but that of I the most. Maize unsprouted shows excess of Bios I, after sprouting more of both but still excess of Bios I, although the Bios II increases most.

Comparison of Miss Eastcott's list of plant products, etc., containing bios with those listed by Sherman and Smith as containing Vitamin B, showed that these two substances are closely associated in nature; their possible identity, debated by Williams, Backmann, Eddy and Stevenson, and many others,[7] might seem to have been decisively negatived by the alfalfa experiment of Fulmer Nelson and Sherwood,[8] but it did not seem superfluous to test the efficiency of the two new preparations. Mr. Lucas accordingly made the trial with polyneuritic pigeons in the laboratory of Professor C. C. Benson, and with rats fed on a B-free diet in that of Professor V. E. Henderson; neither Bios I, Bios II, nor both together, not even malt combings themselves cured the pigeons or caused the rats to gain in weight, while the quantity of rice polishings that contained the same amount of bios as the preparations used was immediately effective. Similar work with scorbutic guinea pigs is now in progress.

At present, Mr. H. Sims is busy making Bios I from tea dust, a material suggested by Miss Eastcott's work, particularly suitable because of its freedom from sugar; an infusion freed from tannin (and no doubt from other substances as well) by sugar of lead, and from Bios II, etc., by charcoal, is precipitated by lead acetate and ammonia and the Bios I recovered by carbonic acid. Addition of methyl alcohol to the concentrated solution throws down two inactive crystalline substances; the filtrate evaporated and heated to 105° C. leaves a colorless extremely hygroscopic residue, largely crystalline, which contains nearly all the Bios I of the original tea; some of the crystals in this product are certainly inactive, the question whether all are impurities can be answered only when our preparations for manufacture on a larger scale are complete. Mr. E. M. Sparling is engaged in purifying Bios II by sorption on charcoal and recovery by acetone or by a solution of barium hydrate.[9]

It is too soon to claim that the preparations described above are pure, so nothing useful can be told at present of their chemical reactions; however, since cheap sources have been found, and recipes that give good yields, it should not be difficult to prepare them both in quantity, and then, of course, the work of establishing their chemical relationships begins. Their "growth-promoting" power is very striking: By adding 0.1 mg Bios I and 0.3 mg Bios II to 10 cc of a solution containing sugar and 180 mg dry salts (in the proportions used by Mr. Clark) the crop after 24 hours at 25° C. is raised from 3 or 4 mg to 50 mg of moist yeast containing 6 mg nitrogen. The work of Fulmer Nelson and White[10] with synthetic media disproves the too-wide claim that bios is "indispensable au developpement de la levûre"; still, auximones exist; and the honor of their discovery rests with the professor of Louvain.

W. LASH MILLER

[7] For bibliography see *Jour. Biol. Chem.*, *46*, 77 (1921).

[8] *J.* Am. Chem. Soc., *43*, 186, 191 (1921).

[9] February 18, 1924. Since the above was written, Mr. Sparling has succeeded in fractionating Bios II; thus Wildiers' bios consists of at least three separable constituents, all of which must be present in the medium to ensure normal reproduction of the yeast.

SOME FORCES IN MAN'S SOCIAL EVOLUTION[1]

I. INTRODUCTION

OUR present conception of the world and its life is of something dynamic, not static. The forces which affect the world and its inhabitants are being investigated and controlled. Diseases are no longer looked upon as arising from an offended deity. We have travelled far from the conception of the world as shown in "Oedipus," when man was utterly at the mercy of a capricious God, when nothing he willed to do could control or modify his fate. Man's knowledge of the sequence of cause and effect is being greatly broadened. The paleontologist has traced the stream of life—somewhat haltingly and interruptedly—but none the less progressively, from pre-Cambrian times through the millions of years to the present. The psychologist has not only traced our instincts, the basis of our mental life, back to their animal origins, but has indicated the way they may be sublimated and redirected to the future control of our evolution.

II. INHERITANCE

The development of the individual is dependent on the interaction of two sets of forces—the intrinsic and the extrinsic, the former represented by the possibilities resident in the individual's germ plasm, the latter by the environment into which he is born and in which he lives.

(1) INHERITANCE THROUGH THE BODY

(a) The body. Man inherits his body from prehuman ancestors. Bone for bone the plan of the skeletons of man and of all other mammals—horse, cat, dog, elephant—is identical. So, too, with all other bodily organs. More than 400 of the muscles moving man's body are present also in the cat, ending in

[10] *Jour. Biol. Chem.*, *57*, 397 (1923).

[1] Address of the vice-president and chairman of Section E—Geology and Geography—American Association for the Advancement of Science, delivered before the joint meeting of Section E, Cincinnati, December, 1923.

exactly the same bones, etc., and controlled by the same nerves and having similar functions. And thus it is with all the mammals. Just as similarity of word form and of construction in French, Italian and Spanish indicates a common ancestry, or the number five in the star-fish, sea-urchin, sea-lily and other classes of echinoderms shows a common ancestor, so the unity of structural plan in mammals indicates a common ancestry for them.

But man is not only related by blood to all the mammals, but more distantly to all animals with a backbone, for all—primitive fish, amphibian, reptile, bird and mammal—are built upon an exactly similar plan. All possess a backbone expanded in front into the skull through which extends the central nervous system sending off similar nerves to all parts of the body. This stiffening and supporting rod, the backbone, has attached to it two pairs of limbs with similar hipbone and shoulder supports. Still more distantly is man related to the animals without a backbone—the jointed worms, the jelly-fish and the microscopic, one-celled, protozoon amoeba. This relationship is corroborated by the individual life history of all the higher animals, including man. Each begins life as a minute protozoon-like cell, which develops into the ground plan of a jelly-fish (the gastrula), and this into an elongate form basically similar to the jointed worm. Thence the development proceeds through a form with gill-arches, etc., characteristic of the fish and thus by innumerable steps to man as he appears at birth. The brain of man shows during its development a similar relationship to lower vertebrates. In a very young embryo it basically resembles the brain of an adult fish, later of such a primitive mammal as the marsupial and still later that of such higher mammals as the lemurs.

The evidence from embryology is corroborated by the chemistry of the blood. A chemical test has long been used in law courts in murder cases. In this test the amount of precipitin formed indicates the animal whose blood is used, and the amount of precipitin formed is less and less, according to the decreasing degree of relationship. Chimpanzee blood gives 90 per cent. as much as man himself, the lower monkeys one fourth or one third as much, the lower mammals much less and thus downward in the scale. The same relationship is shown by the crystals formed from oxyhemoglobin present in arterial blood.

That this succession of animals indicates the steps in man's evolution is corroborated by the fact that these forms during earth history succeed one another in time. The protozoon, jelly-fish and worm were present upon earth during the very ancient Proterozoic time, the fish appeared first during the lower Paleozoic, the amphibian in the middle and the reptile during the upper Paleozoic. The earliest mammal made its appearance in the early Mesozoic, and man in the later Cenozoic. Evolved at various times during earth history, they persisted because of various factors of survival value which were passed on through inheritance to all succeeding generations.

(b) Impulses and instincts. Just as man has inherited his bones, muscles, nerves and other physical organs from the lower animals, so psychology shows he has with them inherited various impulses and instincts. (We are here considering these from an evolutionary point of view and have hence grouped together various instinctive reactions for simplicity of treatment.) An analysis of these forces shows that they were inherited with his body from ancestors at various periods back to the earliest protoplasm at the very beginning of earth history.

The three primary reactions—self-preservation, nutrition and reproduction—man possesses in common with all the lower animals. Without these impulses no form of life could perpetuate its kind; they must thus have been present at the appearance of life upon earth. These alone, of the impulses to be considered, were present in the protozoon, jelly-fish and worm. When the parental instinct, the next of the prominent social forces to be evolved, first made its appearance is impossible to say. It was without much doubt present in the higher fish of the middle Mesozoic and also in the reptiles and mammals of the same time, for it is present in the forms of these which have survived to the present. Many fish, such as the sunfish, are vigilant in the protection of their nests. It may have been exhibited in a rudimentary way by the fish and reptiles of the upper Paleozoic. It was naturally of great survival value to the offspring of the animals possessing it.

Later in time there developed among some mammals an association of individuals for the betterment of their protection, food-supply and care of young. Through this association into herds and packs certain modification in the behavior of the individuals must naturally take place. They would develop a susceptibility to leadership, for those failing to quickly respond would be killed off by the carnivores and thus leave no offspring. Similarly, any decided originality in conduct would be obliterated, since it would tend to expose not only the individual but the entire herd to danger. All members of the herd would thus develop the same fixed mental reactions to all ordinary happenings. Since he finds from infancy onwards both food and protection in the herd, each individual would naturally be happiest when with it; it is his normal environment.

These mental reactions would be impressed upon succeeding generations of Primate and earlier social mammals through the successful survival of the individuals exhibiting them. To-day through natural

inheritance we find them impressed upon man's body. In man we recognize the herd instinct in many characteristic reactions. Decided originality in conduct is looked upon with suspicion. What the majority say or do is right. He has fixed ideas, that is, his mental reactions are governed by what those individuals with whom he most associates, or the literature read by him, say is proper. The herd is his normal environment, that is, he is fearful of solitude, physical or mental. He is remarkably susceptible to leadership. He is subject to the passions of the pack, as is seen in mob violence or in heresy spasms. He is more sensitive to the voice of the herd than to any other influence; it can inhibit or stimulate conduct, courage, energy, endurance. This increase in energy and endurance is the basis of the cheering sections in sports. (It is a question as to how many of the various impulses grouped together under the term herd instinct are due to physical inheritance and how many are due to imitative, *i.e.,* social inheritance).

(2) INHERITANCE THROUGH THE ENVIRONMENT

(a) The physical environment. The physical environment in which organisms live has been constantly, though slowly, changing throughout the entire history of the earth. Such changes as from glacial temperatures to warm temperate, from very moist climates to arid, from land conditions to shallow ocean waters have occurred again and again. There is a progressive change in the ocean waters towards a greater density. There may be similarly a progressive change in the content of the air. But whatever present physical environment man has inherited from the past it constitutes a force with which he must reckon. Whether he lives in a region where climatic contrasts give him a high level of energy, or where the opposite is true, his habitat is a force to be considered.

(b) The social environment. In addition to the gradual expansion of consciousness through the avenues of instincts, man's prehuman forbears constantly gained a larger control over their surroundings through the increasing mass of knowledge possessed by the herd as an inheritance from the past. The lowest animals have only the knowledge (*i.e.,* ability, instinct) with which they are born. Each may add a very slight amount to his own inheritance during his life but can teach none of what he learns to his offspring. With the appearance of parental instinct, and the consequent increasing care of the young, however, there enters the imitation of parent by offspring, hence some knowledge is continued as a sort of tradition in addition to that handed down through the generations by birth inheritance. And with the coming of the herd, the young, associating intimately and long with many more than his parents, finds his imitative faculty expanded and the knowledge of his environment greatly broadened. Finally in man this knowledge is tremendously enlarged through the development of articulate speech.

The elaboration of articulate speech, which gave to man such a vast enlargement of the power of cooperation, must have progressed very slowly at first. In the later paleolithic, and especially in the neolithic stage of development writing was evolved and elaborated. At first it was confined to picture writing but was progressively simplified through the ages. It passed through the conventionalized form for more rapid use of stylus or brush to syllable writing in one direction and letter writing in another.

From now on the mass of human tradition became more full and more exact. Man's thoughts could affect others at a distance both in space and in time; hence, a tremendous impetus was given to further development. Finally, with printing, writing became cheap and thus the common heritage of all mankind. Hence more and more, the world over, men are learning to read, reaching towards the vast store of knowledge already accumulated in books, and urging themselves ever more and more rapidly to higher and higher levels. It has become a tremendous force in man's social evolution.

Earliest appearance	Inheritance through the body	Social inheritance (Through storage of knowledge from the past)					
		Printing	Writing	Elaboration of Articulate Speech	Tradition through the Herd	Tradition through Parents	Through Birth Inheritance only
Cenozoic (Late)	4. Self-consciousness and power of abstract reasoning (Man)						
Cenozoic (Early)	3. Herd Instinct (Mammals)						
Mesozoic	2. Parental Care (Higher Fish)						
Archeozoic	1. Three Primary Impulses. (All animals.) (Self-Preservation, Nutrition, Reproduction)						

III. CONTROL OF EVOLUTION

In man the control of evolution is made possible by self-consciousness and the power of abstract reasoning.

(1) CONTROL OF EVOLUTION OF BODY

Very much may be accomplished in the future along this line through a broader knowledge of eugenics, and the development and spread of this knowledge should become an important force in man's social evolution.

(2) CONTROL OF IMPULSES BY SUBLIMATION

The instinctive reactions inherited through long ages of constant need have naturally a tremendous momentum. They become forces of great import in man's social life. The impulses of self-preservation, nutrition and reproduction, for example, that in the lower organisms are the elevating forces that pull them up against matter, become in man forces against which he must struggle. He may not destroy them, for they are essential to the life of the individual and the continuance of the human race. He must sublimate them, that is, turn their momentum into avenues socially useful. Man does not get rid of fire because it, like these lower impulses, is frequently very destructive, but controlling it turns the force into lines useful to his advancement.

The impulses of self-preservation, nutrition and reproduction, and the later evolved parental and herd instincts, inherited with our body from brute ancestors, are forces with which man must continually reckon, and which, if he is to control his social evolution, he must continually guide into socially useful channels. For example, a child should pass naturally from his intense individualism to consciousness of the rights of the herd; but if his parents, teachers and others are constantly telling him that he is different from others, bad, always doing the wrong thing, it is likely he will become an incorrigible, an individual against society because society failed to make him a part of itself at the beginning. Of the prisoners in the Charlestown (Massachusetts) prison in 1921 Dr. Stearns showed 50 per cent. were the victims of the acquisitive instinct, 25 per cent. of the pugnacious instinct, and 25 per cent. of perverted sex instinct. The acquisitive and pugnacious instincts are two phases of the impulse of self-preservation. Thus 75 per cent. of the prisoners were here because the impulse of self-preservation, which in all its aspects is perfectly right for unsocial animals, had not been acted upon by the later acquired herd instinct. The tracing back of these criminals showed that they usually started in the home as children difficult to deal with, then became incorrigible, hence were sent to delinquent schools, next to reformatories, and finally to prison. The whole life of the child was thus to represent it to itself as one apart from the herd, just the reverse of what it should have been. Such men remain, because of their education, at the mercy of their primitive impulses, unmodified even by the herd instinct, and hence become a social menace.

(3) CONTROL OF ENVIRONMENT

(a) Man's control of his physical environment is getting more and more complete. So large a measure of control has man established over his physical surroundings with his partial conquest of disease, a better knowledge of foods, house construction and heating that the physical is the least conditioned part of his environment.

(b) Control of social environment. Here are almost endless possibilities. It is distinctively human that it is the imponderables that form the most important groups of forces that beset man from the outer world —the ideals of the family into which he is born, the moral standards of the society in which he moves, the state of progress of the government of which he is a member—in short, the education which he receives. Though the effects of this set of forces are not inherited with the body and its accompanying instincts, yet each individual after birth becomes heir to the products of all the past evolution of his race and herein lie great possibilities. The world into which future generations are to be born can be infinitely readjusted. By virtue of being born a member of a herd, each animal is heir to a smaller or larger body of tradition, his social inheritance, built up by the accumulated experience of the herd. By virtue of being born a man, he is self-conscious and hence need not, like the animals below him, be wholly at the mercy of the inherited instincts and the inherited body of social experience. On the one hand, he may control or sublimate the instincts; on the other, he may add his own experience to that he inherits from his herd and may hence consciously shape to some degree the body of social experience, that is, the social inheritance which is handed on to the next generation.

IV. SUMMARY AND PHILOSOPHIC DEDUCTIONS

The flow of evolving energy from early pre-Cambrian times to the present expresses itself through ever more complex forms until individualization is attained in man with consciousness of self. This energy expresses itself through each individual organism in the process of living. But certain acts involved in this process of living are performed so frequently and are so essential to the life of the race that they have become impressed upon the nerve cells as natural impulses and instincts. Three of these impulses, which have characterized life ever since its inception upon earth many millions of years ago, are self-preservation, nutrition and reproduction. Without these life could not have persisted. Later, during the Mesozoic arose the parental instinct, and still later

during the early Cenozoic the herd instinct. As soon as an animal becomes a social organism all its acts, even such individualistic primitive impulses as self-preservation and nutrition, become social forces. For as soon as individuals unite into a group the acts of each affect all. A man may drink alcohol as an individual act, but in his family or when handling an automobile the social aspects of this act are seen.

Man is thus permeated with tendencies toward a definite expression of his energies, that is, impulses and instincts inherited from his brute forbears; but in addition he bears within himself powers, attained with his manhood, capable of controlling and guiding their expression. Below man life is very largely at the mercy of its impulses, but with the incoming of self-consciousness and the power of abstract reasoning man can scrutinize these impulses and decide how to modify their expression. He may not destroy these impulses which he has inherited with his body, for they are essential to his individual life and the continuance of the race. He must turn them into avenues socially useful, or the human race will cease to advance and finally to exist.

The entire behavior of each invertebrate animal and of many of the lower vertebrates is governed by the three primary impulses alone—self-preservation, nutrition and reproduction. When parental instinct appears it becomes, in its best expression, dominant. When in the cat, for example, the offspring are small, the mother will forego her own preservation or nutrition for the sake of her young. Again, when the herd instinct appears, it takes precedence over the others. In wild cattle the preservation of the herd is more important than the preservation of one adult or one young.

The next step is naturally that man with his higher attributes of self-consciousness and his power of abstract reasoning is gradually realizing the oneness of the human race, the brotherhood of man, as well as his kinship with and hence responsibility to the lower forms of life.

With the ability to stand off and view himself attained with the incoming of self-consciousness man apparently again passed through the earlier stages of social evolution. In very primitive man the family is the highest unit; next the tribe takes precedence, then the nation, and to-day the internation is being emphasized. Throughout earth history the movement has been from the care of the individual to the care of an increasingly larger group. In the recent past we note among mankind this enlarging conception of brotherhood in the freedom of slaves, the care of the deformed and crippled, the growing equality of opportunity for the sexes, recognition of insanity and crime as disease and a growth in religious tolerance. Once before, during Roman times, this truth of man's brotherhood was emphasized by the early Christian Church; but the lack of close intercommunication so necessary for any feeling of unity was a fatal obstacle. With worldwide commerce, wireless telegraphy, cheap printing and a growing ability by all peoples to read, it appears that to-day is the time for the next upward step, making of all people one great unity. This enlarging conception of brotherhood is, as we have seen, a force established with the initiation of life upon earth. It has not varied throughout the subsequent millions of years, and is thus a force with which man must reckon if he would continue to live upon earth.

In the very impulses which he inherits from his brute ancestors man possesses forces which he can control for the advancement of the race. For example, because of this inheritance man views with suspicion pronounced originality of conduct. What the majority say or do is considered right, not because each has reasoned it out for himself, but because the fear of originality of conduct is impressed into the very nerve cells of man's body through long ages of inheritance because of constant need. This is not only a tremendous factor in the stability of any social structure, such a society and government, but we recognize that changes may be brought about only slowly and by process of education. The essence of education is self-discovery and self-control. The education of the future should give not only the facts of man's inheritance but the knowledge of them as forces which can be controlled, and the profound conviction that the world must be made a better environment for future generations to be born into, and that each individual can thus modify it to some degree.

HERVEY W. SHIMER

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THE AMERICAN MUSEUM OF NATURAL HISTORY

THE Fifty-fifth Annual Meeting of the Board of Trustees of The American Museum of Natural History was held at the residence of the president, Henry Fairfield Osborn, on the evening of February 4. The following changes took place in the Board of Trustees:

Mr. George F. Baker succeeded Mr. Cleveland H. Dodge as first vice-president, Mr. Dodge having served thirteen years in this office. Mr. Dodge continues his membership on the board which began in February, 1904. Mr. J. P. Morgan was reelected second vice-president for the twelfth year; Professor Henry Fairfield Osborn reelected to the presidency for the sixteenth year; Mr. Percy R. Pyne was reelected secretary for the fourth year.

The late Mr. Thomas DeWitt Cuyler is succeeded