a reviewer will call to the attention of readers recent publications of facsimile editions. This volume will be of considerable interest, however, to all biological scientists and science historians. Practicing systematic botanists still refer to Linnaeus' works, although only the few who work in large universities or famous libraries have access to a first edition of *Species Plantarum*. Now, for a reasonable amount of money, scientists working in any part of the world may own and use an excellent copy of this famous book. Its value for today is greatly enhanced by the scholarly 176 pages of Introduction by W. T. Stearn, of the British Museum. He has brought together from many sources, background materials and interpretations bearing on Linnaeus and Linnaeus' contributions to science. This will be of particular interest to the student. Some of the chapters of the Introduction deal with pre-Linnaean literature, a short biography of Linnaeus, a history of Linnaean herbaria, the species-concept of Linnaeus, the sexual system of classification, nomenclatural impact of *Species Plantarum*, geographical names in *Species Plantarum*, and a general bibliography. Each chapter in turn is followed by a list of references. The Introduction is followed by the 560 pages of facsimile which is quite clear and easily read. The final section of the book is an index to genera and classes, with page references to the 5th edition of *Genera Plantarum*.

If the possessor of this volume does nothing but show it to his students, or if he simply reads the Introduction but has no immediate use for the facsimile, he can derive much benefit. Certainly, for the systematic botanist much of the materials of the Introduction are "must" reading. The libraries of smaller universities and colleges will want one because of the prestige of *Species Plantarum*.

To handle this book gives one much the same feeling as owning a rare, old book of tremendous value. Truly, the publication of *Species Plantarum* was one of the most significant events in the whole history of science, and marked the beginnings of modern systematic botany.

ROBERT W. LONG