MAN IN THE MODERN WORLD

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Note

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THE UNIQUENESS OF MAN

MAN'S opinion of his own position in relation to the rest of the animals has swung pendulum-wise between too great or too little a conceit of himself, fixing now too large a gap between himself and the animals, now too small. The gap, of course, can be diminished or increased at either the animal or the human end. One can, like Descartes, make animals too mechanical, or, like most unsophisticated people, humanize them too much. Or one can work at the human end of the gap, and then either dehumanize one's own kind into an animal species like any other, or superhumanize it into beings a little lower than the angels.

Primitive and savage man, the world over, not only accepts his obvious kinship with the animals but also projects into them many of his own attributes. So far as we can judge, he has very little pride in his own humanity. With the advent of settled civilization, economic stratification, and the development of an elaborate religion as the ideological mortar of a now class-ridden society, the pendulum began slowly to swing in the other direction. Animal divinities and various physiological functions such as fertility gradually lost their sacred importance. Gods became anthropomorphic and human psychological qualities pre-eminent. Man saw himself as a being set apart, with the rest of the animal kingdom created to serve his needs and pleasure, with no share in salvation, no position in eternity. In western civilization this swing of the pendulum reached its limit in developed Christian theology and in the philosophy of Descartes: both alike inserted a qualitative and unbridgeable barrier between all men and any animals.

With Darwin, the reverse swing was started. Man was once again regarded as an animal, but now in the light of science rather than of unsophisticated sensibility. At the outset, the consequences of the changed outlook were not fully explored. The unconscious prejudices and attitudes of an earlier age survived, disguising many of the moral and philosophical implications of the new outlook. But gradually the pendulum reached the furthest point of its swing. What seemed the logical consequences of the Darwinian postulates were faced: man is an animal like any other; accordingly, his views as to the special meaning of human life and human ideals need merit no more consideration in the light of eternity (or of evolution) than those of a bacillus or a tapeworm. Survival is the only criterion of evolutionary

success: therefore, all existing organisms are of equal value. The idea of progress is a mere anthropomorphism. Man happens to be the dominant type at the moment, but he might be replaced by the ant or the rat. And so on.

The gap between man and animal was here reduced not by exaggerating the human qualities of animals, but by minimizing the human qualities of men. Of late years, however, a new tendency has become apparent. It may be that this is due mainly to the mere increase of knowledge and the extension of scientific analysis. It may be that it has been determined by social and psychological causes. Disillusionment with *laisser-faire* in the human economic sphere may well have spread to the planetary system of *laisser-faire* that we call natural selection. With the crash of old religious, ethical, and political systems, man's desperate need for some scheme of values and ideals may have prompted a more critical re-examination of his biological position. Whether this be so is a point that I must leave to the social historians. The fact remains that the pendulum is again on the swing, the man-animal gap again broadening. After Darwin, man could no longer avoid considering himself as an animal; but he is beginning to see himself as a very peculiar and in many ways a unique animal. The analysis of man's biological uniqueness is as yet incomplete. This essay is an attempt to review its present position.

The first and most obviously unique characteristic of man is his capacity for conceptual thought; if you prefer objective terms, you will say his employment of true speech, but that is only another way of saying the same thing. True speech involves the use of verbal signs for objects, not merely for feelings. Plenty of animals can express the fact that they are hungry; but none except man can ask for an egg or a banana. And to have words for objects at once implies conceptual thought, since an object is always one of a class. No doubt, children and savages are as unaware of using conceptual thought as Monsieur Jourdain was unaware of speaking in prose; but they cannot avoid it. Words are tools which automatically carve concepts out of experience. The faculty of recognizing objects as members of a class provides the potential basis for the concept: the use of words at once actualizes the potentiality.

This basic human property has had many consequences. The most important was the development of a cumulative tradition. The beginnings of tradition, by which experience is transmitted from one generation to the next, are to be seen in many higher animals. But in no case is the tradition cumulative. Offspring learn from parents, but they learn the same kind and quantity of lessons as they, in turn,

impart: the transmission of experience never bridges more than one generation. In man, however, tradition is an independent and potentially permanent activity, capable of indefinite improvement in quality and increase in quantity. It constitutes a new accessory process of heredity in evolution, running side by side with the biological process, a heredity of experience to supplement the universal heredity of living substance.

The existence of a cumulative tradition has as its chief consequence —or if you prefer, its chief objective manifestation—the progressive improvement of human tools and machinery. Many animals employ tools; but they are always crude tools employed in a crude way. Elaborate tools and skilled technique can develop only with the aid of speech and tradition.

In the perspective of evolution, tradition and tools are the characters which have given man his dominant position among organisms. This biological dominance is, at present, another of man's unique properties. In each geological epoch of which we have knowledge, there have been types which must be styled biologically dominant: they multiply, they extinguish or reduce competing types, they extend their range, they radiate into new modes of life. Usually at any one time there is one such type—the placental mammals, for instance, in the Cenozoic Epoch; but sometimes there is more than one. The Mesozoic is usually called the Age of Reptiles, but in reality the reptiles were then competing for dominance with the insects: in earlier periods we should be hard put to it to decide whether trilobites, nautiloids, or early fish were *the* dominant type. To-day, however, there is general agreement that man is the sole type meriting the title. Since the early Pleistocene, widespread extinction has diminished the previously dominant group of placental mammals, and man has not merely multiplied, but has evolved, extended his range, and increased the variety of his modes of life.

Biology thus reinstates man in a position analogous to that conferred on him as Lord of Creation by theology. There are, however, differences, and differences of some importance for our general outlook. In the biological view, the other animals have not been created to serve man's needs, but man has evolved in such a way that he has been able to eliminate some competing types, to enslave others by domestication, and to modify physical and biological conditions over the larger part of the earth's land area. The theological view was not true in detail or in many of its implications; but it had a solid biological basis.

Speech, tradition, and tools have led to many other unique pro-

perties of man. These are, for the most part, obvious and well known, and I propose to leave them aside until I have dealt with some less familiar human characteristics. For the human species, considered as a species, is unique in certain purely biological attributes; and these have not received the attention they deserve, either from the zoological or the sociological standpoint.

In the first place, man is by far the most variable wild species known. Domesticated species like dog, horse, or fowl may rival or exceed him in this particular, but their variability has obvious reasons, and is irrelevant to our inquiry.

In correlation with his wide variability, man has a far wider range than any other animal species, with the possible exception of some of his parasites. Man is also unique as a dominant type. All other dominant types have evolved into many hundreds or thousands of separate species, grouped in numerous genera, families, and larger classificatory groups. The human type has maintained its dominance without splitting: man's variety has been achieved within the limits of a single species.

Finally, man is unique among higher animals in the method of his evolution. Whereas, in general, animal evolution is divergent, human evolution is reticulate. By this is meant that in animals, evolution occurs by the isolation of groups which then become progressively more different in their genetic characteristics, so that the course of evolution can be represented as a divergent radiation of separate lines, some of which become extinct, others continue unbranched, and still others divergently branch again. Whereas in man, after incipient divergence, the branches have come together again, and have generated new diversity from their Mendelian recombinations, this process being repeated until the course of human descent is like a network.

All these biological peculiarities are interconnected. They depend on man's migratory propensities, which themselves arise from his fundamental peculiarities, of speech, social life, and relative independence of environment. They depend again on his capacity, when choosing mates, for neglecting large differences of colour and appearance which would almost certainly be more than enough to deter more instinctive and less plastic animals. Thus divergence, though it appears to have gone quite a long way in early human evolution, generating the very distinct white, black, and yellow subspecies and perhaps others, was never permitted to attain its normal culmination. Mutually infertile groups were never produced: man remained a single species. Furthermore, crossing between distinct types, which is a rare and extraordinary phenomenon in other animals, in him

became normal and of major importance. According to Mendelian laws, such crosses generate much excess variability by producing new recombinations. Man is thus more variable than other species for two reasons. First, because migration has recaptured for the single interbreeding group divergences of a magnitude that in animals would escape into the isolation of separate species; and secondly, because the resultant crossing has generated recombinations which both quantitatively and qualitatively are on a far bigger scale than is supplied by the internal variability of even the numerically most abundant animal species.

We may contrast this with the state of affairs among ants, the dominant insect group. The ant type is more varied than the human type; but it has achieved this variability by intense divergent evolution. Several thousand species of ants are known, and the number is being added to each year with the increase of biological exploration. Ways of life among ants are divided among different sub-types, each rigidly confined to its own methods. Thus even if ants were capable of accumulating experience, there could exist no single world-wide ant tradition. The fact that the human type comprises but one biological species is a consequence of his capacity for tradition, and also permits his exploitation of that unique capacity to the utmost.

Let us remind ourselves that superposed upon this purely biological or genetic variability is the even greater amount of variability due to differences of upbringing, profession, and personal tastes. The final result is a degree of variation that would be staggering if it were not so familiar. It would be fair to say that, in respect to mind and outlook, individual human beings are separated by differences as profound as those which distinguish the major groups of the animal kingdom. The difference between a somewhat subnormal member of a savage tribe and a Beethoven or a Newton is assuredly comparable in extent with that between a sponge and a higher mammal. Leaving aside such vertical differences, the lateral difference between the mind of, say, a distinguished general or engineer of extrovert type and of an introvert genius in mathematics or religious mysticism is no less than that between an insect and a vertebrate. This enormous range of individual variation in human minds often leads to misunderstanding and even mutual incomprehensibility; but it also provides the necessary basis for fruitful division of labour in human society.

Another biological peculiarity of man is the uniqueness of his evolutionary history. Writers have indulged their speculative fancy by imagining other organisms endowed with speech and conceptual

thought—talking rats, rational ants, philosophic dogs, and the like. But closer analysis shows that these fantasies are impossible. A brain capable of conceptual thought could not have been developed elsewhere than in a human body.

The course followed by evolution appears to have been broadly as follows. From a generalized early type, various lines radiate out, exploiting the environment in various ways. Some of these comparatively soon reach a limit to their evolution, at least as regards major alteration. Thereafter they are limited to minor changes such as the formation of new genera and species. Others, on the other hand, are so constructed that they can continue their career, generating new types which are successful in the struggle for existence because of their greater control over the environment and their greater independence of it. Such changes are legitimately called "progressive." The new type repeats the process. It radiates out into a number of lines, each specializing in a particular direction. The great majority of these come up against dead ends and can advance no further: specialization is one-sided progress, and after a longer or shorter time, reaches a biomechanical limit. The horse stock cannot reduce its digits below one; the elephants are near the limits of size for terrestrial animals; feathered flight cannot become aerodynamically more efficient than in existing birds, and so on.

Sometimes all the branches of a given stock have come up against their limit, and then either have become extinct or have persisted without major change. This happened, for instance, to the echinoderms, which with their sea-urchins, starfish, brittle-stars, sea-lilies, sea-cucumbers, and other types now extinct had pushed the life that was in them into a series of blind alleys: they have not advanced for perhaps a hundred million years, nor have they given rise to other major types.

In other cases, all but one or two of the lines suffer this fate, while the rest repeat the process. All reptilian lines were blind alleys save two—one which was transformed into the birds, and another which became the mammals. Of the bird stock, all lines came to a dead end; of the mammals, all but one—the one which became man.

Evolution is thus seen as an enormous number of blind alleys, with a very occasional path of progress. It is like a maze in which almost all turnings are wrong turnings. The goal of the evolutionary maze, however, is not a central chamber, but a road which will lead indefinitely onwards.

If now we look back upon the past history of life, we shall see that the avenues of progress have been steadily reduced in number, until

by the Pleistocene period, or even earlier, only one was left. Let us remember that we can and must judge early progress in the light of its latest steps. The most recent step has been the acquisition of conceptual thought, which has enabled man to dethrone the non-human mammals from their previous position of dominance. It is biologically obvious that conceptual thought could never have arisen save in an animal, so that all plants, both green and otherwise, are at once eliminated. As regards animals, I need not detail all the early steps in their progressive evolution. Since some degree of bulk helps to confer independence of the forces of nature, it is obvious that the combination of many cells to form a large individual was one necessary step, thus eliminating all single-celled forms from such progress. Similarly, progress is barred to specialized animals with no blood-system, like planarian worms; to internal parasites, like tapeworms; to animals with radial symmetry and consequently no head, like echinoderms.

Of the three highest animal groups—the molluscs, the arthropods, and the vertebrates—the molluscs advanced least far. One condition for the later steps in biological progress was land life. The demands made upon the organism by exposure to air and gravity called forth biological mechanisms, such as limbs, sense-organs, protective skin, and sheltered development, which were necessary foundations for later advance. And the molluscs have never been able to produce efficient terrestrial forms: their culmination is in marine types like squid and octopus.

The arthropods, on the other hand, have scored their greatest successes on land, with the spiders and especially the insects. Yet the fossil record reveals a lack of all advance, even in the most successful types such as ants, for a long time back—certainly during the last thirty million years, probably during the whole of the Tertiary Epoch. Even during the shorter of these periods, the mammals were still evolving rapidly, and man's rise is contained in a fraction of this time.

What was it that cut the insects off from progress? The answer appears to lie in their breathing mechanism. The land arthropods have adopted the method of air-tubes or tracheae, branching to microscopic size and conveying gases directly to and from the tissues, instead of using the dual mechanism of lungs and bloodstream. The laws of gaseous diffusion are such that respiration by tracheae is extremely efficient for very small animals, but becomes rapidly less efficient with increase of size, until it ceases to be of use at a bulk below that of a house mouse. It is for this reason that no insect has ever become, by vertebrate standards, even moderately large.

It is for the same reason that no insect has ever become even moderately intelligent. The fixed pathways of instinct, however elaborate, require far fewer nerve-cells than the multiple switchboards that underlie intelligence. It appears to be impossible to build a brain mechanism for flexible behaviour with less than a quite large minimum of neurones; and no insect has reached a size to provide this minimum.

Thus only the land vertebrates are left. The reptiles shared biological dominance with the insects in the Mesozoic. But while the insects had reached the end of their blind alley, the reptiles showed themselves capable of further advance. Temperature regulation is a necessary basis for final progress, since without it the rate of bodily function could never be stabilized, and without such stabilization, higher mental processes could never become accurate and dependable.

Two reptilian lines achieved this next step, in the guise of the birds and the mammals. The birds soon, however, came to a dead end, chiefly because their forelimbs were entirely taken up in the specialization for flight. The sub-human mammals made another fundamental advance, in the shape of internal development, permitting the young animal to arrive at a much more advanced stage before it was called upon to face the world. They also (like the birds) developed true family life.

Most mammalian lines, however, cut themselves off from indefinite progress by one-sided evolution, turning their limbs and jaws into specialized and therefore limited instruments. And, for the most part, they relied mainly on the crude sense of smell, which cannot present as differentiated a pattern of detailed knowledge as can sight. Finally, the majority continued to produce their young several at a time, in litters. As J. B. S. Haldane has pointed out, this gives rise to an acute struggle for existence in the prenatal period, a considerable percentage of embryos being aborted or resorbed. Such intra-uterine selection will put a premium upon rapidity of growth and differentiation, since the devil takes the hindmost; and this rapidity of development will tend automatically to be carried on into postnatal growth.

As everyone knows, man is characterized by a rate of development which is abnormally slow as compared with that of any other mammal. The period from birth to the first onset of sexual maturity comprises nearly a quarter of the normal span of his life, instead of an eighth, a tenth or twelfth, as in some other animals. This again is in one sense a unique characteristic of man, although from the evolu-

tionary point of view it represents merely the exaggeration of a tendency which is operative in other Primates. In any case, it is a necessary condition for the evolution and proper utilization of rational thought. If men and women were, like mice, confronted with the problems of adult life and parenthood after a few weeks, or even, like whales, after a couple of years, they could never acquire the skills of body and mind that they now absorb from and contribute to the social heritage of the species.

This slowing (or "foetalization," as Bolk has called it, since it prolongs the foetal characteristics of earlier ancestral forms into postnatal development and even into adult life) has had other important by-products for man. Here I will mention but one—his nakedness. The distribution of hair on man is extremely similar to that on a late foetus of a chimpanzee, and there can be little doubt that it represents an extension of this temporary anthropoid phase into permanence. Hairlessness of body is not a unique biological characteristic of man; but it is unique among terrestrial mammals, save for a few desert creatures, and some others which have compensated for loss of hair by developing a pachydermatous skin. In any case, it has important biological consequences, since it must have encouraged the comparatively defenceless human creatures in their efforts to protect themselves against animal enemies and the elements, and so has been a spur to the improvement of intelligence.

Now, foetalization could never have occurred in a mammal producing many young at a time, since intra-uterine competition would have encouraged the opposing tendency. Thus we may conclude that conceptual thought could develop only in a mammalian stock which normally brings forth but one young at a birth. Such a stock is provided in the Primates—lemurs, monkeys, and apes.

The Primates also have another characteristic which was necessary for the ancestor of a rational animal—they are arboreal. It may seem curious that living in trees is a prerequisite of conceptual thought. But Elliot Smith's analysis has abundantly shown that only in an arboreal mammal could the forelimb become a true hand, and sight become dominant over smell. Hands obtain an elaborate tactile pattern of what they handle, eyes an elaborate visual pattern of what they see. The combination of the two kinds of pattern, with the aid of binocular vision, in the higher centres of the brain allowed the Primate to acquire a wholly new richness of knowledge about objects, a wholly new possibility of manipulating them. Tree life laid the foundation both for the fuller definition of objects by conceptual thought and for the fuller control of them by tools and machines.

Higher Primates have yet another prerequisite of human intelli-ence—they are all gregarious. Speech, it is obvious, could never have een evolved in a solitary type. And speech is as much the physical asis of conceptual thought as is protoplasm the physical basis of life.

For the passage, however, of the critical point between subhuman nd human, between the biological subordination and the biological rimacy of intelligence, between a limited and a potentially unlimited radition—for this it was necessary for the arboreal animal to de-cend to the ground again. Only in a terrestrial creature could fully rect posture be acquired; and this was essential for the final con-ersion of the arms from locomotor limbs into manipulative hands. 'urthermore, just as land life, ages previously, had demanded and eveloped a greater variety of response than had been required in the vater, so now it did the same in relation to what had been required n the trees. An arboreal animal could never have evolved the skill f the hunting savage, nor ever have proceeded to the domestication f other animals or to agriculture.

We are now in a position to define the uniqueness of human evolu-ion. The essential character of man as a dominant organism is con-eptual thought. And conceptual thought could have arisen only in multicellular animal, an animal with bilateral symmetry, head and lood system, a vertebrate as against a mollusc or an arthropod, a and vertebrate among vertebrates, a mammal among land verte-rates. Finally, it could have arisen only in a mammalian line which vas gregarious, which produced one young at a birth instead of everal, and which had recently become terrestrial after a long period f arboreal life.

There is only one group of animals which fulfils these conditions—a terrestrial offshoot of the higher Primates. Thus not merely has conceptual thought been evolved only in man: it could not have been evolved except in man. There is but one path of unlimited progress through the evolutionary maze. The course of human evolution is as unique as its result. It is unique not in the trivial sense of being a different course from that of any other organism, but in the pro-founder sense of being the only path that could have achieved the essential characters of man. Conceptual thought on this planet is inevitably associated with a particular type of Primate body and Primate brain.

A further property of man in which he is unique among higher animals concerns his sexual life. Man is prepared to mate at any time: animals are not. To start with, most animals have a definite breeding season; only during this period are their reproductive

organs fully developed and functional. In addition to this, higher animals have one or more sexual cycles within their breeding seasons, and only at one phase of the cycle are they prepared to mate. In general, either a sexual season or a sexual cycle, or both, operates to restrict mating.

In man, however, neither of these factors is at work. There appears to be indications of a breeding season in some primitive peoples like the Eskimo, but even there they are but relics. Similarly, while there still exist physiological differences in sexual desire at different phases of the female sexual cycle, these are purely quantitative, and may readily be overridden by psychological factors. Man, to put it briefly, is continuously sexed: animals are discontinuously sexed. If we try to imagine what a human society would be like in which the sexes were interested in each other only during the summer, as in song-birds, or, as in female dogs, experienced sexual desire only once every few months, or even only once in a lifetime, as in ants, we can realize what this peculiarity has meant. In this, as in his slow growth and prolonged period of dependence, man is not abruptly marked off from all other animals, but represents the culmination of a process that can be clearly traced among other Primates. What the biological meaning of this evolutionary trend may be is difficult to understand. One suggestion is that it may be associated with the rise of mind to dominance. The bodily functions, in lower mammals rigidly determined by physiological mechanisms, come gradually under the more plastic control of the brain. But this, for what it is worth, is a mere speculation.

Another of the purely biological characters in which man is unique is his reproductive variability. In a given species of animals, the maximum litter-size may, on occasions, reach perhaps double the minimum, according to circumstances of food and temperature, or even perhaps threefold. But during a period of years, these variations will be largely equalized within a range of perhaps fifty per cent. either way from the average, and the percentage of wholly infertile adults is very low. In man, on the other hand, the range of positive fertility is enormous—from one to over a dozen, and in exceptional cases to over twenty; and the number of wholly infertile adults is considerable. This fact, in addition to providing a great diversity of patterns of family life, has important bearings on evolution. It means that in the human species differential fertility is more important as a basis for selection than is differential mortality; and it provides the possibility of much more rapid selective change than that found in wild animal species. Such rapidity of evolution would, of course, be

effectively realized only if the stocks with large families possessed a markedly different hereditary constitution from those with few children; but the high differential fertility of unskilled workers as against the professional classes in England, or of the French Canadians against the rest of the inhabitants of Canada, demonstrates how rapidly populations may change by this means.

Still another point in which man is biologically unique is the length and relative importance of his period of what we may call "post-maturity." If we consider the female sex, in which the transition from reproductive maturity to non-reproductive post-maturity is more sharply defined than in the male, we find, in the first place, that in animals a comparatively small percentage of the population survives beyond the period of reproduction; in the second place, that such individuals rarely survive long, and so far as known never for a period equal to or greater than the period during which reproduction was possible; and thirdly, that such individuals are rarely of importance in the life of the species. The same is true of the male sex, provided we do not take the incapacity to produce fertile gametes as the criterion of post-maturity, but rather the appearance of signs of age, such as the beginnings of loss of vigour and weight, decreased sexual activity, or greying hair.

It is true that in some social mammals, notably among ruminants and Primates, an old male or old female is frequently found as leader of the herd. Such cases, however, provide the only examples of the special biological utility of post-mature individuals among animals; they are confined to a very small proportion of the population, and it is uncertain to what extent such individuals are post-mature in the sense we have defined. In any event, it is improbable that the period of post-maturity is anywhere near so long as that of maturity. But in civilized man the average expectation of life now includes over ten post-mature years, and about a sixth of the population enjoys a longer post-maturity than maturity. What is more, in all advanced human societies, a large proportion of the leaders of the community are always post-mature. All the members of the British War Cabinet are in their post-maturity.

This is truly a remarkable phenomenon. Through the new social mechanisms made possible by speech and tradition, man has been able to utilize for the benefit of the species a period of life which in almost all other creatures is a mere superfluity. We know that the dominance of the old can be over-emphasized; but it is equally obvious that society cannot do without the post-mature. To act on the slogan "Too old at forty"—or even at forty-five—would be to rob

man of one of his unique characteristics, whereby he utilizes tradition to the best advantage.

We have now dealt in a broad way with the unique properties of man both from the comparative and the evolutionary point of view. Now we can return to the present and the particular and discuss these properties and their consequences a little more in detail. First, let us remind ourselves that the gap between human and animal thought is much greater than is usually supposed. The tendency to project familiar human qualities into animals is very strong, and colours the ideas of nearly all people who have not special familiarity both with animal behaviour and scientific method.

Let us recall a few cases illustrating the unhuman characteristics of animal behaviour. Everyone is familiar with the rigidity of instinct in insects. Worker ants emerge from their pupal case equipped not with the instincts to care for ant grubs in general, but solely with those suitable to ant grubs of their own species. They will attempt to care for the grubs of other species, but appear incapable of learning new methods if their instincts kill their foster children. Or again, a worker wasp, without food for a hungry grub, has been known to bite off its charge's tail and present it to its head. But even in the fine flowers of vertebrate evolution, the birds and mammals, behaviour, though it may be more plastic than in the insects, is as essentially irrational. Birds, for instance, seem incapable of analysing unfamiliar situations. For them some element in the situation may act as its dominant symbol, the only stimulus to which they can react. At other times, it is the organization of the situation as a whole which is the stimulus: if the whole is interfered with, analysis fails to dissect out the essential element. A hen meadow-pipit feeds her young when it gapes and squeaks in the nest. But if it has been ejected by a young cuckoo, gaping and squeaking has no effect, and the rightful offspring is neglected and allowed to die, while the usurper in the nest is fed. The pipit normally cares for its own young, but not because it recognizes them as such.

Mammals are no better. A cow deprived of its calf will be quieted by the provision of a crudely stuffed calf-skin. Even the Primates are no exception. Female baboons whose offspring have died will continue carrying the corpses until they have not merely putrefied but mummified. This appears to be due not to any profundity of grief, but to a contact stimulus: the mother will react similarly to any moderately small and furry object.

Birds and especially mammals are, of course, capable of a certain degree of analysis, but this is effected, in the main, by means of trial

and error through concrete experience. A brain capable of conceptual thought appears to be the necessary basis for speedy and habitual analysis. Without it, the practice of splitting up situations into their components and assigning real degrees of significance to the various elements remains rudimentary and rare, whereas with man, even when habit and trial and error are prevalent, conceptual thought is of major biological importance. The behaviour of animals is essentially arbitrary, in that it is fixed within narrow limits. In man it has become relatively free—free at the incoming and the outgoing ends alike. His capacity for acquiring knowledge has been largely released from arbitrary symbolism, his capacity for action, from arbitrary canalizations of instinct. He can thus rearrange the patterns of experience and action in a far greater variety, and can escape from the particular into the general.

Thus man is more intelligent than the animals because his brain mechanism is more plastic. This fact also gives him, of course, the opportunity of being more nonsensical and perverse: but its primary effects have been more analytical knowledge and more varied control. The essential fact, from my present standpoint, is that the change has been profound and in an evolutionary sense rapid. Although it has been brought about by the gradual quantitative enlargement of the association areas of the brain, the result has been almost as abrupt as the change (also brought about quantitatively) from solid ice to liquid water. We should remember that the machinery of the change has been an increase in plasticity and potential variety: it is by a natural selection of ideas and actions that the result has been greater rationality instead of greater irrationality.

This increase of flexibility has also had other psychological consequences which rational philosophers are apt to forget: and in some of these, too, man is unique. It has led, for instance, to the fact that man is the only organism normally and inevitably subject to psychological conflict. You can give a dog neurosis, as Pavlov did, by a complicated laboratory experiment: you can find cases of brief emotional conflict in the lives of wild birds and animals. But, for the most part, psychological conflict is shirked by the simple expedient of arranging that now one and now another instinct should dominate the animal's behaviour. I remember in Spitsbergen finding the nest of a Red-throated Diver on the shore of an inland pool. The sitting bird was remarkably bold. After leaving the nest for the water, she stayed very close. She did not, however, remain in a state of conflict between fear of intruders and desire to return to her brooding. She would gradually approach as if to land, but eventually fear became

dominant, and when a few feet from the shore she suddenly dived, and emerged a good way farther out—only to repeat the process. Here the external circumstances were such as to encourage conflict, but even so what are the most serious features of human conflict were minimized by the outlet of alternate action.

Those who take up bird-watching as a hobby tend at first to be surprised at the way in which a bird will turn, apparently without transition or hesitation, from one activity to another—from fighting to peaceable feeding, from courtship to uninterested preening, from panic flight to unconcern. However, all experienced naturalists or those habitually concerned with animals recognize such behaviour as characteristic of the subhuman level. It represents another aspect of the type of behaviour I have just been describing for the Red-throated Diver. In this case, the internal state of the bird changes, presumably owing to some form of physiological fatigue or to a diminution of intensity of a stimulus with time or distance; the type of behaviour which had been dominant ceases to have command over the machinery of action, and is replaced by another which just before had been subordinate and latent.

As a matter of fact, the prevention of conflict between opposed modes of action is a very general phenomenon, of obvious biological utility, and it is only the peculiarities of the human mind which have forced its partial abandonment on man. It begins on the purely mechanical level with the nervous machinery controlling our muscles. The main muscles of a limb, for instance, are arranged in two antagonistic sets, the flexors bending and the extensors straightening it. It would obviously be futile to throw both sets into action at the same time, and economical when one set is in action to reduce to the minimum any resistance offered by the other. This has actually been provided for. The nervous connections in the spinal cord are so arranged that when a given muscle receives an impulse to contract, its antagonist receives an impulse causing it to lose some of its tone and thus, by relaxing below its normal level, to offer the least possible resistance to the action of the active muscle.

Sherrington discovered that the same type of mechanism was operative in regard to the groups of muscles involved in whole reflexes. A dog, for instance, cannot very well walk and scratch itself at the same time. To avoid the waste involved in conflict between the walking and the scratching reflex, the spinal cord is constructed in such a way that throwing one reflex into action automatically inhibits the other. In both these cases, the machinery for preventing conflicts of activity resides in the spinal cord. Although the matter

has not yet been analysed physiologically, it would appear that the normal lack of conflict between instincts which we have just been discussing is due to some similar type of nervous mechanism in the brain.

When we reach the human level, there are new complications; for, as we have seen, one of the peculiarities of man is the abandonment of any rigidity of instinct, and the provision of association-mechanisms by which any activity of the mind, whether in the spheres of knowing, feeling, or willing, can be brought into relation with any other. It is through this that man has acquired the possibility of a unified mental life. But, by the same token, the door is opened to the forces of disruption, which may destroy any such unity and even prevent him from enjoying the efficiency of behaviour attained by animals. For, as Sherrington has emphasized, the nervous system is like a funnel, with a much larger space for intake than for outflow. The intake cone of the funnel is represented by the receptor nerves, conveying impulses inward to the central nervous system from the sense-organs: the outflow tube is, then, through the effector nerves, conveying impulses outwards to the muscles, and there are many more of the former than of the latter. If we like to look at the matter from a rather different standpoint, we may say that, since action can be effected only by muscles (strictly speaking, also by the glands, which are disregarded here for simplicity's sake), and since there are a limited number of muscles in the body, the only way for useful activity to be carried out is for the nervous system to impose a particular pattern of action on them, and for all other competing or opposing patterns to be cut out. Each pattern, when it has seized control of the machinery of action, *should* be in supreme command, like the captain of a ship. Animals are, in many ways, like ships which are commanded by a number of captains in turn, each specializing in one kind of action, and popping up and down between the authority of the bridge and the obscurity of their private cabins according to the business on hand. Man is on the way to achieving permanent unity of command, but the captain has a disconcerting way of dissolving into a wrangling committee.

Even on the new basis, however, mechanisms exist for minimizing conflict. They are what are known by psychologists as suppression and repression. From our point of view, repression is the more interesting. It implies the forcible imprisonment of one of two conflicting impulses in the dungeons of the unconscious mind. The metaphor is, however, imperfect. For the prisoner in the mental dungeon can continue to influence the tyrant above in the daylight of consciousness. In addition to a general neurosis, compulsive thoughts and acts

may be thrust upon the personality. Repression may thus be harmful; but it can also be regarded as a biological necessity for dealing with inevitable conflict in the early years of life, before rational judgment and control are possible. Better to have the capacity for more or less unimpeded action, even at the expense of possible neurosis, than an organism constantly inactivated like the ass between the two bundles of hay, balanced in irresolution.

In repression, not only is the defeated impulse banished to the unconscious, but the very process of banishment is itself unconscious. The inhibitory mechanisms concerned in it must have been evolved to counteract the more obvious possibilities of conflict, especially in early life, which arose as by-products of the human type of mind.

In suppression, the banishment is conscious, so that neurosis is not likely to appear. Finally, in rational judgment, neither of the conflicting impulses is relegated to the unconscious, but they are balanced in the light of reason and experience, and control of action is consciously exercised.

I need not pursue the subject further. Here I am only concerned to show that the great biological advantages conferred on man by the unification of mind have inevitably brought with them certain counterbalancing defects. The freedom of association between all aspects and processes of the mind has provided the basis for conceptual thought and tradition; but it has also provided potential antagonists, which in lower organisms were carefully kept apart, with the opportunity of meeting face to face, and has thus made some degree of conflict unavoidable.

In rather similar fashion, man's upright posture has brought with it certain consequential disadvantages in regard to the functioning of his internal organs and his proneness to rupture. Thus man's unique characteristics are by no means wholly beneficial.

In close correlation with our subjection to conflict is our proneness to laughter. So characteristic of our species is laughter that man has been defined as the laughing animal. It is true that, like so much else of man's uniqueness, it has its roots among the animals, where it reveals itself as an expression of a certain kind of general pleasure—and thus in truth perhaps more of a smile than a laugh. And in a few animals—ravens, for example—there are traces of a malicious sense of humour. Laughter in man, however, is much more than this. There are many theories of laughter, most of them containing a partial truth. But biologically the important feature of human laughter seems to lie in its providing a release for conflict, a resolution of troublesome situations.

This and other functions of laughter can be exaggerated so that it becomes as the crackling of thorns under the pot, and prevents men from taking anything seriously; but in due proportion its value is very great as a lubricant against troublesome friction and a lightener of the inevitable gravity and horror or life, which would otherwise become portentous and overshadowing. True laughter, like true speech, is a unique possession of man.

Those of man's unique characteristics which may better be called psychological and social than narrowly biological spring from one or other of three characteristics. The first is his capacity for abstract and general thought: the second is the relative unification of his mental processes, as against the much more rigid compartmentalization of animal mind and behaviour: the third is the existence of social units, such as tribe, nation, party, and church, with a continuity of their own, based on organized tradition and culture.

There are various by-products of the change from pre-human to the human type of mind which are, of course, also unique biologically. Let us enumerate a few: pure mathematics; musical gifts; artistic appreciation and creation; religion; romantic love.

Mathematical ability appears, almost inevitably, as something mysterious. Yet the attainment of speech, abstraction, and logical thought, bring it into potential being. It may remain in a very rudimentary state of development; but even the simplest arithmetical calculations are a manifestation of its existence. Like any other human activity, it requires proper tools and machinery. Arabic numerals, algebraic conventions, logarithms, the differential calculus, are such tools: each one unlocks new possibilities of mathematical achievement. But just as there is no essential difference between man's conscious use of a chipped flint as an implement and his design of the most elaborate machine, so there is none between such simple operations as numeration or addition and the comprehensive flights of higher mathematics. Again, some people are by nature more gifted than others in this field; yet no normal human being is unable to perform some mathematical operations. Thus the capacity for mathematics is, as I have said, a by-product of the human type of mind.

We have seen, however, that the human type of mind is distinguished by two somewhat opposed attributes. One is the capacity for abstraction, the other for synthesis. Mathematics is one of the extreme by-products of our capacity for abstraction. Arithmetic abstracts objects of all qualities save their enumerability; the symbol π abstracts in a single Greek letter a complicated relation between the

parts of all circles. Art, on the other hand, is an extreme by-product of our capacity for synthesis. In one unique production, the painter can bring together form, colour, arrangement, associations of memory, emotion, and idea. Dim adumbrations of art are to be found in a few creatures such as bower-birds; but nothing is found to which the word can rightly be applied until man's mind gave the possibility of freely mingling observations, emotions, memories, and ideas, and subjecting the mixture to deliberate control.

But it is not enough here to enumerate a few special activities. In point of fact, the great majority of man's activities and characteristics are by-products of his primary distinctive characteristics, and therefore, like them, biologically unique.

On the one hand, conversation, organized games, education, sport, paid work, gardening, the theatre; on the other, conscience, duty, sin, humiliation, vice, penitence—these are all such unique by-products. The trouble, indeed, is to find any human activities which are not unique. Even the fundamental biological attributes such as eating, sleeping, and mating have been tricked out by man with all kinds of unique frills and peculiarities.

There may be other by-products of man's basic uniqueness which have not yet been exploited. For let us remember that such by-products may remain almost wholly latent until demand stimulates invention and invention facilitates development. It is asserted that there exist human tribes who cannot count above two; certainly some savages stop at ten. Here the mathematical faculty is restricted to numeration, and stops short at a very rudimentary stage of this rudimentary process. Similarly, there are human societies in which art has never been developed beyond the stage of personal decoration. It is probable that during the first half of the Pleistocene period, none of the human race had developed either their mathematical or their artistic potentialities beyond such a rudimentary stage.

It is perfectly possible that to-day man's so-called super-normal or extra-sensory faculties are in the same case as were his mathematical faculties during the first or second glaciations of the Ice Age—barely more than a potentiality, with no technique for eliciting and developing them, no tradition behind them to give them continuity and intellectual respectability. Even such simple performances as multiplying two three-figure numbers would have appeared entirely magical to early Stone Age men.

Experiments such as those of Rhine and Tyrrell on extra-sensory guessing, experiences like those of Gilbert Murray on thought transference, and the numerous sporadic records of telepathy and clair-

voyance suggest that some people at least possess possibilities of knowledge which are not confined within the ordinary channels of sense-perception. Tyrrell's work is particularly interesting in this connection. As a result of an enormous number of trials with apparatus ingeniously designed to exclude all alternative explanation, he finds that those best endowed with this extra-sensory gift can guess right about once in four times when once in five would be expected on chance alone. The results are definite, and significant in the statistical sense, yet the faculty is rudimentary: it does not permit its possessor to guess right all the time or even most of the time merely to achieve a small rise in the percentage of right guessing. If, however, we could discover in what this faculty really consists, on what mechanism it depends, and by what conditions and agencies it can be influenced, it should be capable of development like any other human faculty. Man may thus be unique in more ways than he now suspects.

So far we have been considering the fact of human uniqueness. It remains to consider man's attitude to these unique qualities of his. Professor Everett, of the University of California, in an interesting paper bearing the same title as this essay, but dealing with the topic from the standpoint of the philosopher and the humanist rather than that of the biologist, has stressed man's fear of his own uniqueness. Man has often not been able to tolerate the feeling that he inhabits an alien world, whose laws do not make sense in the light of his intelligence, and in which the writ of his human values does not run. Faced with the prospect of such intellectual and moral loneliness, he has projected personality into the cosmic scheme. Here he has found a will, there a purpose; here a creative intelligence, and there a divine compassion. At one time, he has deified animals, or personified natural forces. At others, he has created a superhuman pantheon, a single tyrannical world ruler, a subtle and satisfying Trinity in Unity. Philosophers have postulated an Absolute of the same nature as mind.

It is only exceptionally that men have dared to uphold their uniqueness and to be proud of their human superiority to the impersonality and irrationality of the rest of the universe. It is time now, in the light of our knowledge, to be brave and face the fact and the consequences of our uniqueness. That is Dr. Everett's view, as it was also that of T. H. Huxley in his famous Romanes lecture. I agree with them; but I would suggest that the antinomy between man and the universe is not quite so sharp as they have made out. Man represents the culmination of that process of organic evolution which has been proceeding on this planet for over a thousand million years.

That process, however wasteful and cruel it may be, and into however many blind alleys it may have been diverted, is also in one aspect progressive. Man has now become the sole representative of life in that progressive aspect and its sole trustee for any progress in the future.

Meanwhile it is true that the appearance of the human type of mind, the latest step in evolutionary progress, has introduced both new methods and new standards. By means of his conscious reason and its chief offspring, science, man has the power of substituting less dilatory, less wasteful, and less cruel methods of effective progressive change than those of natural selection, which alone are available to lower organisms. And by means of his conscious purpose and his set of values, he has the power of substituting new and higher standards for change than those of mere survival and adaptation to immediate circumstances, which alone are inherent in pre-human evolution. To put the matter in another way, progress has hitherto been a rare and fiftul by-product of evolution. Man has the possibility of making it the main feature of his own future evolution, and of guiding its course in relation to a deliberate aim.

But he must not be afraid of his uniqueness. There may be other beings in this vast universe endowed with reason, purpose, and aspiration: but we know nothing of them. So far as our knowledge goes, human mind and personality are unique and constitute the highest product yet achieved by the cosmos. Let us not put off our responsibilities on to the shoulders of mythical gods or philosophical absolutes, but shoulder them in the hopefulness of tempered pride. In the perspective of biology, our business in the world is seen to be the imposition of the best and most enduring of our human standards upon ourselves and our planet. The enjoyment of beauty and interest, the achievement of goodness and efficiency, the enhancement of life and its variety—these are the harvest which our human uniqueness should be called upon to yield.

EUGENICS AND SOCIETY

EUGENICS, Dean Inge writes in one of his essays, is capable of becoming the most sacred ideal of the human race, as a race; one of the supreme religious duties. In this I entirely agree with him. Once the full implications of evolutionary biology are grasped, eugenics will inevitably become part of the religion of the future, or of whatever complex of sentiments may in the future take the place of organized religion. It is not merely a sane outlet for human altruism, but is of all outlets for altruism that which is most comprehensive and of longest range.

However, in addition to holding out these emotional possibilities, the eugenic movement must obey practical necessities. If it is to grow into a soul-compelling ideal, it must first achieve precision and efficiency as a branch of applied science.

At the moment, it is idle to pretend that it has advanced very far in either direction. True that to a limited number of men and women, it is already an inspiring ideal: but for the bulk of people, if not a subject for a jest, it remains either mistrusted or wholly neglected. True that, thanks to the genius of Darwin and his cousin Galton, the notion of evolutionary improvement through selection has provided a firm scientific base for eugenics, and that in recent years distinct progress has been made in appplying the triumphant discoveries of modern genetics to the human species: yet for the bulk of scientists, eugenics is still hardly reckoned as a science.

It may be that, as a scientist myself, I overrate the importance of the scientific side. At any rate, it is my conviction that eugenics cannot gain power as an ideal and a motive until it has improved its position as a body of knowledge and a potential instrument of control: and in this essay I shall endeavour to point out what, in my opinion, is the next step towards the graduation of eugenics into the dignity of an established science. It will be an inquiry into the methodology of our subject.

Eugenics falls within the province of the Social Sciences, not of the Natural Sciences. It shares with the rest of them a suspicion, often very frankly expressed by the pundits of more respectable branches of study, such as physics or pure biology, of being not quite scientifically respectable. Some, indeed, go as far as to assert that the social sciences can never be truly scientific, and imply that they have

illegitimately used the word *science* in their title in order to exploit the prestige attaching to it in this scientific age.

Personally, I do not think that this criticism is justified. All young sciences are attacked by their elders on the ground of irregularity in their canons of scientific behaviour: but they cannot expect to establish rigorous canons until they are no longer young, any more than an untried adolescent can be expected to possess the assurance and practical skill of a man in the prime of life. In addition, young sciences are not merely young like young human beings owing to the accident of the date of their birth. The date of their birth is no accident: they are young because they are more complex and more difficult. Physics is an older science than biology because in physics it is easier to isolate phenomena and to discover simple but fundamental laws. The social sciences are younger than the natural sciences because of the appalling complexity of variables which make up their subject-matter.

This, however, is not all. The social sciences in certain respects differ radically from the natural sciences; they cannot expect to achieve success by applying the same simple methods as served their elder sisters, but must work out new methods of their own. In the natural sciences, we isolate phenomena in order to analyse them. If possible we isolate them in the form of a controlled experiment, as in physics or genetics; if this cannot be achieved, we isolate them in thought, make deductions, and test our conclusions by empirical observations, as in astronomy or stratigraphical geology. By refinements of technique, we can eliminate for practical purposes all irrelevant variables; the geneticist wanting to understand some new type which has appeared in his cultures can eliminate, say, the variable of environment, then the variable of single-gene mutations, then the variable of addition or subtraction of whole chromosomes, and finally pin responsibility for the phenomenon on, for example, the inversion of a particular chromosome-section.

But the social scientist cannot do this sort of thing: he can at the best find a correlation between several variables. In terms of causation, the natural scientist can sometimes find a single definite cause for a phenomenon; the social scientist must always be content with several partial causes. He has to work out a system based on the idea of multiple causation. The attractive simplicity of simple and single causation is for him a false simplicity: he needs a different intellectual techinque. Anyone who asserts that so-and-so is *the* cause of a social phenomenon is bound to be wrong: it can at best be *a* cause. Let us as eugenists therefore beware of making such assertions as that the celibacy of the clergy was *the* cause of the decadence of Spain, or that

the differential birth-rate is *the* cause of the increase of feeble-mindedness: for by so doing we are being scientifically disreputable.

And, of course, the inevitable obverse of the principle of multiple cause is the principle of multiple effect. I need not labour the point, save to stress the need for the working out of suitable methods, of partial correlation and the like, to deal with this multiple complexity.

Another peculiarity of the social sciences, closely linked with the first, is that we cannot make rigorous and repeatable experiments, because we cannot isolate our material or control all its variables. Again a different technique from that of the natural sciences has to be worked out—here a different practical technique. Properly planned regional experiments are an example.

But perhaps the most fundamental difference between natural and social science is that the social scientist is himself part of his own material, and that the criteria for judging the outcome of an experiment are partially subjective. Thus the social scientist cannot escape bias, and he cannot hope to check his work against objective criteria that will be accepted by all normal men.

As regards bias, we may compare this with experimental error in natural science. Just as it is possible to reduce experimental error, but never entirely to eliminate it, so it is clearly possible to a large extent to discount and reduce bias. Discovering the technique of reducing bias will be as important in social science as has been in natural science the long and often tiresome process of discovering the technique of reducing experimental error.

The difficulty of finding an objective criterion of truth in social science cuts deeper. But it is based upon an intellectualist philosophy which hankers after abstract truth. It largely disappears if we take the more robust view that science is control as well as knowledge, and that these two aspects cannot be separated. There can be some measure of general agreement on the practical results of social experiments, especially if these are properly planned. Thus in social science, experiment is not the remote preliminary to action that it is in natural science, but is itself partly action—both pure and applied science simultaneously. *Solvitur operando* should be the working principle of the social sciences. It implies that progress in social science and its applications will be slower and more sprinkled with practical mistakes than progress in natural science; but it does not mean that we should deny its possibility.

These general considerations have many particular applications to our subject. Eugenics is not, as some of its devotees have perhaps unconsciously assumed, a special branch of natural science: it is a

branch of social science. It is not merely human genetics. True that it aims at the improvement of the human race by means of the improvement of its genetic qualities. But any improvement of the sort can only be realized in a certain kind of social environment, so that eugenics is inevitably a particular aspect of the study of man in society.

Up to the present, eugenics has concerned itself primarily with a study of the hereditary constitution, and with deductive reasoning on the effects of selection. It was rightly shocked at the intellectual excesses of the perfectionists and sentimental environmentalists, who adhered to the crudest form of Lamarckism and believed that improvements in education and social conditions would be incorporated in an easy automatic way into human nature itself and so lead to continuous and unlimited evolutionary progress. As a result, it converted the distinction between nature and nurture into a hard antithesis, and deliberately or perhaps subconsciously belittled or neglected the effects of the environment and the efforts of the social reformers —except in so far as their real or alleged dysgenic effects might be used to point a moral or provide a horrid warning.

This was natural, and perhaps necessary; but it was neither scientific nor sufficient. It was an example of the error to which I have already referred, the error of assuming that the methods of the natural sciences will serve for the social sciences. The pure natural science of genetics was able, at least during its early career, to neglect consideration of the environment. It could do this because in its experiments it can and does control the environment in order to deal solely with constitutional factors. By this means it has succeeded (and by no other means could it have succeeded) in making those spectacular discoveries about chromosomes and their doubling and halving, about the existence, number and localization of the genes or hereditary units, their mutation and its effects, which in a brief quarter-century have raised it to the position of being that branch of biology which in its method and its progress most nearly conforms to the standard set by physics.

But in eugenics this is not possible. The purpose of eugenics is on the one hand to study the presence of different inherited types and traits in a population, and the fact that these can be increased or diminished in the course of generations as the result of selection, unconscious or deliberate, natural or artificial, and on the other, eventually to use the results of this study for control. Eugenics studies the selective implications of human genetic differences.

However, these implications may and often indeed must differ in

different environments. Since the social environment is now by far the most important part of the environment of man; and since the social environment differs from one nation to another, one period to another, one class to another, and its differences are outside the control of the eugenist, he must not neglect it. Its uncontrolled variables bring the eugenist face to face with the principle of multiple causation, at work here as in all the social sciences.

The study of the environment is necessary for the eugenist on a number of counts. First, because, he cannot equalize it experimentally, he must learn to discount its effects if he is not to mistake their pinchbeck glitter (as he would be apt to think it) for the true gold of genetic influence. If, for instance, the observed lower stature of the so-called lower classes should prove to be due to an inadequate diet, it is eugenically of no significance. Secondly, because by the limited control of social conditions which is open to us already, it is often possible to alter the effect of a genetic factor. Inherited eye-defects, once a grave handicap in almost every walk of life, are now, in most cases, thanks to the progress of the science of optics and the art of spectacle-making, no more than a minor inconvenience.

Thirdly, the environment itself exercises a selective influence. This fundamental truth, long axiomatic in evolutionary biology, has not been properly recognized in human biology so far as the social environment is concerned. A young pioneer civilization, for instance, will both initially attract and later encourage different types from those attracted and encouraged by a civilization that is old and settled.

Fourthly, in planning a eugenic programme, the eugenist must take account of the social system in which he hopes or expects his improved race to live. Cattle-breeders will set about their work quite differently according to whether they are building up a stock for use in a rich pasture country where winter feed is provided, or one for an undeveloped and semi-arid land, like parts of Africa. Similarly the eugenist must adopt different aims according as to whether he envisages a world of nationalism and war or one of peace and cultural progress. This is already patent in the crude eugenic efforts of to-day —in the encouragement of high fecundity in Fascist Italy and Nazi Germany, together with the persecution of so-called "non-Aryans" and the glorification of the Nordics in the latter.

Finally, there is the question of bias. It is probably inevitable that most men who come fresh to a problem in social science, however scientifically-minded they may be by nature and training, will have some bias due to their own social environment. This bias in social outlook which besets the pioneers in the social sciences is comparable

to the bias in favour of common sense and accepted modes of thought which equally inevitably beset the pioneers in the early stages of the natural sciences. And just as in the natural sciences men had to develop the technique of controlled experiment and verified prophecy and to be willing to follow their findings wherever they might lead, far away from the beaten track of common sense if need be, so in the social sciences a means must be found to detect and discount bias in the observer himself, even though this lead him far from the comfortable road of his preconceived notions.

Let me develop these points a little more fully, one by one. In the first place, one and the same genetic outfit will give different effects in different environments. This is so elementary and fundamental a fact that it has often been neglected, by the geneticist as well as the eugenist. In the early literature of modern genetics, you will often find references to the inheritance of such and such characters. But characters are not and cannot be inherited, in the sense in which inheritance is used by the geneticist. What are inherited are genes, factors, genetic outfit. Any character whatsoever can only be a resultant between genes and environment. A given character expresses the interaction between a particular set of genes and a particular set of environmental conditions. Thus at the outset we see that the old question, whether nature or nurture is the more important, is meaningless. It is like the question "When did you stop beating your wife?" in conveying implications which do not correspond with reality. In general, neither nature nor nurture can be more important, because they are both essential.

You will note that I say "in general." In particular cases, one or the other may be more important. Do not let us forget that all genetics depends on a study of differences. We take two individuals and strains, and ask what is the cause of the difference between them. By adjusting the conditions of our experiment, we find that this is due either to a difference in their environment or to a difference in their inherited constitution (or, often, to a difference in both). We then proceed further and find out, say, that the genetic difference is due primarily to a difference in a single gene. Let us suppose that the difference was one between red and white flowers in a plant. Then we say, if the white-flowered variety is the aberrant one, that we have discovered "a gene for white flower-colour." But this is a shorthand notation. Scientifically, we have discovered that the main cause of the difference in flower-colour is a difference in the nature of one unit-section of the chromosome outfit. That is why certain authors tried at one time to substitute the term *differential* for *gene*.

This rather tedious argument has two corollaries of immediate eugenic importance. The first is this. The more similar are the environments of two human samples, the more likely are the observable differences between the samples to be inheritable. The opposite is also true in theory, that the more similar are their genetic constitutions, the more likely are any differences to be environmental and non-inheritable; but in view of our ignorance of the precise genetic constitution of human populations, this has little applicability save in special cases like that of identical twins.

When on the other hand there are obvious differences in environment between two groups, there is a strong presumption that many of the differences between them will turn out to be mere modifications, which would disappear if the environmental conditions were equalized. This is not, of course, to say that the groups will not differ genetically also: merely that the observed differences in characters are not likely to be wholly inherited.

Genetics can provide interesting examples in which certain conditions of environment may wholly mask the effect of a gene. The classical case is that of *Primula sinensis*. In this plant there is a white-flowered variety and a red-flowered variety, which differ in regard to a single Mendelian gene. The white remains white at all temperatures; but the red variety when raised at a high temperature produces white flowers. A hot-house will thus entirely mask the perfectly real genetic difference between the two.

Even more significant for our purpose is the case of the mutant of the fruit-fly Drosophila known as *abnormal abdomen*, which depends on a single recessive gene. Flies characteristic of this strain show a bloated and rather abnormal-looking abdomen, with an extremely poor and irregular development of the normal pattern of black bands. However, all gradations from this to normal appearance are found. Analysis has shown that in moist conditions the character manifests itself fully, while in very dry conditions it does not show at all, and the flies resemble the normal wild type. Environment may thus wholly mask the effect of a pathological gene.

These cases introduce us to the further principle, somewhat paradoxical at first sight, that equalizing the environment may either increase or decrease the amount of visible variation in a group. In a universe containing both dry and moist conditions, a mixture of wild-type and abnormal-abdomen strains of fruit-fly would show a certain range of variation. Equalize the environment by making the universe wholly dry, and the population becomes uniform: but equalize it by making the universe wholly moist, and the variability is

increased. Hogben has drawn attention to the importance of this point.[1]

In various biometric studies, it has been shown that unfavourable conditions tend to increase the degree of observed variation. But the attempt to erect this into a general principle cannot be correct, since the opposite may in other cases hold good. This is so, for instance, in our fruit-fly example—moist conditions, being associated with abundance and availability of food, are favourable; yet they here increase variability. A human example of the same sort, also cited by Hogben,[2] concerns education. "The effect of extending to all classes of society the educational opportunities available to a small section of it would presumably be that of increasing variability with respect to educational attainment. The effect of depriving the more favoured of their special advantage would be to diminish variability in educational attainments." Either policy would result in an equalization of environment; but equalizing it by making it more favourable would bring out genetic differences more fully, while the reverse process would mask them.

However, whether equalizing the environment will in this or that case increase or decrease variability, what differences then remain *must* be genetic in their origin. Thus without either equalizing or discounting the effect of environment, we cannot be sure what differences between groups are due to inheritance.

This point is of extreme importance in eugenics. For instance, it is well known that members of different social classes differ in their average of stature, physique and intelligence—all of them characters of the greatest evolutionary importance. I take one or two examples from Carr-Saunders.[3] In a sample of fourteen-year-old Liverpool schoolboys, the boys from a secondary school were on the average no less than 6½ inches (over 10 per cent.) taller than those from a council school in a poor neighbourhood; and differences in weight were equally marked. In a similar investigation in London, the "mental age" (as determined by intelligence tests) of boys from a superior school was far above that of boys from a school in a poor neighbourhood. Twelve-year-olds from the superior school had a mental age nearly a year above their real age, while those from the poor school were a whole year behind their real age—a difference of 15 per cent.

Such differences are usually cited by eugenists as proof of a real and considerable difference in genetic qualities. For instance, Professor Carr-Saunders, after quoting these facts, concluded that "so far as

[1] Hogben, 1933, p. 115.
[2] *Op. cit.*, p. 115.
[3] Carr-Saunders, 1926, pp. 97, 105, 126.

persons in this country are concerned, the mental differences which we observe, after stripping off the obvious acquirements in the form of knowledge of facts, habits, customs, manners, are due only in very small part to differences in the physical environment, and in a varying though never to a large degree to differences in the social environment, and for the greater part to inherited differences." And he draws the same general conclusion with regard to the physical differences. Yet in the few years since Professor Carr-Saunders' book was written, this conclusion has become extremely unlikely. For recent work has shown that vitamins and other accessory food-factors have physical and mental effects far transcending what we originally thought possible.

In the early years of vitamin research, attention was concentrated upon the definitely pathological states resulting from total or almost total deprivation. During the last ten years, it has been shown that moderate insufficiency of these accessory food-factors will result in retardation of growth, stunting, lack of physical and mental energy, and reduced resistance to infectious disease. Even boys who by all ordinary canons were regarded as in fine health and well above the average in physique were shown to benefit both in growth and in energy from the addition of extra milk to their diet. Sir John Orr has shown that the diet actually consumed by the poorer classes in Aberdeen, when given in unlimited quantities to rats, results in poor physique, small litters, low expectation of life, and proneness to numerous diseases, while the same diet with the addition of various vitamins and mineral salts kept the animals in tip-top condition.[1]

In the face of such facts, it is no longer legitimate to attribute the observed differences in physique and intelligence between social classes mainly to genetic factors. Genetic differences may of course exist; but the strong probability is that most of the differences are dependent on differences in nutrition. Further, the defective nutrition of the poorer classes is in part due to ignorance, but in a large measure to mere poverty. Until we equalize nutrition, or at least nutritional opportunity, we have no scientific or other right to assert the constitutional inferiority of any groups or classes because they are inferior in visible characters.

The extreme importance of applying accurate methods to the problem is shown by the results of recent investigations on twins. As is well known, twins may be identical or monozygotic, always of the same sex and both derived from the same fertilized egg; or they may be fraternal or dizygotic, either of like or unlike sex, and derived from

[1] Cited in Orr, 1936.

two separate eggs. The former will have identical hereditary outfits, the latter will have hereditary outfits as different as those of members of the same family born at different times.

Yet it is true that in regard to intelligence tests, fraternal twins of like sex, though as we would expect they show considerably less resemblance than identical twins, are more alike than pairs of brothers or pairs of sisters born at different times. The additional similarity of their environment, due to their developing pre-natally and post-natally in more similar conditions, has assimilated them.

Writing of these results, Hogben [1] says that "the ambiguity of the concept of causation" inherent in classical biometrical method has "completely obscured the basic relativity of nature and nurture." The difficulties inherent in multiple causation are here pithily summed up, and attention also drawn to the practical impossibility of comparing results obtained on material from different environments, and drawing genetic conclusions on their face value.

The same is true of racial differences. It seems clear that the very idea of race as applied to man is a misnomer under present conditions. Professor Gates has indeed recently asserted [2] that the major races (colour varieties) of man should be regarded as true species. This appears to me to be a grave error, arising from a failure to recognize the biological peculiarities of the human species, as a species. These are due to man's mobility and his tradition, and result in a unique degree of variability combined with a failure of the usual tendencies to speciation: the incipient species are brought together again by migration and mingled by inter-crossing before any mutual infertility has been established.

While, however, modern genetics has shown that the term *race* only has meaning as a description of somewhat hypothetical past entities or as a goal for even more hypothetical future ideals,[3] yet it is of course clear that different ethnic groups (to use the most general and non-committal phrase) differ in genetic characters. Ethnic groups obviously differ in regard to the mean values, and also the range and type of variability, of physical characters such as stature, skin-colour, head- and nose-form, etc.: and these differences are obviously in the main genetic. There is every reason to believe that they will also be proved to differ genetically in intellectual and emotional characters, both quantitatively and qualitatively. But—and this cannot be too strongly emphasized—we at present have on this point no evidence whatever which can claim to be called scientific. Different ethnic

[1] *Op. cit.*, p. 95. [2] Gates, 1934.
[3] Huxley and Haddon, 1935, especially chapter vi.

groups have different languages and cultures; and the effects of the cultural environment are so powerful as to override and mask any genetic effects.

Most so-called racial traits are in point of fact national traits; and being so, they have no genetic or eugenic significance. In illustration we may think of those chief contributors to our own ancestry, the ancient Britons and the even less civilized Picts and Scots, of the Roman Imperial period. They were truly described by the Romans as barbarians. It is obvious that the difference between their then barbaric state and our present level of relative civilization is due entirely or almost entirely to changes in tradition and culture, material and other. The genetic basis on which this progress has been erected was doubtless a good one; but the only way to see whether other ethnic groups now in the barbaric stage of culture, such as the Bantu, differ in their genetical quality is to give them a similar opportunity. To assert, as is often done, that the present barbarism of, say, the Bantu is proof of their genetic inferiority is a gross error of scientific method.

The dangers of pseudo-science in these matters are being illustrated on a large scale, and with the accompaniment of much individual suffering and political danger, in present-day Germany. The Nazi racial theory is a mere rationalization of Germanic nationalism on the one hand and anti-Semitism on the other. The German nation consists of Mendelian recombinations of every sort between Alpine, Nordic, and Mediterranean types. The theory of Nordic supremacy and initiative is not true even for their own population:[1] it is a myth like any other myth, on which the Nazis are basing a pseudo-religion of nationalism.

When we come to the distinction between Aryan and non-Aryan, the scientific error is magnified; for the very term Aryan denotes the speakers of a particular type of language, and can by definition have no genetic significance. As Max Müller himself wrote in a belated recantation:[2] "To me an ethnologist who speaks of Aryan race, Aryan blood, Aryan eyes and hair, is as great a sinner as a linguist who speaks of a dolichocephalic dictionary or a brachycephalic grammar."

And when it comes to anti-Semitic measures, we must remember the elementary fact that the Jews are primarily a pseudo-national group, with a cultural and religious basis, not primarily an ethnic group with a genetic basis. Laws that lay down the amount of Jewish

[1] Huxley and Haddon, *op. cit.*, chapters iii, vi, vii, ix.
[2] Müller, M., 1888, p. 245.

"blood" permissible in an "Aryan" have no quantitative basis and no real biological meaning.

The alleged inferiority of half-castes between whites and black or browns is another case in point. If the inferiority really exists, it is much more likely to be the product of the unfavourable social atmosphere in which they grow up than to any effect (which would be biologically very unusual) of their mixed heredity.

The results of intelligence tests applied to different ethnic stocks are for the same reason devoid of much value. Intelligence tests are now very efficient when applied to groups with similar social environment; they become progressively less significant as the difference in social environment increases. Again, we must equalize environment upwards—here mainly by providing better educational opportunity —before we can evaluate genetic difference.

To sum up, in the practical handling of every so-called racial problem, the error seems invariably to have been made of confusing genetic with cultural factors. The former alone could legitimately be called racial: but indeed the very term race disintegrates when subjected to modern genetic analysis. The net results are, firstly, that it would be best to drop the term *race* from our vocabulary, both scientific and popular, as applied to man; and secondly, and more importantly for our present purpose, that until we equalize environmental opportunity, by making it more favourable for those now less favoured, we cannot make any pronouncements worthy to be called scientific as to genetic differences in mental characters between different ethnic stocks.

In point of fact, so-called racial problems on analysis invariably turn out to be problems of culture-contact. A dominant civilization or class desires to continue its dominance over a civilization or class of different colour or ethnic type, or is afraid that its values will be impaired if it tries to assimilate those of the other group. These are very real problems: but let us tackle them as such, sociologically, not on the basis of a false appeal to genetic science.

My readers must not imagine that I underrate the extent of the genetic differences between human groups, be they classes or so-called races. Man as an animal organism is unique in several respects: and one of them is his abnormal range of genetic variability. A reminder of the basic nature of this variability is given by the recent work of Blakeslee on taste and smell.[1] He finds that a number of substances which have a strong taste to some people, are not tasted at all by others. Thus the perceptual worlds inhabited by different human

[1] Blakeslee and Fox, 1932.

beings may be different on account of differences in genetic make-up. What far greater differences in conceptual worlds must be due to genetic differences in intelligence and emotion!

It would be most unlikely that this variability should be evenly distributed between different social and ethnic groups. As regards the latter, indeed, the existence of marked genetic differences in physical characters (as between yellow, black, white and brown) make it *prima facie* likely that differences in intelligence and temperament exist also. For instance, I regard it as wholly probable that true negroes have a slightly lower average intelligence than the whites or yellows. But neither this nor any other eugenically significant point of racial difference has yet been scientifically established.

Further, even were the probability to be established that some "races" and some classes are genetically inferior to others as a fact, it seems certain, on the basis of our present knowledge, that the differences would be small differences in average level, and that the ranges would overlap over most of their extent—in other words, that a considerable proportion of the "inferior" group would be actually superior to the lower half of the "superior" group. Thus no really rapid eugenic progress would come of encouraging the reproduction of one class or race against another: striking and rapid eugenic results can be achieved only by a virtual elimination of the few lowest and truly degenerate types and a high multiplication-rate of the few highest and truly gifted types.

Do not let us forget that the over-believers in genetics are not the only ones in error. While the view that the observed differences in achievement and behaviour between class and class, nation and nation, are primarily genetic, is untrue and unscientific, the opposite view that opportunity is all, and that we need only work at reforming the social environment, is precisely as unscientific and untrue. For instance, up to the present, the theoretical foundations of Communism have prevented the Russians, in spite of their great achievements in pure genetics, from paying proper attention to eugenics. It now appears, however, that they are being confronted with problems, such as the rarity of qualities making for leadership and the inherent difference between a born leader and an ordinary man, which are bound to bring them face to face with eugenics. Here we see a social bias operating in the first place, to be checked later by the realities emerging from the social situation.

But while the enormous differences in social environment between nation and nation, class and class, normally mask any genetic differences that may exist, and, so far as visible and effective characters are

concerned, largely override constitutional influences, it is clear that the social environment itself often exercises a selective influence which may be of great importance.

This selective influence is of two distinct kinds, which we may call pre-selective and post-selective. In simplest terms, pre-selective influences are those which attract certain types into an environment and discourage others. Post-selective influences are those which act on the population subjected to the environment, favouring certain evolutionary trends within it at the expense of others.

As a biological example, think of the assemblage of animals found living in caves. They are characterized broadly by poor eyesight and reliance on touch; the extreme types are eyeless, and pale or even colourless. It seems clear that both pre- and post-selective processes must have here been at work. Animals with somewhat poorly developed eyes, which shun the light and normally live in dark corners, will more frequently find themselves in caves, and will be likely to survive there better than more active and more "normal" types. But once a cave-population is established, selection will be at work to encourage the development of tactile and other organs for use in the dark; it will also cease to operate strongly or at all on the genes responsible for keeping up full pigmentation or perfect eyes, so that these will in many cases degenerate.

A striking example is that concerning the selective influence of the environment provided by fields of cultivated cereals. As Vavilov has shown,[1] this favoured certain other plants, which could then flourish as what the farmer calls weeds, in association with the crop. Among these weeds were wild grasses related to the cultivated cereal; and in certain climatic conditions, these weeds flourished relative to the crop, became the dominant species, and were then used by man as the basis for a new crop-plant.

Just as cultivation of one crop-plant here provided the basis for the later development of another, so the social environment appropriate to one stage of human culture gives opportunities for the expression of human traits which may be destined to become dominant at a later stage. The eliciting effect of environment is in both cases essential.

The United States furnishes a classical human example. Pre-selection was at work on the pioneers. The human cargo of the *Mayflower* was certainly not a random sample of the English population. Religious zeal, independence of character, perhaps a tendency to fanaticism, together with courage, must have been above the average among the leaders, and probably in the whole band. The

[1] Vavilov, 1926.

early settlers in Virginia and Carolina were pre-selected on other lines, though some of the characters involved were the same. After the first settlements were made, further immigrants until near the end of the nineteenth century were pre-selected for restlessness, initiative, adventurousness, and the qualities making up the pioneer spirit. The easily contented, the unadventurous and the timid, were pre-selected to remain behind. So, too, on the average, must have been those with artistic, philosophic, literary, or mathematical gifts. Even if the mean differences between those who went and those who stayed were not large, they must have been significant.

Once the immigrants were established in the country, selection continued. This post-selection, so long as there was an open physical frontier to the west, and an open economic frontier in the more settled regions, must on the whole have encouraged and discouraged the same qualities favoured by pre-selection: in addition, assertiveness and ambition were encouraged in the acute phase of "rugged individualism," while artistic and literary endowment still were at a discount. Of course the direct moulding effect of the social environment must have acted in the same sense as its selective effect; so that here again genetic differences would be masked. Yet on deductive grounds we can be certain that the selective effect would be at work, and would produce genetic differences: the only question is the extent of those differences.

Whenever there are mass-movements of population, we are sure to find similar selective effects. The difference between the southern Irish in America and in Ireland strikes every observer: we can hardly doubt that it is due in part (though doubtless not entirely) to a sifting of more from less adventurous types. And the same holds true of the obvious differences between rural and urban population in a country like our own. Whatever be the effect of country life and labour on a man's temperament, we can be sure that those who stayed behind were not as a group genetically identical with those who ventured away into the new life of the towns.

One of the profoundest selective influences ever brought to bear on the human population of the globe must have been that exerted by the invention and spread of agriculture, as has been well stressed by Ellsworth Huntington.[1]

A settled agricultural civilization demands qualities in its members very different from those demanded by a nomadic or a hunting existence. Agriculture demands constant application; the pastoral life is freer, and hunting demands rather occasional outbursts of maximum

[1] Huntington, 1928, chapter xiv.

energy. Agriculture demands foresight and the sacrificing of present comfort to future benefit; in the more primitive modes of life, activity springs more immediately from events. Agriculture demands steady routine in one spot; the nomad and the hunter can profitably indulge the spirit of restlessness.

Inevitably, it would seem, where early agricultural civilizations were growing up, there must have been a considerable drift of the more restless types out of them into the nomad and hunting cultures on their borders; and quite possibly there occurred also a converse movement inwards of more calculating and less restless types.

Further, once the agricultural civilizations were well established, a dominant class always appeared whose interests were bound up with the success of the group. The members of this class therefore were bound to encourage submissiveness and industry in the cultivators of the soil: and although much was in fact accomplished by purely environmental means, such as religion and law, there must again have been a selective effect, so that the level of inherent docility would tend to rise in the peasant class. Thus in the long run, agriculture must have markedly increased the selective value of tendencies making for the humdrum hard-working human virtues, and in its secondary effects, as in the birth of the merchant class and in other ways, have encouraged foresight and calculation.

Class differences in environment may also be selective. It seems to be established that the inhabitants of our industrial towns are on the average smaller and darker than those of the rural and small-town population.[1] It may well be that there is a selection against tall and therefore rapidly-growing types on account of the unfavourable diet and living conditions of the slum dweller, since slow growth makes less demands upon a low supply of vitamins: and that tall stature is on the whole correlated with fair complexion. But whatever the cause, the fact remains, and can only be due to selection of some sort.

A recent report of the Industrial Health Research Board [2] points out that in the early part of the industrial era, the demand in factories was for men of good physique irrespective of build, while appearance or presence counted for more in shops and offices. This may have laid the basis for the observed fact that manual workers average shorter than blackcoated workers, but are stronger. It is quite likely that with the recent introduction of more automatic machinery,

[1] Carr-Saunders, 1926, pp. 195-6.
[2] Ind. Health Res. Bd. Rept., 1935.

which does not demand strength, the type of selection will alter, and the factory workers come to lose their better physique.

The same report mentions that a fairly large sample of unemployed, contrasted with a large sample of employed men, were slightly less tall and distinctly less strong. These were mainly men who would be the first to be turned off and the last to be taken on, so that selection seems definitely to have been at work here.

This brings up the large and important question of the selective effect of the class system as a whole in an industrial capitalist society. As many writers have pointed out, in so far as there is any ladder of opportunity by which men may rise or sink in the social scale, there must be some selective action. With the passage of time, more failures will accumulate in the lower strata, while the upper strata will collect a higher percentage of successful types.

This would be good eugenically speaking *if* success were synonymous with ultimate biological and human values, or even partially correlated with them; *and if* the upper strata were reproducing faster than the lower. However, we know that reproduction shows the reverse trend, and it is by no means certain that the equation of success with desirable qualities is anything more than a naïve rationalization.

Before, however, we discuss this further, let us look at some other effects of our pattern of class-system. Once we begin to reflect, we see that certain qualities are more favoured, often much more favoured, in some classes than in others. For instance, initiative and independence have less opportunity among unskilled labourers than elsewhere. Inclinations to art, science, or mathematics will be more favoured in the upper and upper-middle classes than elsewhere. The result may be truly selective, for instance by encouraging types genetically above the average in submissiveness among the proletariat. For the most part, however, it is likely merely to mask genetic differences. The fact that an undue proportion of artists, writers and scientists spring from the upper strata of society would then not mean that these strata were proportionately well endowed by heredity—merely that in the rest of society the Darwins and the Einsteins, like the Miltons, were mute and inglorious.

Two interesting recent studies by Gray and Moshinsky[1] confirm and extend this conclusion. They show, on the basis of intelligence tests, and without discounting any of the superior performance of upper-class children as partly due to their superior environment, that our present educational system leaves vast reservoirs of innate intelligence

[1] Gray and Moshinsky, 1935, *a* and *b*.

untrained in the children from lower social strata. Contrary to usual belief, only about a third of the children whose performance is in the top thousandth, come from the higher social and the professional classes, while wage-earners contribute 50 per cent. of these children of "exceptional intelligence." Thus our society is not utilizing the innate intelligence of its members as it might, nor does the system give adequate opportunity for intelligence to rise.

Again, highly-strung types are less likely to achieve success in the lower economic strata, more likely to become neurotic or insane. People from the lower-middle and working classes who are apparently mentally deficient or abnormal have often reached their unfortunate condition because they have not had either the care or the opportunities for self-expression which would have been available in a more generous social environment.

Let us also remember that society as a whole can have a similar effect. Those same types which in Siberian tribes would achieve prestige and power as shamans and medicine-men, or in the medieval world would have become candidates for sainthood, would here and to-day often find their way into asylums.

This brings us on to a biological point whose importance has not always been realized. It is that selection is theoretically meaningless and practically without value except in relation to a particular environment. The practical implications are both the easiest to grasp and the more important for our purpose. In breeding domestic animals, as Hammond of Cambridge has so well stressed,[1] selection and breeding will not produce the desired results so quickly, and may not produce them at all, if they are conducted in the unreal environment of an academic breeding station where optimum conditions are provided. They should be conducted in an environment similar to that in which the animals are destined to be used.

An extreme illustration of this is provided by cattle. In various parts of tropical Africa, the semi-arid bush country provides but scanty nutriment, and erosion has led to various mineral deficiencies. The native cattle are scrubby little beasts, no bigger than ponies, yielding not more than two gallons of milk a day, and growing so slowly that they do not breed until four or five years old. Contrasted with cows of a good modern British milking breed, which are double the size, give up to nine gallons of milk daily, and breed at two to three years of age, they are, you would say, very inefficient bits of biological machinery. Yet if we try to introduce European breeds into such areas, they are a complete failure. They make demands

[1] Hammond, 1932 (pp. 251-2), 1935.

which are greater than can be met by the environment. And it is they which suffer; they become stunted, rickety or otherwise diseased, and cannot hold their own in competition with the native breeds. The native stock will stand a little genetic grading up in present conditions; but the only chance for radical improvement is to begin with improvement of the environment—the provision of mineral fertilizers, salt-licks, watering facilities, and so on—and then practise genetic selection to keep pace with the environmental change.

Another example is that of Stapledon's remarkable work on moorland grazings.[1] By his methods, rough hill grazings can be converted into real pastures, capable of carrying many more sheep, and carrying them all the year round instead of only in the summer. But this can only be done by the simultaneous transformation of the environment and of the herbage stocks. The environmental transformation consists in breaking up the soil, followed by the application of certain mineral fertilizers. The genetic transformation consists first in the destruction of the original plant covering, brought about by the breaking-up of the soil, followed by the sowing of more nutritious pasture grasses and clovers. Furthermore, the new plants must be of special strains, previously bred and selected to resist the climatic conditions of the higher altitudes; the ordinary strains that give good lowland pastures will not maintain themselves.

Precisely the same considerations apply to the improvement of man. Our schemes for improving the genetic qualities of the nation or the species are meaningless except in relation to some particular environment, present or future. Our eugenic ideals will be different according as we relate them to a slave order or a feudal order of things, a primitive industrial or a leisure order, a this-worldly or an other-worldly order, a capitalist or a socialist order, a militarist or a peaceful internationalist order. Even if we imagine we are working to absolute genetic standards, we are in reality thinking of them, albeit unconsciously, in relation to some ideal environment of the future, or to the needs and realities of the present social environment, or, very frequently, to our bias and *a priori* views about this present environment and how in our opinion it ought to be changed. If we were really treating of absolute genetic standards, we should have deserted reality for a metaphysical vacuum, and our reasoning and deductions would have even less value than a discussion of, say, eugenics in heaven. (Even in this latter case, be it noted, the discussion would inevitably be related to the environment which we supposed was awaiting us in the next world!)

[1] Stapledon, 1935.

Now all such unconscious thinking is inevitably irrational or at best non-rational: if it had been submitted to the light of reason, it would no longer be unconscious. So that a prime task before eugenists is the reasoned formulation of their views on the environment to which their schemes of genetic betterment are to be related.

There are, it seems to me, three possible courses to be pursued. Either we may accept as given our present type of social environment, and adjust our eugenic programme to it. In practice we shall of course be forced to take a dynamic instead of a purely static point of view, and consider the trends of change within that environment, while assuming that the social system will not be fundamentally altered. Or, going to the opposite extreme, we may assume an ideal social environment—more scientifically, one which is the optimum we can imagine—and plan our eugenic measures in relation to that, piously hoping that in the long run social change will adjust itself to our ideal or to whatever measure of genetic change we may have brought about. Or finally we may envisage, as in Stapledon's grassland work, a joint attack upon environment and germ-plasm. Assuming that we have some measure of control over the social environment, we shall adjust our genetic programme to that programme of environmental change which represents, both in direction and tempo, a happy mean between the ideal and the immediately practical, between what we should like and what we are likely to get.

Let us look at these three alternatives and their implications. First, however, it should be pointed out that they are not wholly alternative to each other. Even if we take the environment for granted, we must face the fact of social change and attempt to meet it eugenically; and in so doing we shall find it difficult to avoid giving some play to our wishes, fears, and hopes. Even if we assume an optimum environment, our ideal must be based on our conscious or unconscious estimate of what developments are inherently possible to the present system. We shall, in effect, be attempting to forecast social improvement, and we shall prove, we can be sure, as widely out in our forecasts as if we were attempting to prophesy the future of scientific discovery. And the third method, of necessity, must take into account both the hard fact of the present and the ideal of wishes and hopes for the future.

None the less, there are real differences between the three; and we must consider these more in detail.

To accept the continuance of the present type of social environment as essentially given (whether given in reality or in our hopes and fears will make no difference to our eugenic plans) means, I take it, two

main things. It means that we must plan for a capitalist class-system, and for a nationalist system. We accept the division of society into economic strata, with large differences in standard of living, outlook, and opportunity between the different classes; and we accept all the implications of the principle that the earning of a return on capital is the primary aim and duty of business and finance, whatever minor modifications and regulations may be found desirable or opportune. We accept individualist competition, however much toned down in practice, as essential. Further, we accept the division of the world into nationalist states, which, however their sovereignty and independence of action may be modified or curtailed by international agreements, will be competing as well as co-operating with each other, and must in certain eventualities be prepared to resort to war.

Coming down to results, we accept the economic and spiritual frustrations of the system also—that is to say, we accept the necessity of some degree of unemployment, for without that there can be no approach to a free market for labour; we accept the continuance of trade cycles of boom and slump, even though they may be toned down in amplitude. We accept the need for restriction of output whenever surplus interferes with profit. We accept the existence of a cheap supply of unskilled and semi-skilled workers; we accept the need for man-power in case of war.

If so, then we must plan our eugenic policy along some such lines as the following:

First comes the prevention of dysgenic effects. The upper economic classes are presumably slightly better endowed with ability—at least with ability to succeed in our social system—yet are not reproducing fast enough to replace themselves, either absolutely or as a percentage of the total population. We must therefore try to remedy this state of affairs, by pious exhortation and appeals to patriotism, or by the more tangible methods of family allowances, cheaper education, or income-tax rebates for children. The lowest strata, allegedly less well-endowed genetically, are reproducing relatively too fast. Therefore birth-control methods must be taught them; they must not have too easy access to relief or hospital treatment lest the removal of the last check on natural selection should make it too easy for children to be produced or to survive; long unemployment should be a ground for sterilization, or at least relief should be contingent upon no further children being brought into the world; and so on. That is to say, much of our eugenic programme will be curative and remedial merely, instead of preventive and constructive.

Then, in systems like the present, man-power is important, and for

man-power, quantity of population above a certain minimum qualitative standard is as essential as higher quality; and if the two conflict, quantity supply must not be interfered with. For qualitative change, a dual standard is indicated—docility and industrious submissiveness in the lower majority; intelligence, leadership and strength of character in the upper few. Since a high degree of intellect and imagination, of scientific and artistic ability and other qualities, cannot be adequately expressed or utilized, under any system resembling the present, in the great majority of the lower strata, it is useless to plan for their genetic increase in these strata. Indeed, it is more than useless, it is dangerous; for the frustration of inherent capacity leads to discontent and revolution in some men, to neurosis and inefficiency in others. The case is strictly analogous to that of cattle in Africa; in an unfavourable environment, too drastic genetic improvement is worse than none.

Next we come to planning for an ideal or optimum environment. An obvious difficulty here is that the various optima conceived by different minds, or groups of minds, will be so different as to be irreconcilable. Putting this on one side, however, it is I think possible to state the sort of optimum which would commend itself to the mass of what we may call "men of goodwill." It would, I take it, be a social environment which gave the opportunity, first of work which was not excessive, which was felt to be useful, and whose rewards would provide not only the necessities but a reasonable supply of the comforts and amenities of life: secondly, of a reasonable amount of leisure: thirdly, the opportunity to everyone of expressing whatever gifts of body and mind they might possess, in athletics or sport; in art, science or literature, passive or actively enjoyed; in travel or politics, in individual hobbies or in social service.

If so, then we should plan a eugenic programme with a single and very high standard. We should aim at a high level of inherent physical fitness, endurance and general intelligence; and we should encourage the breeding of special talent of any and every sort, for mathematical as much as for business success, artistic as much as administrative. We should realize that, if we succeeded, our genetic results would over a great range of the population be out of harmony with their social surroundings, and would either be wasted or lead to friction and discontent, or might express themselves in characters such as neurosis or a sense of maladjustment which would represent a lower level than that from which we started. For ultimate success we should rely on creating a demand for changing the environment towards our optimum. The supply of genetic types which could only reach proper

expression in such an environment would help to create the demand; the friction and discontent would add themselves to the forces of change.

It will, however, by now have become clear that neither of these approaches is so satisfactory as the third. Indeed, neither is methodologically sound. If the aim of eugenics be to control the evolution of the human species and guide it in a desirable direction, and if the genetic selection should always be practised in relation to an appropriate environment, then it is an unscientific and wasteful procedure not to attempt to control environment at the same time as genetic quality. Science is simultaneously both theory and practice, both knowledge and control. For the applied science of eugenics to neglect the environment is a source both of confusion and of practical weakness. I would go further: I would say that we cannot succeed in achieving anything in the nature of adequate positive eugenics unless we attempt the control of the social environment simultaneously with the control of the human germ-plasm, any more than Stapledon could have improved his rough mountain grazings save by a similar double attack.

Let us then look more in detail into this third or dual method of approach. It has two facets, theoretical and practical. On the theoretical side, we shall only progress in our attempt to disentangle the effects of nature from those of nurture in so far as we follow the footsteps of the geneticist and equalize environment. We shall never be able to do this in the same radical way as the pure scientist, by testing out a whole range of controlled and equalized environments on selected stocks. We must therefore concentrate on producing a single equalized environment; and this clearly should be one as favourable as possible to the expression of the genetic qualities that we think desirable. Equally clearly, this should include the following items. A marked raising of the standard of diet for the great majority of the population, until all should be provided both with adequate calories and adequate accessory factors; provision of facilities for healthy exercise and recreation; and upward equalization of educational opportunity. The further we move in this direction, the more readily shall we be able to distinguish inherent physical and mental defects from environmental stunting and frustration; the higher we raise the average, the more certain shall we be that physical or mental performance above the average is dependent upon genetic endowment and therefore provides the raw material for positive eugenics. Not only this, but we know from various sources that raising the standard of life among the poorest classes almost invariably results in a lowering of their fertility. In so far, therefore, as differential class-

fertility exists, raising the environmental level will reduce any dysgenic effects which it may now have.

Returning, however, to the more important aspect of the eugenic knowledge to be gained by levelling up the social environment, I anticipate that at the bottom, the social problem group, though shrinking in size, will be left, clearly marked out by its inadequate performance in the new and favourable conditions, as a well-defined target for measures of negative eugenics such as segregation and sterilization; and that minor targets of the same nature will emerge out of the present fog, in the shape of nests of defective germ-plasm inspissated by assortative mating and inbreeding, such as have been imaginatively glimpsed by Lidbetter and others. I further anticipate that the professional classes will reveal themselves as a reservoir of superior germ-plasm, of high average level notably in regard to intelligence, and therefore will serve as a foundation-stone for experiments in positive eugenics. But I anticipate that society will tap large resources of high ability that are at present unutilized, thus facilitating the social promotion of at least certain fitter elements; and without social promotion we cannot proceed to reproductive encouragement. This is the scientific ideal at which we should aim. Like many other ideals, we shall not achieve it; but any approach to it will help us towards a more certain knowledge.

Science, however, is control as well as knowledge; and new practice may advance theory as much as new theory lay the basis for practice. This is especially true for the social sciences, where, as we have seen, rigorously controlled experiment, on the pattern of pure physics or physiology, is impossible, and problems must frequently be solved *ambulando*. We make a partial experiment which is simultaneously pure and applied science. The experiment is both an attempt to gain knowledge and an effort to realize a wish, a desired control. It is planned, like more crucial experiments in the natural sciences, to verify deductions from known facts. In so far as the desired end is attained, the deductions are verified and knowledge is increased: and even if the control is not attained, knowledge is increased, though not to the same extent.

This more empirical mode of attack must also be used in eugenics. We must attempt to control the change of social environment and at the same time to control the change of human germ-plasm, along lines which appear likely to yield tangible and desirable results. It is the results which interest us. Admirable germ-plasm unable to realize itself owing to unfavourable conditions does not interest us: nor do the most alluring social conditions, if they permit or encourage

the deterioration of the germ-plasm. Thus the two attacks must be planned in relation to each other, and also in relation to practicability.

When we think along these lines, we shall find, I believe, that a system such as ours, a competitive and individualist system based on private capitalism and public nationalism, is of its nature and essence dysgenic. It is dysgenic both in the immediate respect of failing to utilize existing reservoirs of valuable genes, and also in the long-range tasks of failing to increase them, failing to trap and encourage favourable mutations, and failing to eliminate harmful mutations.

Under our social system, the full stature or physique of the very large majority of the people is not allowed to express itself; neither are the full genetic potentialities of health permitted to appear except in a small fraction of the whole, with a consequent social waste of energy and time, not to mention a waste of individual happiness which is formidable in extent; and finally, innate high ability is encouraged or utilized only with extreme inadequacy. For the first two wastes, ignorance is partly responsible, but in the lower economic strata, poverty is the chief cause. For the last, our inadequate educational system is chiefly responsible.

Then R. A. Fisher has brilliantly and devastatingly shown [1] the relentless way in which such a system as ours promotes both infertility and certain types of talent, and in so doing ties together the genetic factors responsible. In the course of the generations genes making for small families become increasingly bound up with those making for social and economic success; and conversely those making for social and economic failure become bound up with those making for high reproduction rates. Eugenically speaking our system is characterized by the social promotion of infertility and the excess fertility of social failure.

If this be true, then so long as we cling to a system of this type, the most we can hope to do is to palliate its effects as best we may, by extending birth-control facilities downwards, instituting graded systems of family allowances, providing for sterilization here and financial relief for children there. But even if we thus reduce the distortion we cannot hope to change its sign.

Then, in so far as our system remains nationalist, the demand for man-power and quantity will continue to interfere with the higher aim of quality. Furthermore, modern war itself is dysgenic. This has often been pointed out as regards its direct effects. It appears, however, also to hold for its indirect effects; many among the more imaginative and sensitive types are to-day restricting their families,

[1] Fisher, 1930, chapter xi.

sometimes to zero, because they feel that they cannot bear to bring children into a world exposed to such a constant risk of war and chaos.

As eugenists we must therefore aim at transforming the social system. There may of course be those amongst our ranks who prefer the not disagreeable rôle of a Jeremiah darkly prophesying gloom to settling down at the more prosaic job of constructive work. But as a body, we shall wish, I take it, to see at least the possibility of our dreams coming true.

What sort of practical changes, then, should we as eugenists try to encourage in the social and economic system? In the first place—what we have already noted as desirable on theoretical grounds—the equalizing of environment in an upward direction. For this, by permitting of more definite knowledge as to the genetic constitution of different classes and types, will at once give us more certainty in any eugenic selection, negative or positive, upon which we may embark. And secondly, we must aim at the abandonment of the idea of national sovereign states, and the subordination of national disputes to international organization and supernational power.

But we need something more radical than this—we must try to find a pattern of economic and communal life which will not be inherently dysgenic; and we must also try to find a pattern of family and reproductive life which will permit of more rapid and constructive eugenics.

On the first point, it seems clear that the individualist scramble for social and financial promotion should be dethroned from its present position as main incentive in life, and that we must try to raise the power of group-incentives. Group-incentives are powerful in tribal existence, and have been powerful in many historical civilizations, such as the old Japanese. What interests us chiefly, however, is to find that they have been to a large extent effective in replacing individualist money incentives, or at least diminishing their relative social importance, in several modern States, notably Germany and the U.S.S.R.

It is not for a biologist to discuss the purely social merits of different political philosophies: but he may be allowed to point out that not all group-incentives are equally valuable from the eugenic standpoint. Those of Nazi Germany, for instance, presuppose an intensification of nationalist feeling and activity instead of their diminution: and this, we have concluded, is actually anti-eugenic. It may of course be urged that it is in its immediate effect eugenic; and there will be many to uphold the value of the eugenic measures recently adopted in Germany under the stimulus of National Socialist ideas and emotions, even if some of them be crude and unscientific. But if in the long run

it leads to over-population and war, it is essentially dysgenic, and in matter of evolution we must, I think, take the long view.

Further, if the social environment is such as to give satisfaction to the possessors of social traits such as altruism, readiness to co-operate, sensitiveness, sympathetic enthusiasm, and so forth, instead of, as now, putting a premium on many antisocial traits such as egoism, low cunning, insensitiveness, and ruthless concentration, we could begin to frame eugenic measures for encouraging the spread of genes for such social virtues. At the moment this is hardly possible, for the expression of such genes is so often inhibited or masked by the effects of the environment. This is a human illustration of Hammond's general principle, that breeding and selection for a given type can only be efficiently carried out in an environment favouring the fullest development of the type.

There is no doubt that genetic differences of temperament, including tendencies to social or antisocial action, to co-operation or individualism, do exist, nor that they could be bred for in man as man has bred for tameness and other temperamental traits in many domestic animals; and it is extremely important to do so. If we do not, society will be continuously in danger from the antisocial tendencies of its members.

Just as the basic structure of our present social system is essentially dysgenic, so we may say that the genetic composition of our present population is largely and perhaps essentially antisocial. Thus both environmentally and genetically the present state of mankind is unstable, at war with itself.

Another important point to remember, especially in these days when the worship of the State is imposing a mass-production ideal of human nature, is the fact and the significance of human variability. The variability of man, due to recombination between divergent types that have failed to become separated as species, is greater than that of any wild animal. And the extreme variants thrown up by the constant operation of this genetic kaleidoscope have proved to be of the utmost importance for the material and spiritual progress of civilization. Whatever bias or prejudice may beset the individual eugenist, eugenics as a whole must certainly make the encouragement of diversity one of its main principles. But here again the environment comes in. If extreme types are to be produced, especially gifted for art, science, contemplation, exploration, they must not be wasted. The social system must provide niches for them.

As a special and important special case of providing for variability, there are the needs of the educational profession. At the moment,

this social category seems definitely selective in that it attracts and encourages men and women of an intellectualist and academic type. This is partly because there are not sufficient outlets provided elsewhere in our social system for such types, partly because the educational profession as at present constituted does not provide sufficient attraction for contrasted types. This restriction of type among those responsible for the upbringing of the next generation cannot be satisfactory, and an altered status for the educational profession so that its genetic basis is broadened is an important task for social biology, and, since it involves genetics, legitimately part of the eugenic movement.

Still more important for the comparatively immediate future is the relation of the dominant group-incentive to reproductive morality, law, and practice. We all know that certain schools of Christian thought to-day are opposed on grounds of religious principle to birth-control, that indispensable tool of eugenics as well as of rational control of population, and even to the very notion of eugenics itself. But even if this opposition could be overcome, there would remain in this field grave obstacles, both to the spread of the eugenic idea and to the rate of its progress in practice. These are the prevailing individualist attitude to marriage, and the conception, based on this and on the long religious tradition of the West, of the subordination of personal love to procreation. The two influences together prevent us collectively from grasping the implications of the recent advances in science and technique which now make it possible to separate the individual from the social side of sex and reproduction. Yet it is precisely and solely this separation that would make real eugenics practicable, by allowing a rate of progress yielding tangible encouragement in a reasonable time, generation by generation.

The recent invention of efficient methods on the one hand of birth-control and on the other of artificial insemination have brought man to a stage at which the separation of sexual and reproductive functions could be used for eugenic purposes. But it is of real interest to note that these inventions represent merely the last steps in an evolutionary process which started long before man ever existed.

In lower mammals, the existence of limited breeding seasons, and, during these, the restriction of mating to the oestrous phase in the female's reproductive cycle, do in fact link sexual behaviour firmly with reproduction. But in the great primate stock to which we belong, a new trend early becomes apparent. Breeding seasons are less definite, and mating may occur at any time during the female cycle, so that most acts of union are in fact and of necessity infertile, without reproductive consequences. This trend becomes more marked as we

ascend the evolutionary scale, and culminates in man. In civilized man, the faint traces of a breeding season apparent in certain primitive ethnic stocks have wholly disappeared, and there is no greater readiness to mate during the short period when alone conception is possible than at most other times of the female cycle.[1]

This has already led in point of fact to the widespread separation of the personal function of sexual union from its racial consequences, of love from reproduction. It is true that some persons and bodies on theological or metaphysical grounds either ostrich-like deny the existence of this separation, or assert that it ought not to be practised; but this does not alter the fact.

The perfection of birth-control technique has made the separation more effective; and the still more recent technique of artificial insemination has opened up new horizons, by making it possible to provide different objects for the two functions. It is now open to man and woman to consummate the sexual function with those they love, but to fulfil the reproductive function with those whom on perhaps quite other grounds they admire.

This consequence is the opportunity of eugenics. But the opportunity cannot yet be grasped. It is first necessary to overcome the bitter opposition to it on dogmatic theological and moral grounds, and the widespread popular shrinking from it, based on vague but powerful feelings, on the ground that it is unnatural.

We need a new attitude to these problems, an attitude which for want of another term we may still call religious. We need to replace the present attitude fostered by established religions by a new but equally potent attitude.

As regards the sense of salvation, we need to substitute social salvation for individual salvation; and as regards the need of some escape-mechanism from the pressure of present difficulty, we need to substitute the real possibility of evolutionary progress for other-worldly phantasies. Once this possibility of true human progress, both social and genetic, is generally apprehended, and the social system remodelled so that individual success does not conflict with communal welfare, and self-expression and personal satisfaction can be largely achieved in serving society, then sex and reproduction can take their due places as individual and social functions respectively. Gone will be many of the conflicts inherent in present-day marriage: any sacrifice involved in parenthood will be made on the altar of the race, and in the knowledge that it will be acceptable. Those who wish to pursue further the possibilities of such a step should consult Mr. Brewer's

[1] Zuckerman, 1932, p. 73*f*.

recent article on Eutelegenesis [1] and Professor Muller's book *Out of the Night*.[2] Here it must suffice to point out that unless we alter the social framework of law and ideas so as to make possible the divorce between sex and reproduction, or if you prefer it between the individual and the social sides of our sexual functions, our efforts at evolutionary improvement will remain mere tinkering, no more deserving the proud title of eugenics than does the mending of saucepans deserve to be called engineering.

That consummation, you will perhaps say, is impossibly remote from our imperfect present, hardly to be affected by any of our little strivings to-day. That may be so: but I am not so sure. Let us remember that modern science is a mere three centuries old: yet it has already achieved changes in outlook that are of comparable magnitude. Biological science is only now attaining its maturity, and the social sciences are mere infants. Looked at in the long perspective of evolution, the present phase of human activity is one of transition between that of acceptance and that of control of destiny, between magic and science, between unconsciously-nurtured phantasy and consciously-faced reason. It is, in the sense of the word used in physics, a critical phase: and being so, it cannot be either stable or long-enduring.

It is to my mind not only permissible but highly desirable to look far ahead. Otherwise we are in danger of mistaking for our eugenic ideal a mere glorification of our prejudices and our subjective wish-fulfilments. It is not eugenics but left-wing politics if we merely talk of favouring the survival and reproduction of the proletariat at the expense of the bourgeoisie. It is not eugenics but right-wing politics if we merely talk of favouring the breeding of the upper classes of our present social system at the expense of the lower. It is not eugenics but nationalist and imperialist politics if we speak in such terms as subject races or miscegenation. Our conclusions in any particular case *may* be on balance eugenically correct (though the correlation between broad social or ethnic divisions and genetic values can never be high), yet they will not be based primarily upon eugenic considerations, but upon social or national bias. The public-school ideal, or that of the working-class movement, or that of colonial imperialism, may be good ideals; but they are not eugenic ideals.

Before concluding, I should like to draw attention to one eugenically important consequence of recent progress in pure genetics. In all organisms so far investigated, deleterious mutations far outnumber useful ones. There is an inherent tendency for the hereditary con-

[1] Brewer, H., 1935.

[2] Muller, H. J., 1935.

stitution to degrade itself. That man shares this tendency we can be sure, not only from analogy but on the all-too-obvious evidence provided by the high incidence in "civilized" populations of defects, both mental and physical, of genetic origin.

In wild animals and plants, this tendency is either reversed or at least held in check by the operation of natural selection, which here again proves itself to be, in R. A. Fisher's words, a mechanism capable of generating high degrees of improbability. In domestic animals and plants, the same result is achieved by our artificial selection. But in civilized human communities of our present type, the elimination of defect by natural selection is largely (though of course by no means wholly) rendered inoperative by medicine, charity, and the social services; while, as we have seen, there is no selection encouraging favourable variations. The net result is that many deleterious mutations can and do survive, and the tendency to degradation of the germ-plasm can manifest itself.

To-day, thanks to the last fifteen years' work in pure science, we can be sure of this alarming fact, whereas previously it was only a vague surmise.[1] Humanity will gradually destroy itself from within, will decay in its very core and essence, if this slow but relentless process is not checked. Here again, dealing with defectives in the present system can be at best a palliative. We must be able to pick out the genetically inferior stocks with more certainty, and we must set in motion counter-forces making for faster reproduction of superior stocks, if we are to reverse or even arrest the trend. And neither of these, as we have seen, is possible without an alteration of social system.

Whether or not I have been asking you to accompany me too far into the visionary future, I will end this essay with a very concrete suggestion for the present, backed by a warning from the immediate past.

Twenty-five years ago, when I had just taken my degree, the field of heredity was still a battle-field. The Mendelians and the Biometricians were disputing for its possession, and in the heat of the struggle little mercy was shown by either side to the other. In the last dozen years or so, however, the apparent conflict of principle has been shown not to exist, and now, thanks to the work of such men as R. A. Fisher and J. B. S. Haldane, we realize that the two methods of approach are complementary, and that certain important problems can only be solved by their simultaneous employment.

The present position of eugenists appears to me to be closely parallel

[1] Muller, H. J., 1935.

with the position of the Mendelians a quarter of a century ago. They find themselves in apparent conflict with the environmentalists and the protagonists of social reform. Speaking broadly, the field of human improvement is a battle-field between Eugenists and Sociologists, and the battle is often as violent as that between the Mendelians and Biometricians—or between Swift's Big-endians and Little-endians. In my opinion, it is also as unreal and useless. We eugenists must no longer think of the social environment only in its possible dysgenic or non-eugenic effects, but must study it as an indispensable ally. Changes in social environment are needed both for the adequate expression of eugenic progress, and as a means for its realization.

The next step for eugenics is, as I urged at the beginning of this essay, a methodological one. We eugenists must familiarize ourselves with the outlook and the concepts of sociology, with the technique and practice of social reform; for they are an indispensable part of the machinery we need to realize our aims.

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CLIMATE AND HUMAN HISTORY

OF late years a determined attempt has been made to rewrite history in economic terms. But this does not go deep enough. Man's thought and social life are built on his economic life; but this, in its turn, rests on biological foundations. Climate and gelogy between them decide where the raw materials of human industry are to be found, where manufactures can be established; and climate decides where the main springs of human energy shall be released. Changes of climate cause migrations, and migrations bring about not only wars, but the fertilizing intermingling of ideas necessary for rapid advance in civilization.

Disease and hygiene play as important a part; half the population of the world is permanently below par on account of animal parasites such as the hookworm and the microscopic malaria germ; and disease may bring about the rise or fall of empires. Nor has selection ever ceased its rigorous activity. To pass from one mode of life to another is not a simple affair for a people; a settled agricultural life demands a very different temperament from hunting, and the hereditary make-up of the race must be altered if a people is to pass successfully from one to the other. Most migrations, too, are selective; to take but one example, the Puritans who first colonized Massachusetts did not bring with them a random sample of the genes responsible for the qualities of the English people. But selection is altered and reduced. The better care of the young and the elaboration of social life allow all sorts of variations, which otherwise would be snuffed out, to survive and often to play an important part in progress. Knowledge for knowledge's sake is out of place in a primitive hunting tribe.

When the world's climatic belts are sharply marked (as they are to-day, in contrast to epochs like the late Eocene, when climate was much more uniform), the temperate zones, flanked poleward by the subarctic and the arctic, are separated from the tropics by two dry belts, along which all the world's great deserts are strung. The only zones where vegetation is abundant and man can easily flourish are the temperate and the tropical. But the temperate has another advantage. It contains the belt of cyclonic storms—in other words, of rapid and frequent changes of weather. And this type of climate, as Ellsworth Huntington has shown, is the one most stimulating to human energy and achievement.

We are still so ignorant of the earliest steps in the evolution of man

from his simian ancestors that ideas as to the influence of climate on this phase of his history are highly speculative. It can scarcely be doubted, however, that the progressive desiccation of the world that took place in the late Cenozoic Epoch helped to drive our ancestors down from the trees and out into the plains. We know that the Himalayas were elevated at this time; and it has been plausibly suggested that man originated to the north of them. For, as the land here grew drier, the forests shrank southward, where they were met by the impassable mountain barrier, and disappeared from Central Asia. Their anthropoid inhabitants were therefore forced either to disappear too or to become adapated to the new conditions, growing more terrestrial and more carnivorous. However this may be, men of a sort were undoubtedly in existence before the beginning of the Ice Age, over half a million years ago. But until we shall have found more traces of Eolithic and Lower Paleolithic man in other parts of the world than Europe (which was doubtless a mere outlier of human development) we shall not be able to piece together the fascinating story of the influence of the different advances and retreats of the ice, or the slow progress of Old Stone Age man. Pekin man and recent discoveries in Africa show how complex the picture was.

When the ice of the glacial period was still in the early stages of its last retreat, the storm belt must have lain over North Africa, making what is now the Sahara green and fertile. It was through Africa, and perhaps eventually from southern Asia, that Europe received its modern men, perhaps about 20,000 B.C. (Until about 4000 B.C. our dating must be regarded as provisional only; for the most part the chronology of Peake and Fleure, in their series, *The Corridors of Time*, is here followed.)

Gradually, as the ice withdrew northward, the belts of climate followed it up. The Sahara began to come within the limits of the dry belt. To-day, in certain parts of the Sahara, crocodiles and certain fresh-water fish exist in scattered oases. But these oases are isolated, without possible connections with other bodies of water. The water beasts that inhabit them are living in the sparse remnants of the well-watered, and indeed probably swampy, expanse of verdure that once spread over the Great Desert. This drying of the Sahara must have sent wave after wave of migrating men out of it, both northward and southward.

II

Meanwhile the zone of greatest fertility and greatest human vigour came to lie along the Mediterranean, through Mesopotamia and

across to Turkestan. This again set great movements afoot. The Magdalenians, last of the Old Stone Age men, pushed northward with the forests in the wake of the retreating game of the treeless plains; till eventually, hemmed in between forest and sea, they were forced to lead a wretched existence as gatherers of shellfish and berries on the Baltic coast. The descendants of the other Stone Age peoples, who had remained behind in North Africa and Spain, evolved what is called the Caspian Culture; later they too trekked northward and eventually fetched up in western Asia.

As the open plains shrank before the advance of the forests, big game grew scarce, and men turned to other sources of food. They became food-gatherers as well as hunters, eating nuts and berries and wild grain. This must have seemed a misfortune to those early hunters. But it was the spur of progress, for from food-gathering to food-growing, to real agriculture, was a natural step. It seems to have been somewhere before 5000 B.C., in the Near East, that the art of agriculture was discovered. Legend has it that Isis, the great goddess, found corn on Mount Hermon in Syria, and gave it to her sacred son. The legend may well contain two kernels of truth. It is probable that women rather than men first hit on the idea of planting grain, for the men's work would still be afield, hunting; and it is probable that it was discovered somewhere in Syria or its near neighbourhood. By 5000 B.C. grain-growing had spread round from Palestine to Mesopotamia, and permanent settlements had come into being. The polish gained by stone implements used for hoeing probably gave men the idea of deliberately polishing their tools; if so, agriculture was the cause of the change to the Neolithic Culture. In any case, agriculture and polished neolithic stone implements appear at about the same time.

The arts of pottery and weaving were in all probability discovered about the same time as that of grain-growing, and the first permanent houses were built. Domestic animals followed soon after; domestication seems first to have been learned by hunters, but the art spread rapidly and was extended and improved by the settled agriculturists. Metal-working was not long behind, though for centuries only copper and gold were employed—copper for use and gold solely for ornament.

The glacial period did not die steadily away; it left the earth in a series of spasms or oscillations, a time of rapid retreat being followed by a standstill or even an advance of the ice, brought about, it would seem, by an elevation of the land. For a century or so about 4500 B.C., there was such an elevation. This seems to have had two interesting consequences. For one thing, the increased snowfall round the Mesopotamian basin gave rise to such violent spring floods, year after year,

that some towns were abandoned, and the memory of the disastrous time has been preserved, it seems, in the story of Noah's flood and the corresponding Mesopotamian legends. But more important was its effect on Egypt. In the centuries before this time, the Nile Valley seems to have been marshy and largely uninhabitable; the elevation must have drained it. And the long ribbon of marvellously fertile land thus provided for the use of man tempted in the agriculturists of neighbouring countries. This, it appears, was the real beginning of the civilization of Egypt; but, once started on its career, its geographical position was such that it soon outstripped its rivals.

Thus, largely as a result of the pressure of changing climate on early man, hunting gave place to agriculture. Well before 4000 B.C. what we may call the Archaic Civilization, based on corn and a settled life, —with houses and pottery, woven fabrics and metal work, in addition,—was fully established, from Egypt round by Syria to the Tigris and Euphrates. This corner of the globe was predestined to be the cradle of the modern world—by its climate, by its great rivers, by the fact of its being the original home of wheat, by its being a natural meeting-place for different streams of culture brought by different migrations of men, east and west as well as north and south.

Before 4000 B.C. there had been added to the achievements of settled man the art of writing, the framing of a calendar, irrigation, the wheel, and the making of fermented liquor. Through the whole of the next millennium this remarkable civilization was free to develop its own potentialities. It was a time of depression of land, a moist time over the steppes and the Arabian peninsula, and so a time when the nomad inhabitants of these regions could thrive and multiply in their own homes, not driven by drought to irrupt into the lands of their richer neighbours. To what height the Mesopotamian civilization reached is attested by the marvellous workmanship of the objects from Ur of the Chaldees, which date from about 3500 B.C. The organization of the State under a priest-king, even the welding of empires a million strong, stone architecture, the arch, written codes of law, sea-going ships—these were some of the achievements of this millennium.

But the available land in this corner of the world was being filled up by the natural increase of population; and this filling up coincided with a new elevation of the land and a new period of drought. Between them, the two caused such a movement in the world of man that the Archaic Culture, though made to totter in its original home, was forced to spread its influence far and wide over Europe, Africa, and Asia.

III

The new millennium dawned favourably enough. Egyptian civilization, borne along on its own momentum, reached new successes. Beautiful temples of stone, and the pyramids, with their astounding exactitude and colossal size, date from its earliest centuries. Mathematics and astronomy take their rise; the State is run by a regular bureaucracy. A little later, in Mesopotamia, King Sargon comes on the scene, the first of the great conquerors to build an empire with armies.

For armies were another new invention. The primitive hunters had doubtless fought, but it had probably never been organized fighting; and the early food-gatherers and cultivators seem to have been peaceable on the whole. There was assuredly never any Golden Age of Peace, as Perry and other enthusiasts imagine, but the early ages of human life were probably on the whole peaceful, because deliberate and organized warfare was not necessary and did not pay. War began as settled man quarrelled over his property and his privileges. The idea of war soon spread to the less civilized peoples who fringed the settled lands; and it became possible for these peoples to practise war efficiently because they had passed from the state of hunters to that of nomads, disciplined herdsmen, and horsemen. The horse must have been domesticated on the steppes somewhere before 3000 B.C. A little later, drought began, and the nomads, lacking food at home, poured down on the settled lands with their horses. These were as terrible an innovation in warfare then as were the tanks in the wars of our own day some 4500 years later; and both Egypt and Mesopotamia were overrun and their civilization put in peril.

Meanwhile the pressure of population, of climatic changes, of invasions in the rear, forced the grain-growers out in all directions. Not till about 3000 B.C. did any settle on the continent of Europe; but well before the close of the succeeding millennium they had spread over its greater part, to Thrace, to Germany, to Belgium, to France. And the push was felt by sea as well as by land. The whole Mediterranean became a great trade-lake, and the Ægean sailors had reached the Atlantic at latest by 2200 B.C. At the same time a great wave of migration spread eastward, and a new culture reached northern India and right across to China, which thus seems to have received the first rude germs of her culture. It is possible that the American continent also received its first dose of civilization during this period, by a migration over the land-bridge where now are the Behring Straits.

The maritime expansion continued into the next millennium, and so did the dry climate, which was especially marked in north-western Europe. Sea trade reached Ireland and Scandinavia. Ireland attained a very high level of culture, which was probably only made possible by this dry and bracing climate, before the excessive moisture of later centuries damped the energies of her inhabitants.

About 1800 B.C. there was again a change. The climate became gradually moister and cooler. From about 1200 B.C. to A.D. 200 there was a new cycle of wet and cold, reaching its maximum about 400 B.C. and then gradually falling off, to pass over to drought about A.D. 500. The belt of storm-tracks again passed through the Mediterranean, giving opportunity for the rise of Babylonia and Assyria, Canaan and Phoenicia, of latter-day Crete and Egypt, of Mycenae and Troy, Greece, Carthage, and Rome. North Africa was then the granary of the world. The Mediterranean was the focus of human energy, and, since the nomads could live comfortably on their steppes while the wet time continued, could pursue its destiny little troubled by barbarian invasions.

But the change of climate was disastrous to the northern lands. On them, cold and wet descended; the peat bogs spread; the forests died off as the swampy moors extended. There was a marked falling off of culture in Ireland and Scandinavia; and the worst cold spell, in the fifth and fourth centuries B.C., has apparently left its permanent trace in the northern legend of the Twilight of the Gods, which pictures a disastrous world bound in the grip of snow and ice.

After this, the classical Mediterranean civilization began to fail. Jones, some twenty-five years ago, suggested in a remarkable book that the downfall of Greece was due to malaria imported from Africa. Now that we know that a progressive desiccation was in progress at the time, the idea gains in probability. The rivers, drying up to a series of pools in summer, would afford countless new breeding-places for the larvae of the malaria-carrying mosquitoes. Malaria probably contributed to the downfall of Rome as well; but since Italy has more rainfall than Greece, the malaria-spreading change would have struck her later. But in addition the yield of agriculture in the Mediterranean began to grow less; and about the same time the first of a new series of barbarian invasions poured in.

For the period from A.D. 500 to 1000 was definitely a dry one. This it seems to have been which in the South drove the Huns and Goths to the limits of Europe, and stimulated the expansion of Islam from drought-stricken Arabia. But it brought new life to the swampy North. The culture of Ireland revived. In Scandinavia this was the

great age of the Vikings, the Norsemen. As toward its close it grew less dry, the wet began to rob the Vikings of their livelihood and their lands as surely as the drought had robbed the steppe dwellers of theirs; and they poured forth in a burst of migration which took them across the Atlantic, and eventually, in the guise of Normans, as far as Sicily.

IV

In the New World too the climatic changes were similar and had the same general effects, notably upon the story of the remarkable Maya civilization of Yucatan. The huge monuments of the Mayas are now buried in dense tropical jungle, which no primitive people could hope to keep at bay. After the first flourishing period of the Mayas, civilization retreated for centuries from Yucatan, but recolonized its northern part for a short time about A.D. 1000. The two flourishing periods of Maya history correspond with what we have called cold, wet periods. But these were wet only in regions at a certain distance from the poles. During these times, the storm tracks shifted further toward the equator; and accordingly the dry belts between temperate and tropical were shifted equatorward too. Today, Yucatan lies just south of where the northern dry zone passes over into the tropical. When the temperate rainy zone shifted south, the margin of the dry zone also was forced southward over Yucatan, the forest melted, and the Mayas could build an empire there.

In the temperate zones, after the short wet period of the eleventh century, there followed a series of minor and drier fluctuations. There was one cold spell in the thirteenth century. There was another in the first half of the seventeenth, in which the tradition of the "old-fashioned" severe winter probably takes its origin (though doubtless perpetuated by the common failing of age to decry the present in favour of the past). Since then there has not been any great change. True, there have been shiftings of sea currents, such as that which brought the herrings to the Baltic, or that which sent the cod away from the coast of Brittany; but there have been no marked movements of the storm belt.

This long string of conclusions is drawn from the most diverse sources—from the deposits in northern peat bogs, from the old shore lines of the Caspian, from the salt lakes of Central Asia, from the now waterless cities, such as Palmyra, that once lay on great trade routes, from legend and historical record. But they find a wonderful corroboration within the trunks of the big trees of the western United States. Rain is the limiting factor of the tree's summer growth, and

so the size of the growth ring in its wood preserves for us the record of the season. By measuring the growth rings of over two thousand big trees, Douglass has given us a curve of climate which corresponds with remarkable accuracy with what we have deduced from other sources. Some of these trees date back four thousand years. In their trunks we can read of the dry periods which spread civilization over the world but spelled the ruin of the first Archaic Culture; of the "classical" rainfall maximum, as Brooks calls it, which allowed Greece and Rome and Yucatan to achieve their destiny; of the new drought which brought the barbarians into the Holy City and raised the Norsemen to their first height of activity. And they record for us the final settling of the fertilizing, energy-giving belt of cyclonic weather in its present place, a thousand miles and more northward of its old position.

Thus climatic belts have not shifted seriously for almost a thousand years. What will happen to civilization when they move again we can hardly foresee; but we cannot suppose that shifting climate will respect our modern balance of power, any more than it spared the civilizations of Mesopotamia. Climate is inexorable.

V

The question of the effects of climate and other natural phenomena on human history is not all speculative. We can see some of its very practical ramifications in the problems of cattle, soil, and grasslands. Here the chemistry of soils enters in as well as climate, but the two are not without relation.

From time to time, in different parts of the world, cattle exhibit perverted appetites. They take to chewing bones, and will sometimes even devour the carcasses of other cattle that have died. These abnormal instincts are invariably the prelude to grave disorders. In typical cases the bones grow soft, the joints become swollen, the animals get thin and feeble and move stiffly and awkwardly; their hoofs grow abnormally long; sterility and abortion are common. Milch cows and young growing beasts are invariably the most seriously affected; and imported modern breeds suffer worse than the poorer native types. Sheep may be affected in the same sort of way; and horses too, though more rarely.

These outbreaks, which may inflict severe losses, may only recur every few years; or they may continue unabated for long periods. In every case they are confined to particular regions. In such a region, even in years when there is no actual disease, the animals are

generally below par. Their fertility is very low; there is much infant mortality among the calves; growth is slow and stunted; milk yield is subnormal.

Much search has been made for the causes of this state of affairs. Bacteria have been blamed, and other parasites, and poisonous plants. But all these were gradually eliminated. It became more and more evident that the cause was some deficiency in the beasts' food; and since the food they eat draws all its supplies (save carbon and oxygen from the inexhaustible air) from the soil, the deficiency must ultimately lie in the soil.

Chemical analysis has confirmed this verdict. The cause of this poor performance and actual loss, specially grave in dry countries like Africa and Australia, is a deficiency of one or more of the elements supplied to plants from the mineral salts of the soil. The commonest deficiency is that of phosphorus or of calcium—or of both at once. Since both are necessary ingredients of bone, a shortage of either will prevent proper bone growth. Both are also necessary for the universal processes of metabolism in the body; and if the supply falls short of the vital minimum needed for tissue life, the tissues draw on the reserves held in the skeleton. The mineral framework of the bones is redissolved to be used up by the living cells, hungry for the missing elements, and the skeleton grows weak and soft. The milk too grows poor in calcium and phosphorus, the calf has to go short of them, and, as he is a rapidly growing organism, feels the lack even more acutely than his parents.

The depraved appetite for carcasses and bones is a last resort for getting back some of the missing elements into the system. It is, however, often disastrous, for many animals thus eat disease-producing bacteria in the decaying bones, and develop serious illness from this cause; and even if they avoid poisoning, the mineral shortage eventually becomes so acute that the animal sickens and dies. In other cases, mere stunting is the chief result. In the Falkland Islands, for example, whose pastures are very short of calcium, an ox will hardly reach five hundred pounds in weight, and the offspring of good breeds of horses grow up no bigger than ponies.

The symptoms vary a good deal from place to place, largely according as the defect is a defect mainly of phosphorus,—perhaps the commonest condition,—or of calcium, or of both. But they all agree in taking origin in a lack of necessary bone-building elements.

Here and there, though much more rarely, the cattle farmer attempts to ply his trade on areas where there is a shortage of other mineral constituents. When the missing element is iron, as in parts

of Kenya and New Zealand, the animals suffer from a progressive anaemia; they grow thinner and thinner, and finally lose control of their limbs. In certain parts of the plains region of the United States and Canada, on the other hand, iodine is the defaulter, and farm animals (like the human population) suffer from the swelling of the thyroid known as goitre, with all the attendant symptoms of low chemical activity and stunted growth. In some areas, the lack of iodine is so pronounced that the young pigs lose all their hair and hardly any of them survive.

VI

The shortages, as we have said, are primarily due to a deficiency native to the soil. It is surprising but true that there are great stretches of country which from the outset are unsuitable (without special treatment) for stock-raising on any large scale, because the ground simply does not have enough of one or another chemical element. Countries composed of igneous rock often have a shortage of calcium. In much of the west of Scotland, where the soil is poor in calcium and phosphorus and the pastures have long been depleted by grazing without any return in the shape of artificial manure, the sheep are frequently afflicted with disease, there is a high rate of mortality among growing lambs, and the carrying capacity of the land is falling. Iodine is generally low in limestone districts, or where, as in parts of North America, the great meltings that followed the Ice Age have leached it out of the soil.

Phosphorus is the trickiest of all these elements. It is the one which usually is nearest to the border line, and there are very big tracts of phosphorus-poor soil. In addition, drought apparently makes it harder for plants to get phosphorus out of the ground, so that an arid climate will turn a soil that elsewhere would be adequate into a phosphorus-deficient one.

Why, then, are these regions of the earth's surface not bare of wild animals? And how is it that man can generally thrive where his cattle sicken? The answer is that the demands are a matter of degree. No region is entirely without any of the essential elements. In nature, a balance is soon struck. The country supports what it can support. If animals fall sick, they are speedily eliminated; as soon as over-multiplication of any grazing animal brings down the supply of any element per individual to the danger point, migration relieves the pressure. Man, on the other hand, attempts more intensive operations. He wants the land to carry the maximum amount of stock, and to carry it all the time. Furthermore, different animals make

very different demands on the mineral resources of the soil. It is the quick-growing beast which suffers, because it has to lay by a large quantity of calcium and phosphorus in its skeleton, of iron in its blood, of iodine in its thyroid, all in a short time; while the slower-growing kinds escape—just as in man a degree of shortage of vitamins which is almost without effect on grown men and women may produce serious rickets in growing children.

Now cattle are in any case quick-growing animals. A human infant takes six months to double his weight after birth; a calf, in spite of his much greater size, takes only about a month and a half. And in domestic breeds of cattle man has intensified this quick growth, since his prime aim is the biggest possible return of meat in the shortest possible time. Besides, he breeds for milk-yielding capacities so enlarged as to be almost unnatural. Whereas, for instance, in the natural state cows at one lactation produce two or three hundred gallons of milk, we ask the best modern breeds to give us up to a thousand gallons. The native cattle of Nigeria have their first calf at about six years; a well-fed cow of a modern breed has hers at three. In beef breeds, the rate of putting on flesh has been doubled. In all these ways, domesticated cattle have been deliberately bred to make more demands upon the soil than other beasts, and the better they are as cattle, the more demands they must make. Accordingly, when good European bulls have been used to grade up native cattle in India or Africa, the result frequently has been merely that the sickness and mortality due to mineral deficiencies have leaped up.

Man the stock-breeder has thus been putting new and unprecedented demands upon the mineral resources of the world's soil. But that is not all. He has also been depleting those resources without making any return. As Sir John Orr says in his book, *Minerals in Pastures*: "Accompanying the visible movement of milk and beef, there is a slow invisible flow of fertility. Every cargo of beef or milk products, every ship ton of bones, leaves the exporting country so much the poorer." For, in nature, animals die where they live, and the constituents of their bodies are returned to their native soil. But man changes all that. He ships off the bodies of his animals or the products of those bodies to distant countries, and in every exported pound of meat or cheese or bone meal so much phosphorus and so much calcium and iron and magnesium have been extracted from the soil and removed from the country's shores. Richardson calculates that since 1870 the export of animals from Victoria alone has taken out of its soil the equivalent of two million tons of superphosphates.

As we are now beginning to see, man's difficulties about grassland and the products of grassland are not merely due to local and natural deficiencies. They are due too to deficiencies of his own making, and these artificial deficiencies are cumulative and world-wide. In old days, the cattle of mineral-deficient areas would make periodic journeys to salt-licks, where the instinctive cravings for the elements they lacked would save them from disease and death. It is interesting to find the same instinctive cravings in man. In some parts of Africa, where mineral deficiency is serious, the black children spend their pennies, not on sweets, but on lumps of unpurified salt, imported from distant salt-pans and full of all the elements for which their systems are crying out. To-day, fencing has often made the cattle's annual 'cure' impossible. In one part of Kenya, for instance, the settling of the country happened to put an important salt-lick on to land allocated to whites, to the great detriment of the native cattle, which either could not get at their necessary supply of minerals, or strayed and trespassed in search of it, and were lost to their owners. Economic restrictions may have the same effect. In the old days of the heavy French tax on salt, you could tell without a map when you crossed the boundary in the Jura from France to Switzerland by looking at the cattle. The French cows looked poorly, the Swiss beasts fine and healthy.

The next step was the discovery that the amount of mineral which would prevent disease in a pasture was not enough to give the best results. By adding more, up to a definitely ascertainable point, sheep and cattle could be made to grow faster, to yield more milk, and especially to be more fertile.

Thus what began as a study of local cattle diseases has turned into a problem of the soil chemistry of grasslands. The problem is one of first-rate importance. Cereals may be the staff of life; but the products of grass are more varied. Grass gives us not only meat, but also wool, leather, milk, butter, cheese, and various valuable by-products from bones and hides and horns. The value of the products of grass consumed annually in Britain alone is over £400,000,000, and the quantity of this which is imported makes nearly a quarter of the country's total imports. And some countries, like New Zealand, live almost wholly by grass.

VII

The question at issue becomes the question of the future of the world's grass. We have spent an enormous amount of energy on improving wheat and maize, and have hardly given a thought to grass;

but there is little doubt that by proper attention to the ecology and genetics of grasses we could double the output of the world's pastures.

For one thing, proper dosing with mineral salts helps the growth of plants which make greater demands on the soil, and so takes the ecological succession a stage further to a richer herbage. In dry areas it often helps also by conserving more moisture in the soil. Then there are strange and subtle interrelations between grass and the beasts that eat it. Their trampling and their browsing alter conditions for the herbage. Too little grazing may allow scrub or moor to invade the pasture; too much may impoverish the sward. Such problems are especially prominent in new countries—in New Zealand, for instance, there seem to have been no indigenous grazing creatures, save possibly the giant flightless bird, the moa; yet to-day 94 per cent. of the country's exports are the products of grass-eating animals. Here, to clear scrubland for sheep, not only must the scrub be cut and rooted up and burned, but cattle must be introduced to keep the bracken and brush from winning back the land they have lost. As Dr. Stapledon says, "Cattle, no matter how prices rule, are essential to the reclamation and maintenance of scrublands. They are implements as necessary to the wool grower on hilly, scrubby country as the plough to the producer of wheat on the plains." Trampling, too, prevents the grass from getting coarse and rough. The amount of grazing a pasture will stand depends a good deal on climate. If grassland (as in so much of Europe and New Zealand) is not the natural climax of plant life, but is only a "sub-climax," which would go on to a richer type of vegetation, such as forest, if left to itself, then it will stand very heavy grazing. If, however, the climate is so dry that grass of sorts is the natural climax, it has fewer reserves, so to speak, and heavy grazing may seriously damage it.

But the amount of grazing will also depend on the kinds of grasses there are to be grazed. In New Zealand the native vegetation, unused to being nibbled down to the ground, succumbs to this new treatment. A judicious mixture of the right grasses and clovers from all over the world (only we must remember that what is right for one place may be very wrong for another!) is rapidly raising the productive power of grass. This will soon get to a limit; but then the geneticist can step in and continue the process by deliberately breeding richer and more resistant pasture plants. A beginning has been made with this at places like the Grass Research Station at Aberystwyth, and the results already obtained, together with the comfortable knowledge of what has been actually achieved with wheat, warrant great hopes for the future.

We could vastly increase the productive power of the world's grasslands by deliberately working for types of beast that make greater demands on the grass, and types of grass that make greater demands on the soil. We have only got to make sure that we can continue to provide the soil with the necessary chemical ingredients. But to achieve this result we need the services, not only of the farmer and the scientific agriculturist, but of the plant and animal geneticist, the soil chemist, the systematic botanist, and the ecologist; nature cannot be improved upon without the amassing of a deal of knowledge and the expenditure of a deal of pains.

THE SIZE OF LIVING THINGS

THE size of things has a fascination of its own. There is a certain thrill in hearing that a fish weighing hundreds of pounds has been caught with rod and line; that one of the big trees of California has an archway cut through its bole capable of letting a stagecoach pass; that the bulkiest of men have attained a quarter of a ton weight; that it takes two harvest mice to weigh as much as a halfpenny; that an average man contains only about two and a half cubic feet; or that many bacteria, capable of producing virulent diseases, are so small that it would take over three hundred, end to end, to get from one side to the other of the full stop at the end of this sentence.

But when we look into the subject more systematically, the passing thrill of surprise gives place to a deeper interest. For one thing, we shall find ourselves confronted by the problem of the limitations of size. Why has no animal ever achieved a weight of much more than a hundred tons? Why are the predatory dragon-flies never as large as eagles, or these social beings, the ants, as big as those other social beings, men? Why do lobsters and crabs manage to reach weights more than a hundred times greater than the biggest insect, but more than a thousand times smaller than the biggest vertebrates? Why, to choose something which at first sight seems to have nothing to do with size—why do you never see an insect drinking from a pool of water? As we follow up the clues, we shall begin to understand some of life's difficulties in a new way—the difficulties attendant upon very small size, the quite different difficulties attendant upon great bulk; and we shall realize that size, which we are so apt to take for granted, is one of the most serious problems with which evolving life has had to cope.

Reflection upon our own size will also help us toward an estimate of our position in the universe—of how we stand between the infinitely big and the infinitely little. It has been only in the last few decades that this estimate could be justly made. We knew the bulk of the big trees and whales; but not till quite recently did the existence of filter-passing viruses reveal to us the lower limit of size in life. And when we pass to the lifeless background, we seem, in discovering the electron, to have attained to the ultimate degree of smallness, to the indivisible unit of world stuff; and the development of Einstein's theory has made it possible to state at least a minimum weight for the entire universe. Where does the physical body of man stand? Is he

nearer in size to whale or to bacterium? How many electrons are there in a man? And how does this number compare with the number of men it would take to weigh down the earth?—the sun?—the entire universe?

Let us begin with a foundation of hard fact, giving the weights in grams. A gram is about $\frac{1}{28}$ of an ounce; a thousand grams make a kilogram, close to $2\frac{1}{6}$ pounds; a thousand kilograms make a metric ton, almost identical with an English ton. A milligram is a thousandth part of a gram. But both upward and downward the weights prolong themselves to regions where we have no units to deal with them. The simplest way to bring them home is to express them all in grams, but in powers of ten. The exponent, or little number after and above the ten, represents the number of ciphers to put into the figure for grams. When, for instance, the weight of the moon is given as 7×10^{24} g., this means $7 \times 1{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000$ grams, or, since there are one million grams to the ton, seven million million million tons—that is, seven trillion tons. When the exponent has a minus sign in front of it, it denotes a fraction of a gram, and again the number of ciphers in the denominator of the fraction is given by the exponent. Thus one of the insulin-secreting cells of our pancreas weighs about 10^{-9} gram. This is $\frac{1}{1{,}000{,}000{,}000}$ gram, or one millionth of a milligram.

In most cases, since the specific gravity of protoplasm is very close to that of water, the weight in grams is close to the volume in cubic centimetres. With trees, this volume will be considerably greater than the weight; while with armoured creatures like crabs or some dinosaurs the weight in grams will exceed the volume in cubic centimetres. Let us also remember that volumes go up as the cube of the linear dimensions. An animal weighing a ton, for instance, would be just balanced by a cubic vessel full of water measuring one metre each way. The corresponding cube of water which would balance a human insulin-producing cell would measure 10^{-3} centimetre along each side, which is $\frac{1}{1000}$ centimetre, or $\frac{1}{100}$ millimetre, or 10μ, one μ being $\frac{1}{1000}$ millimetre.

Since the weights of animals and plants are variable, since many are not very accurately known, and others have to be calculated, with a certain unavoidable margin of error, from their linear dimensions, we do not pretend to give precise weights, but only put organisms between certain limits of weight, the upper limit of each pigeon-hole being ten times as heavy as the lower. Thus most men come in the class between 10^4 and 10^5 grams—between ten and a hundred kilograms. Men are near the upper limit of the class; in the same class,

in descending order, come sheep, swans, and the largest known crustaceans.

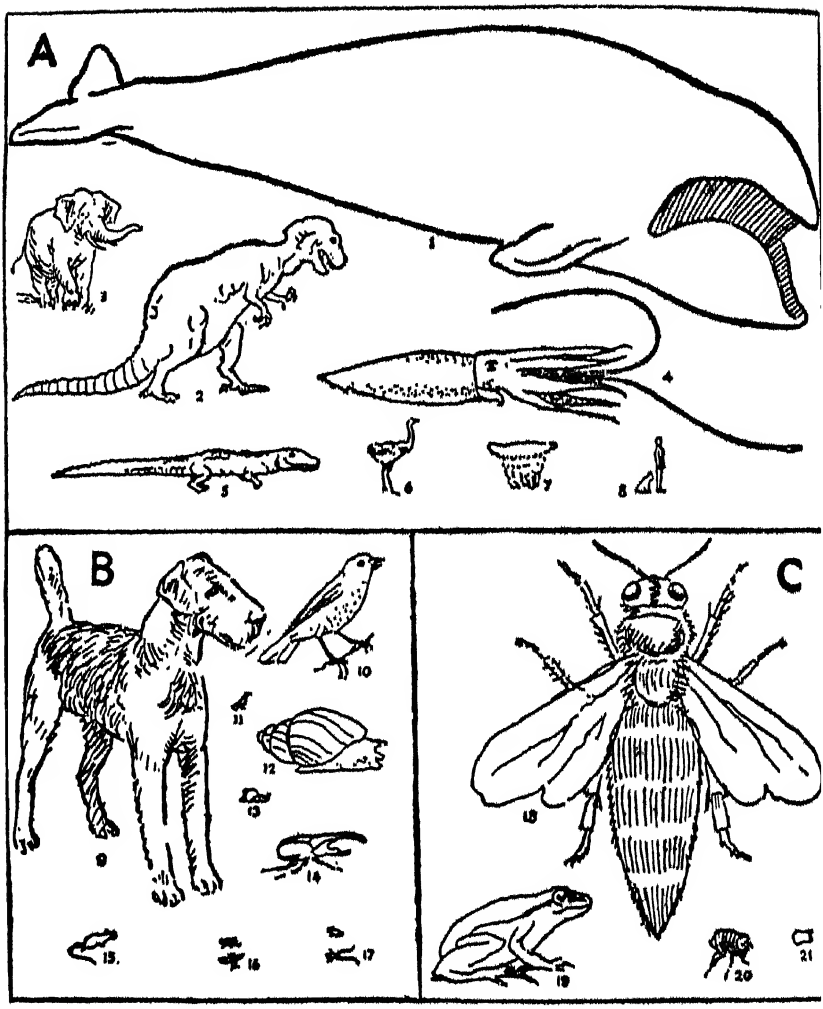
II

So much for necessary introduction; now for the facts. The largest organisms are vegetables, the big trees of California, with a weight of nearly a thousand tons. A number of other trees exceed the largest animals in weight, and a still greater number in volume. The largest animals are whales, some of which considerably exceed one hundred tons in weight. They are not only the largest existing animals, but by far the largest which have ever existed, for the monstrous reptiles of the secondary period, which are often supposed to hold the palm for size, could none of them have exceeded about fifty tons. Some of the lazy great basking sharks reach about the same weight; so, since we shall never know the exact size of the dinosaurs, the second prize must be shared between reptiles and elasmobranch fish.

The largest invertebrates are to be found among the molluscs; some of the giant squids weigh two or three tons. The runner-up among invertebrate groups is a dark horse; very few even among professional zoologists would guess that it is the coelenterates. But so it is. In the northern seas, specimens of the jellyfish *Cyanea arctica* have been found with a disc over seven feet across and eighteen inches thick, and great bulky tentacles five feet long hanging down below. One of these cannot weigh less than half a ton, with bulk equal to that of a good-sized horse. The clams come next, if we take their shell into account, for Tridacna may weigh nearly as much as a man. If, however, we go by bulk of living substance, the giant clam is beaten by a crustacean, the giant spider crab from Japanese seas.

Then come a number of groups, all of which manage to exceed one kilogram, but fall short of ten. There are the hydroid polyps, with the deep-water Branchiocerianthus which, rooted in the mud, and with gut subdivided into hundreds of tiny tubes for greater strength, stands over a yard high and sifts the slow-passing deep-sea currents for food with its net of tentacles, adjusted by being hung from an obliquely-set disc. There are the largest marine snails; the largest lamp-shells; the largest sea-urchins, starfish, sea-cucumbers, and sea-lilies; and, rather surprisingly, the largest bristle-worms, both marine forms and earthworms. Possibly the largest tapeworms, such as *Bothriocephalus latus*, which may reach a length of over seventy feet of coiled living ribbon in human intestines, just come into this class, though their flatness handicaps them.

The insects and spiders come far below, the largest beetles and



A diagram of relative sizes. In each major division (A, B, C, D, E) of the diagram, all the creatures are dra to the same scale. The smallest of each division is enlarged to make the largest of the division followi

A

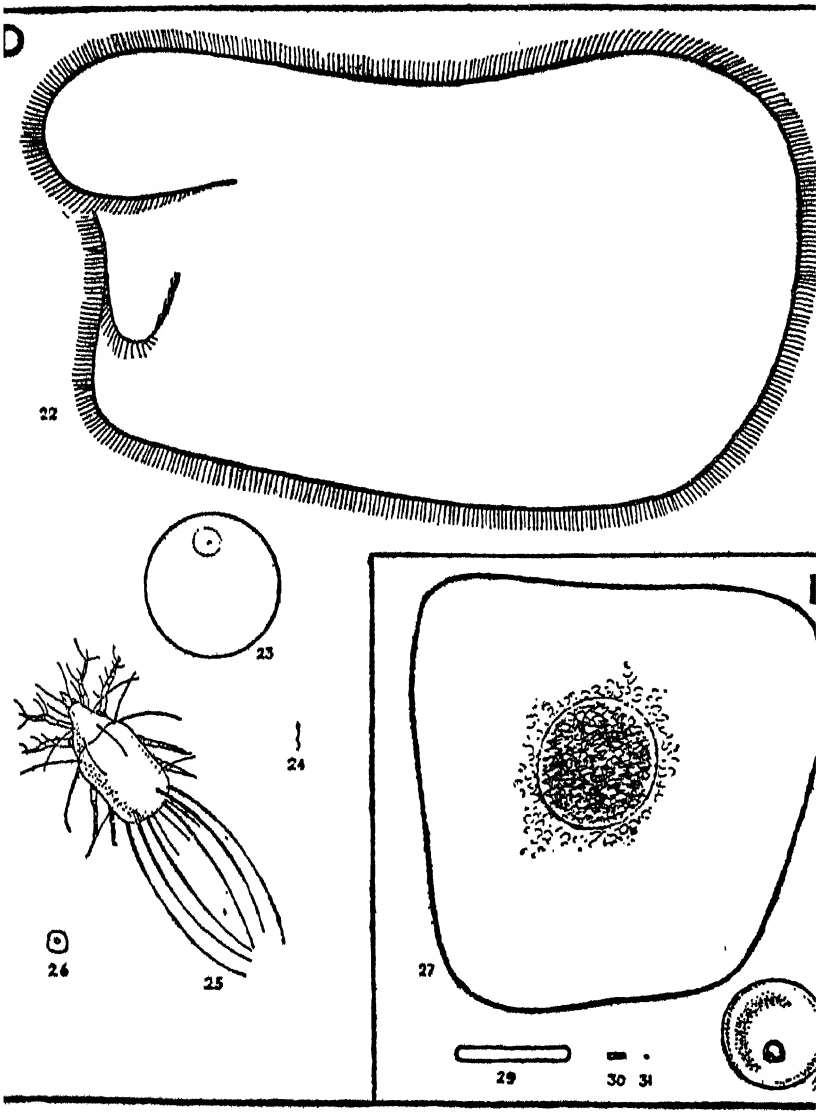
1. A very large whale.
2. The largest known land carnivore, the extinct reptile Tyrannosaurus.
3. A large elephant.
4. A giant cuttlefish.
5. The largest recorded crocodile.
6. An ostrich.
7. The largest known jellyfish.
8. A man and a dog.

B

9. The dog (8) enlarged.
10. A thrush.
11. A humming-bird.
12. A giant land snail.
13. The common snail.
14. The bulkiest insect.
15. A mouse.
16. A queen bee.
17. The smallest vertebrate.

C

18. The queen bee (16) enlarged.
19. The frog (17) enlarged.
20. A flea.
21. A very large single-celled anir (Bursaria).



D

22. Bursaria (21) enlarged.
23. A human unfertilized ovum.
24. A human sperm.
25. A cheese-mite.
26. A human gland-cell.

E

27. The gland-cell (26) enlarged.
28. A human red blood-corpuscle.
29. A very large bacterium.
30. A small bacterium.
31. An ultramicroscopic filter-passing virus.

tarantulas not exceeding two or three ounces. The pigmy among animal groups is that of the rotifers or wheel animalcules, the most gigantic among which fails to weigh ten milligrams! They comprise, too, the smallest of all multicellular animals, some of their adult males weighing considerably less than a thousandth of a milligram, so that it would take about a thousand of them to equal one of our striated muscle fibres, and over a million of them to weigh as much as a hive-bee.

Even the biggest rotifers are much smaller than the biggest among the Protozoa, or single-celled animals. Some of the extinct nummulites, flattened disc-shaped Foraminifera, were bigger than a shilling, and must have weighed well over a gram. They easily beat many small fish and frogs in size, and were bigger than the largest ants, which, though the most successful of all invertebrates, never reach one gram in weight, and are usually much less. The largest ant colonies known possess a million or so inhabitants. This whole population would weigh about as much as one large man. Indeed, the small size of most insects is at first hearing barely credible. Three average fleas go to a milligram. If you bought an ounce of fleas, you would have the pleasure of receiving over eighty thousand of them. Even a solid hive-bee weighs less than a gram—over five hundred bees to the pound, nearly a hundred thousand to outweigh a single average man!

The lower limit of size among the various groups is much more constant than the upper. The smallest insects, crustacea, most groups of worms, and coelenterates, all lie between one hundredth and one thousandth of a milligram. Some very primitive worms run down one class further, and rotifers two. The smallest molluscs, lamp-shells, and echinoderms are between ten and a thousand times larger, while the smallest vertebrate is four classes up—ten thousand times as big. Even so the difference between the maximum sizes attained by different main groups is greater by a hundred thousand times than the difference between their minima.

There is clearly a lower limit set to a multicellular animal by the fact that it must consist of at least several hundred cells. But it seems to be impossible or unprofitable to construct a vertebrate out of less than several hundred million cells. The vertebrates, both at top and at bottom, are the giants of the animal kingdom.

It is a surprise to find a frog that weighs as much as a fox-terrier. It is still a greater surprise to know that there exist fully formed adult insects—a beetle or two, and several parasitoid wasplike creatures—of smaller bulk than the human ovum and yet with compound eyes, a

nice nervous system, three pairs of jaws and three pairs of legs, veined wings, striped muscles, and the rest! It is rather unexpected that the smallest adult vertebrate is not a fish, but a frog; and it is most unexpected to find that the largest elephant would have ample clearance top and bottom inside a large whale's skin, while a full-sized horse outlined on the same whale would look hardly larger than a crest embroidered on the breat pocket of a blazer.

Then we come to single cells. By far the largest is—or was—the yolk of the extinct Aepyornis's egg, which must have weighed some ten pounds. But eggs are exceptional cells; so are multinucleated cells like striated muscle fibres and the biggest nummulites. Of cells with a single nucleus, some protists such as Foraminifera may reach over a milligram—gigantic units or protoplasm; and the ciliate Bursaria is nearly as big. But among ordinary tissue cells of Metazoa the largest are only about one hundredth of a milligram, while average cells of a mammal range between a thousandth and a ten-millionth of a milligram. In our own frames, the body of a large nerve-cell is well over ten thousand times bulkier than a red blood-corpuscle or a spermatozoon—a difference five or ten times greater than that between the largest whale and the average man. (In these calculations the outgrowths of the nerve-cells have been left out of account, as peculiar products of cell activity. If they are included, then the spinal sensory and motor nerve-cells, supplying the limbs of the giant dinosaurs and of giraffes, take the palm for size; but even they can only reach a few milligrams, in spite of being over ten feet long.)

The smallest free-living true cells are in the same size-class with the smallest tissue cells; but parasitic Protozoa, which live inside other cells, may be a hundred times smaller. Bacteria are built on a different scale. The largest of them are little bigger than the smallest tissue cell, and the average round bacterium or coccus is a thousand times smaller. These finally pass below the limits of microscopic vision, until, with the filter-passers, such as the virus of distemper or yellow fever, we reach organisms with only about a thousand protein molecules. Somewhere near these we may expect to find the lower limit of size proscribed to life; for several hundred molecules are probably as necessary in the construction of an organic unit as are several hundred cells for the construction of a multicellular animal.

III

Having made a little voyage of discovery among the bare facts, it is time to begin a quest for principles. The great bulk of land verte-

brates range from ten grams to a hundred kilograms. What is it that has led to this comparatively narrow range of weight · not a fifth of that found in animal life as a whole—being most popular in the dominant group?

A disadvantage in being *very* small is that you are not big enough to be out of reach of annoyance by the mere inorganic molecules of the environment. The molecules of a fluid like water are rushing about in all directions at a very considerable speed. They run against any object in the water, and bounce off again. When the surface of the object is big enough for there to be thousands of such collisions every second, the laws of probability will see to it that the number of bumps on one side will be closely equal to that on the other; and the steady average effect of the myriad single bumps we know and measure as fluid pressure. But when the diameter of the object falls to about 1μ, it may quite easily happen that one side of it momentarily receives an unusually heavy rain of bumps while the other is spared, and the object will be pushed bodily in one direction. The result is that the smallest organisms (like the old lady in the nursery rhyme) can never keep quiet; they are in a constant St. Vitus's dance, christened Brownian movement after its discoverer.

Such hectic existences are only possible when the surface is absolutely very small; but let us not forget that an absolutely very small surface must be *relatively* a big one. This question of relative surface is perhaps the most important single principle involved in our dealings with size. Simply magnify an object without changing its shape, and, without meaning to, you have changed all its properties. For the surface increases as the square of the diameter, the volume as its cube; and so the amount of surface relative to bulk must diminish with size. Let us take an example or so. The filter-passing organisms photographed by Barnard with ultra-violet light are $\frac{1}{10}\mu$ across; the yolk or true ovum of an emu's egg is about 10 centimetres across—a million times greater. Both are of the same shape; but the proportion of surface to bulk is one million times greater in the filter-passer than in the bird's egg. In other words, if the substance of the bird's egg were divided into round pieces each as big as one of the filter-passers, the same weight of material would have a million times more surface than before. Or again, a big African elephant is roughly one million times as heavy as a small mouse. The amount of surface for each gram of elephant is only one-hundredth of what it is in the mouse.

The most familiar effect of this surface-volume relation is on the rate of falling. The greater the amount of surface exposed relative to weight, the greater the resistance of the air. So that it comes about

that the spores of bacteria or ferns or mushrooms, or the pollen-grains of higher plants, are kept up by the feeblest air currents; and even in still air they cannot fall fast. They float down, like Alice down the well, rather than fall. If a mouse is dropped down the shaft of a coal-mine, the acceleration due to gravity soon comes up against the retardation due to air resistance, and after a hundred feet or so a steady rate is reached, which permits it to reach the bottom dazed but unhurt, however deep the shaft. A cat, on the other hand, is killed; a man is not only killed, but horribly mangled; and if a pit pony happens to fall over, the speed at the bottom is so appalling that the body makes a hole in the ground, and is so thoroughly smashed that nothing remains save a few fragments of the bones and a splash on the walls.

The same principles hold good for the much slower rate of falling through water; and consequently the microscopic animal will have to make much less effort to prevent itself sinking than any fish unprovided with a gas-bladder.

Relative surface is also important for temperature regulation in warm-blooded animals; for the escape of heat must be proportional to the surface, through which it leaks away. As the heat is derived from the combustion of the food, a mouse must eat much more than a man in proportion to its weight to make up for this extra heat-loss which its small size unavoidably imposes upon it. The reason that children need proportionately more food than grown-ups is not only due to the fact that they are growing, but also to the fact that their heat-loss is relatively greater. A baby of a year old loses more than twice as much heat for each pound of its weight than does a twelve-stone man. For this reason, it is doubtful whether the attempt should be made to harden children by letting them go about with bare legs in winter; their heat-requirements are greater than their parents', not less.

IV

The intake of food and oxygen is another function with which surfaces are concerned. When a cell doubles its linear size, the bulk to be nourished increases eightfold, but the surface through which nourishment is to be absorbed increases only fourfold. It is obvious that such a process could not go on indefinitely, any more than could the growth of a nation dependent on foreign trade if its ports and harbour facilities fell progressively behind the increase of its population. The biggest single cells (excluding such mere storehouses as egg-yolks) have only attained their size by adopting some device for

increasing relative surface—they are flattened, or cylindrical, or, like Foraminifera, have much of their substance in the form of a network of fine living threads, or possess long thin processes, like nerve-cells.

With many-celled animals, similar considerations still hold good. Food must be absorbed from a surface—the surface of the intestine. In small forms, enough surface is provided by a straight, smooth tube, but this would never work in larger animals. To get over the difficulty, all sorts of dodges have been adopted. In large flatworms, the whole gut is branched; in large Crustacea like lobsters and crabs, absorption mostly goes on in the feathery 'liver,' which provides thousands of tubes instead of one; in the earthworm, the absorptive surface of the intestine is nearly doubled by a projecting fold; in ourselves, not only is the effective inner surface of the intestine multiplied many times by the myriads of miniature finger-like villi, but the intestine itself is coiled; and in some herbivores the coiling is prodigious. Among lower animals without a fixed adult size, the period for which rapid growth can continue must often depend upon the inherited construction of the intestine. For instance, in flatworms, if the gut is a simple tube, increase of bulk rapidly brings down the relative surface, and the animal while still quite small can only eat enough to keep itself going, but not to grow; while if the gut is elaborately branched, growth will not be slowed down until a much larger bulk has been reached.

The same sort of arguments apply equally well to other processes, such as respiration and excretion, whose amount depends on amount of available surface. In small animals gills can be unbranched; in big ones they must be feathery. Large vertebrates like us could not breathe if their lungs were not partitioned off into millions of tiny sacs. The coiling and multiplication of kidney tubules in large animals are equally necessary. An embryo frog excretes by means of three pairs of kidney tubules. An adult frog would die from accumulation of waste substances if he possessed only six large tubes of equivalent proportions, even if their walls remained thin enough for secretion; what he needs is many thousands of small tubules.

When the animal is small, no transport system is necessary to get the food or water or oxygen to the cells from the original absorptive surface; all goes well by diffusion alone. But bulk brings difficulties here too. The flatness of the larger flatworms is partly due to the need for having every cell near enough to the surface to be able to get oxygen by diffusion. The elaborate branching of their intestines and all other internal organs is needed to ensure that no cell shall be more than a microscopic distance away from a source of digested food.

Mahomet and the mountain meet halfway. With the biological invention of a blood-system, this need for branching disappears. The enormous area of surface which is needed is now furnished by the linings of innumerable tiny vessels, and the organs themselves can revert to a compact form. Finally, insects and spiders have developed a breathing system which supplies air direct to the tissues, providing a large surface for gas exchange in the tiny end branches of the air-tubes, which penetrate even into the individual cells.

In swimming and flying, too, surface comes into play. No large animal could move with sufficient rapidity by means of the microscope "hairs" we call cilia, since the size of a single cilium *can* never be more than microscopic, and their number depends on the extent of surface. The largest animals provided with cilia are new-hatched tadpoles, and all they can achieve is an exceedingly slow gliding.

When muscles are employed in swimming, their force must be applied to the water through the intermediary of some surface—the body may be wriggled, or its motions communicated to an enlargement at the tail, or limbs developed as oars or paddles. When the animal is small, these swimming surfaces are relatively so big that little or no special adaptations are needed; but once it grows bulky, the swimming surface must be enlarged. The body itself is expanded sideways, as in leeches; or up and down, as in sea-snakes; a regular tail-fin is developed, as in most fish; or the limbs are expanded into flat plates, as in turtle or swimming-crab.

The necessary increase of surface in swimming limb or tail can at first be achieved by stiffening and multiplying hairs and spines; but as soon as the animal exceeds a few millimetres in length this ceases to be enough, and the organ itself must be expanded. The change is beautifully seen within the individual development of many crustaceans.

The same applies to wings. All flying animals more than a fraction of a gram in weight require a broad and continuous expanse to fly with, whether this be a sheet of skin, as in bats, a marvellous compound structure such as the wing of a bird, or the thin hinged flap of an insect's wing. But if they are much smaller, a double row of hairs on either side of a central rod will serve perfectly well. This is seen in some minute insects, such as the little thrips, which include several plant pests, and some tiny wasps which parasitize other insects' eggs. The lovely plume-moths are a little larger, and are intermediate in wing construction; their flight surface is made of hairs, but it is only rendered sufficient by a multiplication of the number of hair-fringed rods.

V

There are many other ways in which the big animal inevitably fails to be a mere scale enlargement of its smaller relatives. The relative size of many organs decreases instead of increasing with total absolute bulk, so that in a big animal they do not have to be proportionately so large as in a small one. Relative wing-size is a case in point.

Then everyone knows the small-eyed look of an elephant, or, still more, of a whale. To obtain a good image, an eye has to be of a certain absolute size; this is because the image even in our own eyes is really a mosaic, each sensory cell in the retina behaving as a unit. The image we see is built up out of unitary spots of colour, just as a half-tone picture in a newspaper is built up out of combinations of single black and white dots. To give an image of a reasonably large field, they must be numerous. Once a certain absolute size of eye is reached, any advantage due to further enlargement is more than counterbalanced by the material used and the difficulties of construction, just as very little advantage is to be gained in photography by making a camera over full-plate size. Even in a giraffe, which has an exceptionally large eye for a big animal, the eye's relative weight is small compared with that of a rat.

Most sense-organs behave in a similar way. This is especially true of the organs of touch and temperature in the skin. It matters to a mouse to be able to deal with things the size of breadcrumbs. But such trivialities do not concern an elephant; the elephant accordingly can, and does, have its skin sense-organs much more thinly spread over its surface.

This in turn has an effect on the size of the nervous system; for the fewer the sense-organs, the fewer sensory nerve-cells are needed, and the smaller the size of the ganglia on the spinal nerve-roots which are composed of sensory nerve-cells. Since the sense-organs of touch are distributed over the surface, we should only expect these ganglia to grow proportionately to surface, and not to bulk, even if the sense-organs were as thickly scattered over the skin of a big as of a small animal; but as they are more sparsely scattered in the big animal the weight of a ganglion does not even keep up with the size of the animal's surface, and its growth is actually only just more than proportional to the square root of the weight.

As a matter of fact, when the nervous system as a whole, or the brain by itself, is compared in a series of related mammals or birds of different size, it is found to increase only about as fast as the surface,

instead of keeping pace with the weight; and the same is true of the heart. It would take us too far to go into the detailed reasons for this; but the fact that a large animal does not need a brain or heart of the same porportional size as a small model of the same type is important. It warns us not to be too hasty in drawing conclusions as to intelligence from *percentage* brain-weight, or as to the efficiency of circulation from *percentage* heart-weight. Size itself reduces the percentage weight; we must know the proper formula before we can tell whether an individual, a sex, or a species has a brain-weight *effectively* above or below that of another individual, sex, or species of different magnitude. In man, comparisons (often invidious) have frequently been made between the brain-size of men and women; but not until Dubois and Lapicque worked out the proper formulae for change of brain-proportion with size was it possible to say whether the smaller brain of women meant anything save that the bodies of women were smaller.

Another such example, but of a rather different type. We marvel at the size of an ostrich's egg, which would provide a large party with breakfast, and is the equivalent by weight of about twenty hen's eggs. But we forget to marvel at the ostrich itself, which weighs as much as about forty or fifty hens. The size of birds' eggs, in fact, does not increase as fast as the size of the birds that lay them. A humming-bird lays an egg 15 per cent. of its own weight; that of a thrush is 9 per cent., that of a goose some 4 per cent., and that of an ostrich only 1·6 per cent. Two competing forces are here at work. It is advantageous to have large eggs, since they give the young bird a better start in life; but the purely physical fact that all the new material for the egg's enlargement must pass through the egg's surface will, as bulk grows, slow down egg-increase below body-increase. And, as a matter of fact, we find that in quite small birds, below the size of a goose or swan, egg-weight increases only a little faster than body-surface.

These figures apply to averages only. Adjustments can be made in response to special needs. In wading birds the young must run about immediately on being hatched; and accordingly their egg-size is well above that of equal-sized birds whose young are born naked and fed in the nest. The common cuckoo, to deceive its hosts, must have an egg not too unlike theirs in size; and accordingly its egg is uniquely small—appropriate to a bird one-third of its body-weight. The limitation of egg-size is prescribed by laws which apply to dead as well as to living matter; its regulation within these inexorable limits is the affair of the interplay of biological forces.

VI

We come back again to the advantages and disadvantages of size. At the outset, it is not until living units are quit of the frenzy of Brownian movement that they themselves become capable of accurately regulated locomotion. The first desirable step in size is to become so much bigger than ordinary molecules that you can forget about them.

But even then you are still microscopic, still wholly at the mercy of anything but the most imperceptible currents. Only by joining together tens or hundreds of thousands of cells can you begin to make headway against such brute forces. About the same level of size is necessary for any high degree of organization to be achieved. Size also brings speed and power, and this is of advantage in exploring more of the environment. But the effective range (apart from involuntary floating with the wind or the current) of any creature below about half a million cells and a hundredth of a gram is extremely limited. Ants with fixed nests make expeditions of several hundred yards, and mosquitoes migrate for a mile or so. When we get to whole grams, however, winged life at least has the world before it. Many migratory birds that regularly travel thousands of miles weigh less than ten grams. Swimming life soon follows suit; think of the migrations of tiny eels across the Atlantic, or of baby salmon down great rivers. Most land life lags a little; though driver ants are always on the move, and mice shift their quarters readily enough, controlled migration hardly begins in land animals till weight is reckoned by the pound.

If a certain size is needed for any degree of emancipation from passive slavery to the forces of environment, it is equally needed to achieve active control over them. Before anything worthy of the name of brain can be constructed, the animal must consist of tens of thousands of cells. The insects with best-developed instincts run from a milligram to a gram. But while a very efficient set of instincts can be built up with the aid of a few hundred or thousand brain-cells, rapid and varied power of learning demands a far greater number. For instincts are based on fixed and predetermined arrangements of nerve-paths, while efficient learning demands the possibility of almost innumerable arrangements. The facts are that no vertebrates of less than several grams weight (such as small birds) show any power of rapid learning, and none below several ounces weight (such as rats) are what we usually call intelligent, while even the smallest human dwarf has a body-weight to be reckoned in tens of pounds. We are

far from knowing the precise size needed; but the intelligence of a rat would be impossible without brain-cells enough to outweigh the whole body of a bee, while the human level of intellect would be impossible without a brain composed of several hundred million cells, and therefore with a weight to be reckoned in ounces, outweighing the very great majority of existing whole animals. In any case, a very considerable size was a prerequisite to the evolution of the human mind.

Size too means a disregarding of obstacles: the rhinoceros crashes through the bush that halts and tangles man; the horse gallops over the grass that is a jungle to the ant. Size may help to intimidate or to escape from enemies, or may enable the carnivore to attack new and larger prey; and it usually goes with longevity.

Size thus holds out many advantages for life. But size brings disadvantages as well as advantages, and so life finally comes up against a limit of size, where disadvantages and advantages balance.

The limits are different for different kinds of animals, for they depend upon the construction of the type, and upon the world which it inhabits. Single-celled animals, as we have seen, soon reach a limit on account of the surface-volume relation. Organisms that must swim and have only cilia to swim with come to a limit even earlier. Whether they be one- or many-celled, the limit is at about a milligram. Those which use cilia, not to swim, but to produce a food current, are not handicapped until much later; by folding the current-producing surface, and arranging neat exits and entrances for the current, many lamp-shells and bivalve molluscs reach several ounces; but as the current-producing cilia are confined to a surface, there comes a limit, which is attained when the soft parts reach a weight of a few pounds.

With most slow-moving sea animals, it is the food question which restricts size. It is usually more advantageous to the race to have a number of medium-sized animals utilizing the food available in a given area than to put all the biological eggs into the single basket of one big individual. Without some greater degree of motility than these possess, sea-urchins or sea-cucumbers as big as sheep would be inefficient at exploiting the food resources of the neighbourhood. The only such slow creatures above a few pounds weight of soft parts are jellyfish, the largest of which manage to obtain sufficient food in the crowded surface waters of cold seas by spreading prodigious nets of poisonous tentacles.

Insects and spiders have so low a limit of size because of their air-tube method of breathing, which is inefficient over large distances.

Crustacea are limited by their habit of moulting. A crab as big as a cow would have to spend most of its life in retirement growing new armour-plate. Land vertebrates are limited by their skeleton, which for mechanical reasons must increase in bulk more rapidly than the animal's total bulk, until it becomes unmanageable. And water animals are presumably limited by their food-getting capacities.

VII

At last we come to the position of man, as a sizable object, within the universe. Eddington begins his fascinating *Stars and Atoms* by pointing out that man is almost precisely halfway in size between an atom and a star.

> The sun belongs to a system containing some 3000 million stars. The stars are globes comparable in size with the sun, that is to say, of the order of a million miles in diameter. The space for their accommodation is on the most lavish scale. Imagine thirty cricket balls roaming the whole interior of the earth; the stars roaming the heavens are just as little crowded and run as little risk of collision as the cricket balls. We marvel at the grandeur of the stellar system. But this probably is not the limit. Evidence is growing that the spiral nebulae are "island universes" outside our own stellar system. It may well be that our survey covers only one unit of a vaster organization.
>
> A drop of water contains several thousand million million million atoms. Each atom is about one hundred-millionth of an inch in diameter. Here we marvel at the minute delicacy of the workmanship. But this is not the limit. Within the atom are the much smaller electrons pursuing orbits, like planets round the sun, in a space which relatively to their size is no less roomy than the solar system.
>
> Nearly midway in scale between the atom and the star there is another structure no less marvellous—the human body. Man is slightly nearer to the atom than to the star. About 10^{27} atoms build his body; about 10^{28} human bodies constitute enough material to build a star.

We can pursue this train of thought a little further. The size-range of living beings, the amount by which the big tree is bigger than the filter-passer, is 10^{24}; in other words, the biggest single organism is a quadrillion times larger than the smallest. Among different phyla only one has a range over half as great, and this is the unexpected group of the Protozoa. Molluscs and coelenterates have a range of 10^{11}, and vertebrates, arthropods, and worms one of 10^{10}—ten

thousand million. Echinoderms have only a range of a million times, rotifers even less. As proof of how soon the size of insects and of flying birds is cut short, we find they have ranges of only a million and ten thousand, respectively.

Man is a very large organism. During his individual existence he multiplies his original weight a thousand million, and comes to contain about a hundred million million cells. He is a little more than halfway up the size-scale of mammals, and nearly two-thirds up that of the vertebrates.

Then we look at the range of life as a whole, and compare it with the size-ranges of not-living objects above and below the limits of living things; here too there are surprises. The sun is almost precisely as much heavier than a big tree as the big tree is heavier than the filter-passer; but the range from the filter-passer downward to the ultimate and smallest unit of world-stuff, the electron, is only half this—only as much as from the big tree to such an easily visible creature as the flea. It takes more tubercle bacilli to weigh one man than there are electrons in a tubercle bacillus.

It is possible to calculate, on the Einstein hypothesis, a minimum weight for the whole universe, a minimum figure for the totality of matter. This is nearly 10^{24} times as much as the sun—in other words, the sun is halfway between the big tree and the whole universe of size.

Although the molecules of living matter are, for molecules, enormous, yet the smallest living organisms are far down on the world's size-scale. Once started, however, life has achieved a size-range which is two-fifths of that from electron to star, and probably well over a quarter of the whole range of size within the universe. Man is almost halfway between atom and star; he is nearly two-fifths up the cosmic scale from electron to the all-embracing weight of the universe. But so vast is that scale that to be halfway up he would have to be as big as a million big trees rolled into one. Even if we were to take the thousand million people who now inhabit the globe as constituting but one single organism, this would still be more than ten times too small. The individual man is all but halfway between atom and star; humanity entire stands in the same position between electron and universe.

WE men like to see animals courting. It amuses us to see them thus imitating humanity, and throws something at once romantic and familiar into those dumb and hidden lives which they veil so closely from us. "One touch of Nature makes the whole world kin," we murmur, and find a new pleasure in the hackneyed words. They are really not quite apropos, however; for what we in our heart of hearts mean to say is one touch of *human* nature. Man is a vain organism, and likes to stand surrounded by mirrors—magnifying mirrors if it be possible, but at any rate mirrors. And so we read the ideas of our own mind into the animals, and confidently speak of "suitors" and "coy brides to be won" and "jealous rivals" and what not, as if birds or even spiders or newts were miniature human beings, in fancy dress no doubt, but with the thoughts of a twentieth-century inhabitant of London or New York.

Some of the more reflective, perhaps, may wonder how far we are justified in our assumptions as to the motives and meaning of animal courtship; while others, with maybe some biological knowledge behind them, may try to look at it all from the other side of the gulf between man and beast, imagine how our own courtship would look to an external and dispassionate intelligence, wonder whether much of human behaviour had better not be interpreted from the animal side rather than the animal's from ours, and how much we are walled in by our biological heritage.

Animal courtship is an unfashionable topic among biologists at present; and I do not exaggerate when I say that it is also one on which both ignorance and prejudice prevail. My own real interest in the subject began when, one spring in Wales, I observed the beautiful courtship of the redshank, a common shore bird, and when I got back to libraries, could find no ordered account of it, or indeed of bird courtship in general. And now, after some twenty-five years of reading and thinking about the subject, interspersed with a number of pleasant if strenuous holidays in Britain, in Louisiana, in Holland, in Spitsbergen, trying to find out what really does happen with this or that common bird, I can confidently assert that Darwin's theory of sexual selection, though wrong in many details, yet was essentially right: that there is no other explanation for the bulk of the characters concerned with display, whether antics, song, colour, or special plumes or other structures, than that they have been evolved in

relation to the mind of the opposite sex; that *mind* has thus been the sieve through which variations in courtship characters must pass if they are to survive.

Down at the base of the animal scale courtship of course does not exist. Jellyfish or sponges or sea-urchins simply shed their reproductive cells into the water and trust to luck for fertilization. It is only when male and female must actually co-operate for fertilization to be effected, that we can expect to find courtship; and even so it will not exist unless there is a fairly elaborate brain and nervous system.

Perhaps the first adumbration of courtship is seen in the nuptial dances of certain marine bristle-worms (Polychaetes), in which at certain seasons of the year and phases of the moon the creatures swim up out of their crannies in the rocks and gather in groups, excited males wriggling round the females. It is possible that the presence of the dancing males in some way stimulates the females to lay their eggs, upon which the male elements are discharged in milky clouds. Snails too have a primitive courtship, which is complicated by the fact that they are bi-sexual and each in its rôle of male attempts to stimulate the other in its rôle of female.

But the first actions to which the name *courtship*, and not merely perhaps direct stimulus to fertilization, must be given are those of a few crabs and most spiders. Among the crustaceans, the fiddler-crab is characterized by the presence in the male of one enormously enlarged claw, which may weigh almost as much as the rest of the body, and is often brightly coloured. It used to be supposed that with this the males stopped their burrows, or fought other males, or seized and carried off the females. However, the careful studies of Dr Pearce show that its main function is one of display. In the mating season, when a female comes past, the males throw themselves into a tip-toe attitude, with big claw rigidly held aloft. If the female takes no notice, the male runs again to where she can see him, and again strikes the statuesque pose: if she goes too far, he returns to his burrow. The observer summed up his impressions thus: "One could only say that the males appeared to be displaying their maleness."

There we have the clue to the origins of courtship in a nutshell. Once the brain reaches a certain complexity, it controls behaviour. A crab can react to various situations—a food-situation, a hunger-situation, a fear-situation, a sex-situation; and the statuesque male with his uplifted claw is the sign and symbol of the sex-situation, just as the coming of a man or other large animal among the burrows constitutes an enemy-situation, with resultant scuttling. Doubtless even without such male advertisement, mating would eventually

occur; but, as Darwin so clearly saw, the advantage may be to the male and not to the race—the male who did not display himself as such would not get mated and would leave no descendants.

In the spiders, we find a very interesting difference between the hunters and the web-spinners. Among the former, who catch their prey by sight and stalking, males perform strange dances before the females, and often have the parts they thus display brightly coloured. The latter are almost blind; and in them there are no dances, but the male comes up to the web of the female and vibrates one of the threads in a special manner, quite different from the vibrations made by trapped prey. In both cases it seems clear that the courtship's primary function is to indicate the existence of a "sexual situation." But here, to do so is a good deal more important than in the crab, for all the evidence goes to show that if this indication were not made, the female would simply treat the male like any other small living object, and eat him! In many species she actually does so after the act of mating (and this occurs too in the scorpions); and in some others she is definitely hostile at first, while the male, who is usually much smaller than she is, is always obviously very ready to run away during the early phases of courtship.

In one hunting spider the male offers the female a nice fly, neatly wrapped in silk. If put in a box by himself with a fly, he will eat it; but if with a fly and a female, he will wrap and offer it; and if in a box from which a female has recently been removed, and in which her odour still presumably lingers, he will still wrap it, and search, like Shelley with his bouquet, "That he might there present it!—Oh, to whom?"

In the carnivorous flies of the family *Empidae*, strange developments of the love-gift have taken place. In some species the male offers an unadorned carcass to the female. In others, however, the prey is stuck in the front end of a glistening "balloon," made of bubbles of viscous liquid secreted by the male, larger than his own body, and carried in his legs as he flies to and fro; doubtless this makes the "sexual situation" more conspicuous from afar. Finally, in a few species there has been a refinement. The balloon is there, but prey is no longer carried in it; instead, the males stick a leaf or flower-petal in it—and indeed they will dart down and pick up any small conspicuous objects, such as fragments of paper, that you may choose to sprinkle on the surface of the water over which they hover. Here, in quite a different evolutionary line from our own, we find quite definitely the employment of a non-utilitarian "present" as gift from male to female.

When we come to the vertebrates, matters become even more interesting, for it is among them, especially in the birds, that courtship and display reach their highest elaboration. Only in a few fish is there much of a courtship, as would be expected from the fact that most species produce large numbers of eggs which are only fertilized after laying. The frogs and toads that make night pulse with sound in the warm regions of the earth use their voices, as do the grasshoppers their legs or wings, in the interests of reproduction; and if the grasshoppers were life's first instrumentalists, the frogs were the first vocalists.

The male frog, however, merely broadcasts an advertisement of his presence; it is among the tailed amphibians that true display is found. Our common newts in the breeding season take to the water and develop a high fin all along the back and tail. This is much larger in the males, who in addition change their winter livery for one of brighter colours. They may also be seen performing their courtship —actively moving in front of the females, often scraping up against them, all the time vibrating the bent tail. The strange fact about this procedure, however, is that they do not begin their display until after they have emitted their fertilizing elements. These are deposited on the bottom of the pond or aquarium inside a special packet of spermatophore, which the female must pick up for fertilization to occur; and courtship begins when this deposition is completed.

Here we see that display may have a racial function, adjuvant to successful fertilization, and not an affair between rival males. For even the most hardened Darwinian would hardly maintain that a female, if two males simultaneously deposited spermatophores and then began their display before her, would be able to remember which male had deposited which spermatophore even were she to be better pleased or more stimulated by the display of one rather than of the other; and of course unless the approved male were also to be the father of the young, his pleasing of the female could have no evolutionary effect. No: it seems clear that here the function of display has again to deal with the "sexual situation"; with the difference that it is not merely to advertise the male's presence and masculinity, but to generate a sexual situation in the mind of the female. As a matter of fact, Finkler has by experiment shown that in the absence of a male's display, the female will not pick up spermatophores, so that this conception of courtship's function being to facilitate fertilization via the mind, by stimulating the mental mechanism into the right phase, seems justified.

There is one species of bird for which Darwin's original theory has been definitely shown to hold good. That is the well-known shore

bird, the ruff (*Machetes*). In the winter the sexes are only to be told apart by size, but in the breeding season the males grow a magnificent ruff—a tippet or collar—round the cheeks and neck, and two fine ear-tufts above. What is more, it is hard to find two males alike; not only do they develop different ground-colours in their plumage, but the collar and ear-tufts may either or both be of some special colour or marking, one black, the other white; or chestnut, pepper and salt, buff, sandy, grey, sepia, and what not. Arrived at their breeding places, the males assemble at a definite spot, usually known as a 'hill,' though it may be but a dry area in the marsh. The females visit the hill from time to time, but the males never go near the nests out in the marshes, nor take any share in brooding or the cares of the young. On the hill each male usually keeps to a little private area of his own. When no females are present, the male birds will be dancing, whirring round like Dervishes, and sparring and jousting with each other. On the arrival of a female, the scene is changed. The males crouch down, immobile, sometimes flat on the ground with spread wings. The hen may simply stroll round and fly away again—on which the cock birds rise rather sheepishly from their prostrate posture, as if pretending that nothing had been going on. Or she may approach a male and nibble at his neck, on which mating is consummated.

Edmund Selous watched one particular ruff hill in Holland for weeks, arriving at his hide at or before dawn. Every male on the hill was distinguishable by his appearance; and so Selous was able to discover that some were more successful than others.

Here is Darwin's theory in practice, working itself out in every detail—the adornments developed only by the male in the breeding season, and used only in sexual combat and sexual display; the male with no power to enforce his desires, the female completely arbiter of her choice; and, finally, the evidence that choice is exercised. The only puzzling point is the extreme variability of the males. This may be explained by some later discoveries. Various biologists, as we shall see later, have found that display, combat, and threat have a direct physiological effect on birds of both sexes, actually helping to ripen the reproductive organs. And Fraser Darling and others have recently shown that this effect is cumulative, some stimulus resulting from the sight of other birds courting or fighting. This at once explains the frequent occurrence of communal display-grounds: they are arrangements for heightening reproductive efficiency. But it also explains the ruff's variability. If, as seems reasonable, the unfamiliar is more exciting than the familiar, variety will have a greater mass-

stimulating effect than uniformity. So, granted a tendency to marked variation, variety will be encouraged and preserved.

This clear-cut case is of importance, because it enables us to draw pretty definite conclusions in other similar cases. In the blackcock, for instance, a handsome member of the grouse tribe, there are similar assembly-places for mating—veritable temples of Venus. Here the individual males cannot be distinguished, but each again appears to have his own definite pitch or stand, and, both from direct watching and by analogy with the ruff, it seems that here, too, there is true selection. Finally, in some birds of paradise there are also mating-places, but in the trees, where the males dance and display their gorgeous plumes.

It is interesting to note that the evolution of such special mating-places with assemblies of males and visits by females has taken place at least three separate times in birds—in the waders, the game-birds, and the birds of paradise. The influence of mode of life on type of courtship is another problem that can be followed out in birds. Where there is polygamy and where the female alone broods the eggs and cares for the young, there we find the greatest disparity in colour and courtship-behaviour between the sexes. The female is generally drab, protectively coloured; the male, *per contra*, brilliant, and alone participating in display. Since there is polygamy (or promiscuity), the successful male will imprint his characters on a larger number of descendants—and so display-brilliance will be at a premium; while, since he plays no biologically useful rôle after fertilization is once effected, there is less need for protective colour, since it does not much matter whether he be killed or no.

Most birds are monogamous, however, at least for the season (or sometimes only for a single brood—like the American wren, which as bird-banding experiments have shown, usually changes partners between the first and second broods of a single year). Most of the largest group of monogamous birds, the song-birds proper, have their whole sex-life hinge on what we may call the territorial system. They have their young hatched naked and helpless, needing abundant food for their growth, and liable to die of cold if left too long unbrooded. Hence it is necessary, first, for both parent birds to feed the young; second, for the presence round the nest of an area sufficiently large to supply the young's needs, and not trespassed upon by other food-seeking parents of the same species. This is ensured through an extension of the instinct, nearly universal among birds, to resent intrusion into the area round the actual or future nest-site.

Even in colonial nesters, like egrets or guillemots, the defended area

exists, though it may be only a couple of feet across. In what we may call the true territorial birds, or birds with feeding as well as nesting territory, the course of events is as follows (I follow in this particular Eliot Howard's admirable description of the course of events in the European warblers or *Sylviidae*). The males are first on the breeding-grounds. If the species be a spring migrant, the males generally migrate north a week or so ahead of the females. Arrived, they take possession of an area—a territory—sometimes without dispute, sometimes after a fight with a simultaneous arrival or a bird already in possession. Then they begin their singing. Contrary to usual belief, the song of most song-birds is at its best before the mate has even arrived. As Howard has, I think, convincingly shown, the prime function of song is an advertisement. It is an advertisement of eligibly-occupied territory, which serves the double purpose of attracting females and warning off other males. Similarly, many of the special display-characters of males are used in threat-display against other males as well as in courtship-display to females.

When the females arrive on the scene, no immediate courtship on the part of the males is to be observed. If the female is alone, she simply takes her place in the territory, and the two are a pair for the season. Nature abhors a vacuum, and this particular vacuum, the absence of the female from a territory, is filled with the least possible fuss. If two rival females arrive together, it is they who fight for the possession of territory-plus-male, while he hovers about, an interested and even excited spectator, but without participating. Then follows the strange fact, which at first sight seems to upset the whole Darwinian apple-cart, namely that courtship and display now begin vigorously—only now, after the two birds are mated for the season. The male vibrates his wings, spreads his tail, puffs his feathers, bows and scrapes, runs before his mate, often with a leaf or twig or other piece of nest material in his beak, and his antics may be so extravagant as to testify to the most ardent excitement within. How can this be fitted in with Darwin's view that these antics and displays have been evolved in large measure through the female's selection? To this, what we have learned from the lowly newt provides the answer. Courtship and display need not always have as their chief result the choosing of a mate. They may be, and indeed normally appear to be, accessory to the act of pairing and fertilization itself. The mind of a bird is a complex thing, and so is its life; the bird cannot always be tuned to a sexual situation. The simplest way, it would appear, of ensuring that it is not always so tuned (with consequent excessive pairing), and yet of ensuring that both sexes shall be simultaneously

ready to mate often enough, is that one sex—the male—shall be more constantly in the phase of sexual preparedness, and by his display shall both advertise the fact and also help to stimulate the female to the proper emotional level.

Finally, as we have mentioned, there is a more direct biological advantage in display. It appears that in seasons which have been inclement just before and during egg-laying, the number of eggs is often reduced and the percentage of infertility raised. It is also known that all the reproductive processes of birds are very much under the control of the higher, emotional centres of the brain. For instance, a female dove brought up in isolation from infancy will usually lay no eggs; but the presence of a male bird in a near-by cage, or even the caressing of her neck with a human finger in a way reminiscent of the caresses of the male's nibbling beak, will almost always cause an egg to be laid. It has now been demonstrated that display and threat promote the ripening of the reproductive organs; this will be of advantage, especially in bad seasons, since birds' emotions are very much at the mercy of the weather.

Before leaving this group, mention should be made of the curious fact that in all-the-year residents who are also territory-birds, there is an "engagement" period in the spring. For some weeks after the pair are in possession of a territory, fertilization is not effected. The biological reason for this is plain—it is advantageous for a bird to be on its territory early, or it may not find one; but it must not breed before a date which will give the probability of there being plenty of food for the young. The physiological machinery by which it is effected resides in the female; it is only at a certain season (probably depending on a certain mean temperature) that the eggs in her ovary start to grow rapidly, and only then that her full sex-instincts arise.

Finally, we come to the large group of birds in which both male and female not only help look after the young, but also share in incubation and in the building of the nest. Such are the herons, the pelicans, the grebes, the divers, and many others. In them, neither parent is biologically the more precious; so that if protective colour is needed, it is needed by both. Furthermore, their instincts have to be so similar in regard to nest, eggs, and young that the similarity, it appears, has spread to their courtship habits, too. For it is at any rate a fact that in a large number of this group of birds, and nowhere else, we find what we must call mutual courtship—both sexes developing bright colours, and special structures for the breeding season, and both using them simultaneously in a mutual display (which, as with other monogamists among birds, begins only after pairing-up).

Anyone who, like myself, has watched such birds by the hour day after day, must be struck by the fact of their enjoyment of the courtship ceremonies for their own sake, and the further fact that the ceremonies are often what we may call biologically self-exhausting, in that the birds' emotional tension is often liberated through them, instead of being stimulated and leading on to actual pairing. It would seem as if these strange and romantic displays—head-shaking, or diving for weed, or aquatic dances breast to breast, or relieving guard on the nest with ceremonies of parade, or presentation of a twig with wings and crest a-quiver,—as if they constituted a bond between the two birds of the pair, binding them together so long as the breeding season lasted by emotional links. And after all, why not? Does not something similar obtain in human society? And does it not there play a valuable rôle, in cementing with love and joy the racially important edifice of the family? And if it has this value in man, why not in these birds, for whom too the co-operation of both parents for the good of the family is essential?

Here then we see display pressed, not merely into the service of one male against the rest, not merely facilitating fertilization, but into that of the super-individual unit, the family. And it is interesting that the family life of birds attains its highest development in these forms which have, we may say, equal sex rights and duties.

In yet other cases we see display becoming social, and courtship tending (as again sometimes in man) to be again diverted from its original character of individual wooing, this time toward the publicity of the dance. Among birds I myself have investigated, this is best seen in the oyster-catcher, the bold black-and-white shore bird, with red bill, sometimes known as sea-pie. Gatherings of eight or ten birds of this species may be seen in spring, all careering around together in their stiff courtship attitude with neck out-thrust and long bill pointing vertically downwards, and a piercing noise of trilled piping issuing from their throats. Observation revealed that this is not only the commonest form of display, but the only one used while on the ground; that it may be employed by the male alone, or mutually by male and female together; and that, in addition to its courtship function, it expresses jealous hostility of other trespassing birds, whether trespassing on territorial or sexual rights. When, in a flock in early spring, courtship begins, other birds may join in the excitement; hostility re-enforces love, and soon the whole number are careering round in frenzied excitement which is, it seems, neither sexual nor hostile, but social. Here the social dance appears to have little or no special function, but is rather a biological accident.

Psychologically, one of the most interesting things about bird courtship is the frequency with which in display the birds will carry in their beaks a piece of the material of which their nest is built. This holds good even for the Adélie penguins, charmingly described by Dr. Levick. Here the nest is nothing but a rim of stones round a depression; and accordingly the male presents stones to his mate as part of his courtship. Interestingly enough, this action sometimes becomes diverted to serve other instincts and emotions, such as wonder—the birds will present stones to dogs and to men; and Dr. Levick confesses to having felt quite embarrassed the first time he was the recipient! Still another tale hangs by these stones. The sitting birds are all the time stealing stones from each other's nests. Levick painted a number of stones different colours, and placed them at one margin of the nesting area. After this he could mark the rate of their progress (all by theft!) across the colony; and found that the red stones travelled much quicker than the rest. This is of great theoretical interest, for red is a colour which is to all intents and purposes absent in the penguin's environment—and yet they prefer it above all others. If a male penguin could grow a red patch he would probably be very quick to gain a mate.

Such an example also shows in what sort of way the extraordinary bowers of the bower-bird can have developed. These are a blend between art gallery and museum, usually a tunnel of twigs with a collection of shells, bones, berries, and flowers at one end. In one species a space of ground is cleared, and large leaves laid upon it, their silvery under-surface upwards. As they wither, they are replaced; if they are blown over, the silver side is turned up once more.

Among the mammals, there is on the whole little courtship or display by the males, but correspondingly more fighting. This probably depends on the fact that the reproductive instincts of the female mammal are more rigidly under a definite physiological control, less under the fluid control of higher, emotional centres; the male deer or elephant-seal has but to guard his harem, and they will automatically accept him in due time. There is, however, a great deal still to be discovered of the courtships of monogamous mammals—a difficult subject, because so many are nocturnal or burrowers, but one that would well repay study. Among some intelligent quadrupeds, however, such as the elephant, a pleasant mutual courtship, of trunk-caresses, has been described; and when we move up toward *Homo sapiens* and reach the monkeys and apes, we find a number of display and threat characters among the males. Some are to us repulsive,

like the naked scarlet and azure cheeks of the Mandril, or the blue of Stevenson's

> . . . blue-behinded ape that skips
> about the trees of Paradise.

But others, like the orang or some of the marmosets with their mustachios, or the Satan monkey with his fine beard, are curiously reminiscent of ourselves, and we are reminded of Mr. Hilaire Belloc's baboon—

> The Big Baboon who lives upon
> The plains of Caribou,
> He goes about with nothing on
> —A shocking thing to do.
>
> But if he dressed respectably
> And let his whiskers grow,
> How like that Big Baboon would be
> To Mister—So-and-So!

* * * * *

Courtship in animals is the outcome of four major steps in evolution. First, the development of sexuality; secondly, the separation of the sexes; thirdly, internal fertilization, or at least the approximation of males and females; and finally, the development of efficient sense-organs and brains. Without any one of these, there would never have existed that host of strange and lovely features of life, summed up under the head of courtship, which beautify the appearance and variegate the existence of so many of the higher animals, including our own species.

THE INTELLIGENCE OF BIRDS

A CENTURY and a half ago, it was generally accepted, even by professional naturalists, that nature represented a single scale, culminating in man. There existed, they supposed, a ladder of life, each rung of which was represented by a different type of animal, with humanity as the highest of all. And from this point of view, each kind of living creature represented merely a step on the way to man, its nature an incomplete realization of human nature.

But with further study, especially after it was illuminated by the theory of evolution, a wholly different and more interesting picture emerged. The various types of animals—insects, fish, crustaceans, birds and the rest—could not be thought of as the rungs of one ladder, the steps of a single staircase; they now appeared as the branches of a tree, the ever-growing tree of evolving life. And with this, they took on a new interest. It might still be that man was at the summit of the whole; but he was at the top of the tree only by being at the top of one particular branch. There existed many other branches, quite different in their nature, in which life was working out its ends in a different way from that she had adopted in the human branch. By looking at these branches we are able to see not merely our own natures in an incomplete state, but quite other expressions of life, quite other kinds of nature from our own. Life appears not as a single finished article, but as a whole series of diverse and fascinating experiments to deal with the problems of the world. We happen to be the most successful experiment, but we are not therefore the most beautiful or the most ingenious.

Of these various experiments, the two which are the most interesting are on the one hand the insects, with their bodies confined within the armour of their skeletons, their minds cramped within the strange rigidity of instinct, and on the other hand the birds.

It is with these latter that I am concerned here; and I shall try to picture some of the differences between their minds and our own. But first we need a little evolutionary background so as to grasp some of the main characters of this particular branch of life. Birds, then, branched off from reptiles somewhere about a hundred million years ago, a good long time after our own mammalian ancestry had taken its origin from another branch of the great reptilian stock. The birds' whole nature was of course remodelled in connection with flight, so that their fore-limb was irrevocably converted into a wing,

and no chance was left of remoulding it into a hand. They clung obstinately to one important character of their reptilian ancestry—the shelled egg, whereas their mammalian rivals came to specialize in the internal nourishment of the young inside the mother's body; and by this the birds debarred themselves from ever being born into the world at such an advanced state of development as is possible to man and other higher mammals. But in one thing at least they went further than any mammal; they not only developed a constant temperature, but kept it constant at a greater height. Birds and mammals are unique among living things in having evolved the self-regulating central-heating system that we call "warm blood," a system which is of the utmost importance, since it enables their activities of body and mind to continue on a more or less constant level instead of being slowed down by cold, speeded up by heat, as is the case with all other kinds of animals, and makes it possible for them to laugh at extremes of temperature which send insects or reptiles into the sleep of hibernation or aestivation. But birds have pushed the invention to its limits: they live at temperatures which would be the extremes of fever for us.

It is this extremely high temperature, 105 degrees or over, combined with the agility that comes of flight, which gives birds their fascinating quality of seeming always so intensely alive. But being intensely alive does not necessarily, as we know from human examples, mean being intensely intelligent. And in fact, in respect of their minds just as much as their bodies, birds have developed along other lines than mammals. Mammals have gradually perfected intelligence and the capacity for learning by experience, until this line has culminated in that conscious reason and in that deliberate reliance upon the accumulated experience of previous generations, which are unique properties of the human species. And with the gradual rise of intelligence, the power and fixity of the instincts has diminished. Birds, on the other hand, have kept instinct as the mainstay of their behaviour; they possess, like all other backboned animals, some intelligence and some power of profiting by experience, but these are subordinate, used merely to polish up the outfit of instincts which is provided by heredity without having to be paid for in terms of experience. Indeed, the anatomist could tell you as much by looking at the brains of bird and mammal, even if he had never studied the way the creatures behave. For whereas in mammals we can trace a steady increase in the size and elaboration of the cerebral hemispheres, the front part of the brain which we know to be the seat of intelligence and learning, this region is never highly developed in any bird, but

remains relatively small, without convolutions on its surface; while other parts which are known to be the regulating machinery for complicated but more automatic and more emotional actions, are in birds relatively larger than in four-footed creatures.

But enough of this generalizing. What I wanted to show at the outset was the fact that in the lives of birds we are not merely studying the actions of creatures which, though small and feathered, had minds of the same type as ourselves, albeit on a lower level, but of a branch of the tree of life which, in mind as in body, has specialized along a line of its own, showing us mind of a different quality from ours. They have raised emotion to the highest pitch found in animals; the line of mammals has done the same thing for intelligence.

Perhaps the most obvious way in which birds differ from men in their behaviour is that they can do all that they have to, including some quite complicated things, without ever being taught. Flying, to start with, is an activity which, for all its astonishing complexity of balance and aeronautical adjustment, comes untaught to birds. Young birds very frequently make their first flight when their parents are out of sight. Practice, of course, makes perfect and puts a polish on the somewhat awkward first performance; but there is no elaborate learning needed as with our learning of golf or tennis or figure-skating. Furthermore, the stories of old birds "teaching" their young to fly seem all to be erroneous. Some kinds of birds, once their young are full-fledged, do try to lure them away from the nest. But this merely encourages them to take the plunge; there is no instruction by the old bird in the movements of flight, no conscious imitation by the young.

But flight, after all, is something very organic. What is much more extraordinary than that a bird should be able to fly untaught (though this demands a formidable complexity of self-regulating machinery provided ready-made by Nature in the form of muscles and skeleton, nerves and nerve centres, eyes and balance organs) is that it should be able to build its nest untaught. And of this there can be no manner of doubt. Young birds, mating for the first time, can make perfectly good nests, and nests of the usual type found among their particular species. Some people have suggested that this may be due to their having absorbed the necessary knowledge from contemplating the structure of the nest in which they were brought up. But even if we were to admit that this was possible—which is very unlikely, considering that the young of small birds are very stupid, only live a few days in the nest after their eyes are open, and are never given any lessons in nest-building by their parents—it is negatived by the facts.

For instance, the celebrated mound-builders or brush-turkeys of the Australian region build large mounds of rubbish and decaying leaves and deposit their eggs at the end of tunnels in the mounds, leaving them to be hatched out by the heat of the fermenting vegetation. The young brush-turkey on hatching scrambles out of the tunnel; it can get no instruction from its parents, since they have long since gone about their own business; and not only does it not stay around the mound long enough to observe how it is constructed, but does not bestow on it so much as a look. None the less, when the time comes for it to mate, it will build a mound just as its ancestors have done.

Secondly, even young birds which have been brought up by hand in artificial nests—boxes lined by cotton wool or what not—will build the proper kind of nest for their species when the time comes for mating, and will not attempt to reproduce their own early homes. We are reminded of Dr. Johnson's comment on the suggestion that the attraction which woman's bosom has for the male sex is due to its pleasurable association with food during infancy. He did not notice, he said, that those who had been hand-fed when babies evinced any passionate fondness for bottles. In fact, the impulse of sex attraction in the one case, the impulse to construct a nest of a certain type in the other, cannot be explained by any rationalistic arguments of this sort; the one and the other are based not upon reason, not upon association, but upon instinct. The finch, for instance, has the impulse, when its mating urge is upon it, to weave coarse material into a rough cup, and then to line this with some finer material; the tailor-bird has the impulse to take leaves and sew them together; the house-martin to collect mud or clay and construct a cup against the side of a cliff or a house.

In a not dissimilar way, the bird which is in the physiological state of broodiness will have the violent urge to sit on eggs, or, if no eggs are available, it will often take something else. Crows have been known to brood golf-balls, gulls to sit on tobacco-tins substituted for their eggs; and the majestic emperor penguin, if it loses its egg or chick, will even brood lumps of ice in its inhospitable Antarctic home.

This fobbing off of a natural urge with an unnatural substitute is doubtless unintelligent; but we may ask whether it is more unintelligent than the behaviour of elderly maiden ladies who spend their maternal impulses upon lapdogs or canaries, or that of disappointed old bachelors who turn their energies into a useless hobby.

In all probability, however, the bird's behaviour *is* more unintelligent; for undoubtedly it does not even rationalize as we do, or seek to find reasons for its behaviour. How un-humanly a bird regards

the central facts of its life is seen in many of its relations to its offspring. Birds undoubtedly have a strong emotional concern over their eggs and young, but it is an instinctive, irrational concern, not an instinct entwined, as is the human parents' concern, with reason, memory, personal affection, and foresight. A pair of birds is robbed of their whole brood; the parental instinct finds itself frustrated, and they will show great agitation. But if one or more of the nestlings die before they are fledged—a frequent and in some species a normal occurrence—the old birds show no signs of sorrow or even agitation, but merely throw the corpse out of the nest as if it were a stick or a piece of dirt. And while a chick is, to our eyes, obviously failing, the old birds, far from making special efforts to restore it, as would human parents, definitely neglect it. The fact seems to be that the bird parent feels parental only when stimulated by some activity on the part of its children. When they gape and squawk, this is a stimulus to the parent to feed and tend them assiduously; when the stimulus fails, the parental feeling is no longer aroused, the bird is no longer impelled to parental actions.

This same incapacity to experience things as men and women would experience them is shown by the fact that if you remove young birds from a nest, as Mr. Kearton did with some starlings, and substitute some eggs, the mother, after a moment's apparent surprise, may accept the situation with equanimity, and respond to the new stimulus in the proper way, by sitting on the eggs. There was no trace of the distraction and grief which a human mother would have felt.

But perhaps the familiar cuckoo provides us with the completest proof, over the widest field, of the dissimilarity of birds' minds with our own. The young cuckoo, having been deposited as an egg in the nest of some quite other species of bird—a meadow-pipit, say, or a hedge-sparrow—and having hatched out in double-quick time, the rate of its embryonic development being adjusted to its parasitic habits, so that it shall not lag behind its foster-brothers, next proceeds to evict all the rest of the contents of the nest, be these eggs or young birds. It is provided with a flat and indeed slightly hollow back; and, hoisting its victim on this, it crawls backwards up the side of the nest, to pitch the object outside. Thus it continues to do until the nest is empty.

What cruelty, you will say, and what unpleasant ingenuity! But you will be wrong. The nestling cuckoo is not cruel, nor does he know why he is murdering his fellow nest-mates. He acts blindly, because he is a machine constructed to act thus and not otherwise. Not only is his back slightly concave, but this concavity is highly irritable and

over-sensitive; the touch of any object there drives him frantic, and if it is continued, it releases the impulse to walk upwards and backwards until he has reached the edge of whatever he is walking on, and then to tilt the object overboard. He will behave in just the same way to marbles or hazel-nuts or any other small object. Indeed, if you think of it, he *cannot* know what he is doing. For he will act thus immediately he is hatched, before his eyes are open; even if he could be taught, his parents have never been near him, and his foster-parents are hardly likely to instruct him in this particular! No, the whole train of actions is the outcome of a marvellous piece of machinery with which he is endowed by heredity, just as he is endowed with the equally marvellous adaptive mechanism of his feathers. The machinery consists in the shape of the back, its hyper-sensitiveness, and the intricate pattern of nervous connections in the brain and spinal cord which set the particular muscles into action. The act in fact is purely instinctive, just as instinctive and automatic as sneezing or coughing in ourselves. And, like coughing, it has been brought into being by the long unconscious processes of natural selection, not by any foresight or conscious will.

Once the foster-brothers are outside, we shall get another surprising peep into bird mind. When the foster-mother comes home, she does not seem in the least distressed by the absence of all but one of her brood, but at once sets about feeding the changeling. What is more, she pays no attention to her own offspring, even should some of these be dangling just outside the nest. As long as there is something in the nest which appeals to her parental instincts, it seems that young birds outside the nest, even if they be her own, are treated as so many foreign objects.

Then the young cuckoo begins to grow. It grows into a creature entirely different from its foster-parents, and eventually becomes several times bulkier than they, so that they have to perch on its head to drop food into its mouth! But they are not in the least disconcerted, as would human parents if their children began growing into giants, and giants of quite a different appearance from themselves. They are built to respond to the stimulus of appeals for food from any nestling that starts life in their nest, and they continue their response, whether the nestling is their own or a cuckoo.

At last the young cuckoo is ready to fly, leaves his foster-parents, and very soon must leave the country on migration. So far as we know, all the old cuckoos have before this time left the country for the south, so that it is again without any teaching or any knowledge that the young ones must obey the migration urge.

Some very interesting experiments by Professor Rowan of Alberta have thrown a good deal of light on this mysterious question of the impulse to migrate. In autumn, he caught a number of birds which usually leave the regions of an Alberta winter for the south (crows and the little finches called juncos were the kind he used), and kept them in unheated aviaries. So long as they were supplied with plenty of food, they remained perfectly healthy and happy, even with the temperature many degrees below zero. One lot were simply kept thus, as "controls" for the experiment: but another lot, in place of being exposed to the natural shortening of the days in early winter, had their days artificially lengthened by electric light, a little more every evening. In midwinter, Rowan liberated a number of birds. The controls made no attempt to migrate southwards, but just hung about the place. The birds whose day had been lengthened, however, for the most part did move away—but apparently most of them moved north and not south!

Other birds were killed and examined: all the controls, as was expected, had their reproductive organs shrunken to the tiny size characteristic of birds in winter; but the long-day birds showed reproductive organs which were enlarging like those of ordinary wild birds in early spring about the time of northward migration.

The view held by Rowan—and though it cannot yet be regarded as completely proved, it certainly seems probable—is as follows. The extra length of day caused the birds to spend more of their time in activity, less in sleep; this, by some mechanism we do not yet understand, caused the reproductive organs to begin to grow instead of shrinking; and the secretions of the reproductive organs control the migratory urge. When they are shrinking in early autumn, the changed secretion in the blood impels the birds to move south. When they are tiny and inactive, as normally in the dead of winter, there is no impulse to migrate at all; and when they are growing again, the secretion impels to northward movement, even if the bird be already in the most wintry and inhospitable conditions.

Whatever the precise interpretation, it is at least clear that the impulse to migrate is a strange blind urge, controlled and set in motion by the chemical agency of the reproductive secretions, and wholly unrelated to reason, or to any consciously-envisaged destination.

Then again there is the well-known "broken-wing trick" practised by so many birds when their young are threatened. Most writers of natural-history books set this down as a remarkable example of intelligence:—the bird, seeing its offspring in danger, deliberately

invents a ruse, and acts its part with consummate skill to draw the intruder away. All the evidence, however, points to this too being merely instinctive, a trick not invented by the individual bird, but patented by the species. If it were the fruit of intelligent reflection, we should expect to find some individuals of a species practising it, others not, and great variations in the efficacy of the performance; but in species like the purple sandpiper or the arctic skua, every individual seems to be a good performer, and this without any previous training. The trick, in fact, is on a par with the purely automatic "shamming dead" which many insects practise: it is the inevitable outcome of the animal's nervous machinery when this machinery is stimulated in a particular way.

Besides instinctive actions, we could multiply instances of unintelligent behaviour among birds. If a strange egg is put among a bird's own eggs, the mother may accept it through uncritical instinct, or may intelligently turn it out of the nest and continue to sit. But a quite common reaction is for it to turn the strange egg out, and *then* to desert its nest—a most decidedly illogical procedure! Again, Mr. St. Quentin had two hens and one cock of a kind of sand-grouse in his aviary. This is a bird in which the hens normally sit by day, the cock by night. One year, both the hens laid at the same time. The cock tried his best, sitting part of the night on one clutch, part on another, but of course the eggs came to nothing. If the birds had had any intelligence, they would have divided up the twenty-four hours so that the eggs were always brooded; but the day-brooding of the hens and the night-brooding of the cock are mechanical instincts, and intelligence neither enters into them in normal nor modifies them in abnormal circumstances.

But because birds are mainly instinctive and not intelligent in their actions, it does not follow that their minds are lacking in intensity or variety: so far as we can judge, they must be experiencing a wide range of powerful emotions.

A bird clearly finds an intense satisfaction in fulfilling its brooding impulse or the impulse to feed its young, even though the impulse may be, for want of intelligence, what we should call a strangely blind one: and when the young birds are threatened with danger, the parents clearly are suffering very real distress, just as birds suffer very real fear when cornered by an enemy. In song, too, the bird, besides expressing a certain general well-being, is giving vent to a deep current of feeling, even if it does not understand the feeling or reflect upon it, as would a human poet or musician. For the moment, they *are* that feeling. Some birds are so obsessed by their emotions during their

courtship display that they become oblivious of danger. The males of that huge bird of the grouse tribe, the capercaillie, have an extraordinary courtship ceremony which they carry out at daybreak in the branches of a favourite tree. While they are in the ecstasy of this passionate performance a man can easily creep up within range; and it is by this method that in certain countries many are shot.

Again, birds seem as subject as men to the emotion of jealousy. Rival cocks may fight to the death. One remarkable case with captive parrakeets is quite human in its incidents. Two cocks and a hen were in one cage. After much squabbling, one night one of the cocks killed the other: upon which the hen, who had hitherto rather favoured this bird, turned upon him and might have killed him too if they had not been separated.

Then bird-mind has sufficient subtlety to indulge in play. Dr. Gill of Cape Town records seeing a hooded crow fly up into the air, drop a small object it was carrying, swoop after it, croaking loudly, catch it in mid air, and repeat the performance over and over again with the greatest evidence of enjoyment. And tame ravens often display what seems a real sense of humour, though it must be admitted humour of rather a low order. A pair of them will combine to tease a cat or dog, one occupying its attention from the front, while the other steals round behind to tweak its tail and hop off with loud and delighted squawkings. They will play tricks on each other; in an aviary, one raven of a pair has been seen to slink up from behind when its mate was sitting on a low perch, and then reach up to knock the perching bird's foot from under it, with evident malicious enjoyment.

But in all these varied manifestations of emotion, birds still differ in a fundamental way from ourselves. Being without the power of conceptual thought, their emotion, while occupying their life with a completeness which is perhaps rarer with us, is not linked up with the future or the past as in a human mind. Their fear is just fear: it is not the fear of death, nor can it anticipate pain, nor become an ingredient of a lasting "complex." They cannot worry or torment themselves. When the fear-situation is past, the fear just disappears. So, as we have seen, with their maternal instincts. The bird mother is not concerned with the fate of an individual offspring, as a human mother would be concerned about Johnny's career or Tommy's poor health. She is concerned just to give vent to her instincts impersonally, as it were; and when the young grow up and her inner physiology changes, there is no intellectual framework making a continuing personal or individual interest possible.

That indeed is the greatest difference between the bird and ourselves. We, whether we want to or not, cannot help living within the framework of a continuing life. Our powers of thought and imagination bind up the present with the future and the past: the bird's life is almost wholly a patchwork, a series of self-sufficing moments.

THE ANALYSIS OF FAME

(WRITTEN AS A REVIEW OF *WHO'S WHO*, 1935)

WHO really is who? Who, indeed? *Who's Who* should provide the answer, at least so far as concerns society's collective Who in Britain. The trouble is that the answer is so collective, so formidably vast. The present edition runs to 3694 pages of entries, involving something like 30,000 miniature biographies.

Obviously there are numerous methods for approaching our problem of who really is who, and why. As a scientist, I feel that the quantitative method should first be given a chance. There are plenty of interesting questions to which it could provide an answer. For instance:—How many foreigners does the editor admit within the British precinct? In what proportion are the different professions and occupations represented in this Annual Hall of Fame? Are these proportions sensibly different for the British-born and the foreigners? What relation, if any, does length of entry bear to degree of eminence? What are the proportions of the sexes, both in bulk and detail?

I cannot claim to have penetrated very far along this road, but I have made a beginning. I have taken a random sample of over two hundred names, under a couple of letters of the alphabet, and present a few facts resulting from its preliminary analysis.

The Army, to my surprise, comes an easy first, with 34 entries out of 222. The mere fact of belonging to the Aristocracy ties for second place with Religion—19 each. Literature also accounts for 19, but only when it is enlarged by journalism and publishing. Then come Foreign and Imperial administration, including the diplomatic and consular services (17); Finance and Business (16); Science and Engineering (15); representatives of academic learning in other fields than science (14); Home politics and administration (13); the Navy, surprisingly low, with 12; Medicine (10); the Fine Arts, Music, and Architecture (8); Education (8); Miscellaneous (7); Law (6); the Air Force and Aviation in general (3); and last the Drama, including both acting and management, with only 2. (The Miscellaneous, by the way, include a food expert, a girl-guide organizer, and a traveller.)

The male sex-ratio is very high. In fact, there are only 6 women in the sample, or less than 3 per cent., and 4 of these are in literature.

Non-Britishers are much more generously treated than mere females, there being 26 of them. Ten of these are from the United

States, 9 are Hindus, 4 Europeans, 2 from the British Dominions, and one is a native African.

However, the selection of representatives of foreign countries is curiously haphazard. For instance, Hemingway is in, but not Faulkner; Sherwood Anderson, but not Stark Young; William Beebe, but not Thomas Barbour; Lindbergh, but not Professor Piccard; Frankie Buchman of the Oxford Groups, but not Aimée Semple MacPherson; Edith Wharton, but not Gertrude Stein; Charles Seltzer (author of *The Boss of the Lazy Y*, etc., etc.), but not Christopher Morley; Mary Garden, but not Lawrence Tibbett; General Smuts, but not General Botha; Ethel Barrymore, but not Ruth Draper; the Abbé Dimnet, but not Ogden Nash. . . . It is all very mysterious.

This quantitative method of study is capable of almost indefinite extension. In fact, it might be good for the progress of science if for a year, say, our army of sociologists were to relinquish all other research, and make a vast co-operative study, intensive, extensive, and comparative, of the "Who's Whos" of the world.

There is the question of Clubs, for instance. What sort of men are those without a single club, and those who belong to more than one? Is there as much correlation as is popularly supposed between clubs and professions—the Athenaeum and the upper ranges of an ecclesiastical career, for instance, or the Authors' and the practice of literature? There is further the question of recreation. What sort of men, on the average, are they who have no recreations, or at least do not record them? Of what type are the comparatively rare few who comply with editorial request and insert their motor-car numbers? What types of men and women omit to state their ages?

On all these and many other points of absorbing interest *Who's Who* could provide an answer if only sociological science would undertake the research. Unfortunately, the statistical labour involved is too great for an unaided worker, and I must pass on to the less precise but none the less absorbing facts to be gained by the merely qualitative methods of browsing and pouncing.

I cannot pretend, for example, to any precision of result on the question of length of entry. For a considerable time, I thought that the record was held by Nicholas Murray Butler—a proud position for a foreigner to hold among alien hosts! But he is exceeded, by another *Bu*, curiously enough—Sir Ernest Wallis Budge, the archaeologist, who runs to 165 lines against N. M. B.'s 135 (and this in spite of the list of the latter's foreign orders running to 20 lines).

However, it is true that the United States entries tend to be on the

long side. Professor Rice of the Peabody Museum gets (or perhaps one should say takes) 108 lines: by the way, he achieves what appears to be a record in the matter of club memberships, listing 22 (as against the mere 16 of Will Hays). Harry Elmer Barnes has 106; Irving Fisher 89 (as against H. A. L. Fisher's humble 42). That is three American "centenarians": among other nationals I can find but one —Monsieur Bouchor, French artist (102); and in the ranks of the far more numerous British I can only trace seven.

By way of contrast with these long entries we find that even Mr H. G. Wells's formidable list of publications (he does not, however, cite his articles) only gives him 84 lines, while Shaw has 65; Mussolini and General Smuts are content with 32, the Rockefellers, Sen. and Jun., with 29 and 18 respectively, Lloyd George with 21, Franklin Roosevelt with 18. However, for real restraint give me Stalin. Let me quote his entry in full:

> STALIN, Joseph Vissarionovich Djugashirli [surely, by the way, this is one of *Who's Who's* rare misprints: should it not be Djugashvili?], b. Gori, Tiflis Province, 1879; m. Nadejda Sergeyevna Alleluya (d. 1932); two c. Address: The Kremlin, Moscow, Russia.

I suppose, however, this entry is an editorial production. For personal modesty give me Professor Griquard, who, though he once divided the Nobel Prize for Chemistry, takes up but 5 lines. I like too his publication:—"Traité de Chimie Organique (10 vols.), commencera à paraître en 1934."

No, the correspondence between length of entry and degree of eminence is not high. It is, however, doubtless positive: I should put the coefficient of correlation at about 0·2, perhaps 0·3.

One curious point is the stern, almost puritanical, attitude taken up by the Editors to the theatre and the screen. Charlie Chaplin and Douglas Fairbanks get reasonable entries. The only producers I can find are Alexander Korda and Jesse Lasky. Mary Pickford and George Arliss receive 8 lines each, and the Garbo 5; but Marlene Dietrich, Norma Shearer, Marion Davies, Jean Harlow, Katharine Hepburn, and even Mae West are absent, as are Clark Gable, Gilbert, Cagney, and all four of the Marx Brothers. Even on the stage, and the British stage at that, there are curious gaps: for instance, I can't find Leslie Howard, Diana Wynyard, or Elsa Lanchester.

This is the only general criticism I have of this very great work. No one can, or at least ought to, deny that Norma Shearer, Cecil de Mille, or Harpo Marx are most definitely WHO, much more so than

professors and second-rate novelists, or the hordes of Brigadier-Generals and Archdeacons.

Another gap concerns royalty. There is a sort of proem concerning the British Royal Family, but nothing whatever concerning other monarchs, which seems a pity, and also illogical. Even ex-kings, however much in the public eye, are omitted. The only exceptions to the rule are subject kings, like the King of Buganda.

Of course, the most obvious source of interest for the reviewer is to be found under *Recreations*. For years George Bernard Shaw's "anything except sport" has been a classic *mot*. The Sitwells live up to their reputation for demanding public notice. Osbert recreates himself by "entertaining the rich and charity generally"; Sacheverell by "model aeroplanes, plats régionaux, improvisation, the bull-ring." Edith has no specific recreation, but she makes up for this by giving her antipathies: "in early youth took an intense dislike to simplicity, morris-dancing, a sense of humour, and every kind of sport except reviewer-baiting, and has continued these distastes ever since."

The Sitwellian sense of satire is further illuminated by such entries as this of Sacheverell's, "*educ.* Eton Coll.; Balliol College, Oxford. Left latter owing to continued success of Gilbert and Sullivan season at Oxford; mainly self-educated." Or, even more, by Osbert's "*educ.* during the holidays from Eton . . . was put down for M.C.C. on day of birth by W. G. Grace, but has now abandoned all other athletic interests in order to urge the adoption of new sports such as: Pelota, Kif-Kif, and the Pengo (especially the latter)." Considering the high cost of composition, ought not the editors to undertake some cutting in cases such as this?

Among the recreations of the great are these:—Naomi Mitchison, "hitting back"; E. S. P. Haynes, "divorce law reform"; Sir Denison Ross, "languages" (such busmen's holidays are frequent); Evelyn Underhill, the writer on mysticism, "talking to cats"; Benito Mussolini, "violino, equitazione, scherma, automobilismo, aviazione"; A. M. Low, the writer on popular science, "the encouragement of scientific research"; Sir William Bowden, the newspaper proprietor, "lecturing for charitable and educational purposes" (golly! but this is not unique—Professor Henderson of the University of North Carolina, lists simply "public lecturing"); Senator Gogarty of the Irish Free State, "archery and aviation"—delightful combination; the Rev. Hon. E. Lyttelton, late Headmaster of Eton, "scenery" (this is curiously rare; perhaps many people include it under *travel*); Sean O'Casey, sweepingly and, it seems to me, rather rashly, "everything except work"; M. E. G. Sebastian, D.S.O., British Consular Service,

"needlework"; Athene Seyler, "walking, talking." It is an interesting commentary on the social conventions that whereas music is set down quite commonly, and at least Ernest Hemingway has had the courage to include *drinking*, nowhere can I find either *gambling* or *women* as a recreation.

Often the biographies include fascinating facts. A hint that Epstein may possess an inferiority complex is given by the remark that his work on the British Medical Association, though "attacked by newspapers, religious bodies, etc., was defended by *Times*." It is pleasant to know that J. D. Rockefeller senior has given away more than $500,000,000 in charity. It is also pleasant that in these days of specialization such a paragon of versatility can exist as Dr. Satischandra Bagchi, Principal of the University Law College at Calcutta, who, in addition to numerous legal works, notably on the "Juristic Personality of Hindu Deities," has written books on "The Mathematics of Transformation and Quantum Theory"; "Rabelais"; and "Morality in Art," besides translating French stories into Bengali.

It is tempting to browse on. Almost every page has its rewards. The clergyman whose recreations are caricature and philately; the fact that Marie Stopes mentions her marriage to her first husband, but that he does not mention the fact of his marriage to Marie Stopes; the omission by H. G. Wells of any mention of the first marriage for which in his autobiography he finds so much space; the fact that neither Sir Charles Sherrington nor Miss Ethel M. Dell give their ages. . . . But I must refrain.

Who's Who is a great work. It is not only so useful as to be all but indispensable; not only, as I have tried to point out, one of the world's most valuable source-books in sociology; but also contains more interesting specimens of what are usually known as "human documents" than any other work in existence. And if you think the price is high, reflect that it works out at less than a farthing per closely printed page—far cheaper than a novel.

SCIENCE, NATURAL AND SOCIAL

I. Methods in Social Science

SCIENCE, in the more restricted sense in which it is normally employed in English-speaking countries, is that activity by which to-day we attain the great bulk of our knowledge of and control over the facts of nature. This activity, like other human activities, has developed and evolved, and by no means all the stages in its evolution have merited the title of scientific. In remote prehistoric times, our early ancestors worked by trial and error combined with simple, intuitive common-sense. This pre-scientific approach, however, was combined with the non-scientific methods of control that we call magic, and equally non-scientific rationalizations in the field of explanation.

Once agriculture had given the possibility of settled civilizations, with written record and specialized social classes, the hand-to-mouth methods of common-sense could be replaced by something much more scientific. Science was born—witness the astronomy and geometry of ancient Mesopotamia and Egypt. But science in this phase was still, to our modern view, unscientific in two major aspects—it was traditional and it was esoteric. Scientific knowledge was confined to a limited group among the priesthood and it was cast in a mould of tradition which rendered change and progress slow. Being associated with the priesthood, it was also intimately bound up with non-scientific practice and non-scientific interpretation—magic and theology.

The era of groping trial and error lasted from the first dawn of essentially human intelligence, as marked by true speech, to the beginnings of settled civilization—perhaps a million, perhaps half a million years. The next, or traditional-esoteric phase, lasted for thousands instead of hundreds of thousands of years. After some three or four millennia, the Greeks suddenly burst free of the prison of secrecy and traditionalism and proclaimed the freedom of intellectual inquiry. The "birth of science" is usually fathered on them, but the assumption is only a half-truth. At best, their achievement was the acquisition of freedom and self-consciousness by the scientific spirit, not the emergence of a wholly new activity called science. And secondly, the type of science which it inaugurated differed radically from modern science in several respects. It was almost entirely divorced from industry and practical application; it was exceedingly speculative and did

not lay the same stress on experimental verification as we do; and, correlated with this, it had not invented the modern methodology of publication of the data and methods used, as well as the conclusions reached.

A few centuries later, the combination of Greek intellect and ingenuity with the practical spirit of the Roman imperium made Alexandrian science something much more like modern science in outlook and methods of working. But this was swallowed up in the anti-scientific Christian flood and the general collapse of Roman civilization.

During the Dark Ages in the West, the Arabs kept the scientific spirit alive, and by means of their mathematical inventions paved the way for immense improvements in the technique of scientific research.

Natural science, in its modern form, can fairly be said to date back no further than the seventeenth century. With Bacon as its St. John the Baptist, it developed its gospel and its ministry. Curiosity for its own sake, but also interest in industrial techniques and practical control; freedom of inquiry; experimental verification in place of authority; full publication and abundant discussion—with these a truly new phase was inaugurated.

To-day it seems that we are again in the process of launching a new phase of science—one in which social as well as natural phenomena are to be made amenable to scientific understanding and rational control.

As with natural science, social science too has had its earlier stages. It too passed through the stage of trial and error, in which social organization shaped itself under the influence of unconscious adjustment together with non-rational rules of conduct and non-scientific interpretations of human destiny. It also had its traditional phases, often tightly bound up with philosophical and theological interpretative principles, as, for example, in the climax of the Middle Ages. And it has had its birth of free speculative inquiry, parallel to the Greek phase of natural science—but two thousand years later, in the philosophers of the seventeenth and especially the eighteenth century.

Finally, its modern stage now dawning has had, like the modern stage of natural science, its scattered precursors, its Roger Bacons and Leonardos—and it has had its precursor in the restricted sense, its equivalent of Francis Bacon in the Renaissance. Many, I am sure, would put Herbert Spencer in this position; but I believe that the true John the Baptist of social science is Karl Marx. Herbert Spencer, for all his academic knowledge, or perhaps because of it, was more in

the position of an Old Testament prophet. His work was essentially analogical. He demonstrated that social science was an inevitable development; but his notions of what form it would actually take and what methods it should employ were vague and essentially erroneous.

Marx, on the other hand, developed a system directly based on social facts and directly applicable to them. He did not just prophesy *a* Messiah; he indicated *the* Messiah. As natural scientists tend to undervalue Bacon because he himself did not make discoveries or work out experimental techniques, so social scientists tend to underrate Marx because his system is a dialectical one, ready-made and complete with answer to any problem, not sufficiently empirical and inductive for their scientific taste. But at least Marx, like Bacon, gave expression to a new outlook and a new method of attack, and helped materially to alter the intellectual climate so as to make it propitious for scientific work in his field.

The question immediately poses itself as to why the emergence of social science into large-scale and efficient operation has been so long delayed. The triumphs of natural science, both in discovering radically new knowledge and in applying it practically to satisfy human needs, have been so spectacular and so fruitful that it would seem natural and obvious to extend the same methods to the field of social phenomena.

The answer is a very simple one: the methods are *not* the same. The scientific spirit remains unaltered whether it is contemplating a nebula or a baby, a field of wheat or a trades union. But the methodology of social science is inevitably different from that of natural science. It is different and must be different for one basic reason—the investigator is inside instead of outside his material. Man cannot investigate man by the same methods by which he investigates external nature. He can use the methods of natural science to investigate certain aspects of man—the structure and working of his body, for instance, or the mode of his heredity; but that is because these are shared with other organisms and because they are partial aspects which can be readily externalized. But when he starts investigating human motive, his own motives are involved; when he studies human society, he is himself part of a social structure.

What consequence does this basic difference imply? In the first place, man must here be his own guinea-pig. But this is impossible in the strict sense, for he is unable to make fully controlled experiments. Even if an absolute despot were to subject a group of people to rigorous experimentation—by depriving them of alcohol, for in-

stance, or by adopting a new form of education—the results would have only a limited application. The smallness of the group, the compulsion involved, the inevitable limitations on the contacts and full social activity of the group, would make it impossible to apply the results directly to an entire normal society, however regimented. And the difficulties are of course enormously greater in any free society.

A second, more technical difficulty is in a sense a consequence of the first. Causation in social science is never simple and single as in physics or biology, but always multiple and complex. It is of course true that one-to-one causation is an artificial affair, only to be unearthed by isolating phenomena from their total background. None the less, this method is the most powerful weapon in the armoury of natural science: it disentangles the chaotic field of influence and reduces it to a series of single causes, each of which can then be given due weight when the isolates are put back into their natural interrelatedness, or when they are deliberately combined into new complexes unknown in nature.

This method of analysis is impossible in social science. Multiple causation here is irreducible. The difficulty is a twofold one. In the first place, the human mind is always looking for single causes for phenomena. The very idea of multiple causation is not only difficult, but definitely antipathetic. And secondly, even when the social scientist has overcome this resistance, extreme practical difficulties remain. Somehow he must disentangle the single causes from the multiple field of which they form an inseparable part. And for this a new technique is necessary.

Next, and in many ways even more important than the first two together, comes the question of bias. Under this head I include anything appertaining to the investigator which may deflect his scientific judgment. It is the equivalent of experimental and observational error in natural science. In natural science, there are statistical methods for discounting both sampling error and personal error; the limits of accurate measurement are determined for different types of instrument; the procedure of controlled experimentation has been reduced to a fine art. The procedure of the discounting of error in natural science by these methods has proved difficult enough. But to discover how to discount bias in social science is proving very much harder.

Then there is the inherent genetic bias imposed by his own temperament. For certain purposes, investigators in social science are their own instruments to a very great extent, and in a way unknown

in natural science—and the individual instruments differ in their very construction.

Next we have the bias introduced by the peculiar psychological development of human beings. They can only resolve their inevitable conflicts during childhood and adolescence by relegating a great deal to their unconscious, whether by the psychological mechanism of suppression or that of repression. Roughly speaking, the former introduces bias by leaving gaps in a person's knowledge and outlook, whereas in the latter the gaps are accompanied by strong emotional distortions and resistances. The scientific study of sex, for instance, has been much retarded by repressional bias—witness the reception originally given to Havelock Ellis's great work and the extraordinary resistance still offered to Freud's ideas.

Bias of this type has the additional danger that those who make an effort to discount it may readily swing into over-compensation—a bias of opposite sign. The investigator whose youth was tormented by intolerant religion is apt to discount the social importance of religion far too much; the convert to Freudian methods is liable, in discounting his own early sexual repressions, to underestimate the social value of repression in general.

Bias has also been encountered in natural science, but only when its findings come up against emotionally held convictions—only, that is, when it has had social entanglements. We may cite the prohibition of anatomical dissection, the proscription of Galileo's findings, the hostility to the Darwinian theory, the Nazi distortion of racial anthropology, the Soviet attack on modern genetics. The present course of general anti-scientific feeling, so noticeable during the past decade, has been due in part to a general feeling that scientific findings, by sapping the traditional view of man's place in the universe and in society, are undermining the basis of ordered society.

Finally, there comes the most fundamental difference of all. Values are deliberately excluded from the purview of natural science: values and all that they connote of motive, emotion, qualitative hierarchy and the rest constitute some of the most important data with which the social scientist must deal. But how can science deal with them? Science must aim at quantitative treatment: how can it deal with the irreducible absolutes of quality? Science must be morally neutral and dispassionate: how can the social scientist handle the ethical bases of morality, the motives of passion?

Let us be frank with ourselves. There is a sense in which, because of this qualitative difference between its data and those of natural science, social science can never become fully and rigorously scientific.

To understand and describe a system involving values is impossible without some judgment of values, and still more impossible without such value-judgment is the other scientific function, that of control.

However, this is not quite so serious as at first sight appears. Even in natural science, regarded as pure knowledge, one value-judgment is implicit—*belief in the value of truth.* And where natural science passes into control, a whole scale of values is involved. The application of natural science is guided by considerations of utility—utility for profit, for war, for food-production, for health, for amusement, for education. The application of science through the instrument of *laisser-faire* economic systems has brought us to a position at which we are being forcibly reminded that these different utilities may conflict.

Put in another way, this is because natural science, by the fact of being applied, becomes a social problem and so a subject for social science. In social science, to set up a new value-system is in certain ways analogous to advancing a new hypothesis in natural science, and to demonstrate that such a new system is desirable or necessary is to discover and formulate some of the "laws of nature" for the coming phase of social evolution.

Thus, rather crudely, we may say that in respect of the problem of values, social science in its aspect of knowledge is faced by the same difficulties as is natural science in its aspect of control. The difficulty is thus in a sense an artificial one. Its consideration has reminded us that natural science is not such a pure disembodied activity as is often assumed. Language is in part responsible for the assumption. There is no such thing as natural science *per se.* The phrase is a shorthand description of those activities of human beings which are concerned with understanding and controlling their natural environment. And, just as simple one-to-one causation is a fiction, only approximated to in artificially isolated systems, so the emancipation of natural science from considerations of value is a fiction, approximated to by the possibility of temporarily and artificially isolating scientific activity from other human activities.

The essential differences between natural and social science thus boil down to this—that the phenomena with which the latter deals are less readily isolated, and that as an activity it is more closely entangled with human values. These differences, however, even if only qualitative, are very real, and it remains true that social science must develop its own methodology if it is to become an efficient instrument.

In regard to multiple causation, we may look forward to an extended use of techniques of mathematical correlation. These have already been developed to a high pitch for dealing with problems of multiple causation in physical science, and special methods have been worked out by Spearman and his school for dealing with psychological questions. The use of probability methods is also indicated. Here again, these have been developed to a high pitch for use in natural science. Mathematical methods also enter into another technique which is now being rapidly developed in social science, that of the questionnaire, and especially the set of questions asked by the trained interviewer. The questionnaire method is widely used, but the reluctance or inability of large sections of the public to fill up its elaborate forms restricts its sphere and impairs its sampling accuracy. The success of the method in this form depends chiefly on two things —the proper framing of the questions and the obtaining of a truly representative sample of the population to answer them.

Some questions do not admit of a significant answer, or any answer at all; others will defeat their own ends by influencing the form of the answer. In any case, the method of questioning a representative sample of a large population can only be applied to a restricted set of problems, though within limitations it may become extremely efficient. The modern scientific public opinion poll, indeed, is developing such uncanny accuracy that it is infringing upon practical politics. Some people are asking whether a properly conducted straw ballot could not be profitably substituted for the trouble and expense of a full election; while others feel that the announcement of a straw vote may itself influence the course of the subsequent election.

Psychologists are busy devising modifications of the questionnaire method so as to build up objective rating scales (objective, that is, for the population of which the questionees are a representative sample) for various value-judgments. In addition, they are essaying to assess the distribution among the population of various human qualities. Intelligence-testing has long been practised, and is now approaching full scientific validity. Attempts are also being made to assess temperament and even more elusive qualities. The method of Mass Observation constitutes an attempt to attain objective information on various aspects of public opinion and behaviour which elude the method of yes-and-no questioning. Inquiries may concern the reaction of the public to a particular place, like the Zoo or the National Gallery; to a particular event, like the Coronation; to a particular activity, such as smoking or the time of rising; or to a general situation, like that of war. In some cases, composite pictures which could

have been obtained in no other way have resulted from the use of this method. But in general its technique, both as regards sampling and questioning, will have to be refined a good deal before it can claim to be scientifically dependable.

Another set of methods which are being developed to cope with the complexity of social problems are those of anonymous group working, repeated drafting, and circulation of the preliminary draft results for comment and criticism. A combination of all three seems to yield the best results when tackling large and many-sided problems, such as the structure of a national agency like a health service or a big industry like steel or agriculture, the organization of leisure, or international adjustments.

Joint work is on the increase in natural science, but here largely because of the quantitative burden of routine procedures in subjects like biochemistry or genetics. We may distinguish such work from true group work, using the term group in the sense of a body of people pooling their different knowledges and skills to cope with qualitatively differentiated problems. Group work in this sense is also to be found in natural science, as when geneticists, ecologists and statisticians make a united attack on some problem of micro-evolution. But it is far more necessary in social science, where various bodies, such as P.E.P., are studying how to perfect it as a research method. Anonymity is often desirable in group work to enable the participation of public servants or well-known men whose opinions might be distorted or discounted in advance. It may also be desirable, for an essentially opposite reason, to give the weight of a recognized study organization to the work of young and unknown men whose findings would otherwise tend to be disregarded. In both these ways anonymous group working, in addition to securing greater efficiency, helps to discount bias of one sort or another.

Provided that a good drafter is available, together with a chairman and a small core of members who will give regular attendance, group membership can be fluid, and specialists invited for one or a few meetings as required.

Repeated drafting is a substitute for experimentation in problems where the experimental attack is ruled out. As soon as a preliminary survey has been made of the problem in its entirety, a draft is circulated for discussion at the next meeting. The gaps and errors thus brought to light form the subject of the next period of work, when the process is repeated. Three, four, or even more complete drafts may be required before publishable conclusions are reached, just as new sets of experiments must be planned and executed to deal with ten-

tative conclusions and new facts arising in a piece of research in natural science, before it can be written up.

Some or all of the successive drafts may also be circulated to a comparatively large number of outside experts for written criticism. The collation of such comments often brings to light new details and unexpected points of view which the group, in its preoccupation with its own trend of thought, has overlooked. It affords a method of enlarging the group without the time-consuming business of large-scale discussion.

In other cases, the actual investigator may be a single man, while the group element is provided by interviews and by circulation of drafts. This method is best adapted to problems which are of large geographical scale and local diversity, though it may also be used for those which are qualitatively diversified in themselves.

It may be expected that the working out of various techniques made necessary by the nature of the data of social science will have fruitful repercussions in certain fields of natural science, such as evolution and comparative biological study in general, where the present bias in favour of experimental work and specific results is leaving vast bodies of published data awaiting the synthetic treatment which only organized group attack can provide.

I have already mentioned certain substitutes for the controlled experimentation of the natural sciences. But experimentation as a method is not ruled out in social science, though it must take different forms. Regional or group experimentation is the most obvious method. Two regions or groups are chosen which are as similar as possible, and certain measures are introduced in the one, while the other serves as control. The Carlisle experiment on liquor control in Britain was an early essay in this method, but unfortunately it has been allowed to drag on without any serious attempts to draw theoretical conclusions or to frame practical policies on the basis of its operation. The TVA in America is perhaps the largest social experiment ever undertaken, at any rate in a non-totalitarian country. The area involved, however, is so large that strict controls are difficult to find.

As the spirit of scientific planning extends with government, we may expect to see regional experiments tried out in many fields. Medical and health services would afford another excellent field. The social results of cheap electric power could be made the subject of local experiments much more rigorous than that of the TVA. Different methods of developing backward tropical territories—by international or national chartered companies, by public works

schemes under the local administration, by the establishment of co-operatives—could and should be made the subject of carefully planned regional experiments.

The fact that in social science man is his own guinea-pig has a number of methodological consequences, both for social science research and for its practical applications. The social scientist often requires true co-operation from his material in the sense of understanding of the reason for his work and voluntary participation in its course. Education as a social experiment can never succeed without properly equipped teachers, specially trained in pedagogy. The interview method will give entirely misleading results without interviewers skilled in the technique of their job.

In the field of application, propaganda and public relations may be of prime importance. A good example is the cancer campaign recently instituted in the United States. Cancer has been presented to the public in such a way as to create a real interest in it as a social problem, and the public is collaborating in the attack upon it. The vast problem of malnutrition will never be solved unless the public is made to take a similar interest in it. The British Medical Association has made a beginning in this field with its milk campaign; but it is a beginning only.

In general the whole technique of propaganda, persuasion, and public relations needs the most intensive study before the findings of science can be socially applied. When does propaganda defeat its own ends by setting up counter-resistance? What are the relative values of reiteration and of variety of appeal? Of the printed word, the poster, the cinema, or the radio? Of rational persuasion as against mere suggestibility? Of intellectual comprehension as against a sense of active participation? We simply do not know, and until we know, our progress towards efficient social structure and a fuller life will be fitful and slow. In many ways, the enlistment of public co-operation is to social science what the enlistment of capital investment is to natural science: it provides motive power for application.

There remains the question of bias. In this there is no ready method to hand. It took generations for natural science to work out the technique of discounting experimental and observational error; it will take generations for social science to work out that of discounting the errors due to bias. The first step is obviously to make the world aware of the existence of bias and of the need for its discounting. Where human affairs are still handled in a pre-scientific spirit, bias is apt to play a very large practical rôle, especially the bias in favour of one's own group, whether class, religion or race. Such bias produces

powerful rationalizations, which are then used to justify policies of the merest self-interest. The enslavement of negroes was justified on the basis of the scriptural authority for the menial destiny of the sons of Ham; the brutalities of the Nazi Jew-baitings on that of the racial superiority of "Aryans." The group bias of the prosperous classes in early nineteenth-century England appeared in astonishing assertions about the inherent inferiority of "the poor"; the same bias is evident in certain aspects of the eugenics movement to-day.

Another widespread and disastrous form of bias arises from psychological conflict and tension. Censoriousness in respect of moral taboos, the desire to see the infliction of vindictive punishment, the unconscious reluctance of many parents to see the harsh school discipline under which they suffered replaced by humaner methods, the emotional basis of militarism—all these and many other undesirable determiners of human conduct are the result of bias arising from repression or emotional conflict and the inflicting of lasting distortion on the psyche.

In these fields, bias is thus an urgent subject for investigation by social science, and the application here will lie in making its findings universally known and accepted by the public in general and by administrators in particular.

But even in scientific circles bias may play a surprisingly large part. A good example was the resistance of the great majority of medical men during the early part of the last war to admitting any cause for breakdown among soldiers save physical shell-shock and malingering. And the uncritical assumptions, even among scrupulously careful persons, that differences in intelligence between social classes were genetic and not due to nutrition or other social factors, is another. Again, we have the thesis of anthropologists like Lévy-Bruhl, that savage mentality is in some way qualitatively different from and inferior to our own, whereas it is in fact essentially similar, but operating in different material and social conditions.

No golden rule can be laid down for the avoidance of such pitfalls, apart from the obvious step of realizing that they exist. Beyond that, special methods must be worked out in each field.

Voices are still raised proclaiming that social science is a contradiction in terms, that human affairs are not intrinsically amenable to the scientific method. Those who hold this opinion are, I believe, wrong. They are confusing the methods of natural science with scientific method in general. Social science differs inevitably from natural science in many important respects, notably in its lesser capacity for isolating problems, and more generally in its lesser degree of

isolation from other aspects of human activity and its consequent greater entanglement with problems of value. It must therefore work out its own technique and its own methodology, just as natural science had to do after Bacon and the eager amateurs of the seventeenth century had glimpsed natural science as a new form of human activity.

Let us not forget that the working out of this technique and this methodology by natural science took a great deal of time and is indeed still progressing. During the growth of modern science, the amateur has been largely replaced by the professional; university laboratories have been supplemented by governmental and industrial institutions; whole-time research has become a new profession; the team has in many types of work replaced the individual; co-operative group work is beginning; and the large-scale planning of research is in the offing.

Finally, the enormous growth of applied science has had effects of the utmost importance on pure research. It has done so partly by providing new instruments which would otherwise have been unavailable; one need only instance the gifts of the wireless industry not only to pure physics but to such unexpected branches of science as nervous physiology. And partly by suggesting new lines of research, the needs of wireless have again revealed new facts concerning the upper atmosphere, while the study of plant pests and human diseases has brought to light new modes of evolution.

We need have no fear for the future of social science. It too will pass through similar phases from its present infancy. By the time that the profession of social science, pure and applied, includes as many men and women as are now engaged in natural science, it will have solved its major problems of new methods, and the results it has achieved will have altered the whole intellectual climate. As the barber-surgeon of the Middle Ages has given place to the medical man of to-day, with his elaborate scientific training, so the essentially amateur politician and administrator of to-day will have been replaced by a new type of professional man, with specialized training. Life will go on against a background of social science. Society will have begun to develop a brain.

II. The Biological Analogy

Writers and philosophers have often attempted to illuminate human affairs by means of biological analogies. Shakespeare, in *Coriolanus*, drew the analogy between the human body and the body politic in Menenius' speech on the body and its members. Herbert Spencer's

work is shot through with the premise that human biology is but an extension of biology *sensu stricto*, and that, accordingly, biological analogies will in general have validity. Various German philosophers during the latter half of the past century justified war on the basis of the Darwinian conception of the struggle for existence, and the apostles of *laisser-faire* in Britain found support for economic individualism in the same doctrine. Socialists, on the other hand, have pointed to the fact of mutual aid in nature, as set forth by Kropotkin. Analogies with the social organization of ants and bees have been used, according to taste and prejudice, to glorify or to attack the doctrines of human collectivism. The Marxist thesis of progress being achieved through a reconciliation of opposites, only to lead to a new antithesis, which in turn paves the way for a new synthesis, is customarily documented in the works of communist philosophers by examples from biological evolution.

It is interesting to ask ourselves precisely what validity resides in this method of extending biological principles by analogy into human affairs. At the outset, it is clear that analogy, unless applied with the greatest caution, is a dangerous tool. This is clear to the modern scientist, but it has not always been so. Indeed, to put too great a burden on the back of analogy is a fundamental temptation of the human mind, and is at the base of the most unscientific practices and beliefs, including almost all magical ritual and much of supernaturalist superstition. During the last millennium, moralists, theologians and scholastic philosophers have often regarded analogy, even of the most far-fetched kind, as the equivalent of proof.

Has analogy, then, no part to play in scientific thought? Far from it. Analogy is in the majority of cases the clue which guides the scientific explorer towards radically new discoveries, the light which serves as first indication of a distant region habitable by thought. The analogy with waves in water guided physics to the classical wave-theory of light. The analogy with human competition, after playing an important rôle in Darwinian theory (did not Darwin arrive at the theory of natural selection from his reading of Malthus?), was transferred by Wilhelm Roux to a smaller sphere, the struggle of the parts within the individual.

But analogy may very readily mislead. Weismann sought to apply this same analogy of intra-organismal struggle and selection to the units of heredity; but the analogy happens not to hold good. The analogy of a stream of particles misled Newton as to the nature of light.

Analogy thus provides clues, but they may easily be false clues; it

provides light, but the light may be a will-of-the-wisp. However pretty, however seductive, analogy remains analogy and never constitutes proof. It throws out suggestions, which must be tested before we can speak of demonstration.

But if non-scientists often overrate the importance of analogy, scientists themselves tend to be over-cautious and to underrate its potential value. Its value is especially great when the analogy is one between closely related subjects. The analogy between the evolution of different groups of animals is often surprisingly close, for the simple reason that both the material and the conditions are essentially similar throughout. None the less, unpredictable results are not infrequent. The adaptive radiation of the marsupials in Australia was in its broad lines similar to that of the placentals in the rest of the world; but the placentals never developed large jumpers like the kangaroo, and, conversely, the marsupials produced no quick runners like horse or antelope, and no freshwater fish-eaters like the otter. Again, the parallelism in the social evolution of the quite unrelated ants and termites is truly astonishing; yet the termites have never produced grain-storers or slave-makers, while the ants have no system of second-grade queens in reserve.

One further caveat before we pursue the biological analysis of man's social existence. Human societies, though indubitably organic, are unlike any animal organism in the mode of their reproduction. Strictly speaking, they do not usually reproduce at all, but merely perpetuate themselves. They exhibit no process of fertilization between living gametes, no distinction between mortal body and immortal germ-plasm. They continue indefinitely by the aggregate reproduction of their component individuals. In their development, change of structural and functional pattern can be dissociated from growth in a way impossible to a developing animal, and social heredity operates via cultural transmission, not by the physical transmission of material potencies of development. On the other hand, the separation of phylogeny and ontogeny, the development of race and the development of the individual, which is so evident in higher animals, is blurred in social development to such an extent that the two often coincide.

All analogies between the birth, development and death of civilizations or nations and of animal organisms must be very heavily discounted because of this fundamental difference in the mode of their reproduction and inheritance.

Now, with these facts in mind, let us look at some of the biological analogies that lie near to hand. In the first place, there is the analogy

between the societies of insects and those of man. This, however obvious and however often applied, must be rejected out of hand. The two rest on different bases—those of ants, bees and termites on the fixity of instinct, those of man on the plasticity of intelligence. For this reason man cannot and will not ever develop specialized castes, with functions predetermined by heredity, nor will human society ever work with the machine-like smoothness of an ant-hill of a termitary. Furthermore, we must not expect that in man the altruistic instincts will ever become predominant: as Haldane has demonstrated, this can only occur when neuter castes of workers or soldiers exist. Altruism in man must be fostered by education and given fuller play by appropriate social machinery; it cannot be implanted once and for all by heredity.

The next analogy to be considered is that between the body of a higher animal and human society. This has taken two main forms. In the one, the analogy is drawn between the main classes of society and the main organ-systems of the body, or, going a little further into detail, between the specialized functions of various agencies of social existence—trade, government, war, education and so forth—and those of particular bodily organs. In the other, which has been attempted only since the discovery of the cell and the rise of the cell-theory, the cell within the body is compared to the individual within society. An extension of this second analogy bridges the gap between it and the first: instead of the individual cell, attention is concentrated on the different types of cells and the different resultant tissues of the body; and these, rather than the still more complex organs, each composed of numerous tissues, are compared with the various specialized trades and professions in human society.

In assessing the value and limitations of these analyses, we must begin by recalling the basic difference between the animal body and human society, namely, the far greater subordination of the parts to the whole in the former. This is especially important for the comparison between cells and human individuals. The difference here is the same basic one as that between the castes of a social insect society and the specialized aptitudes of human beings, but pushed to a much greater length. The cells of the body are irrevocably specialized during early development, and their divergent specialization is far greater than that between even a queen and a soldier termite. Without embryological study, no one could guess that a nerve-cell, with its long nerve-fibre and its branching dendrites, a sperm, with condensed head and motile tail, and a fat-cell, an inert lump crowded with globules of reserve fat-stores, were all modifications of a single

common type. Altruism, in the sense of sacrifice of the unit for the good of the whole, has also been carried to a much higher pitch. As with drone bees, only one out of many sperms can ever perform its fertilizing function; but the ratio is one to many tens of millions, instead of one to a few hundreds. The cells of the outer skin have no other function than to be converted into dead horny plates, constantly shed and as constantly renewed; the red blood-cells lose their nuclei before being capable of exerting their oxygen-carrying function, and have a life much more limited even than that of worker bees. Units may even be pooled. The giant nerve-fibres of cuttlefish are the joint product of numerous united nerve-cells; our own striped muscle-fibres are vast super-units, comparable with a permanently united tug-of-war team.

In terms of biologically higher and lower, there is thus a radical difference between cells and human beings. Both are biological individuals which form part of more complex individualities. Cells are first-order individuals, bodies second-order ones, and human societies (like hydroid colonies or bee-hives) third-order ones. But whereas the individuality of the body of a higher animal, be it cuttlefish, insect or vertebrate, is far more developed than that of its constituent cells, that of a human society is far less so than that of its individual units.

This fact, while it makes the analogy between cell and human individual almost worthless, is of great value itself as a biological analogy, since it immediately exposes the fallacy of all social theories, like those of Fascism and National Socialism, which exalt the State above the individual.

A book could be written on the subject of analogies between biological organisms and society. One with peculiar relevance to-day is the tendency, repeated over and over again in evolution, for types to specialize on the development of brute strength coupled with formidable offensive or defensive weapons, only to be superseded by other types which had concentrated on efficiency of general organization, and especially on the efficiency of the brain. The outstanding example is the supersession of the formidable reptiles of the late Mesozoic by the apparently insignificant mammals of the period.

This phenomenon is often somewhat misinterpreted as the replacement of specialized by generalized types. There is an element of truth in this idea, but the fact is often lost sight of that the successful generalized type always owes its success to some improvement in basic organization. Such improvements in general organization are specializations, but they are all-round specializations, whereas what are

usually called specializations are one-sided. This distinction contains the kernel of what is probably the most important of our biological analogies—the analogy concerning desirable and undesirable directions of change.

A detailed analysis of type of evolutionary change shows that some of them can legitimately be called progressive, in the sense that they constitute part of a steady advance on the part of living matter toward a greater control over and independence of its environment. Only a small and steadily diminishing fraction of life participates in progressive change.

Each step in progress is constituted by all-round specialization—an improvement in general organization; one-sided specialization always leads into an evolutionary blind alley.

Here I have only space to mention the two types of change which have been most important in the later phases of evolutionary progress. One is the development of mechanisms for regulating the internal environment of an animal, and so making it more largely independent of changes in external environment or better able to pass from one type of activity to another. The other is the improvement of the mechanisms for obtaining and utilizing knowledge of the environment, which in its later stages, after the efficiency of sense-organs had reached its limit, has been brought about by improvement in brain mechanism.

The biological analogy from the former is obvious. It provides the most abundant justification for the abandonment of *laisser-faire* in favour of social and economic planning: but the planning must be designed to give society an internal environment which shall be both stable in essentials and flexible in detail, and to enable it to undertake the greatest diversity of functions with the least dislocation.

The biological analogy from brain evolution is, however, even more illuminating. As animal evolution continued, the avenues of progress were cut off one by one. Changes that had been progressive in their time were exploited to the full and reached the limit of their potentialities. Mere bulk of body had reached its limit in the dinosaurs during the Mesozoic, some sixty million years ago. Ten or twenty million years later, temperature-regulation in certain animal forms had been perfected. The exploitation of the insectan type of social life by ants was over about twenty-five million years back, and ants have not evolved since.

Similarly, the number of the groups which might share in progressive change steadily narrowed down. Groups like the echinoderms were soon eliminated owing to their headlessness; then the

great phylum of molluscs, through defects in general organization; then the insects, through their limited size. Only the vertebrates remained. The cold-blooded forms were eliminated by the biological invention of temperature-regulation; the birds, by their over-specialization for flight; the marsupials, by their greatly inferior reproductive mechanism. Among the placentals, now sole repositories of potential advance, the majority of lines cut themselves off from progress by one-sided specialization. Only the arboreal primates escaped, since their mode of life left teeth and limbs unspecialized, while demanding greater efficiency in the highest sense of all, vision, and greater correlation between hand and eye. This correlation meant improvement in brain structure, which spilled over in the form of increased educability and awareness. Finally, all the primate lines but one wandered into blind alleys, becoming over-specialized for tree life. Only the one stock which early redescended to the ground and concentrated on all-round adaptability remained potentially progressive — man. The human species has now become the only branch of life in which and by which further substantial evolutionary progress can possibly be realized. And it has achieved this enviable, but at the same time intensely responsible, position solely by concentrating on brain as against other organs as its line of specialization.

This evolution of brain, as the one inexhaustible or at least unexhausted source of progress, thus demands our closest attention as a biological analogy for social affairs. With some simplification, the process of brain evolution in vertebrates is resolvable into two main steps—first, the addition of two centres of correlation in different parts of the brain, one for the correlation of sensory knowledge, the other for the correlation of action, and of course with the two centres united by communicating cables. This is the stage arrived at in fish. The next step was the provision of a further quite new centre of correlation, superimposed on the previous mechanism. This organ of ultimate adjustment and control consists of the cerebral hemispheres, which are wholly unrepresented in the lowest vertebrates. Its essential exchange mechanism consists of the cerebral cortex. So far as we know, the cortex, in spite of all localizations and functional specializations within it, always acts as a whole, in the sense that its activity can be thought of as a complex field which is altered in its total functioning by any alteration in any of its parts.

The final step between ape and man is marked by the great enlargement of those areas of the brain which have the least specialized function—the so-called association areas, which lie between the regions

wherein are localized the reception of relayed sensory information and the emission of executive messages for action. It is this, it seems, which has made possible self-consciousness and true conceptual thought.

During the course of their evolution, the cerebral hemispheres increased from zero to a mass which exceeds that of all the rest of the central nervous system taken together, and became one of the larger organs of the body.

Our brain analogy undoubtedly illuminates the social problem in an extremely valuable way. In the first place, the highest stage of evolution in this respect which has as yet been reached by any society is, by biological standards, extremely primitive. It corresponds with a quite early stage in the development of cerebral hemispheres and cortex: higher than that of a fish, but certainly not beyond that found in reptiles. Before humanity can obtain on the collective level that degree of foresight, control, and flexibility which on the biological level is at the disposal of human individuals, it must multiply at least tenfold, perhaps fiftyfold, the proportion of individuals and organizations devoted to obtaining information, to planning, correlation, and the flexible control of execution. The chief increases are needed in respect of correlation and planning and of social self-consciousness. In these respects, wholly new social organs must be evolved, whose nature we can only envisage in the most general terms.

In respect of planning and correlation, we can dimly perceive that some large single central organization must be superposed on the more primitive system of separate government departments and other single-function organizations; and that this, like the cerebral cortex, must be at one and the same time unified and functionally specialized. It will thus contain units concerned with particular social and economic functions, but the bulk of its personnel will be occupied in studying and effecting the interrelations between these various functions.

As regards social self-consciousness, the course of evolution must be quite different. Newspapers and books, radio, universal education—these and other points of technological and social advance have given us, in primitive form, the mechanisms needed. At the moment, however, they are being, in the light of biological analogy, largely misapplied. Education stops dead for most people in early adolescence, and concerns itself mainly with providing specialized techniques, together with a froth of obsolescent "culture." The cinema to-day is primarily an escape mechanism. Newspapers distort the balance of

truth in the service of political or financial interests, and are driven by competition for advertising into sensation-mongering. The radio is as yet essentially a collection of scraps, a functional patchwork. Art as a communal function is moribund and needs to be recreated on a new social basis. Religion is in a similar position, and much of the population no longer feels its influence.

The first need is to recognize that, in this increasingly complex world, a free country cannot exist, let alone find satisfaction, without being self-conscious, and all the agencies of public opinion must be moulded to this end. A self-conscious society would be one in which every individual comprehended the aims of society, his own part in the whole, the possibilities of intellectual, artistic and moral satisfaction open to him, his rôle in the collective knowledge and will. But for this, as for correlation or planned control, the most elaborate organization is required.

Meanwhile our social planners would undoubtedly benefit from a study of the evolution of individuality in animals, and still more from an intensive course in the comparative neurology of vertebrates.

RELIGION AS AN OBJECTIVE PROBLEM

RELIGION, like any other subject, can be treated as an objective problem, and studied by the method of science. The first step is to make a list of the ideas and practices associated with different religions—gods and demons, sacrifice, prayer, belief in a future life, tabus and moral rules in this life. This, however, is but a first step. It is like making a collection of animals and plants, or a catalogue of minerals or other substances, with their properties and uses. Science always begins in this way, but it cannot stop at this level: it inevitably seeks to penetrate deeper and to make an analysis.

This analysis may take two directions. It may seek for a further understanding of religion as it now exists, or it may adopt the historical method and search for an explanation of the present in the past.

With regard to the historical approach, it is clear that religion, like other social activities, evolves. Further, its evolution is determined by two main kinds of factors. One is its own emotional and intellectual momentum, its inner logic: the other is the influence of the material and social conditions of the period. As an example of the first, take the tendency from polytheism towards monotheism: granted the theistic premise, this tendency seems almost inevitably to declare itself in the course of time. As examples of the second, we have the fact of propitiatory sacrifice related to helplessness in face of external nature.

The comparative evolutionary study of religion brings out two or three main points. For instance, we have the original prevalence of magical ideas, and their application first to the practical activities of communal existence such as food-getting and war, and only later to the problems of personal salvation: and these in their turn come gradually to be dominated more by moral ideas and less by magic. In the sphere of theology we have the early prevalence of rambling myth, and its gradual crystallization into a fully rationalized system. In this domain too we see an interesting evolution from an early stage in which certain objects, acts, and persons are supposed to be imbued with an impersonal sacred influence or *mana*, and a later stage at which this sacred influence is pushed back a stage and attributed to supernatural beings behind objects.

Finally, there is the important fact that religious beliefs and practices have a very strong time-lag—a high degree of hysteresis, if you prefer a physical metaphor.

We next have to ask ourselves what is the result of our other type of analysis of the nature of religion. In the most general terms, it is that religion is the product of a certain type of interaction between man and his environment. It always involves an emotional component—the sense of sacredness. It always involves a more than intellectual belief—a sense of compulsive rightness. It is always concerned with human destiny, and with a way of life. It always brings the human being into some sort of felt relation with powers or agencies outside his personal self. It always involves some sort of escape from inner conflict. These different components may be very unequally developed, but they are always present.

Pushing the analysis a stage further, religion is seen as an attempt to come to terms with the irrational forces that affect man—some cosmic, some social, some personal. These terms may be terms of capitulation or of victory, of compromise or of escape. Here once more there is immense variety.

A very important further point is this—that there is no single function of religion. We may class religious functions by their external points of reference or by their internal origins. Externally, the first religious function is to place man in a satisfactory emotional relation with his non-human environment, regarded as outer destiny or fate. The second is to do the same for his social environment; the third, to do the same for his personal actions.

Looked at from the point of view of internal origin, the matter is much more complicated. One very important religious function is that of rationalization—giving coherent explanations in rational terms for acts and feelings which arise from instinctive and therefore irrational sources. Another is that which we have already mentioned, the desire for unity. These two between them provide the theological side of religions.

More fundamental—since they provide the raw materials on which the rationalizing and unifying urges act—are the purely emotional components. These fall under two main heads—the functions arising from conflict or reaction between the self and the outer world, and those arising from conflict or reaction between parts of the self.

Among the former we may mention the need to escape from frustration and limitations; and the need for enhancement of the actual, the gilding of the imperfect. At length we come to relations between parts of the self, which are the most potent of all in generating religious reactions. Here we must take account of several basic facts of human mind. First there is the inevitability of conflict—a necessary consequence of man's mental make-up. Then there is the illimitable nature

of desire and aspiration. Analogous to this last, but in the intellectual instead of the emotional sphere, is man's concept-forming activity, which inevitably gives rise to abstract terms like justice, truth, and beauty. These, being abstract, are empty; but illimitable desire perennially fills them with its imaginations. Then there is the fact of childhood repression, with its consequences, only now beginning to be realized by the world, of a burden of (often unconscious) guilt. Closely linked with this is the obsession of certitude. The mechanism of repression is an all-or-none mechanism: and the conscious accompaniment of such a mechanism is a subjective sense of certitude.

Another very important function is to provide something which is felt as eternal and unchanging (even though in reality it may merely be long-range and slow-changing) over against the limitations and changes of ordinary existence.

But I must not spend too much time on mere analysis. The next question is whether the scientific approach can throw any light on the present crisis in religion and its possible future solution.

The particular situation that confronts the religion of western civilization is this. The concept of God has reached the limits of its usefulness: it cannot evolve further. Supernatural powers were created by man to carry the burden of religion. From diffuse magic *mana* to personal spirits; from spirits to gods; from gods to God—so crudely speaking, the evolution has gone. The particular phase of that evolution which concerns us is that of gods. In one period of our western civilization the gods were necessary fictions, useful hypotheses by which to live.

But the gods are only necessary or useful in a certain phase of evolution. For gods to be of value to man, three things are necessary. The disasters of the outer world must still be sufficiently uncomprehended and uncontrolled to be mysteriously alarming. Or else the beastliness and hopelessness of common life must be such as to preclude any pinning of faith to the improvement in this world: then God can, and social life cannot, provide the necessary escape-mechanism. The belief in magical power must still be current, even if it be in a refined or sublimated form. And the analytic exploration of his own mind by man must not be so advanced that he can no longer project and personify the unconscious forces of his Super-ego and his Id as beings external to himself.

The advance of natural science, logic, and psychology has brought us to a stage at which God is no longer a useful hypothesis. Natural science has pushed God into an ever greater remoteness, until his function as ruler and dictator disappears and he becomes a mere first

cause or vague general principle. The realization that magic is a false principle, and that control is to be achieved by science and its application, has removed the meaning from sacrificial ritual and petitionary prayer. The analysis of the human mind, with the discovery of its powers of projection and wish-fulfilment, its hidden subconsciousness and unrealized repressions, makes it unnecessary to believe that conversion and the like are due to any external spiritual power and unscientific to ascribe inner certitude to guidance by God.

And theological logic, inevitably tending to unify and to universalize its ideas of the Divine, has resulted in a monotheism which is self-contradictory and incomprehensible, and in some respects of less practical value than the polytheism which it replaced.

If you grant theism of any sort, the logical outcome is monotheism. But why theism at all? Why a belief in supernatural beings who stand in some relation to human destiny and human aspirations? Theistic belief depends on man's projection of his own ideas and feelings into nature: it is a personification of non-personal phenomena. Personification is God's major premise. But it is a mere assumption, and one which, while serviceable enough in earlier times, is now seen not only to be unwarranted, but to raise more difficulties than it solves. Religion, to continue as an element of first-rate importance in the life of the community, must drop the idea of God or at least relegate it to a subordinate position, as has happened to the magical element in the past. God, equally with gods, angels, demons, spirits, and other small spiritual fry, is a human product, arising inevitably from a certain kind of ignorance and a certain degree of helplessness with regard to man's external environment.

With the substitution of knowledge for ignorance in his field, and the growth of control, both actually achieved and realized by thought as possible, God is simply fading away, as the Devil has faded before him, and the pantheons of the ancient world, and the nymphs and the local spirits.

> Peor and Baalim
> Forsake their temples dim . . .

Milton wrote of the fading of all the pagan gods; and Milton's God too is joining them in limbo. God has become more remote and more incomprehensible, and, most important of all, of less practical use to men and women who want guidance and consolation in living their lives. A faint trace of God, half metaphysical and half magic, still broods over our world, like the smile of a cosmic Cheshire Cat. But

the growth of psychological knowledge will rub even that from the universe.

However—and this is vital—the fading of God does not mean the end of religion. God's disappearance is in the strictest sense of the word a theological process: and while theologies change, the religious impulses which gave them birth persist.

The disappearance of God means a recasting of religion, and a recasting of a fundamental sort. It means the shouldering by man of ultimate responsibilities which he had previously pushed off on to God.

What are these responsibilities which man must now assume? First, responsibility for carrying on in face of the world's mystery and his own ignorance. In previous ages that burden was shifted on to divine inscrutability: "God moves in a mysterious way." . . . Now we lay it to the account of our own ignorance, and face the possibility that ignorance of ultimates may, through the limitations of our nature, be permanent.

Next, responsibility for the long-range control of destiny. That we can no longer shift on to God the Ruler. Much that theistic religion left to divine guidance remains out of our hands: but our knowledge gives us power of controlling our fate and that of the planet we inhabit, within wide limits. In a phrase, we are the trustees of the evolutionary process and, like all trustees, responsible for our trust.

Thirdly and most urgently, responsibility for the immediate health and happiness of the species, for the enhancement of life on this earth, now and in the immediate future. Poverty, slavery, ill-health, social misery, democracy, kingship, this or that economic or political system —they do not inhere inevitably in a divinely appointed order of things: they are phenomena to be understood and controlled in accordance with our desire, just as much as the phenomena of chemistry or electricity.

Finally, there is the question of the immediate future of religion. Can science make any prophecy or offer any guidance in regard to this? I think that within limits, it can. In the first place, by analysing the reasons for the breakdown of the traditional supernatural religious systems of the west, it can point out that, unless the trend of history is reversed, the breakdown is an irremediable one. For it is due to the increase of our knowledge and control, the decrease of our ignorance and fear, in relation to man's external environment—machinery, crop-production, physical and chemical invention, floods, disease germs—and unless science and technology disappear in a new Dark Age, this will persist.

The collapse of supernaturalist theology has been accompanied by the collapse, first of supernatural moral sanctions, and then of any absolute basis for morals. This too must be regarded as a process which, in the event of the continuance of civilization, is irreversible.

We can, however, go further. We have seen that the breakdown of traditional religion has been brought about by the growth of man's knowledge and control over his environment. But biologists distinguish between the external and the internal environment. Our blood provides our tissues with an internal environment regulated to a nicety both as regards its temperature and its chemical constitution, whereas the blood of a sea-urchin affords no such constancy. The organization of an ants' nest provides for the species an internal environment of a social nature. And in contrast with the rapid increase of man's knowledge of and control over his external environment, there has been little or no corresponding progress as regards the internal environment of his species. This is equally true in regard to the structure of society which provides the social environment for the individual and the race, and for the complex of feelings and ideas which provide the psychological environment in which the personal life of the individual is bathed.

These two aspects of man's internal environment of course interact and at points indeed unite—witness the field of social psychology: but for the most part they can be best considered from two very different angles—on the one side from the angle of economics, politics, law and sociology, on the other from the angle of psychological science. Not only have we as yet no adequate scientific knowledge or control over these phenomena, but our absence of control is causing widespread bewilderment. The common man to-day is distressed not only over his own sufferings, but at the spectacle of the helplessness of those in responsible positions in face of the maladjustments of the world's economic and political machinery.

In this field the fear of the uncomprehended, banished elsewhere, has once more entered human life. The fear is all the more deadly because the forces feared are of man's own making. No longer can we blame the gods. The modern Prometheus has chained himself to the rock, and himself fostered the vulture which now gnaws his vitals: his last satisfaction, of defying the Olympian tyrant, is gone.

The distress and the bewilderment are experienced as yet mainly in the more tangible realm of social and economic organization: the mental stresses and distortions arising from the social maladjustment remain for the time being in the background of public consciousness.

With the aid of our analysis of the nature and functions of religion, we can accordingly make certain definite assertions as to its future. The prophecy of science about the future of religion is that the religious impulse will become progressively more concerned with the organization of society—which, in the immediate future, will mean the organization of society on the basis of the nation or the regional group of nations.

The process, of course, has already begun. Many observers have commented on the religious elements in Russian communism—the fanaticism, the insistence on orthodoxy, the violent "theological" disputes, the "worship" of Lenin, the spirit of self-dedication, the persecutions, the common enthusiasms, the puritan element, the mass-emotions, the censorship. A very similar set of events is to be seen in Nazi Germany. In that country, of especial interest to the scientist and the student of comparative religion are such phenomena as the falsification of history and anthropological theory in the interest of a theory of the State and of the Germanic race which serves as the necessary "theological" rationalization of the emotions underlying the Nazi movement, and the dragooning of the Protestant churches to fit them into the Nazi scheme of things. The modern persecution of the Jews, which has its real basis in economic and social dislike, is justified on the basis of this new religiously-felt Germanism, just as the medieval persecution of the Jews, which equally sprang from economic and social dislike, was justified on the basis of Christianity.

These are the first gropings of the human mind after a social embodiment of the religious impulse. They are as crude and in some respects as nasty as its first gropings, millennia previously, after a theistic embodiment of religion. The beast-headed gods and goddesses of those earlier times, the human sacrifice, the loss of self-criticism in the flood of emotional certitude, the sinister power of a privileged hierarchy, the justification of self, and the vilification of critics and the violence toward opponents—these and other primitive phenomena of early God-religion have their counterparts in to-day's dawn of social religion. And the general unrest and the widespread preoccupation with emotionally-based group movements such as Fascism and Communism, is in many ways comparable with the religious unrest that swept the Mediterranean world in the centuries just before and after the beginning of the Christian Era.

To achieve some real understanding and control of the forces and processes operating in human societies is the next great task for

science; and the applications of scientific discovery in this field will have as their goal what we may call the Socialized State. The religious impulse, itself one of the social forces to be more fully comprehended and controlled, will increasingly find its outlet in the promotion of the ideals of the Socialized State.

Exactly how all this will happen no one can say—whether the religious impulse will again crystallize into a definite religious system with its own organization, or will find its outlets within the bounds of other organizations, as it does for instance in the Communist party in Russia. We can, however, on the basis of the past history of religion, make a further prophecy. We can be reasonably sure that the inner momentum of logic and moral feelings, combined with the outer momentum derived from increasing comprehension and control, will lead to an improvement in the expression of this socialized religion comparable to the progress of theistic religion from its crude beginnings toward developed monotheism.

Accordingly, we can prophesy that in the long run the nationalistic element in socialized religion will be subordinated or adjusted to the internationalist: that the persecution of minorities will give place to toleration; that the subtler intellectual and moral virtues will find a place and will gradually oust the cruder from their present preeminence in the religiously-conceived social organism.

We can also assert with fair assurance that this process of improvement will be a slow one, and accompanied by much violence and suffering.

Finally, we can make the prophecy that part of this process will come about through interaction between two expressions of the religious spirit—one which strives to identify itself with the Socialized State, the other which reacts against the limitations thus imposed and strives to assert and uphold values that are felt to be more permanent and more universal. The cruder and more violent is the socialized religion, the more will it encourage such reactions. Already in Nazi Germany such a reaction has taken place among certain elements of the Protestant churches, who feel that their principles embody something higher, more lasting, and more general than anything, however intense, which is at the basis of a nationalist and racialist conception of social aims.

This is the one domain in which traditional religion, with its universalist monotheism, will in the near future have a real advantage over socialized religion, which for some time will inevitably be bound up with nationalist states.

It is probable, however, that a universalist Humanism (and probably

Communism too) will soon become a strong rival of the old theistic systems in this field. It is also probable that with the growth of intolerant socialized feeling, both in Communistic and Fascist societies, the pioneers of such a Humanism will be those most exposed to religious persecution, but also those who will be doing most for their form of socialized religion and for religious progress in general.

One final prophecy, and I have done. It seems evident that as the religious impulse comes to create these new outlets of expressions, whether by way of the Socialized State or by way of Humanism, it will be increasingly confronted by psychological problems—as indeed will the Socialized State itself. Men will realize that economic and social planning will not solve their problems so long as ignorance and absence of control obtain in regard to their own minds. Psychological science will then come into its own, with social psychology as its dominant branch. And this will mean a new understanding of religious phenomena, and new possibilities of integrating them with the life of the community.

To sum up, I would say first that the so-called "conflict between science and religion" has been a conflict between one aspect of science and one aspect of religion. These aspects have both been concerned with man's relation to his *external* environment. The systems of religion which are in danger of collapse grew out of man's ignorance and helplessness in face of external nature; the aspect of science which is endangering those religious systems is that which has provided knowledge and control in this same domain.

In the near future, the religious impulse will find its main outlet in relation to the internal environment of the human species—social, economic, and psychological—for it is the forces of this internal environment that are now causing distress and bewilderment and are being felt as Destiny to be propitiated or otherwise manipulated. Meanwhile science will find its main scope for new endeavour in this same field, since it is here that our ignorance and our lack of control are now most glaring.

There will again be a race between the effects of ignorance and those of knowledge: but with several new features. For one thing, the growth of science in the new field will this time not lag by many centuries behind that of the new modes of religious expression; and for another, the facts concerning the religious impulse and its expression will themselves fall within the scope of the new scientific drive. The probable result will be that in the Socialized State the relation between religion and science will gradually cease to be one of conflict

and will become one of co-operation. Science will be called on to advise what expressions of the religious impulse are intellectually permissible and socially desirable, if that impulse is to be properly integrated with other human activities and harnessed to take its share in pulling the chariot of man's destiny along the path of progress.

LIFE CAN BE WORTH LIVING

I BELIEVE that life can be worth living. I believe this in spite of pain, squalor, cruelty, unhappiness, and death. I do not believe that it is necessarily worth living, but only that for most people it can be.

I also believe that man, as individual, as group, and collectively as mankind, can achieve a satisfying purpose in existence. I believe this in spite of frustration, aimlessness, frivolity, boredom, sloth, and failure. Again I do not believe that a purpose inevitably inheres in the universe or in our existence, or that mankind is bound to achieve a satisfying purpose, but only that such a purpose can be found.

I believe that there exists a scale or hierarchy of values, ranging from simple physical comforts up to the highest satisfactions of love, aesthetic enjoyment, intellect, creative achievement, virtue. I do not believe that these are absolute, or transcendental in the sense of being vouchsafed by some external power or divinity; they are the product of human nature interacting with the outer world. Nor do I suppose that we can grade every valuable experience into an accepted order, any more than I can say whether a beetle is a higher organism than a cuttlefish or a herring. But just as it can unhesitatingly be stated that there are general grades of biological organization, and that a beetle *is* a higher organism than a sponge, or a human being than a frog, so I can assert, with the general consensus of civilized human beings, that there is a higher value in Dante's *Divina Commedia* than in a popular hymn, in the scientific activity of Newton or Darwin than in solving a crossword puzzle, in the fulness of love than in sexual gratification, in selfless than in purely self-regarding activities—although each and all can have their value of a sort.

I do not believe that there is any absolute of truth, beauty, morality, or virtue, whether emanating from an external power or imposed by an internal standard. But this does not drive me to the curious conclusion, fashionable in certain quarters, that truth and beauty and goodness do not exist, or that there is no force or value in them.

I believe that there are a number of questions that it is no use our asking, because they can never be answered. Nothing but waste, worry, or unhappiness is caused by trying to solve insoluble problems. Yet some people seem determined to try. I recall the story of the philosopher and the theologian. The two were engaged in disputation

and the theologian used the old quip about a philosopher being like a blind man, in a dark room, looking for a black cat—which wasn't there. "That may be," said the philosopher; "but a theologian would have found it."

Even in material matters of science we must learn to ask the right questions. It seemed an obvious question to ask how animals inherit the result of their parents' experience, and enormous amounts of time and energy have been spent on trying to give an answer to it. It is, however, no good asking the question, for the simple reason that no such inheritance of acquired characters exists. The chemists of the eighteenth century, because they asked themselves the question, "What substance is involved in the process of burning?" became involved in the mazes of the phlogiston theory: they had to ask "what sort of process is burning?" before they could see that it did not involve a special substance but was merely a particular case of chemical combination.

When we come to what are usually referred to as fundamentals, the difficulty of not asking the wrong kind of question is much increased. Among most African tribes, if a person dies, the only question asked is, "Who caused his death, and by what form of magic?"; the idea of death from natural causes is unknown. Indeed, the life of the less-civilized half of mankind is largely based on trying to find an answer to a wrong question: "What magical forces or powers are responsible for good or bad fortune, and how can they be circumvented or propitiated?"

I do not believe in the existence of a god or gods. The conception of divinity seems to me, though built up out of a number of real elements of experience, to be a false one, based on the quite unjustifiable postulate that there must be some more or less personal power in control of the world. We are confronted with forces beyond our control, with incomprehensible disasters, with death, and also with ecstasy, with a mystical sense of union with something greater than our ordinary selves, with sudden conversion to a new way of life, with the burden of guilt and sin. In theistic religions all these elements of actual experience have been woven into a unified body of belief and practice in relation to the fundamental postulate of the existence of a god or gods.

I believe this fundamental postulate to be nothing more than the result of asking a wrong question: "Who or what rules the universe?" So far as we can see, it rules itself, and indeed the whole analogy with a country and its ruler is false. Even if a god does exist behind or above the universe as we experience it, we can have no knowledge of

such a power; the actual gods of historical religions are only the personifications of impersonal facts of nature and of facts of our inner mental life.

Similarly with immortality. With our present faculties we have no means of giving a categorical answer to the question whether we survive death, much less the question of what any such life after death will be like. That being so, it is a waste of time and energy to devote ourselves to the problem of achieving salvation in the life to come. However, just as the idea of god is built out of bricks of real experience, so too is the idea of salvation. If we translate salvation into terms of this world, we find that it means achieving harmony between different parts of our nature, including its subconscious depths and its rarely touched heights, and also achieving some satisfactory adjustment between ourselves and the outer world, including not only the world of nature but the social world of man. I believe it to be possible to "achieve salvation" in this sense, and right to aim at doing so, just as I believe it possible and valuable to achieve a sense of union with something bigger than our ordinary selves, even if that something be not a god but an extension of our narrow core to include in a single grasp ranges of outer experience and inner nature on which we do not ordinarily draw.

But if God and immortality be repudiated, what is left? That is the question usually thrown at the atheist's head. The orthodox believer likes to think that nothing is left. That, however, is because he has only been accustomed to think in terms of his orthodoxy.

In point of fact, a great deal is left.

That is immediately obvious from the fact that many men and women have led active, or self-sacrificing, or noble, or devoted lives without any belief in God or immortality. Buddhism in its uncorrupted form has no such belief; nor did the great nineteenth-century agnostics; nor do the orthodox Russian Communists; nor did the Stoics. Of course, the unbelievers have often been guilty of selfish or wicked actions; but so have the believers. And in any case that is not the fundamental point. The point is that without these beliefs men and women may yet possess the mainspring of full and purposive living, and just as strong a sense that existence can be worth while as is possible to the most devout believers.

I would say that this is much more readily possible to-day than in any previous age. The reason lies in the advances of science.

No longer are we forced to accept the external catastrophes and miseries of existence as inevitable or mysterious; no longer are we obliged to live in a world without history, where change is only mean-

ingless. Our ancestors saw an epidemic as an act of divine punishment; to us it is a challenge to be overcome, since we know its causes and that it can be controlled or prevented. The understanding of infectious disease is entirely due to scientific advance. So, to take a very recent happening, is our understanding of the basis of nutrition, which holds out new possibilities of health and energy to the human race. So is our understanding of earthquakes and storms; if we cannot control them, we at least do not have to fear them as evidence of God's anger.

Some, at least, of our internal miseries can be lightened in the same way. Through knowledge derived from psychology children can be prevented from growing up with an abnormal sense of guilt and so making life a burden both to themselves and to those with whom they come into contact. We are beginning to understand the psychological roots of irrational fear and cruelty; some day we shall be able to make the world a brighter place by preventing their appearance.

The ancients had no history worth mentioning. Human existence in the present was regarded as a degradation from that of the original Golden Age. Down even to the nineteenth century what was known of human history was regarded by the nations of the West as an essentially meaningless series of episodes sandwiched into the brief space between the Creation and the Fall, a few thousand years ago, and the Second Coming and Last Judgment, which might be on us at any moment and in any case could not be pushed back for more than a few thousand years into the future. In this perspective a millennium was almost an eternity. With such an outlook no wonder life seemed, to the great mass of humanity, "nasty, brutish, and short," its miseries and shortcomings merely bewildering unless illuminated by the illusory light of religion.

To-day human history merges back into prehistory, and prehistory again into biological evolution. Our time-scale is profoundly altered. A thousand years is a short time for prehistory, which thinks in terms of hundreds of thousands of years, and an insignificant time for evolution, which deals in ten-million-year periods. The future is extended equally with the past; if it took over a thousand million years for primeval life to generate man, man and his descendants have at least an equal allowance of time before them for further evolution.

Most of all, the new history has been a basis of hope. Biological evolution has been appallingly slow and appallingly wasteful. It has been cruel; it has generated the parasites and the pests as well as the more agreeable types. It has led life up innumerable blind alleys. But in spite of this it has achieved progress. In a few lines, whose

number has steadily diminished with time, it has avoided the cul-de-sac of mere specialization and arrived at a new level of organization, more harmonious and more efficient, from which it could again launch out toward greater control, greater knowledge, and greater independence. Progress is, if you will, all-round specialization. Finally, but one line was left which was able to achieve further progress; all the others had led up blind alleys. This was the line leading to the evolution of the human brain.

This at one bound altered the perspective of evolution. Experience could now be handed down from generation to generation; deliberate purpose could be substituted for the blind sifting of selection; change could be speeded up ten-thousandfold. In man evolution could become conscious. Admittedly it is far from conscious yet, but the possibility is there, and it has at least been consciously envisaged.

Seen in this perspective, human history represents but the tiniest portion of the time man has before him; it is only the first ignorant and clumsy gropings of the new type, born heir to so much biological history. The constant setbacks, the lack of improvement in certain respects for over two thousand years, are seen to be phenomena as natural as the tumbles of a child learning to walk or the deflection of a sensitive boy's attention by the need of making a living.

The broad facts remain. Life had progressed even before man was first evolved. Life progressed in giving rise to man. Man has progressed during the half-million or so years from the first Hominidae, even during the ten thousand years since the final amelioration of climate after the Ice Age. And the potentialities of progress which are revealed, once his eyes have been opened to the evolutionary vista, are unlimited.

At last we have an optimistic instead of a pessimistic theory of this world and our life upon it. Admittedly the optimism cannot be facile, and must be tempered with reflection on the length of time involved, on the hard work that will be necessary, on the inevitable residuum of accident and unhappiness that will remain. Perhaps we had better call it a melioristic rather than an optimistic view; but at least it preaches hope and inspires to action.

I believe very definitely that it is among human personalities that there exist the highest and most valuable achievements of the universe —or at least the highest and most valuable achievements of which we know or, apparently, can have knowledge. That means that I believe that the State exists for the development of individual lives, not individuals for the development of the State.

But I also believe that the individual is not an isolated, separate thing. An individual is a transformer of matter and experience; it is a system of relations between its own basis and the universe, including other individuals. An individual may believe that he should devote himself entirely to a cause, even sacrifice himself to it—his country, truth, art, love. It is in the devotion of the sacrifice that he becomes most himself; it is because of the devotion or sacrifice of individuals that causes become of value. But of course the individual must in many ways subordinate himself to the community—only not to the extent of believing that in the community resides any virtue higher than that of the individuals which compose it.

The community provides the machinery for the existence and development of individuals. There are those who deny the importance of social machinery, who assert that the only important thing is a change of heart, and that the right machinery is merely a natural consequence of the right inner attitude. This appears to me mere solipsism. Different kinds of social machinery predispose to different inner attitudes. The most admirable machinery is useless if the inner life is unchanged; but social machinery *can* affect the fulness and quality of life. Social machinery can be devised to make war more difficult, to promote health, to add interest to life. Let us not despise machinery in our zeal for fulness of life, any more than we should dream that machinery can ever automatically grind out perfection of living.

I believe in diversity. Every biologist knows that human beings differ in their hereditary outfits, and therefore in the possibilities that they can realize. Psychology shows how inevitably different are the types that jostle each other on the world's streets. No amount of persuasion or education can make the extrovert really understand the introvert, the verbalist understand the lover of handicraft, the non-mathematical or non-musical person understand the passion of the mathematician or the musician. We can try to forbid certain attitudes of mind. We could theoretically breed out much of human variety. But this would be a sacrifice. Diversity is not only the salt of life but the basis of collective achievement. And the complement of diversity is tolerance and understanding. This does not mean rating all values alike. We must protect society against criminals; we must struggle against what we think wrong. But just as if we try to understand the criminal we shall try to reform rather than merely to punish, so we must try to understand why we judge others' actions as wrong, which implies trying to understand the workings of our own minds and discounting our own prejudices.

Finally, I believe that we can never reduce our principles to any few simple terms. Existence is always too various and too complicated. We must supplement principles with faith. And the only faith that is both concrete and comprehensive is in life, its abundance and its progress. My final belief is in life.

ON LIVING IN A REVOLUTION

I

THE world's most important fact is not that we are in a war, but that we are in a revolution. It is perhaps a pity that the word *revolution* has two senses—one an insurrection, a bloody uprising against constituted authority, the other a drastic and major change in the ideas and institutions which constitute the framework of human existence; yet so it is. If we like, we can use *rebellion* for the first, *historical transformation* for the second; but I prefer the word *revolution*, and shall continue to use it in what follows, with the express warning that I do not thereby mean merely barricades or bolshevism. If we once accept that statement and all its implications we find ourselves committed to the most far-reaching conclusions concerning both immediate action and future policy. From a combination of brute fact and human reason an argument emerges, proceeding as inexorably to its conclusion as a proposition of Euclid.

Let me anticipate my detailed discussion by setting down the proposition as baldly as possible. This is the sequence of its steps:

First. The war is the symptom of a world revolution, which, in some form or another, is inescapable.

Second. There are certain trends of the revolution which are inevitable. Within nations, they are toward the subordination of economic to non-economic motives; toward more planning and central control; and toward greater social integration and cultural unity and a more conscious social purpose. Between nations, they are toward a higher degree of international organization and a fuller utilization of the resources of backward countries.

Third. During the present war both military efficiency and national morale are positively correlated with the degree to which the inevitable trends of the revolution have been carried through.

Fourth. There are alternative forms which the revolution may assume. The chief alternatives depend on whether the revolution is effected in a democratic or a totalitarian way.

Fifth. The democratic alternative of achieving the revolution is the more desirable and the more permanent; the purely totalitarian method is self-defeating in the long run.

Sixth. The only universal criterion of democracy and the democratic method is the satisfaction of the needs of human individuals

their welfare, development, and active participation in social processes. A further democratic criterion, applicable in the immediate future, is equal co-operation in international organization, including the treatment of backward peoples as potential equals.

Seventh. The revolution, like the war, must be consciously accepted and deliberately entered upon. Formally, this can be accomplished by proclaiming war aims or peace aims which include the achieving of the revolution. This releases the latent dynamism of the nation and the social system.

Eighth and last. This again can be done on a democratic as well as on a totalitarian basis. By deliberately entering on the revolution in a fully democratic way it is possible to arrive at satisfactory and detailed war or peace aims which will release the powerful forces latent in the democracies, shorten the war, and, if implemented, produce a stable peace.

There is our proposition of political Euclid in skeleton form. Let us now take its bare bones and clothe them with convincing flesh and blood.

II

Point Number One was that the war is a symptom of a world revolution. Clearly the first thing to do about a revolution is to recognize it as a fact. Surprisingly enough, however, it is quite possible to ignore its existence. Just as Monsieur Jourdain in Molière's *Bourgeois Gentilhomme* discovered that he had been speaking prose all his life without knowing it, so many people to-day are beginning to discover that they have been living in a revolution without knowing it, and many others have still to discover this surprising phenomenon.

This is possible, partly because a world revolution is so vast in scope and, even though it proceeds at a rate far faster than that of history in its more normal phases, so gradual compared with the happenings of everyday life. The ordinary man sees his taxes raised, or unemployment go up, or banks crash down, or the central government extend its control, or war break out in some remote part of the globe; and he is concerned with each incident as an event in itself, not as a symptom of a larger process. It is also partly because most of us dislike radical change; after all, it is a somewhat dubious privilege to be living in anything so drastic as a revolution. Because

we dislike it, we unconsciously push it away from us, begin to treat the danger as if we were ostriches, and are temporarily enabled to believe that the nasty revolution doesn't really exist.

It is worth remembering that it took us democracies a long time to recognize the existence even of the war. It is and always has been a world war, ever since its first beginnings in Manchukuo. But we refused, most of us, to admit the fact. German rearmament and the occupation of the Ruhr; Italy's attack on Abyssinia; the fighting in Spain; Munich: though some were bloodless, all were parts of a rapidly ripening world conflict. Both the fact that a world war existed and the ostrichism of our reactions to it were most obvious in the case of Spain. Here we had Franco's revolution, aided and abetted by the Axis; then Italy and Germany actively intervening, partly to secure the triumph of their side and partly to enjoy a little practice for the major struggle that they knew was to come; the Axis intervention providing counter-intervention by the Russians and the Volunteer Brigades, and undercover help from France. And yet the democratic Great Powers persisted in building up the fiction that it was nothing but a local civil war. I remember a cartoon in a left-wing French paper—an official of the Non-Intervention Committee saying to an attendant, "Put the non-carafe on the non-table." Non-Intervention was England and France saying to each other, "Let us take non-sides in the non-war." It was the political expression of a psychological refusal to recognize an unpleasant fact —the fact that a world conflict existed. Hitler's marching into Czechoslovakia at last made Britain as a nation realize that the world war existed. I suppose it was not till his invasion of Poland that the full realization came to the United States.

It was even later that the democracies began to recognize the existence of a world revolution. This is a surprising fact, considering that it had been going on for much longer than the war. The old tribal and feudal Japan had always been totalitarian in the sense that the individual was entirely subordinated to society. The new Japan merely translated this into modern terms, with the addition of an aggressive foreign policy (in the process anticipating many of the ideas of the Nazis); but the transformation was drastic and had obvious immediate consequences. The Russian Revolution of 1917, the Turkish Revolution, the Fascist Revolution in Italy, the social and industrial transformation in Britain and other Western European democracies, the New Deal in America, the Nazi Revolution in Germany, the establishment of a dictatorship in Portugal, the revolution and counter-revolution in Spain—these, among other events,

were all manifestations, sometimes total and drastic, sometimes partial and hesitant, of the world transformation that is in progress.

The Russians long ago recognized its existence, and so, in their fashion, did the Fascists, the Nazis, and the Japanese expansionists. Britain as a nation did not recognize it until much later, but when it came the recognition was explicit enough. A distinguished Swedish woman economist who spent some weeks in England in 1941 on her way to the U.S.A. told me how one night in the Savoy Hotel she found herself sitting next to a young officer in one of the Guards regiments, a typical English aristocrat. "You know," he said, "we're living in a Social Revolution here: very interesting, what?" Very interesting indeed to a representative of a class which was likely to suffer considerably as a result! The remark was a symptom. Toward the end of 1940 the adjustments of people and Government alike to the threat of invasion and to the Nazi air bombardment, together with the writings and radio talks of men like Priestley, had brought an acceptance of the fact which was both general and, on the whole, remarkably good-natured.

France had to accept the revolution, in the guise of Pétain's pale imitation of Fascism. The United States is the only great Power which has not generally recognized its existence as an inescapable fact. The proportion of its people who still imagine that after the war they can go back to the old social and international system—with a few minor differences no doubt, but essentially the same—is still high. When I was there in the winter of 1941-42 I would have said at least eighty per cent.; many American friends to whom I talked said ninety or more. Thanks to events and the writings of men like Wendell Willkie and Walter Lippmann, the proportion has been much reduced; but it is still high enough, especially as regards social and economic affairs, to prevent the emergence of a common consciousness. The most important single thing for the Americans to do now is to recognize that they, like the rest of the world, are living in a revolution, and that in some form or other it will achieve itself inevitably, whether they like it or not.

III

The next step after recognizing the existence of the revolution is to understand its nature and probable results. This can best be done by studying the trends already manifested by the revolution as it has operated in various countries, discovering what they have in common, and projecting them forward to their logical conclusion.

At the outset let us be quite clear in our minds that the revolution can achieve itself in a democratic or a totalitarian way (or a mixture of the two), but that in all cases it manifests certain common tendencies. We thus can and must distinguish sharply between the inevitable aspects of the revolution and its alternative possibilities.

The inevitable aspects of the revolution are those trends which are being produced by economic and social forces entirely beyond our control. It is they that constitute the "wave of the future." But it is a plain error to equate this revolutionary "wave of the future" with Nazism or any other brand of totalitarianism. The character of the wave depends on which of the alternative methods we adopt to achieve the revolution—or, perhaps we had better say, to guide the revolution as it inevitably achieves itself. Thus dictatorship and forcible regimentation are not inevitable aspects of the revolution. Neither, we may add, is greater concern for the Common Man.

The revolution is a result of the breakdown of the nineteenth-century system, and especially of economic *laisser-faire* and political nationalism. Peter Drucker documented this in an exciting and stimulating book called *The End of Economic Man.* But he made no attempt to characterize the new system that is destined to emerge from the transformation of the old. If one must have a summary phrase, I would say that the new phase of history should be styled the Age of Social Man. Let us consider the trends of the revolution so far as it has taken place, to justify this assertion.

Within nations, in the first place, purely economic motives, though naturally they continue to be important, are being relegated to second place in favour of non-economic motives which may broadly be called social, since they concern the national society as a whole, or else the welfare of the individual considered in his relation to the society of which he forms a part.

In Nazi Germany the primary motive has been national power and prestige, to be realized through war. The complete subordination of purely economic motives can be measured by the criticisms levelled by orthodox economists against the methods adopted by Dr. Schacht. Since then the democratic countries have had to do the same sort of thing. The extent of the change can be realized when we find the May Committee reporting, only eight years before the outbreak of this war, that "democracy was in danger of suffering shipwreck on the hard rock of finance," because Britain was confronted with a budget deficit of 120 million pounds—not much more than a week of its war expenditure in 1942. To-day finance has come to be generally regarded merely as a necessary part of the machinery for

realizing our aims. People are no longer asking, "How shall we pay for the war?" Instead, they are beginning to say, "If we can finance the war in this way why can't we apply similar methods on a similar scale to realizing social and cultural aims in peace?"

In Russia the subordination of the ordinary profit motive to social ends has been even more obvious. The deliberate encouragement of heavy industry under the Five Year Plan, at the expense of all other kinds of enterprise which would have flourished in a *laisser-faire* economy, is the most clear-cut example. In general, though economic efficiency is naturally insisted upon, the primary criterion for an enterprise is not whether it shall show a profit in its balance sheet, but whether it is desirable from the broad national point of view summed up in the current plan. A particular example of some interest is the expenditure on scientific research. As Bernal has pointed out in his book *The Social Function of Science*, the U.S.S.R., in spite of its low *per capita* wealth, was already before the war expending one per cent. of its national income on scientific research. Under the system of competitive private enterprise this does not "pay"; and we find that Britain (before the war) expended only one-tenth of one per cent. of its national income on science, and even the U.S.A. only six-tenths of one per cent.

In many other aspects of life in totalitarian countries the economic motive has been relegated to the background. I will mention only the concern with recreation. In Italy the *Dopo Lavoro* organization and in Germany the *Kraft durch Freude* or "Strength through Enjoyment" did give the common man an outlet and a sense that the community was interested in him and his personal needs for a richer life: economic considerations were entirely subordinated to this. In Russia the elaborate system of rest-houses and holiday centres and the equally elaborate arrangements for holiday transport achieved the same end.

It is especially significant that similar trends have been at work in democratic countries, even when there has been no recognition of the existence of a revolution. One of the most telling examples is that of housing in Britain. It is impossible to provide the lower-income group with decent housing which shall give an economic return. Accordingly, the State has stepped in, and has given subsidies toward the building of no fewer than one and a quarter million houses or apartments in England and Wales alone during the inter-war period. The economic motive of profit has been overridden by the social motive of providing adequate living accommodation.

Nutrition offers in some ways a still more interesting example

because of the progressive change to be seen. In the nineteenth century charity did its best to alleviate obvious distress. The new outlook was first expressed in Britain by the recognition that badly undernourished children could not possibly profit by education, and the consequent provision of cheap or free school meals for them. To-day the provision of free meals has been considerably extended and has been combined with the scheme for providing cheap dinners to a steadily increasing proportion of all children in State-aided schools. Free or undercost milk for children and for all expectant and nursing mothers is also being provided on a much more generous scale than before the war.

In general, the motives that have become dominant or are tending to do so are those of social security, health and housing, education and culture, recreation and amenity, and national prestige and military power; in special cases economic considerations have been overridden for almost mythological considerations, as in the Nazi persecution of the Jews as an inferior and enemy race, and the expulsion from Germany of some of the best German brains, in the interests of uncritical acceptance of orthodox Nazi doctrine.

Other apparently inevitable trends are those toward more planning and toward a greater degree of social unity or self-consciousness. The trend toward planning is so universal and obvious that little need be said on the subject. It is inevitable because, with the end of the era of primary industrial expansion, *laisser-faire* was defeating itself and unregulated private and sectional interests were coming into disastrous conflict with one another and with the common good. The trend is not merely toward more extensive planning in more fields; it is also toward a greater initiative and authority at the centre. Here again the totalitarian countries have gone farther; but the U.S.A. contains some remarkably developed examples of planning, such as the Tennessee Valley Authority, and the war has forced a planned economy on every belligerent country.

Social unity and self-consciousness perhaps demand a little more discussion. The Nazi doctrine of "Aryan" and Germanic superiority and Jewish inferiority and evil is a myth encouraging permanent and super-patriotic unity. In all totalitarian nations, and in the U.S.A. as well, the Government has encouraged art and other cultural activities on a large scale until they provide a much fuller and more intensive expression of society's awareness of itself and its ideals than in other countries. In Britain the war has produced C.E.M.A. to fill the cultural gap. In the U.S.S.R. the subsidiary nationalities have been deliberately encouraged to develop their

own traditional cultures. The organized youth and health movements of the totalitarian countries and of pre-war Czechoslovakia, the fostering of the belief in a peculiar "German science," the great prestige and publicity given in Russia to scientific and geographical achievement are also symptoms of the same trend, as is the tendency to see in education not merely an intellectual, a moral, or a practical function, but a social one—the function of projecting the character, the ideals, the needs, and, in general, the social consciousness of the nation into the next generation.

In international affairs one inevitable trend is toward a higher degree of international organization. This has gone much farther in totalitarian countries—largely theoretically in Japan's "East Asian Co-Prosperity Sphere," very practically in the unification of Europe in Hitler's iron "new order." In the democratic countries it is beginning to appear under the stress of war. Lend-Lease, the leasing and sharing of strategic bases, organizations like the Middle East Supply Council, the various organizations for unified strategy and supply—these are important beginnings.

The second international trend is the greater concern with the organized exploitation of the resources, both material and human, of backward areas. This, like the first, is an inevitable outcome of that shrinking of the world to which Mr. H. G. Wells has so forcibly drawn attention. The world has become a unit, its frontiers and empty spaces are filling up.

The exploitation may be exploitation in the bad sense, like that of occupied and dominated Europe by Germany at the present moment, or like that of the mineral resources of helpless or dependent peoples by powerful foreign financial interests. Or it may be exploitation in the good sense, like the encouragement given by the United States to the political development of the Filipinos, or certain aspects of native development in British colonies like Uganda or the Gold Coast. Another symptom of the trend is the widespread talk about the need for investing very large sums in the development of backward regions, even if this be uneconomic in the short-range terms of private finance.

The logical conclusion of these various inevitable trends is a world where nations or federations put non-economic aims into first place, and exhibit a high degree of central planning, extending to every main activity of life, and a high degree of social integration in education, cultural expression, and social self-consciousness; but also a world where nations are getting tied together more closely in international organizations, and where the resources of backward areas are being more consciously exploited and developed.

IV

The third step in our proposition was that the degree to which the revolution had been achieved was in some way related to military efficiency in the war. The correlation is striking though by no means complete, and the relation appears to be a causal one, in the sense that planning, social integration, and the deliberate relegation of economic motives to second place are all essential to the successful waging of modern total war.

Here again the totalitarian countries provide the most obvious examples. Germany and Japan have been able to score their spectacular military successes because they have for years been planning for war, and because they have carried out the most drastic revolutions of their economy and social structure in the interests of that plan. The same is true of Russia: the military and technical efficiency which has surprised the world is the fruit of a deliberate and truly revolutionary plan. The lesser military efficiency of Italy has many reasons; but it is a fact that the Fascist revolution was not so thoroughgoing or so wholehearted as the Nazi revolution in Germany or the Communist revolution in Russia, and this fact is undoubtedly one of the causes for Italy's military failure in this war.

In other countries failure to embark upon the revolution has demonstrably impeded military efficiency. The most conspicuous example was France, where conflict as to the form the revolution should take was so acute that no agreed action was possible, and the result was disunity, disintegration of morale and national feeling, unpreparedness, and inefficiency. The inadequacy of British production and planning during the Chamberlain "phony war" period is another illustration. So is the unfortunate effect of Britain's slowness in changing her official attitude toward so-called inferior races, whether subject peoples or allies. American readers will be able to provide plenty of examples from their own country during the early months after Pearl Harbour. From an earlier period, the shipment of oil and scrap iron to Japan, the behaviour of Standard Oil and other big companies with regard to synthetic rubber and other new technical advances, and the huge output of pleasure automobiles during 1941 provide further examples of how failure to abandon the ideas of an earlier age may interfere with military efficiency when the revolutionary war eventually blasts its way in.

There will be more to say on this subject in relation to war and peace aims. Meanwhile the fact that there is a definite connection between the extent to which a country has progressed in achieving the inevitable

trends of the revolution and that country's efficiency in the war, is a solemn warning to those who persist in proclaiming that the war is no time for social experiments. On the contrary, the war itself calls for the most drastic social experimentation, so drastic as to merit the term revolutionary. The only question at issue is the form which the social experiment is to take.

V

This brings us to the most interesting step in the argument, for it is here that alternatives present themselves and that the outcome may be determined by our conscious choice and deliberate effort. The revolution itself is inescapable. Even if we struggle against it we merely make the inevitable process longer, more painful, perhaps more bloody. But its form and character are not: it can be achieved in different ways, of which the alternative extremes may be described as the democratic way and the totalitarian way.

So our fifth point concerns the desirability and the efficiency of the two alternatives. We in the democracies know the undesirability of the totalitarian way. It is the way of force and domination. Inside the nation, it is employed to secure power for a small gang. It operates by means of armed force, secret police, concentration camps, the building up of irrational mass enthusiasm, the suppression of freedom of discussion, thought, and inquiry, and the persecution of contrary opinion and of scapegoat minorities. It demands disciplined uniformity and regimentation. Internationally, it imposes the domination of a chosen people or a master race, who will shoulder the burden of directing the international organization required; in return, other peoples are expected to acquiesce in remaining at a lower level of development and prosperity. In both cases, power is the primary aim, force is the primary method, and domination of the less powerful by the more powerful is the primary object.

The totalitarian method of achieving the revolution may be undesirable, but it is certainly capable of producing extreme efficiency, as the enemies of Nazi Germany have found to their cost. However, there is every reason to believe that this advantage is not lasting, and that the method is essentially a self-defeating one. It is self-defeating just because it holds its power by sheer force and can maintain itself only by constantly extending that power. But the more it extends its power the more resistance it generates both from the inside and from the outside. The question is thus not whether it will fail in the long run, but how long that run will be, and how much of civilization it will destroy in the process.

What of the democratic way? To be clear on this, the sixth step in our proposition of political Euclid, requires some hard mental effort. We may be sure in principle that it is preferable, and that it does not contain the necessary seeds of its own defeat within itself. But we must be quite sure of what we mean by democracy, sure that we are not misapplying the term or merely talking platitudes. Democracy requires rethinking in relation to the changing world. A great deal of what we have taken for granted as being of the essence of democracy turns out to be applicable only to a partial aspect of democracy or only in the particular period from which we are now escaping.

Thus it is entirely wrong to equate democracy with a system of free individual enterprise. That was the form taken by democracy, in its economic aspects, during the period initiated by the industrial revolution. In those conditions that aspect of democratic freedom worked efficiently in many ways, but also generated contradictions—for instance, by creating economic unfreedom for large masses of the lower-paid workers. For a different reason, it is entirely wrong to equate democracy with representative government. That is one aspect only of democracy, the political aspect: democracy must extend into the economic and social and all other aspects of life if it is to be complete.

Our first problem is, then, to find a criterion or a principle of democracy which is universal and is applicable in every period of history, under any conceivable set of conditions. So far as I can see, there is only one such criterion—the individual human being, his needs and his development. The yardstick by which we can measure democratic achievement is the satisfaction of the needs of human individuals, and the yardstick by which we can measure democratic method is their active and voluntary participation in all kinds of activities. The two are in reality not separate, for participation is itself a human need to be satisfied, but for some purposes the distinction is useful.

Under the satisfaction of needs there is to be included not merely the provision of a reasonable standard of security and welfare, including adequate nutrition and health, but also equal opportunity for education, for recreation, for freedom, and for self-development and self-expression. Looked at from another angle, every human being born into the world has in the eyes of true democracy a certain individual birthright—a birthright of health, strength, intelligence, varied enjoyment, and free interest, which must not be denied or stunted if the society into which he is born lays claim to being democratic.

Under participation there is to be included participation in national

politics and in local government and community affairs, by discussion, through the ballot box, and by actual service; but there is also freedom of participation in group organizations, whether to protect particular interests (like trade unions), or to give outlet to a shared enthusiasm (like choral societies or natural history clubs); and there is also the opportunity of participation in cultural life and in organizations for service. The technique adopted in planning schemes like the TVA or the Columbia Basin projects is demonstrating how the general public can participate in a bold central plan.

Throughout, the basic criterion is that the individual and his ultimate welfare and fullest development shall be paramount; not the State, nor national power or wealth, nor maximum profits, nor even the cultural achievements of a society in art or science or literature. And this implies the maximum amount of freedom, the fullest equality of opportunity for development, and the maximum degree of co-operation. The freedom must not be freedom at the expense of others, the opportunity must not impair the possibilities of co-operation.

The individual is the ultimate yardstick; but he cannot develop fully or freely except in an organized society. Nor is any one individual the yardstick: his freedom and opportunities must obviously be limited by the need for guaranteeing freedom from interference to his fellow-individuals.

VI

So much for the universal criterion of democracy. What remains is to find those special applications of democracy which will be necessary in the new phase upon which the world is now entering. Liberty, Equality, Fraternity—these will always constitute democracy's triple crown; but, to change the metaphor, their edges have grown blunted by use, so that they need redefining in new terms; and their particular expressions must be to a large extent determined by the social and economic conditions of the time.

The outstanding characteristic of the early nineteenth century was that it was an expanding and an industrial world. In that world democratic freedom was inevitably concerned with throwing off the shackles of the semi-feudal past, and with the rights and duties of free individual enterprise to exploit the resources of nature to the fullest possible degree; democratic equality was largely limited to political equality for the middle classes; and democratic fraternity was still largely confined to the concepts of charity and *noblesse oblige*. The outstanding characteristic of the world we are now entering upon is

that it is a closed world, still organized in the form of independent nation-states, but with those states brought into constant contact and constant friction. What application of democratic principle will these conditions bring out and emphasize?

Nationalist self-determination leads, in this closed world, to competition and war; but cultural self-determination (as practised, for instance, to a notable extent in the U.S.S.R., where regional cultures are encouraged to develop fully and freely) is perhaps the best expression of Liberty in to-morrow's internationalism. The principle of Fraternity may be broadly translated as co-operation: co-operation for defence, for trade, for increased general consumption. This at once rules out punitive tariffs, purely national armies, and imperialist domination, and suggests the lines for new world-scale economic and political organizations, both international, transnational, and supernational.

In the new international sphere the most difficult of the three democratic principles to translate into the relevant concrete terms is Equality, since at the present time the world is composed of peoples at such manifestly unequal levels of cultural and economic development. However, we find a general principle to hand in that of Potential Equality. Our aim with backward peoples will then be to raise them to a position where they can take their international place on a footing of actual equality. This does not imply that all peoples are potentially identical culturally or that there may not be real differences in innate temperament or capacity. Cultural diversity is as desirable as individual diversity. As with individuals, peoples and nations contain vast reservoirs of untapped potentiality, and the democratic approach demands in both cases that they should be provided with equality of opportunity to develop that potentiality.

We are beginning to realize the implications of these ideas in relation to China: the Chinese people must be treated on a footing of equality if the war is to be won and if we are to have a stable peace in the Far East. The same realization is dawning with regard to India. In the case of politically dependent peoples, the United States adopted the principle of potential equality in its encouragement of the Filipino's development toward independence. This was in strong contrast with the British attitude in Malaya—with appropriate results in the military sphere.

The general implications of this principle are twofold. First, a redefinition of the status of colonies and dependent peoples, with a formal pronouncement to the effect that the goal of colonial administration is preparation for self-government at the earliest possible

moment. And second, a policy of large-scale development for all peoples or regions who are backward in the sense of being below standard in any aspect of life. This would not "pay" in the short-range terms of *laisser-faire* finance, but will certainly do so in the long run if our other two principles of co-operation and of freedom for cultural development are borne in mind.

VII

The final step in our argument remains—the need for entering upon our revolution consciously and of set purpose, deliberately guiding its course instead of allowing its blind forces to push and buffet our unplanned lives. The war is not merely a symptom of the world revolution; it is also one of the agencies for its accomplishment. The two are bound up together.

Our best method for achieving the revolution deliberately is through the proclamation of comprehensive war or peace aims which include the achieving of the revolution. Our enemies have long ago done this. Hitler, for instance, has included in his aims the establishment of a "new order" in Europe, with the establishment of Germany in a dominant position as a "Master Race," and with the crushing both of bolshevism and democracy in favour of National Socialism. Japan has done the same with its slogan of Asia for the Asiatics, and its project of the "East Asia Co-Prosperity Sphere," with Japan in a similar dominant position as divinely appointed leader.

The war and peace aims of the United Nations are beginning to take more definite shape. But they could and should become both more comprehensive and more precise. For this it is not necessary that we should refer explicitly to the revolution nor envisage its complete fulfilment. But it is necessary that we take it and its implications into account.

If the revolution in some form is inevitable, and if we agree that the democratic way of carrying it out is the better way, that is the first step. The next is to make sure that we understand the inevitable trends of the revolution, and also learn how to translate the standards and methods of democracy into the new terms that the changing world demands. Then we shall have not only a body of principles to act as a touchstone, but a set of general aims to give us our direction. Our concrete schemes can then be framed in relation to those aims and checked in detail against that touchstone.

It is surprising how much assistance such a coherent body of aims and principles can give—on social security, on our treatment of

subject peoples, on the role of art in the community, on international trade, and a hundred other subjects. They can also be important in warning us against possible mistakes—against a disregard of the trends of history, against every kind of undemocratic short cut to apparent efficiency, against the possible imposition of plans, however admirable, without the interest and the participation of the plannees (if I may coin a term), against every kind of narrow exploitation and racial arrogance.

It may be suggested that the best method of setting about this business is to draw up and proclaim a series of Charters, extending the general principles of the Atlantic Charter into greater detail and into various special fields. Once these were formally proclaimed by as many as possible of the United Nations there could be no going back on them; and meanwhile the experts behind the scenes could be charged with working out the practical schemes through which they would take effect. There has already been considerable talk in Britain of a Colonial Charter. A Pacific Charter might be useful to formulate the democratic point of view on the relations between the Asiatic and the white nations. A Charter of Welfare and Service would formulate the rights and duties of the individual and be in effect the charter of the common man; a Charter of Security would be the banner under which nations would be invited to co-operate in the prevention of war and aggression; and one might add a Charter of Prosperity to cover international economic co-operation, and a Charter of Peaceful Change as the first step toward the setting up of new international machinery for political adjustment.

Meanwhile it is imperative that we should be clear in our own minds as to the inescapable nature of our proposition of political Euclid. Only when we have accepted the logic of its earlier steps and fearlessly worked out their implications, can we hope to write Q.E.D. at its close by drawing the final conclusion of a set of aims which shall shorten the war, revivify the democratic nations, and lay solid foundations for peace.

PHILOSOPHY IN A WORLD AT WAR

[NOTE.—When I was in the U.S.A. early in 1942, *Fortune* magazine was running a series with the above title. After reading the articles by W. E. Hocking, Professor of Philosophy at Harvard, W. L. Sperry, Dean of the Harvard Divinity School, W. P. Montague, Professor of Philosophy at Columbia, and Jacques Maritain, the well-known French writer and scholar, I asked if I might state the biologist's position; and this essay is the result.]

WHAT has Philosophy to do with War, the one so abstract and theoretical, the other so terribly concrete and practical? In point of fact, the two have a great deal to do with each other. Philosophy in the broad sense is an attitude to the universe, a *Weltanschauung*, an appraisal of values in their relation to brute material facts. Its essence, in Professor Montague's words, is not proof but vision: it is concerned with what Professor Hocking has called the continued revision of goals. And war must be about something, must have a goal. No nation ever went to war without some belief in the value of the war's goal. Even when the mainspring of a war is merely economic advantage or conquest, some justification has to be invented—the rightness of your cause, or defence against aggression, or the superiority of your race, or the sacred duty to spread your religion; and the justification, even if hypocritical in its origin, will have its effect on the thoughts and actions of those who fight the war. Even then, and still more in those numerous cases when moral aims genuinely exist and do not have to be invented, war is deeply entangled with philosophy.

To-day all the protagonists have a philosophy of the war they are waging—we in saying that we fight for freedom; the Germans in saying that they fight for the triumph of the highest human race; the Russians in saying that they fight for their fatherland and to rid the world of the evil thing they call Hitlerism. Such philosophies are all incomplete; some of them, like the Germans' claim to be a superrace, are demonstrably erroneous.

The business of Philosophy with a capital P is to provide us with the completest and truest philosophy possible. Once we have a philosophy, it can be applied to the immediate needs of the war, just as pure scientific knowledge can be applied to satisfy immediate material needs. One of its main applications lies in its helping us to achieve a stronger morale and to formulate peace aims. The truer our philosophy, the more complete, and the more efficiently it is applied to the circumstances of the war (which of course implies a

comprehension of the intricate human, economic, and political background), the more it will help us to formulate peace aims which will be not merely satisfying, but themselves an efficient weapon of war. But conversely, if our philosophy is false or partial, its application will give us incomplete or unsatisfactory peace aims, which will have a correspondingly lower efficiency as psychological weapons.

The Western world to-day is caught in an apparent dilemma between two conflicting modes of thought. The one thinks in terms of absolutes—the absoluteness of truth, beauty, justice, goodness, themselves all deriving from an Absolute of absolutes, which is God. The natural world is complemented by the supernatural, the body by the soul, the temporal by the eternal. This view gives an essentially static world-picture; the flux of events is merely change, in which the only progress is a spiritual one, toward the perfection of eternal values. Empiricism and the experimental method are alien to it; the absolute of Revelation and the absolute of pure Reason will between them answer all the questions that can be answered. Man's place in the universe is the place of an eternal soul, created by God, and working out its destiny in terms of eternal values.

The other is the scientific method. It subjects the conclusions of reason to the arbitrament of hard fact to build an increasing body of tested knowledge. It refuses to ask questions that cannot be answered, and rejects such answers as cannot be provided except by Revelation. It discovers the relatedness of all things in the universe—of the motion of the moon to the influence of earth and sun, of the nature of the organism to its environment, of human civilization to the conditions under which it is made. It introduces history into everything. Stars and scenery have their history, alike with plant species or human institutions, and nothing is intelligible without some knowledge of its past. As Whitehead has said, each event is the reflection or effect of every other event, past as well as present. It rejects dualism. The supernatural is in part the region of the natural that has not yet been understood, in part an invention of human fantasy, in part the unknowable. Body and soul are not separate entities, but two aspects of one organization, and Man is that portion of the universal world-stuff that has evolved until it is capable of rational and purposeful values. His place in the universe is to continue that evolution and to realize those values.

These two ways of approaching and thinking about the universe are irreconcilable—as irreconcilable as is magic with scientific agriculture,

witch-doctoring with preventive medicine, or number-mysticism with higher mathematics. Because our thinking still contains elements from both, it and we are confused.

This is not the view of the previous contributors to this series. In different ways they have maintained that the two systems of thought are not mutually exclusive but complementary. Though they all admit that the scientific or relativist approach is adequate and indeed essential so far as it goes, they agree in asserting that it cannot go all the way—that it is necessarily partial and needs to be supplemented by some elements derived from the alternative way of thinking. Professor Sperry says that we must supplement science with moral universals. Professor Maritain frankly finds the only chance of regeneration in a philosophy based on Christian theology. Professor Montague, more vaguely, postulates a tendency toward ideal good operating in nature—an omnipresent but not omnipotent Holy Spirit, strongly reminiscent of Matthew Arnold's "something, not ourselves, which makes for righteousness." Professor Montague calls this a god, without the capital letter. Professor Hocking is more definite: for him the truth of science needs to be supplemented by another truth: that the world "has its own unity in a living purpose: it is the truth of the existence of God."

To me, this mixing of two totally different kinds of thinking can only lead to confusion. When men assert that the scientific approach is incomplete, it is because they have not been willing to follow it to its final conclusion, or because they are mistaking an early stage in its growth for full development.

Science inevitably began by trying its hand on the simpler phenomena of nature. Its first triumphs were in mechanics, including the spectacular celestial mechanics of Newton. It next proceeded to simple physics, like the gas laws or the decomposition of white light. Chemistry, even elementary chemistry, did not take real shape till a century later. The life sciences developed later than those of lifeless matter, for the sufficing reason that they deal with more complex phenomena. Physiology had to wait on physics and chemistry before it could become scientific. Evolution, the central fact of biology, was not established until modern science had been in existence for over two hundred years; the mysteries of heredity did not become clear until well on in the present century. In the same way the science of mind developed later than biological science. What Newton was for mechanics and physics, and Darwin for biology, Freud was for

psychology—the originator of a new and illuminating way of thinking about the subject-matter of his science.

It is of some significance that none of the previous writers in this series have even mentioned Freud or taken the findings of modern psychology into consideration at all—not excluding Professor Montague, though he essays a psychological analysis of the development of conscience in the growing child.

This is one of the reasons for their claim that the scientific approach is insufficient. Of course it is insufficient if you leave out the latest stage of its development. You might just as well leave out physiology and evolution and then claim that the scientific approach as represented by classical physics and chemistry was insufficient. No, the only cure for the insufficiency of science is more science. The scientific approach, empirical and where possible experimental, preferring the relative to the absolute, and rejecting the deductions of pure reason except when based upon the inductions of raw fact, cannot be rejected as insufficient until it has been completely tried out on the analysis of human mind and human affairs as well as on that of non-living matter. In these less complex fields its application has already revolutionized our way of thinking about the universe (not to mention producing the most spectacular practical results): there is no reason why it should not continue to do so as it consolidates its hold on the new areas it is now invading. Let us not forget that scientific method is extremely young: what are three centuries compared to the few millennia of civilization, the million years of man, or the thousand million years of evolving life?

Scientific method to-day has reached about as far in its understanding of human mind as it had in the understanding of electricity by the time of Galvani and Ampère. The Faradays and Clerk-Maxwells of psychology are still to come; new tools of investigation, we can be sure, are still to be discovered before we can penetrate much farther, just as the invention of the telescope and calculus were necessary precursors of Newton's great generalizations in mechanics.

However, even with the progress that science has already made, it is possible to give a reasonably coherent world-picture based on the scientific approach; and this contains elements of the greatest importance to our philosophy and to our practical outlook. One is that the universe is not dualistic but monistic; another is the incorporation of values within the scientific picture, and a reconciliation of their absoluteness in principle with their relativity in practice; a third is the real existence of progress in evolution; a fourth is the complete and sole responsibility of man for achieving any further

progress that may be made on this planet, and the falsity of all his attempts to shift any of the burden of his responsibilities on to the shoulders of outside powers; and a fifth is the establishment of the developed human personality as the highest product of the universe (or at least the highest product of which we have any knowledge), with all the implications of this fact for our social and political philosophy.

Let me take these points one by one, to show their interconnection. The way of advance for truth is in general the same as the way of advance for existing life: of two alternatives, one dies out, not because the other destroys it directly, but because it is less fitted to survive. Even after Copernicus, the doctrine that the sun goes round the earth could still be logically maintained. But it demanded enormous complexity of epicycle upon epicycle. The rival theory that the earth goes round the sun was far simpler and more satisfying; in the climate provided by developing civilization it survived, the other simply died out of human thinking.

The monistic, unitary view of the universe will survive for the same kind of reason. Our scientific knowledge now permits us to assert definitely that there is no break in the continuity of phenomena. All matter, living or lifeless, is composed of the same units—all the millions of different lifeless substances, as well as of living species, are made of different combinations of the chemical elements, and these in turn of different combinations of still more elementary particles (or "wavicles"). In reproduction, there is no moment at which life enters; there is continuity of life between the offspring and its parent or parents. The offspring is merely a detached portion of the parental living substance. Nowhere in the transformation of microscopic ovum to adult human being is there a break at which one can say "here mind appears," or "there personality enters"; development is continuous.

It is the same with the vast process of organic evolution. Here, too, gradualness and continuity reign; there is no moment at which we can say that reptile ends or bird begins, no definite demarcation between man and not-man, no sharp line at which we must or indeed could postulate the sudden injection of thought or soul into evolving life. The ideas of evolution by brusque mutations of large extent have disappeared: with the new knowledge of the last twenty years the overwhelming consensus of biology has returned to support Darwin's original view of the extreme gradualness of all evolutionary change.

Nor is there the least reason for postulating any sudden injection of life into our world. Living matter is composed of the same elements as non-living, and no trace of any special "vital energy" has been detected. The scientific view is that under the conditions obtaining during the early history of the earth, the particular combination of matter that we call life was formed in the cosmic test-tube, and once formed could maintain itself by its power of self-reproduction. Any other hypothesis is less simple: the onus of proof falls on those who would maintain it.

What then becomes of the apparent dualism between matter and spirit? Many philosophers, including Professor Montague, persist in affirming that the only alternative is materialism, according to which mind is "a function of the body (matter), and depends upon it completely." This is an easy thesis to demolish; and having demolished it, they conclude that the dualistic alternative is true. However, the real alternative to dualism they have conveniently omitted to mention.

The only logical alternative to dualism is monism—that matter and mind are two aspects of one reality, that there exists one world-stuff, which reveals material or mental properties according to the point of view. Looked at from the outside, the world-stuff has nothing but material properties; its operations appear as mind only to itself, from within.[1] The first objection to this, that we have experience of the minds of other people, disappears when we remember that this experience is not direct, as is the experience of our own psychic processes, but indirect, deduced from other people's behaviour (including expression and verbal behaviour), combined with our knowledge of our own minds. The second objection, that a dead man still has the same body as a live one, and therefore differs by the loss of a living soul, is still more easily disposed of. A dead body is *not* the same as a living body: the chemical conditions in it—for instance, the presence of enough oxygen for the functioning of the tissues—are different. If you substitute oil for acid in the battery of your automobile, no current will pass. The interpretation of a primitive savage might well be that the living soul of the contraption had fled. But we know that the conditions have been altered: restore the old conditions and the battery becomes "live" again. It is the same with the body. The physicochemical conditions of the dead body are different from those of the living body: if you could restore the conditions found in the

[1] The term *mind* is used here broadly, to denote all psychical activity and experience, conscious or subconscious, sensory, emotional, cognitive, and conative.

living body, the dead body would live again. This has been done by artificially restarting the heart; but owing to the rapidity with which irreversible changes take place in dying cells, this has so far proved possible only within a very short time after death (or, if you prefer, what otherwise would have been death) has occurred.

But if the world-stuff is both matter and mind in one; if there is no break in continuity between the thinking, feeling adult human being and the inert ovum from which he developed; no break in continuity between man and his remote pre-amoebic ancestor; no break in continuity between life and not-life—why, then, mind or something of the same nature as mind must exist throughout the entire universe. This is, I believe, the truth. We may never be able to prove it, but it is the most economical hypothesis: it fits the facts much more simply than does any dualistic theory, whether a universal dualism or one that assumes that mind is suddenly introduced into existing matter at a certain stage, and very much more simply than one-sided idealism (in the metaphysical sense) or one-sided materialism.

The notion that there is something of the same nature as human mind in lifeless matter at first sight appears incredible or ridiculous. Let us, however, illustrate its possibility by considering certain well-established biological facts concerning electricity. Apart from lightning, the only powerful electric phenomena known before the late eighteenth century were the electric shocks produced by the electric eel, the electric ray, and one or two other kinds of fish. The production of electricity by life might justly have appeared as something rare and sporadic. However, as physiology progressed, it was found that electric currents pass when a nerve is stimulated, when a muscle contracts, when a gland secretes; in fact, we now know that all vital activities, of whatever kind, from conscious thought to the fertilization of the egg, are accompanied by some electrical activity. The electrical charges are extremely minute and can be detected only by the most refined instruments; but they are always there. They are there because what we call electricity is one aspect of all matter (indeed, when we get down to the ultimate units of matter, such as electrons, their electrical properties seem to be the most essential).

In the electric eel, certain muscles have been modified so that, though they have lost their original function of contraction, their electric discharges are accumulated as in a galvanic pile, and the total voltage and current are quite respectable. Whereas in the great

majority of cases the electrical properties of living matter play no special part in the life of the animal, they have become the specific function of the eel's electric organs: an accident of nature has become biologically significant.

One may suggest that the same sort of thing has happened with mind. All the activities of the world-stuff are accompanied by mental as well as by material happenings; in most cases, however, the mental happenings are at such a low level of intensity that we cannot detect them; we may perhaps call them "psychoid" happenings, to emphasize their difference in intensity and quality from our own psychical or mental activities. In those organs that we call brains, however, the psychoid activities are, in some way, made to reinforce each other until, as is clearly the case in higher animals, they reach a high level of intensity; and they are the dominant and specific function of the brain of man. Until we learn to detect psychoid activities of low intensity, as we have learned to do with electrical happenings, we cannot prove this. But already it has become the simplest hypothesis that will fit the facts of developmental and evolutionary continuity.

In evolution, science has not merely revealed the bridge that provides continuity between man and lifeless matter, but has also discovered what is perhaps the most important single biological fact yet known—the fact of evolutionary progress. A great deal of evolution is mere diversification. New species constantly arise, adapted to slightly different conditions, or produced by the biological accidents of isolation or hybridization. Through this frill of diversity, however, there can be perceived a series of long-range trends, whose course runs for millions or tens of millions of years. The great majority of these trends are specializations. They fit the existing type more closely to one mode of life, and in so doing cut it off from success in others. In the evolution of higher mammals, for instance, one line specialized as predators, and become the carnivores; another specialized in chewing and digesting foliage and herbage, and usually in swift running, to become the ungulates; a third in flying—the bats; a fourth in marine life—the whales and porpoises; and so on. It is a universal rule that one-sided specializations eventually come to a dead end. There is a point beyond which natural selection cannot push them. It is impossible to be more perfectly streamlined than a dolphin; when the horse stock had reduced its digits to one, it could go no further; elephants are close to the limit of weight that is possible for an efficient land animal. When a specialization has reached its biomechanical limit, it remains unchanged—unless

new competition causes it to become extinct. Thus most mammals have not evolved in any important way for ten or twenty million years, birds not for twenty or twenty-five million, ants not for thirty million.

But besides these lines of specialization we find a few lines whose trend is toward all-round instead of one-sided improvement; and these are not doomed to come to a stop. It is this all-round and therefore potentially unlimited advance that may legitimately be called progress. It is concrete and measurable. It consists in an increased control by life over its environment, an increased independence in relation to the changes of that environment, an increase of knowledge, of harmonious complexity and self-regulation.

But it is not universal or inevitable. It occurs in a few only out of the tens of thousands of evolving types. It reveals itself not in any advance of life as a whole, but in a raising of the level reached by the type that is biologically dominant at any given time. The union of many cells to form a single individual was evolutionary progress. So was the formation of a central nervous system, of a head, of a blood circulation, of elaborate sense-organs. Later on, emergence on to land, with its consequent increase of self-regulation, marked a step in progress; so did the self-regulation of temperature that we call warm blood, the nourishment of the mammalian young by its mother, and the steady development of intelligence and the power to profit by experience in the mammalian stock. The evolution by man of conceptual thought, of conscious reason and purpose, finally produced a dominant type with radically new biological characteristics.

To assert that man is the highest product of evolution to date is a statement of simple biological fact. There are, however, some other points concerning man's position relative to evolutionary progress that are less obvious. First is the curious fact that the human species is now, in all probability, the sole repository of any possible future progress for life. When multicellular animals first appeared, they all had reached a new level of progress: later, some cut themselves off from further advance by entering on blind alleys, such as the fixed, vegetative existence of the polyps and corals or the headlessness and radial symmetry of the starfish and other echinoderms. The process of restriction has now, it seems, gone so far that all future progress hangs on the human germ-plasm. It is apparently a biological impossibility for any other line of life to progress into a new dominant type—not the ant, the rat, nor the ape.

Second, with the evolution of man the character of progress becomes altered. With human consciousness, values and ideals appeared on earth for the first time. The criteria of further progress must include the degree to which those ideal values are satisfied. The quest for truth and knowledge, virtue, beauty and aesthetic expression and its satisfaction through the channels of science and philosophy, mysticism and morality, literature and the arts, becomes one of the modes or avenues of evolutionary progress. A tendency in this direction had been manifested earlier in evolution. On the whole, biological progress in its later stages had been more concerned with independence of the environment than with control over it. The introduction of ideal values makes it possible for this tendency to go further. We may anticipate that in the remote future human control over the environment will become increasingly devoted to securing greater independence—in other words, greater freedom from material exigencies—and both of them together to securing a greater degree of self-realization and of the satisfaction of human values.

It is also important to note that biological progress demands no special agency. In other words, it does not require the intervention of a conscious Divine purpose, nor the operation of some mysterious life-force or *élan vital*: like most other facts of evolution, it is the automatic result of the blind forces of reproduction, variation, and differential survival. Newton's great generalization of gravitational attraction made it possible and indeed necessary to dispense with the idea of God guiding the stars in their courses; Darwin's equally great generalization of natural selection made it possible and necessary to dispense with the idea of God guiding the evolutionary courses of life. Finally, the generalizations of modern psychology and comparative religion make it possible, and necessary, to dispense with the idea of God guiding the evolutionary courses of the human species, through inspiration or other form of supernatural direction.

The present culmination of the thousand-million-year sweep of biological progress is the human species, with all its defects and mistakes. Thus the highest and richest product of the cosmic process (or, again, the highest of which we have any knowledge) is the developed human personality. It is among individual men and women that we must search for our exemplars.

A corollary of the facts of evolutionary progress is that man must not attempt to put off any of his burden of responsibility on to the shoulders of outside powers, whether these be conceived as magic or

necessity, as life-force or as God. Man stands alone as the agent of his fate and the trustee of progress for life. To accept his responsibility consciously is itself an important step toward more rapid progress. Here is a field where a philosophy based on the scientific outlook is of the utmost practical importance.

But the problem that most perplexes our present age remains the question of moral certitude. As Dean Sperry says, it is the loss of the "ethical universals" with which Christianity has equipped Western civilization that creates the "grave moral perplexities" of the present. This is where modern psychology enters the picture. For a justification of our moral code we no longer have to have recourse to theological revelation, or to a metaphysical Absolute; Freud in combination with Darwin suffice to give us our philosophic vision. The great contribution of Freud was the discovery of the unconscious mind. What matter if logicians assert that the phrase is a contradiction in terms? It is now firmly established that through the process known as repression, desires and ideas, emotions and purposes, can be forced out of consciousness, or at least out of contact with the main organization of consciousness that we call the self or ego. They are then "in the unconscious," but in the unconscious they continue operating just as if they were ordinary processes of the mind, and they are still able to influence the conscious life of the ego in the most varied ways.

Repression is the banishment from consciousness of desires and ideas that produce otherwise intolerable conflict. It is a special form of what psychologists and neurologists call inhibition. The repressed ideas are so intolerable that consciousness will not even recognize their existence or examine them rationally; yet they are so powerful that they distort consciousness itself. They may manage to enter, in suitably disguised forms, into the very forces of the mind that aid in their repression, and lead to a neurotic conflict that is indefinitely prolonged. They may emerge under the guise of perversions, sublimations, compulsions, or mere oddities of behaviour. Most important for our purpose, the conflict, since it is never faced in the light of conscious reason, has to be resolved by irrational methods; emotional force must be met by emotional force. This is accomplished by the development of what psychoanalysts call the super-ego, a mental construction embodying both the repressive forces and also the feelings of guilt engendered by the conflict. From another angle, the super-ego may be looked on as the injection of external authority into the infant's developing personality, where it takes root under the form of a sense of moral compulsion. To complete the story, we may add

that it is often re-projected outward, so to speak, in the form of a jealous God, an absolute moral law, an infallible Führer, or some other externalization.

The super-ego is a rationalization of the conflict between primitive unregulated impulse and the deep infantile need for dependence. It can be equated with certain aspects of conscience; it gives the compulsive force to taboos, both ritual and ethical; it provides morality with its irrational certitudes, and sometimes with an unpardoning ruthlessness; primitively, its strength is bound up with cruelty, and this issues in the idea of punishment for sin, including expiatory self-torture. It is, in fact, the non-rational and emotional element in ethics.

It has not, I think, been sufficiently recognized that repression is normal in man. Man is the only organism whose mind is so constructed that long-continued conflict is inevitable. The young child is subjected to powerful conflicts even before it can talk and reason, and long before it has adequate experience to resolve a conflict rationally. Repression is thus an adaptation to conflict, especially to early conflict; in its absence, the degree of assurance necessary for action and adjustment would be impossible.

Undoubtedly the picture of human psychology given by psychoanalysis and other modern dynamic theories is crude and incomplete, but equally undoubtedly it is a first approximation to the truth. It is as great an improvement over older theories as was mid-nineteenth-century physiology, for all its crudity, over the medieval theory of humours, or Dalton's atomic theory of chemistry, for all its incompleteness, over alchemy.

Its importance for philosophy, and especially for ethics, is enormous, for it enables us to understand how ethical and other values can be absolute in principle while remaining obstinately relative in practice; and, in conjunction with our knowledge of evolution, it enables us to reconcile absolutism and relativism by uniting them in the concept of right direction.

Values appear absolute for two reasons. The first is a result of the structure of language. The very existence of general and abstract terms like *true* and *truth* implies that an absolute Truth exists, and also that there is always an absolute difference between truth and falsehood. This, however, is not the case. Truth is only absolute when it deals with the incomplete, such as the abstractions from reality that form the basis of mathematics. The absolute difference between truth

and falsehood only applies in a limited number of situations. The atomic theory of Dalton was true in giving a reasonably accurate picture of chemical fact. It was incorrect in ascribing indivisibility to atoms; but this does not make it false, only incomplete. The fact remains, however, that man's capacity for conceptual thought makes it extremely difficult for him to think in relative terms. The general and the abstract tend, almost automatically, to become invested with the intellectual halo of the absolute. The lesson of science is that this tendency should be resisted. Paradoxically, we find that we are enabled to accumulate a more complete and a more certain store of knowledge when, as in science, we reject the possibility of absolute completeness or absolute certainty, and are prepared to abandon our dearest theories in the face of new facts.

What holds for truth holds also for beauty and goodness. But in the case of goodness in particular, this predisposition to translate the particular into the general, the general into the abstract, and the abstract into the absolute, is reinforced by another effect—the sense of emotional certitude which in its origin is to be traced to the mental mechanisms growing out of the need for infantile repression. Thanks to repression, it is natural for us not only to think in absolute terms, but to feel in them. The inhibiting influences of the super-ego tend to produce an intolerant assurance of being right, because only through such an assurance could they have succeeded in repressing their opponents into the unconscious. In so far as they succeed, they acquire emotional certitude; and that emotional certitude, given the construction of the human mind, inevitably tends to rationalize itself by claiming absolute value.

When, however, we come to practice, we find ourselves plunged back into the confusion of the relative. For instance, when we win this war, what will be the right way of treating Germany? The absolute principle of justice makes us feel the demand that crime should be punished. But, applied to the Germans, does this mean punishing Hitler, the Nazi leaders, all those directly guilty of cruelty and injustice, or the whole German people? Furthermore, the absolute principle of justice conflicts with the equally absolute principles of mercy and love. And finally, these absolute emotional principles come in conflict with the frankly utilitarian principles, like the greatest good of the greatest number, whose application can only be decided rationally and relatively to circumstances. Clearly one course will prove to be more right than another; but in deciding

which to adopt, the so-called absolute ethical and moral principles will only take us part of the way.

The same is true of the individual. As he grows up, he finds that his apparently absolute ethical values constantly need the assistance of relativism, in the shape of rational judgment in the light of experience, if they are to be applicable to particular situations. It is wrong to lie; but we all know circumstances where it is more wrong to tell the truth. It is wrong to take life; but it needs rational judgment to decide whether this applies to war, to certain cases of suicide and abortion, to euthanasia, to birth-control.

In fact, one of the chief tasks before each individual is to make a rational and relative adjustment of the apparent absolute of his primitive ethics, derived from infantile repression, to the practical realities of life. To accomplish this, it may even be necessary that the original structure of repressed and repressing forces be destroyed, whether by some violent emotional or religious experience, or by the deliberate "mental operation" of psychoanalysis or other form of psychotherapy.

Looked at from the evolutionary point of view, both the individual ethical values of the super-ego and the collective ones of the current system of religion and morality are adaptations enabling human life to carry on without too great a degree of incertitude and inner conflict. This means that they must have some degree of external relevance to the environment in which they arise, and are bound to change as it changes. For instance, so long as infectious disease was supposed to be a punishment for sin, it was possible to regard sacrifice to the gods as an ethical duty in times of pestilence. To-day our modern knowledge makes it ethical for us to compel the forcible isolation of sufferers from such diseases. Again, under the new conditions of Hitler's aggression and hateful methods of warfare, many convinced pacifists have changed their strong ethical belief that war is always wrong.

In the light of these facts, the dilemma of ethics begins to look rather different. The absoluteness of ethical values turns out to be apparent only, springing partly from the feeling of certitude or even compulsion associated with repression, partly from man's natural yearning for certitude, partly from his language habits. On the other hand, the inconstancy of ethical values revealed by history and anthropology, which is at first so confusing and distressing, turns out not to be wholly at random. Ethics is related, though incompletely and indirectly, to the solid facts of man's environment: it is a social adaptation.

The task before us, as ethical beings, now begins to take shape. It is to preserve the force of ethical conviction that springs up naturally out of infantile dependence and the need for inhibition and repression in early life, but to see that it is applied, under the correctives of reason and experience, to provide the most efficient and the most desirable moral framework for living. This will undoubtedly mean radical changes in the early upbringing of children, as well as in the methods of education and in accepted religions and codes of ethics. For instance, sociologists realize that existing ethico-religious systems often contain a large element of psychological compensation: they compensate for the miseries of this world with the bliss of a world to come, they compensate for ignorance of fact with certitude of feeling, they compensate for actual imperfections of ethical practice by setting up impossible ethical ideals. This is not merely hypocrisy; it is a primitive method of self-defence against a hard and difficult reality.

Again, it is becoming clear that harshness of punishment in early life tends to the development of a morally vindictive super-ego: other methods are required for the development of a character where the aggressive and sadistic impulses are kept subordinate. The most difficult lesson to learn is that irrational and intolerant certitude is undesirable. We have seen how this applies to truth: the lesson is difficult there also, but science has learned it. It will be even more difficult to learn in ethics: but it must be learned if we are to emerge from psychological barbarism. To cling to certitude is to prolong an infantile reaction beyond the period when it is necessary. To become truly adult, we must learn to bear the burden of incertitude.

Another serious difficulty is how to arouse strong ethical feeling on important moral issues. It is easy to feel strongly about sexual behaviour, because almost inevitably certain components of the sexual impulse become repressed in early life—so easy, in fact, that "morality" is often used to mean sexual morality alone. But it is much harder to feel strongly about social problems such as malnutrition or unemployment, because the connection with the repressive mechanism is not so automatic. However, through education and general social attitude such problems could be linked with a strong feeling about the wrongness of cruelty, a feeling which in its turn is readily generated by the repression of the aggressive impulses. In addition, of course, the child's natural sense of sympathy can be appealed to and strengthened, and primitive feelings of aggression can be sublimated and canalized into constructive activities. But any strong emotional sense of absolute wrongness can only be introduced

by utilizing the fact of repression, with its accompanying load of guilt. Society must make rational use of an irrational mechanism to create the system of values it wants.

I would draw some such general conclusion as this. A scientifically based philosophy enables us in the first place to cease tormenting ourselves with questions that ought not to be asked because they cannot be answered—such as questions about a First Cause, or Creation, or Ultimate Reality. Secondly, it encourages us to think in terms of right direction and optimum speed in place of complete but static solutions. At the present moment, for instance, it is much more essential to know that we are moving with reasonable speed toward certain general types of supernational co-operation than to nail some elaborate blue-print of international organization to our masthead. Thirdly, it is capable of giving man a much truer picture of his nature and his place in the universe than any other philosophic approach. Man is now the dominant biological type, and the developed human individual the highest product of the cosmic process that we know. That is a proud piece of knowledge. It is tempered by the reflection that very few human individuals realize a fraction of their possibilities, and that in a large proportion passive or active evil predominates. But the knowledge has important practical bearings. Once we realize that the development of individuals is the ultimate yardstick by which to measure human progress, we can see more clearly how to formulate our aims for the world after the war.

The fact that we, all the human beings now in existence, are the exclusive trustees for carrying any further the progress already achieved by life is a responsibility which, if sobering, is also inspiring; as is the fact that we have no longer either the intellectual or the moral right to shift any of this responsibility from our own shoulders to those of God or any other outside power. Indeed, the problem that appears to be the most perplexing and distressing turns out, in the light of a thoroughgoing scientific approach, to be full of encouragement. I mean the problem of ethical and other values. We have been accustomed to think of these as a scaffolding for our morals, conveniently run up for us by some outside agency. Now that this is no longer possible, we feel bewildered, unable to conceive of any firm moral construction in which we can abide. The truth, however, as shown by the extension of scientific method into individual and social psychology, is that we create our own values. Some we generate consciously; some subconsciously; and some only indirectly, through

the structure of the societies in which we live. Through a fuller comprehension of these mechanisms we shall be able to guide and accelerate this process of value creation, which is not only essential for our individual lives but basic to the achieving of true evolutionary progress in the future.

WAR AS A BIOLOGICAL PHENOMENON

WHENEVER we tend to become completely absorbed in an enterprise or an idea, it is a good thing to stand off from it now and again and look at it from the most dispassionate point of view possible. War is no exception. Quite rightly, all our major efforts must to-day be devoted to the urgent business of making sure that we win the war and win it as quickly as possible. We are for most purposes immersed in the war; however, it will not merely do no harm, but will actually be of service, if now and again we try to get outside it and to look at it as objectively as we can in long perspective.

The longest possible perspective is that of the biologist, to whom man is a single animal species among hundreds of thousands of others, merely one of the products (albeit the latest and the most successful) of millions of years of evolution.

How does war look when pinned out in the biologist's collection? In the first place, he is able to say with assurance that war is not a general law of life, but an exceedingly rare biological phenomenon. War is not the same thing as conflict or bloodshed. It means something quite definite:—an organized physical conflict between groups of one and the same species. Individual disputes between members of the same species are not war, even if they involve bloodshed and death. Two stags fighting for a harem of hinds, or a man murdering another man, or a dozen dogs fighting over a bone, are not engaged in war. Competition between two different species, even if it involves physical conflict, is not war. When the brown rat was accidentally brought to Europe and proceeded to oust the black rat from most of its haunts, that was not war between the two species of rat; nor is it war in any but a purely metaphorical sense when we speak of making war on the malaria mosquito or the boll-weevil. Still less is it war when one species preys upon another, even when the preying is done by an organized group. A pack of wolves attacking a flock of sheep or deer, or a peregrine killing a duck, is not war. Much of nature, as Tennyson correctly said, is "red in tooth and claw"; but this only means what it says, that there is a great deal of killing in the animal world, not that war is the rule of life.

In point of fact, there are only two kinds of animals that habitually make war—man and ants. Even among ants war is mainly practised by one group, comprising only a few species among the tens of thousands that are known to science. They are the harvester ants,

inhabitants of arid regions where there is little to pick up during the dry months. Accordingly they collect the seeds of various grasses at the end of the growing season and store them in special underground granaries in their nests. It is these reserve supplies which are the object of ant warfare. The inhabitants of one nest set out deliberately to raid the supplies of another group. According to Forel and other patient students of ant life, they may employ quite elaborate military tactics, and the battles generally result in heavy casualties. If the attackers win, they remove the stores grain by grain to their own nest. Ant wars never last nearly so long as human wars. One campaign observed by the American myrmecologist McCook, in Penn Square in the centre of Philadelphia, lasted almost 3 weeks. The longest on record is 6½ weeks.

Harvesters are the only kind of ants to go in for accumulating property, as well as the chief kind to practise war. This association of property with war is interesting, as various anthropologists believe that in the human species war, or at any rate habitual and organized war, did not arise in human evolution until man had reached the stage of settled civilization, when he began to accumulate stores of grain and other forms of wealth.

Less deliberate wars may also occur in some other species, between communities whose nests are so close that they compete for the same food-territory. When similarly provoked conflicts occur between closely related species, the term war may perhaps be extended to them. On the other hand, the raids of the slave-making ants are not true war, but a curious combination of predation and parasitism.

There is another group of ants called army ants, which suggests military activity; but the phrase is really a misnomer, for these army ants are in reality simply predatory species which happen to hunt in packs: they are the wolves of the insect world, not the war-mongers.

So much then for war as a biological phenomenon. The facts speak for themselves. War, far from being a universal law of nature, or even a common occurrence, is a very rare exception among living creatures; and where it occurs, it is either associated with another phenomenon, almost equally rare, the amassing of property, or with territorial rights.

Biology can help put war in its proper perspective in another way. War has often been justified on biological grounds. The progress of life, say war's apologists, depends on the struggle for existence. This struggle is universal, and results in what Darwin called "Natural

Selection," and this in its turn results in the "Survival of the Fittest." Natural Selection, of course, works only in a mass way, so that those which survive in the struggle will merely have an average of fitness a little above those which perish or fail to reproduce themselves. But some of the qualities which make for success in the struggle, and so for a greater chance of survival, will certainly be inherited; and since the process continues generation after generation not merely for thousands but for millions of years, the average fitness and efficiency of the race will steadily and continuously be raised until it can be pushed no higher. In any case, say the believers in this doctrine, struggle is necessary to maintain fitness; if the pressure of competition and conflict is removed, biological efficiency will suffer, and degeneration will set in.

Darwin's principle of Natural Selection, based as it is on constant pressure of competition or struggle, has been invoked to justify various policies in human affairs. For instance, it was used, especially by politicians in late Victorian England, to justify the principles of *laisser-faire* and free competition in business and economic affairs. And it was used, especially by German writers and politicians from the late nineteenth century onwards, to justify militarism. War, so ran this particular version of the argument, is the form which is taken by Natural Selection and the Struggle for Existence in the affairs of the nations. Without war, the heroic virtues degenerate; without war, no nation can possibly become great or successful.

It turns out, however, that both the *laisser-faire* economists and the militarists were wrong in appealing to biology for justification of their policies. War is a rather special aspect of competition between members of the same species—what biologists call "intra-specific competition." It is a special case because it involves physical conflict and often the death of those who undertake it, and also because it is physical conflict not between individuals but between organized groups; yet it shares certain properties in common with all other forms of intra-specific struggle or competition. And recent studies of the way in which Natural Selection works and how the Struggle for Existence operates in different conditions have resulted in this rather surprising but very important conclusion—that intra-specific competition need not, and usually does not, produce results of any advantage to the species as a whole.

A couple of examples will show what I mean. In birds like the peacock or the argus pheasant, the males are polygamous—if they

can secure a harem. They show off their gorgeous plumage before the hen birds in an elaborate and very striking display, at definite assembly grounds where males and females go for the purpose of finding mates. The old idea that the hen deliberately selects the male she thinks the most beautiful is putting the matter in human terms which certainly do not apply to a bird's mind; but it seems certain that the brilliant and exciting display does have an effect on the hen bird, stimulating her to greater readiness to mate. Individual male birds meet with different degrees of success in this polygamous love business: some secure quite a number of mates, others only one or a few, and some get none at all. This puts an enormous biological premium on success: the really successful male leaves many times more descendants than the unsuccessful. Here, then, is Natural Selection working at an exceedingly high pitch of intensity to make the display plumage and display actions more effective in their business of stimulating the hens. Accordingly, in polygamous birds of this kind, we often find the display plumage developed to a fantastic extent, even so far as to be a handicap to the species as a whole. Thus the display organ of the peacock, his train of enormously overgrown tail-covert feathers, is so long and cumbersome that it is a real handicap in flight. In the argus pheasant the chief display organs are the beautifully adorned wings which the male throws up and forward in display so that he looks like a gigantic bell-shaped flower. The business of display has been so important that it has overridden the business of flying, and now the male argus pheasant can fly only with difficulty, a few feet at a time.

Here are two good examples of how a purely intra-specific struggle, in this case between individual rival males, can produce results which are not merely useless but harmful to the species as a whole in its struggle for existence against its enemies and the forces of nature. In general, selection for success in reproduction reaches greater intensities than selection for individual survival, for the simple reason that reproduction implies multiplication: the individual is a single unit, but, as we have just seen for polygamous birds, success in reproduction may give the individual's characteristics a multiple representation in later generations.

In flowering plants, the intra-specific struggle for reproduction between different individuals often produces results which, if not directly harmful to the species, are at least incredibly wasteful. We need only think of the fantastic profusion of bloom on flowering trees like dogwood or hawthorn or catalpa, or the still more fantastic profusion of pollen in trees which rely on fertilization by the wind, like

pine and fir. The individual trees are competing for the privilege of surviving in their descendants; the species could certainly perpetuate itself with a much more modest expenditure of living material.

One final example. Naturalists have often noted the almost unbelievable perfection of the protective resemblance of certain insects to their surroundings. The most extraordinary cases are the resemblances of various butterflies, like the Kallima, to dead leaves. Not only do the folded wings perfectly resemble a dead leaf in shape and colour, not only do they have a projection to imitate the stalk, and dark lines which perfectly simulate the veins, but some even go so far as to be marked with imitation mould-spots and holes!

Now, in all butterflies the survival of the species depends to a preponderant degree on the capacity of the defenceless and juicy caterpillar and chrysalis to survive. Selection presses with much greater intensity on the larval and pupal stages than on the adult. Furthermore, there is some sort of balance between the number of adults which survive to reproduce themselves and the intensity of selection which presses on the next generation of caterpillars. If more adults reproduce, there will be many more caterpillars, and they will be more easily found by their enemies, especially the tiny parasitic wasps which lay eggs inside the caterpillars, the eggs growing into grubs which devour the unfortunate animals from within. Conversely, if fewer adults reproduce, there are many fewer caterpillars, but each of them has a better chance of surviving to the butterfly stage. Accordingly, the protection of the adults is, from the point of view of the species, a secondary matter. Of course they must be protected sufficiently well for a reasonable number to survive and reproduce, but after this it is quite unimportant—for the species—if a slightly higher or a slightly lower proportion survives.

It is unimportant for the species but it remains important for the individual. If one kind of adult is better protected than another, it will automatically leave a higher average number of offspring; and so the intra-specific struggle for reproduction among the individual adult butterflies will continue to push any protective devices they possess on toward ever greater efficiency, even though this may be quite immaterial to the survival of the species. The perfection of the kallima's resemblance to a dead leaf is one of the marvels of nature; not the least marvellous part of it is that it is of no value to the species as a whole.

On the other hand, intra-specific competition and struggle need

not always lead to results which are useless to the species. The competition between individuals may concern qualities which are also useful in the struggle of the species against its enemies, as in deer or zebra or antelope—the same extra turn of speed which gives one individual an advantage over another in escaping from wolf or lion or cheetah will also stand the whole species in good stead. Or it may concern qualities which help the species in surviving in a difficult environment; an extra capacity for resisting drought in an individual cactus or yucca will help the species in colonizing new and more arid regions. It will not be useless or harmful to the species unless the competition is directed solely or mainly against other individuals like itself.

Furthermore, the results will differ according to conditions. When there is competition for mates among male birds, it will become really intense only when polygamy prevails and the advantage of success is therefore multiplied. Monogamous birds also stimulate their mates with a display of bright plumage, but in this case the display plumage is never developed to a pitch at which it is actually harmful in the general struggle for existence: the balance is struck at a different level.

All these considerations apply to war. In the first place it is obvious that war is an example of intra-specific competition—it is a physical conflict between groups within the same species. As such, it might be not merely useless but harmful to the species as a whole—a drag on the evolutionary progress of humanity. But, further, it might turn out to be harmful in some conditions and not in others. This indeed seems to be the truth. Those who say that war is always and inevitably harmful to humanity are indulging in an unjustified generalization (though not nearly so unjustified as the opposite generalization of the militarists who say that war is both necessary and beneficial to humanity). Warfare between peoples living on the tribal level of early barbarism may quite possibly have been on balance a good thing for the species—by encouraging the manly virtues, by mixing the heritage of otherwise closed communities through the capture of women, by keeping down excessive population-pressure, and in other ways. War waged by small professional armies according to a professional code, was at least not a serious handicap to general progress. But long-continued war in which the civilian population is starved, oppressed, and murdered and whole countries are laid waste, as in the Thirty Years War—that is harmful to the species; and so is total war in the modern German sense in which entire populations may

be enslaved and brutalized, as with Poland or Greece to-day, whole cities smashed, like Rotterdam, the resources of large regions deliberately destroyed, as in the Ukraine. The more total war becomes, both intensively, as diverting more of the energies of the population from construction to destruction, and extensively, as involving more and more of the countries of the globe, the more of a threat does it become to the progress of the human species. As H. G. Wells and many others have urged, it might even turn back the clock of civilization and force the world into another Dark Age. War of this type is an intra-specific struggle from which nobody, neither humanity at large nor any of the groups engaged in the conflict, can really reap any balance of advantage, though of course we may snatch particular advantages out of the results of war.

But it is one thing to demonstrate that modern war is harmful to the species, another thing to do something about abolishing it. What has the biologist to say to those who assert that war is inevitable, since, they say, it is a natural outcome of human nature and human nature cannot possibly be changed?

To this the biologist can give a reassuring answer. War is not an inevitable phenomenon of human life; and when objectors of this type talk of human nature they really mean the expression of human nature, and this can be most thoroughly changed.

As a matter of observable fact, war occurs in certain conditions and not in others. There is no evidence of prehistoric man's having made war, for all his flint implements seem to have been designed for hunting, for digging, or for scraping hides; and we can be pretty sure that even if he did, any wars between groups in the hunting stage of human life would have been both rare and mild. Organized warfare is most unlikely to have begun before the stage of settled civilization. In man, as in ants, war in any serious sense is bound up with the existence of accumulations of property to fight about.

However, even after man had learned to live in cities and amass property, war does not seem to have been inevitable. The early Indus civilization, dating from about 3000 B.C., reveals no traces of war. There seem to have been periods in early Chinese history, as well as in the Inca civilization in Peru, in which war was quite or almost absent.

As for human nature, it contains no specific war instinct, as does the nature of harvester ants. There is in man's make-up a general aggressive tendency, but this, like all other human urges, is not a specific

and unvarying instinct; it can be moulded into the most varied forms. It can be canalized into competitive sport, as in our own society, or as when certain Filipino tribes were induced to substitute football for head-hunting. It can be sublimated into non-competitive sport, like mountain-climbing, or into higher types of activity altogether, like exploration or research or social crusades.

There is no theoretical obstacle to the abolition of war. But do not let us delude ourselves with the idea that this will be easy. The first step needed is the right kind of international machinery. To invent that will not be particularly simple: sanctions against aggressors, the peaceful reconciliation of national interests in a co-operative international system, an international police force—we can see in principle that these and other necessary bits of anti-war machinery are possible, but it will take a great deal of hard thinking to design them so that they will really work.

The second step is a good deal more difficult. It is to find what William James called a "moral equivalent for war," while at the same time reducing the reservoir of potential aggressiveness which now exists in every powerful nation. This is a psychological problem. Thanks to Freud and modern psychology in general, we are now beginning to understand how the self-assertive impulses of the child may be frustrated and repressed in such a way as to drive them underground. There in the subconscious they may persist in the form of crude urges to aggression and cruelty, which are all the more dangerous for not being consciously recognized.

To prevent the accumulation of this store of psychological dynamite and to find ways in which our self-assertive impulses can issue along conscious and constructive channels is a big job. It means a better structure of social and family life, one which does not inflict such frustrations on the growing human personality; it means a new approach to education; it means providing outlets in the form of physical or mental adventure for the impulses which would otherwise be unused even if not repressed. It is a difficult task; but by no means an impossible one.

Thus in the perspective of biology war first dwindles to the status of a rare curiosity. Further probing, however, makes it loom larger again. For one thing, it is a form of intra-specific struggle, and as such may be useless or even harmful to the species as a whole. Then

we find that one of the very few animal species which make war is man; and man is to-day not merely the highest product of evolution, but the only type still capable of real evolutionary progress. And war, though it need not always be harmful to the human species and its progress, indubitably is so when conducted in the total fashion which is necessary in this technological age. Thus war is not merely a human problem; it is a biological problem of the broadest scope, for on its abolition may depend life's ability to continue the progress which it has slowly but steadily achieved through more than a thousand million years.

But the biologist can end on a note of tempered hope. War is not inevitable for man. His aggressive impulses *can* be canalized into other outlets; his political machinery *can* be designed to make war less likely. These things *can* be done: but to do them will require a great deal of hard thinking and hard work. While waging this particular war with all our might, we have a duty to keep a corner of our minds open, engaged on the job of thinking out ways and means of preventing war in general in the future.

DARWINISM TO-DAY

DARWIN'S great book, *The Origin of Species*, comprised two quite distinct elements. In the first place, it demonstrated, with a vast wealth of examples, that the current theory of the fixity of species was untenable, whether in its theological guise of special creation or in any other form; it simply would not fit the facts of nature. The facts of nature demanded an evolutionary theory: gradual change was the rule in life, constantly producing new types —not only new species, but also larger groups of every degree. In the second place, Darwin proposed a mechanism to account for evolution—the theory of Natural Selection, by which favourable varieties would automatically be accumulated and the apparent purposefulness of life could be accounted for in straightforward mechanistic terms.

It was this latter element which gave Darwin's work its influence among professional biologists. Many of them were ripe for conversion to the idea of evolution, but before 1859 no one had put forward any but the most improbable suggestions as to how evolution could have been brought about. T. H. Huxley, for instance, records how, when he read the *Origin*, he said to himself, "How stupid of me not to have thought of that!" and from then on became the champion of Darwinism.

This Darwinian view of evolution was generally accepted by biologists in the latter part of last century. But about 1890 doubts began to be thrown upon it, and around 1910 it had become so unfashionable that some critics proclaimed the death of Darwinism. By Darwinism, of course, was meant the selectionist theory of the method of evolution: the fact that evolution has occurred was never seriously questioned by biologists after 1859, except by a few survivors from the pre-Darwinian period, and a very few later cranks.

This sceptical attitude of the early twentieth century was due to two main causes. For one thing, orthodox Darwinism was tending to become purely speculative, invoking natural selection to explain anything and everything without requiring proof and without providing any explanation of the machinery by which the results could be brought about. For another, genetics had discovered the fact of mutation—in other words, that hereditary change proceeds by jumps; and the theory was advanced that evolution proceeded by large jumps, not by the gradual change which was the keystone of Darwin's view.

In the last twenty-five years, however, an enormous amount of new facts about evolution and heredity have been discovered, and the balance has now swung over heavily, and, I think, permanently, in favour of Darwinism or selectionism. Chief among these new facts is the discovery that most mutations are not large, but very small steps of change.

It turns out that the reports of the death of Darwinism, like those of the death of Mark Twain, were very much exaggerated. Indeed, the net result of the last quarter-century's work in biology has been the re-establishment of natural selection as the essential method of evolution, and its re-establishment not merely where Darwin left it, but on a far more secure footing. For one thing, the alternative explanations have ceased to be plausible. First among these is Lamarckism, or the so-called inheritance of acquired characters (which means the inheritance of characters acquired by an individual as a result of changes in the environment, like tanning due to sun, or of use or disuse of organs, like the more powerful muscles of the athlete or heavy worker; it does not refer to characters "acquired" through new mutation). This has now been thoroughly discredited. It has been definitely disproved in a number of cases; it cannot in any case apply to a large range of facts (such as the evolution of the hard skeleton of higher insects, or of our own teeth); the apparent examples of its existence have all been shown either to be due to error or susceptible of an alternative explanation; and it is logically self-contradictory.

Second, there is orthogenesis, or evolution in a predetermined direction, supposedly due to the germ-plasm being predestined to vary only in a certain way. It is true that when we can trace the actual course of evolution by means of abundant fossils, we often find that it does proceed in straight lines. The most familiar example is the steady evolution of the horse toward speed and the one-toed foot and toward elaborate teeth for grinding grass—but wherever (as is in most cases obvious) the direction is toward greater efficiency, this is to be expected on the basis of natural selection. In any case, there are some examples, like that of the elephants or the baboons, where evolution is not in a straight line, but changes direction during its course. There are a few puzzling cases, like the trend toward apparently useless or harmful characters, as seen in a number of groups of Ammonites shortly before their final extinction; but they are quite exceptional, and may prove to be susceptible of alternative explanation. In any case, orthogenesis in a useless (or harmful) direction would demand mutation-rates much higher than any yet found in nature.

There are also the vitalistic theories of a mysterious life-force or unconscious purpose, like Bergson's *élan vital*. However, these are in reality not explanations at all, but mere confessions of ignorance. To say that life evolves because of an *élan vital* is on a par with saying that a locomotive runs because of an *élan locomotif*.

Not only have the alternative explanations become implausible, but a great deal of new support has been forthcoming for the theory of natural selection. One of Darwin's difficulties about his own theory (which caused him to give greater weight to Lamarckism than he would otherwise have done) was that he could not see how new hereditary variations of small extent—what we to-day should call small mutations—could be preserved and kept from being swamped by crossing. This, as R. A. Fisher has pointed out, was due to his acceptance of the idea, current in his time, of "blending inheritance." In a cross between two distinct types, the material bases of their heredity (and Darwin's generation completely lacked concrete knowledge on this subject) were supposed to blend in the resultant offspring, as two drops of coloured ink will blend with each other. Thus, any new character would be quite literally diluted on crossing with the original type, and would soon fade out. The essence of Mendelism, however, is that the genes or units of heredity remain unchanged (apart from rare mutation), however they are combined with other genes. Many of the new genes produced by mutation can remain in the germ-plasm indefinitely until conditions are favourable, when they will begin to increase their representation in the stock. If a new mutant gene is recessive—i.e. must appear in double dose before it produces any visible effect—it can be carried in single dose for an indefinite period, even if it is slightly deleterious.

What is more, we now know that the effects of genes can be markedly altered by other genes, and numerous examples exist where slightly deleterious genes have been rendered harmless or even beneficial by being "buffered," in the chemist's phraseology, by new combinations of other genes. A beautiful example comes from domestic dogs. In producing the show type of St. Bernard, man has encouraged features characteristic of abnormal overgrowth of the pituitary gland: yet St. Bernards are not themselves abnormal, as a man with comparable characteristics would be. However, when St. Bernards are crossed with other breeds like Great Danes, a considerable number of the offspring show actual pathological symptoms. In producing his ideal of a St. Bernard, man has selected for genes making the pituitary abnormal: but he has also aimed at healthy dogs and so has automatically selected for other genes which would prevent the

genes influencing the pituitary from exerting any major harmful effect. But when these "buffering" genes are diluted or reduced in number by crossing, the potential abnormality of the pituitary can become actual.

This fact of recombination is the source of a whole category of variation unsuspected by Darwin; much that is new in evolution is due, not to wholly new genes produced by mutation, but only to new combinations of old genes.

To sum up, most of the raw material of evolution is produced in the first instance by mutation of genes into new forms. Owing to the fact that they are not blended in crosses, this new variation does not have to be accepted or rejected immediately, but can be stored in reserve, so to speak. If not acceptable in itself, it can even be rendered acceptable by combination with other genes. And, in the second place, recombination of old genes is capable of producing a large further supply of new variation.

Still another fraction of the raw material of evolution depends on the fact that the genes are arranged in a row along a series of visible (but of course microscopic) threadlike bodies called the chromosomes. Owing to accidents in cell reproduction, whole sets of chromosomes may be added or subtracted. Doubling of the normal complement of chromosomes is a frequent subsidiary method of evolution in plants. The polyploids, as the types with increased chromosome-number are called, are often more resistant to extreme conditions: for instance, polyploids constitute an unusually large proportion of the varieties found in the arctic and mountain regions that have become re-colonized since the retreat of the ice after the Ice Age.

Chromosome-doubling may also occur after a cross between two true species. In this case, a new species is formed at one jump—a process which would have shocked most of Darwin's nineteenth-century followers, who believed that all evolution was gradual. Sometimes such new types are weakly, and die out: in other cases the new combination of genes gives them exceptional vigour, and they may even oust both their parents. The classical example of this comes from the rice-grasses, *Spartina*, which live on mud-flats. During the last half-century a new type of rice-grass appeared in Western Europe, and has been so successful that the Dutch have used it to reclaim land from the sea. Investigation has proved that this is a new polyploid species produced by the crossing of an original European species with one accidentally imported from America. In some areas the European species has been virtually exterminated by the new type.

Another instance is the crossing of the two poppies *Papaver nudicaule* and *P. striatocarpum*, the offspring of which are quite distinct from either parent, are fully fertile, and breed true.

Single chromosomes or groups of them may also be added or subtracted to give favourable results: a cytological accident of this sort gave rise, it seems, to the very successful branch of the rose family which later produced the apples and pears and their relatives.

Finally, bits of chromosomes may be shifted about. Small sections may be repeated, thus increasing the total number of genes available. Sections may be inverted, a process which tends to isolate the genes they contain from those contained in the uninverted section. Or chromosomes may exchange sections, which will help in the reproductive isolation of the new strain.

All these kinds of chromosome mutations, too, provide a source of variation unknown to Darwin, thus helping to account for the almost incredible profusion of distinct species in life (nearly a million in insects alone!). But the most important raw material of evolution seems to consist of gene mutations. In the early days of Mendelism the existence of mutation was taken to mean evolution by big jumps, and to run counter to Darwin's conception of steady and gradual change. This, however, was merely due to the fact that attention was, quite naturally, first concentrated on those mutations which could be readily detected—in other words, those with large effects. Just because they have large effects, however, they are apt to throw the hereditary machinery out of gear, and so not to be of much value for evolution. Later, it was discovered that the majority of gene mutations are of small extent, often quite difficult of detection save by the most refined techniques. And the accumulation of such small mutations, constantly buffered by new recombinations, will give precisely the type of change that Darwin had in mind. Evolution does go by jumps, but in most cases the jumps are so small that they hardly ever take the new type outside the range of variation already existing in the species, and the visible result is a gradual one. Discontinuity of variation is thus translated by selection into continuity of evolutionary change: life marches up a ramp, not a staircase.

So much for the mechanism of evolution. But Darwin was almost equally unprovided with knowledge about the actual course pursued by evolution in different groups and in different conditions. He was aware of the fact that fossils from an earlier epoch differed from the modern inhabitants of the region, though resembling them in general type; he was aware that isolation might play a role in the production of new species; he knew of animal or plant groups which were on

the border-line between a mere variety and an obviously "good" species; he worked out for himself some of the results to be expected of sexual selection (i.e. competition for mates between rival males). But that, together with the indirect evidence provided by comparative anatomy and geographical distribution, was about all.

With this meagre body of knowledge at his disposal, his genius was able to put evolution on the map; but he could not proceed to the further task of mapping evolution itself. That was reserved for the slow cumulative work of several later generations of biologists.

It is not easy to sum up the chief results of that later work in brief and intelligible form; but it must be attempted. First, there is the formation of new species. These, we now know, originate in many different ways, and even those with the same type of origin may come to differ later in size and internal structure. The chief method of origin is through physical isolation. Once two groups are physically isolated so that they can no longer interbreed, they inevitably come to diverge from each other in the new mutations and the new gene-recombinations which they accumulate under the influence of natural selection. And after a certain time the differences in their constitution reach such a pitch that, even if the two stocks are brought together once more, they are partially or wholly infertile on crossing.

In addition, when an isolated group is small in numbers, it can be shown on mathematical grounds that it is likely to pick up and incorporate some mutations and recombinations that are useless or even slightly unfavourable. Thus, some of the diversity of life is, biologically speaking, purely accidental.

These effects, both of physical isolation and of small populations, are well illustrated by the plants and animals of islands. A population on an island is more or less completely isolated from other groups: and, accordingly, islands have a disproportionate number of distinctive sub-species and species, different from the species inhabiting the nearest mainland and from those inhabiting other near-by islands.

The extraordinary number of distinctive species of giant tortoises and of ground-finches on the Galapagos archipelago was one of the main facts met with by Darwin in his voyage on H.M.S. *Beagle* which convinced him of the reality of evolution. Again, there is only one form of mouse-deer on the whole of Sumatra and Borneo, while the Rhio-Linga archipelago close by, with only $\frac{1}{150}$th of the area, boasts no less than seven distinct subspecies.

In the Adriatic a large number of islands have been formed by subsidence of the land since the end of the Ice Age. Many of them are inhabited by distinctive races of lizards. A recent study has

shown that the smaller the island, and therefore the smaller its lizard population, the more different this has become from the mainland type from which it was originally derived (see Table).

DIFFERENTIATION IN ISLAND LIZARDS

area (arbitrary units)	0–6	6–12	12–18	18–24	24–30	30–36	depth (m)
<0·5	2½		2½				
0·5–1	1	1					
1–5	1, 2	1, 2	2, 2½, 2½, 3	3		4	
5–10	1						
10–100	0		2				
100–1000			0				

Table showing the influence of time and of size of population on the differentiation of island lizards from the mainland form. The depth is the maximum depth of water between the island and the mainland; as the islands have been formed by subsidence, the depth gives a measure of the time since isolation occurred. The area represents the area of the island, which is a measure of the population. The figures 1-4 in the chequer-board represent degrees of difference of the island forms from the mainland form. It will be seen that on the whole the longer the time of isolation and the smaller the size of the population, the greater is the degree of divergence. (Reproduced by kind permission of the publishers of J. S. Huxley's *Evolution : the Modern Synthesis*, Messrs. Allen & Unwin.)

The other chief method by which new species are formed is through genetic isolation. This happens when a new form, wholly or partly infertile when crossed with its parent, is produced by some genetic accident—by means of the reduplication of whole chromosome sets,

with or without previous species-hybridization; by means of the subtraction or addition of whole chromosomes; or, in some cases, by the breakage of chromosomes and the reunion of the pieces in new arrangements.

The result is an overwhelming multiplicity of distinct species. Naturally they are all adapted to their surroundings: but the geographical and cytological accidents that produced physical and genetic isolation cause their number to be much greater than that which would be necessary on purely adaptive grounds; and non-adaptive variation adds its quota to the diversity.

Most of evolution is thus what we may call short-term diversification. But this kaleidoscopic change is shot through with a certain proportion of long-term diversification in the shape of the long-range trends revealed in fossils by the palaeontologist and deduced from comparative studies by the morphologist. These trends are almost all of them one-sided specializations, each one exploiting a particular mode of life. Thus, both reptiles and mammals, beginning with small and generalized creatures, radiated out into specialized lines including carnivores, herbivores, climbing forms, flying forms, and aquatic forms. Every possible niche is filled; some trends even involve degeneration, such as the trend of the barnacles from a free-living, shrimp-like creature to a sedentary life, or of other active crustacea to an existence as shapeless parasites.

These trends may continue for a very long time—up to tens of millions of years: but they always come at last to a dead end. After this, minor diversification may continue at the species level, but no further improvement takes place in the major specialization. Thus, birds ceased to show any improvement as flying mechanisms some 15 million years ago, and there has been no evolutionary improvement of the ant type for perhaps 25 or 30 million years.

Such trends in a given direction are to be expected on Darwinian principles. Improvement of teeth and claws for a carnivorous existence, for instance, will be an advantage to a small generalized mammal when there are no specialized carnivorous mammalian competitors already in the field, and will be favoured by natural selection. And once the type has become at all adapted to flesh-eating, it will be almost impossible for it to switch over to a herbivorous existence, for example: the number of mutations needed is much too great, and meanwhile any single mutation making for greater efficiency as a carnivore will be caught in the net of natural selection and incorporated in the constitution of the stock. The stock thus finds itself at the bottom of an evolutionary groove of specialization. Natural selection

forces it farther along in the same direction, while constantly deepening the groove and so making it ever more impossible for the stock to escape out of it into some other way of life. The dead end comes when the specialization is so near its maximum possible perfection that selection cannot force the stock any further.

A third and still rarer type of change is evolutionary progress, which escapes the dead end awaiting specialization. It does so because its essence is all-round improvement, as opposed to the one-sided improvement that characterizes all specialization. It raises the general level of life's performance, instead of merely improving performance in respect of one particular mode of existence. The development of a head and brain or of a blood-system were early steps in progressive evolution, while the acquisition of "warm blood" and so of a constant internal temperature, or the gradual development in mammals of higher mental faculties such as association and the capacity for learning by experience, are later examples.

The net result of evolutionary progress can be defined as the raising of the upper level attained by life in respect of certain very general properties—greater control; greater independence; greater harmony of construction; greater capacity for knowledge (and, we may probably add, for emotion). More concretely, it has permitted the rise of a succession of what the biologist calls dominant groups, because they spread and evolve rapidly, cause the extinction of many representatives of other groups, and play a new and predominant role on the evolutionary stage. The last three dominant groups in life's history have been the reptiles, the mammals, and man, each later one arising from an unspecialized branch of the one before. Most (or, in some cases, all) the branches of a dominant group undergo specialization, and then eventually come to a dead end, either by ceasing to evolve, or by the still deader end of complete extinction, as with most of the reptilian specializations, like the Dinosaurs, Ichthyosaurs, and Pterodactyls.

I said that progressive lines were rare. If we define progress strictly as capacity for unlimited further avoidance of dead ends, there has only been one progressive line in the whole of evolution—that which has led in its later stages through fish, amphibian, reptile, and mammal to man; for it appears established that all other lines have come to an evolutionary dead end well before the later part of the tertiary period.

Thus, in the broad view, evolution as a process consists of one line of unlimited progress among thousands of long-range trends toward specialization, each of these latter in turn beset with a frill, so to

speak, of thousands of short-range diversifications producing separate species. Some of the peculiarities of these separate species are due to non-selective accidents; but all the rest have been closely guided and moulded by natural selection.

Darwin introduced time into biology, and forced us to regard human history as the extension of a general process of change, operating by an automatic natural mechanism. Darwinism to-day has fully confirmed these general conclusions, but has, in addition, enabled us to distinguish between different types of change, and to link up human with biological history more fruitfully by introducing the idea of progress and the criterion of desirable or undesirable evolutionary direction.

The modern extension of Darwinism has also enabled us to analyse the process of selection in a way that was impossible in Darwin's day. In the first place, the intensity of selection may vary very considerably, and this will be reflected in its results. Where a group is freed from the full normal pressure of competitors or enemies, it is enabled to evolve in quite unusual directions. The classical examples of this are found on remote oceanic islands. In such areas of biological low pressure, the few types which manage to find their way thither proceed to radiate out in many new directions. The best instance is that of the birds called sickle-bills (*Drepanididae*) on the Hawaiian archipelago. Derived from some kind of honey-creeper, they have in their oceanic isolation evolved into no less than 18 separate genera, adapted to an extraordinary range of habits, from nut- to insect-eaters, from woodpecker-like types to nectar-sippers, each with a characteristic form of bill.

In the Great Lakes of Africa, nature has conducted a demonstrative experiment by permitting powerful predatory fish to reach some lakes but not others. The little fish known as Cichlids exist in all the lakes. Where predators are present, as in Lake Albert, only four different Cichlid species have evolved since the Ice Age; but where predators are absent, as in Lake Victoria, there are over fifty Cichlid species, adapted to many new habitats and ways of life. Predator-pressure has had a restrictive effect on the diversification of prey.

The same sort of thing has happened in Australia, where the early or marsupial type of mammal was isolated before the more efficient placental type had been evolved. Accordingly, as everyone knows, the marsupials in Australia have produced dozens of types, such as kangaroos, Tasmanian wolf, and flying phalanger, not found either living or fossil in any other part of the world. Elsewhere the pressure of more efficient competitors has prevented this efflorescence, and

only a few generalized marsupials, such as the American opossum, have survived.

The Australian marsupials illustrate another point. The Australian area is much smaller and less varied than the great land masses of the northern hemisphere where the higher placentals evolved. There is less scope for variation, less need for extremes of efficiency, so that general selection-pressure never became so intense. As a result, the Australian marsupials were not pushed so hard or so far along their lines of specialization as were the placentals; they were not forced to such a pitch either of biomechanical efficiency or of intelligence; and they at once go downhill and are threatened with extinction when they have to compete with introduced placental types.

Even more interesting are the recent studies on qualitative differences in the results of different kinds of selection, or, if you prefer, of selection operating in different circumstances. Thus a peculiarly acute competition takes place before birth among such mammals as produce several young at a time. More eggs are always fertilized than can survive to birth; there is thus an intra-uterine selection which puts a premium on quick and vigorous growth, for any laggard embryos will fail to get their fair share of the available nutriment and will die and be resorbed or aborted. As J. B. S. Haldane has pointed out, this pre-natal rapidity of growth will certainly tend to continue after birth; and so the slow growth and prolonged infancy which makes human learning possible could never have been evolved except in a mammalian stock like that of the monkeys, where only one young is normally born at a time.

Haldane has also drawn attention to the interesting point that instinctive altruism, such as is shown by bees or ants, cannot possibly be evolved except in social organisms where reproduction is confined to a limited caste and the altruistic types are sterile.

The most far-reaching conclusion deriving from modern analysis, however, is that the results of natural selection are not necessarily beneficial to the species, and may even be harmful. This apparent paradox is based on the fact that much of the struggle for existence is not directed against the forces of nature, nor against enemies, nor against competitors of other species, but against other members of the same species. Not only does the species as a whole have to struggle (in a metaphorical sense) to survive and reproduce, but so do the individuals within it. In a given species of butterfly, for example, only a small proportion of the young caterpillars will survive into the butterfly stage. But among these, the decision as to which shall reproduce may depend on whether one can escape detection by its enemies

better than others. Accordingly protective resemblance, as, for instance, of the famous Kallima to a dead leaf complete with imitation veins and mould-spots, may be pushed to an incredibly high pitch, and yet have no effect on the survival of the species as a whole, which will be decided mainly by the capacity of the caterpillars to survive their much more numerous dangers.

Other examples of such "hypertelic" adaptations are seen in the leaf-fish, which drifts up to within reach of its prey under the guise of a floating dead leaf; the sea-horse of the Sargasso Sea, which resembles a bit of Sargasso weed; or the extraordinary plant-bug *Heteronotus*, which carries about an imitation ant on its upper surface to scare off its enemies.

This *intra-specific* competition is most obvious when rival males compete for mates, and most acute when polygamy prevails and success in reproduction thus brings a multiple advantage. When this is so, the characters which bring success in mating may become so over-developed as to embarrass their possessors in the struggle for mere existence, as with the train of the peacock or the wings—almost useless for flight—of the argus pheasant. Sexual selection here has benefited none but certain types of males as against others: its results for the species as a whole are harmful.

This distinction, it is clear, has great importance for human affairs. Apologists for the *laisser-faire* system on the one hand and for militarism on the other hand, appealed to the Darwinian struggle for existence as a justification. Now we realize that these forms of the struggle, far from being helpful, are either useless, in which case they will be also wasteful, or actually inimical to progress.

Space forbids more than the barest mention of the ways in which studies on development have illuminated some of the dark places of evolution. I will confine myself to two examples. The antlers of a stag, like the jaws of a male stag-beetle and many other masculine characteristics, increase disproportionately with the increase in the adult size of the animal. In a small stag, the antlers average about 2 per cent. of his total weight. But in a large stag weighing twice as much, the antlers average almost 4 per cent.—while the body has doubled its weight, they have quadrupled theirs.

If now during the evolution of deer, selection takes place for increased bulk, there will be an automatic tendency for the antlers to increase in relative size (a conclusion borne out in general by the relative weight of antlers in species of deer of different sizes). Selection may also operate directly on antler-size, but so far as our automatic tendency is operative, change in relative antler-size is a mere by-

product of change in general size. It is what Darwin called a "correlated character"—something useless in itself but correlated with some other character which is useful. We now know of a great many such correlated characters—for instance, tuning up or down the activity of one or other of the ductless glands to adjust the animal to its particular environment may produce changes in colour or in bodily proportions—and without question a great many apparently meaningless differences characterizing related species or sub-species are mere external signs of such invisible but insignificant inner adaptations.

Another old objection to Darwinian explanations of evolution is the incredible complexity of the detailed adjustments needed to effect a change such as the lengthening of an animal's neck. To take but this one example: all the tendons tying the neck vertebrae together must be strengthened and their direction adjusted. How could random variation and selection account for this? We now know that the tissue of which tendons are made, like many other tissues of the body, has the faculty of responding to demands upon it—by excess growth and by changes in the direction of its fibres. Granted this one basic adaptation, all the rest follow. The myriad detailed adjustments are not determined by heredity and selection, but are built anew in each individual during its development.

In these and many other ways our modern knowledge of growth and development has lightened the burden on natural selection, at the same time that advances in heredity have shown natural selection to be a much more flexible instrument than the last generation of biologists thought possible.

To sum up, Darwinism to-day is very much alive. In certain respects, indeed, modern evolutionary theory is more Darwinian than Darwin was himself. Darwin's special contribution to the evolution problem was the theory of natural selection, but, owing to the rudimentary state of knowledge in certain biological fields, he was forced to bolster this up with subsidiary Lamarckian hypotheses, of the inheritance of the effects of use and disuse and of modifications produced by the direct agency of the environment. To-day we are able to reject these subsidiary hypotheses, and can demonstrate that natural selection is omnipresent and virtually the only guiding agency in evolution.

Darwin has with some justice been called the Newton of biology. Like Newton, he gave his science a unifying concept, and one capable of extension into every corner of its field. There are evolutionary implications in every branch of biology. The human physiologist

may provide the most detailed physico-chemical analysis of some bodily process: but his description will be incomplete unless he takes account of its evolutionary history as well.

The unifying power of the concept is also seen in the way in which the study of evolution makes a call upon the most diverse fields of biological study and links them together in solving its problems. Comparative anatomy, embryology, natural history and ecology, classification, palaeontology, genetics and cytology, the study of behaviour—all these and many more are now meeting and illuminating each other in the new evolutionary synthesis.

Evolution, too, was one of the first branches of inquiry to demand that relativist point of view which is becoming increasingly central to the modern scientific outlook. The single organism, looked at through evolutionary spectacles, has no meaning except in relation to a particular environment, to a particular set of enemies and competitors, to a particular past history, and to a particular set of potentialities for the future. All this was implicit in Darwin's masterly formulation of the problem.

The implications for man and for his general conception of nature and of his own place in nature are equally far-reaching. The idea of a past Golden Age vanished into smoke; so did all static conceptions of human life. In their place we see inevitable change and possible progress, while at the same time the time-span of the human drama is enlarged a thousand-fold in the past and still more in the future.

Newton showed that the same general principles applied to the motion of heavenly bodies and to that of the humblest terrestrial objects. Similarly, Darwin, with his few simple principles of the struggle for existence, natural selection, and consequent adaptation, linked man with all the rest of life, from monkeys and flowers to bacteria and amoebae, in a common web of necessity and change. The fundamental principles of Newtonian physics have now been superseded (though it still remains as the most effective first approximation to physical truth). Though Darwin's principles have been more modified in detail than Newton's, there seems less likelihood of their being superseded by a different set of basic principles. There are no signs that evolutionary biology will not indefinitely remain Darwinian.

THOMAS HENRY HUXLEY AND JULIAN HUXLEY: AN IMAGINARY INTERVIEW[1]

JULIAN (*rather crossly*): The fellow who runs these interviews has told me to come here and exchange a few words with my grandfather, Thomas Henry Huxley, who died in 1895 at the beginning of his seventy-first year. That's all very well, but how can even the B.B.C. put one in touch with a world of departed spirits—in the existence of which my grandfather no more believed than I do, though he was scrupulously undogmatic in all merely speculative judgments of that kind?

I remember him very vividly, as a child does.

THOMAS HENRY: And I remember you, young Julian.

JULIAN: But what *are* you?

THOMAS HENRY: A projection of your private fancy.

JULIAN: That's a good working hypothesis, anyhow. After all, your achievements, both as a scientist and as an expositor of science, have meant a tremendous lot to me, and did exercise a most powerful influence on my early life and career.

THOMAS HENRY: Well, there's no reason why our working hypothesis should obstruct our conversation. You spoke of your career, Julian. I understand that you have become a biologist, like myself. I knew you had the makings of a biologist in you, my boy, from the day that you, as a child of seven, put me right on a point of biological fact.

JULIAN: My father often told me about that. I wish I could remember the occasion!

THOMAS HENRY: Yes. It was at the luncheon-table. There was some talk about parental care in animals, and I remarked that one didn't find it among fish. Whereupon you piped up: "What about the stickleback, Gran'pater?" How we all laughed!

JULIAN: I bet you did.

THOMAS HENRY: The beauty of it was that you were right. My general statement—that fishes take no care of their young—was true. But of course there are sporadic exceptions. And the stickleback is one of them.

JULIAN (*laughing*): Well, it's very gratifying. I think I'd been reading one of those popular children's books on biology by Arabella Buckley.

[1] Originally arranged as a broadcast.

THOMAS HENRY: I fancy you had. . . . Ah, those were happy times —or so we thought. In any case, they were very happy in comparison with your present chaos.

JULIAN: I gather you don't find 1942 a very congenial period? I'm not surprised!

THOMAS HENRY: From all I hear, it's a bad time for a Victorian scientist to come visiting.

JULIAN: You discussed a great many topics in those famous essays of yours, but I don't remember that war was among them.

THOMAS HENRY: I think you are right. We lived through various wars: but we never conceived, even as an idle speculation, that the world as a whole would ever again collapse into a state of belligerent barbarism, nor did we dream of what you call total war.

JULIAN: And what about the political theories of to-day? You, I know, like most progressive men of your time, were a great admirer of German science, German literature, German philosophy. What do you make of their modern doctrines of Blood and Soil, of Aryan and Nordic racial superiority, of their burning of books, their persecution of thought because it is unorthodox by Nazi standards, or even because it is Jewish?

THOMAS HENRY: It appals me. Knowing that cranks are always with us, I'm not in the least surprised to find *some* people believing such nonsense. But that it can have become the official doctrine of a great nation, and apparently one of the forces contributing to its military triumphs, and to its belief in its high destiny—this I find scarcely conceivable.

JULIAN: It isn't conceivable—but it's happened.

THOMAS HENRY: It must have shaken the very foundations of your thinking.

JULIAN: Of course, we have had nearly thirty years to adjust ourselves to the collapse of the world system that seemed so stable and so full of promise in your time and even in my young days. . . . First the war of 1914-18; then a period of cynical disillusionment; then the most spectacular economic collapse in history; then the rise of Fascist aggression. But there are plenty of people who have still not adjusted themselves, and quite fail to realize that they're living in the middle of one of the greatest revolutions in human history.

THOMAS HENRY: What about those who *do* realize that they are living in a revolution, but happen not to enjoy the fact? I am trying, you see, to visualize the impact of the situation.

JULIAN: Well, there are several ways in which such people react. A few indulge in tempered optimism and try to plan ahead for the

new world that must some time or other emerge. Some—and these perhaps the majority—are consciously pessimistic. And many try to escape from an unacknowledged pessimism by taking refuge in superstitions, like astrology, or in mere hedonism.

I expect this widespread pessimism strikes you as one of the chief differences between our age and yours.

THOMAS HENRY: I always did my best to demonstrate the falsity of unreasoning optimism, about the inevitability of progress and the like. But it is true that the general background of our age was optimistic; knowledge and invention and material wealth were all increasing; and superstition and bigotry were being pushed on to the defensive. Optimism, within limits, seemed justifiable.

JULIAN: Actually you were very lucky in your period. It seems to us to-day that you had a double advantage. New discovery and new techniques, in making expansion inevitable, had rendered hope reasonable, while at the same time the stable framework provided by traditional ways of thinking had not yet been lost.

THOMAS HENRY: I'm not sure that I understand you. I would say that we *had* largely destroyed traditional ways of thinking—at any rate, the claims of theological orthodoxy and of out-of-date authoritarian systems of political thought.

JULIAN: Yes. But you still lived in a tidy world of absolute Truth and absolute Morality.

THOMAS HENRY: Can you really say that? We believed in the scientific spirit and therefore in a steadily increasing harvest of truth and a steady destruction of error. And we believed that the laws of moral conduct resemble the laws of nature in being discoverable only by observation and experiment. But we emphatically repudiated the claims of the clerics and all others who set themselves up to be in possession of a complete body of truth and a complete system of morals.

JULIAN: All the same, though you did attack and overthrow authoritarian truth and authoritarian morals, the truth and the morality which you were discovering and testing were still surely regarded as absolutes. To-day the more philosophical among us prefer to regard science and morality from a relative point of view, as organs of society, varying according to the conditions of the time.

THOMAS HENRY: But surely you would not deny that morality has an absolute quality—what Kant called the Categorical Imperative?

JULIAN: It has the quality of being *felt* as absolute. But that, according to modern psychological discoveries, is the result of the somewhat crude psychological process called repression, which we all undergo in infancy.

THOMAS HENRY: I should like to know rather more about these discoveries you talk of before committing myself to what seems at first hearing to be a deplorable degree of moral relativity.

JULIAN: I would recommend your perusing some of the works of Freud. You will undoubtedly experience a considerable inner resistance against accepting his main conclusions, just as many in your time experienced a resistance against accepting the conclusions of Darwin. But once that resistance is overcome, I venture to say that you will find them very illuminating.

THOMAS HENRY: I hope so. But I still fail to see how they can dethrone morality from its position of transcendental importance in life.

JULIAN: That, if I may say so, is because you were always a great moralist as well as a great scientist. But there's a question which I have longed to ask you ever since, as a young man, I read your famous Romanes lecture, *Evolution and Ethics*. There you stated (I remember the passage vividly) that the ethical progress of society depends not on imitating the cosmic process but in combating it, and by the cosmic process you of course meant mainly the ruthless struggle for existence. As an evolutionist, I never understood how man, himself a part of nature, could fulfil his destiny by fighting against that same process which gave him birth.

THOMAS HENRY: Is it not self-evident? Any theory of ethics cannot but repudiate the gladiatorial theory of life; the practice of virtue must be opposed to the type of conduct which is successful in the cosmic struggle for existence.

JULIAN: I begin to see your point. But I think that modern biology has something rather different to say on the subject. To-day, after eighty years, we look back to Darwin as the Newton of our science, the man who gave it the unifying concept for which it had been waiting. . . .

THOMAS HENRY (*interrupting*): Yes, yes, very true. That was how his work seemed at the time—a flash of light illuminating a dark and confused landscape. When I first read *The Origin of Species*, I said to myself, "How extremely stupid not to have thought of that!"

JULIAN: Yes, I remember. And you had the rare privilege for a scientist, not only of living through one of the great controversies of science, but of playing an outstanding part in getting the new theory accepted. But to return to my point. In your day, the urgency was to demonstrate the fact of evolution. But now biology has moved beyond that stage and has built up a fairly full and detailed picture both of the course of evolution and of its methods.

THOMAS HENRY: The theory of Natural Selection as Darwin presented it was certainly very general, and I confess that I was always a little sceptical over the theorizing zeal of some of his followers, and anxious for a fuller basis of concrete fact. So do tell me something about the new developments.

JULIAN: Well, for one thing we now have a pretty thorough knowledge of the astonishingly elaborate machinery of heredity and hereditary change through which evolution comes into being. But it would take too long to go into all that now, and I can only recommend that you include some books on mendelian genetics in your reading list. What I think is chiefly relevant to our discussion is that biologists have now arrived at two far-reaching conclusions: one about the struggle for existence, the other about its results.

THOMAS HENRY (*reminiscently*): The struggle for existence—my friend Tennyson summed it up: "Nature red in tooth and claw."

JULIAN: That appears to have been an undue simplification. For instance, intelligence seems to have played as important a part in evolution as brute force, and co-operation has contributed as much as competition.

THOMAS HENRY: That certainly bears thinking about.

JULIAN: But that is not my main point. We now distinguish two radically different forms of the struggle for existence. One is primarily a struggle of the species as a whole against its enemies and against the adverse forces of nature, and the other is a struggle for success between individual members of the species. And this latter kind of competition within the species may not benefit or improve the species as a whole in any way, and in some cases can be shown to be actually harmful to it.

THOMAS HENRY: That seems a paradox, but nature is often paradoxical, and I am prepared to accept it. You imply that my "cosmic process" represents only this less useful form of the struggle, while the ethical force which makes for human progress represents the other?

JULIAN: Roughly speaking, yes. And your word *progress* brings me to my second point. I think the most important outcome of biology for general thought has been the demonstration that there *is* such a thing as progress in biological evolution.

THOMAS HENRY: You mean even apart from man? But there is the fact of degeneration to reckon with, and also the fact that an amoeba or a louse is every whit as well adapted to survive as a singing bird or the most gifted human being.

JULIAN: But surely progress does not cease to exist either because it is not universal or because it is not inevitable? Your generation

put evolution on the map: ours has mapped evolution. And our analysis has shown that progress is one of the types of evolutionary change. It is true that most of the results of evolution are not progressive. Much is mere change; much else, though advance, is one-sided advance, doomed to come eventually to a dead end. But a narrow thread of true progress does run through the whole web of change.

THOMAS HENRY: I hope you are not arguing in a circle, and defining progress merely from a human standpoint. After all, man is but one species among hundreds of thousands.

JULIAN: No, progress can be defined biologically in a perfectly objective way, as denoting increased harmony of construction, increased capacity for knowledge and for feeling, and increased control over nature, increased independence of outer change.

THOMAS HENRY: I still have the feeling that you are slipping back into an anthropomorphic view, and creating progress in your own image.

JULIAN: I don't think so. In fact, it is the exact reverse. The Middle Ages judged the universe from the standpoint of man: the modern biologist investigates the trends of evolution, and then finds that man happens to be at the top of the trend toward progress.

THOMAS HENRY: Man as the trustee of progress instead of the Lord of Creation?

JULIAN: If you like. At any rate, it is some comfort to feel that there is some standard, some direction in things, quite independent of ourselves. Against that background, this fearful war can be seen in better proportion and better perspective, and our efforts and sufferings appear as part of a process which extends far beyond the immediate necessity of winning.

THOMAS HENRY: That is one of the gifts of science: it sets our life in the midst of spacious and inspiring vistas, while never allowing us the delusion that we can achieve anything without effort. But ultimate standards are rather too large a proposition to discuss now: it's time for me to leave you.

JULIAN: Not so soon, surely?

THOMAS HENRY: What can it matter? I am merely, after all, a projection of your private fancy. Wasn't that agreed at the outset?

JULIAN: All the same, there's much else we could say to each other.

THOMAS HENRY: Indeed, yes. Even from the little you've had time to tell me, it's clear that science has made great strides since my day. I am old, I come from another age, but perhaps I am not entirely out of date.

JULIAN: No, you're certainly not.

THOMAS HENRY: If I may bring a message from my age to yours, I would say three things. First, do not let the advance of science slacken, for knowledge is power, and the pursuit of truth is one of the ultimate and eternal imperatives for man. Second, do not allow science to be divorced from morality: your age has different views on morality from mine, but we both agree that moral rectitude is another of the ultimate human imperatives, and that it is linked with something outside ourselves. Finally, there is freedom: one of the sentences I am proud to have written is this—"It is better for a man to go wrong in freedom than to go right in chains." Therefore I say to you: Hold fast to truth, to justice, and to freedom. These are still the only foundations on which any enduring new world can be built.

DOCTOR SPOONER: THE GROWTH OF A LEGEND

DOCTOR SPOONER was one of the rare few who have not only become a legend during their lifetime, but, like Colonel Boycott, given their name to a new word. The word "Spoonerism" appeared in our dictionaries years before Spooner's death. A Spoonerism is defined—I quote the big Oxford Dictionary—as "an accidental transposition of the initial sounds, or other parts, of two or more words." The example given in the Concise Oxford Dictionary is "a well-boiled icicle" instead of "a well-oiled bicycle"—to my mind, a very poor one, but I hope to give plenty of better ones later.

Almost all of us make Spoonerisms sometimes, and some people deliberately invent them. Why, then, has Spooner's name been attached to this verbal form of slip? And why have so many Spoonerisms been quite unjustly fastened on to him as their parent? The growth of a legend such as this is quite an interesting subject for study, and I shall discuss the Spoonerism from this angle. I had the good fortune to serve under Doctor Spooner for six years when I was a Fellow of New College and he was Warden of that ancient and distinguished foundation. He established what must, I think, be a record for an Oxford or Cambridge college, namely continuous residence for sixty-three years without missing a single term—first as undergraduate, then as Fellow and Tutor, then Dean, and eventually Warden. And he survived and remained active for several years after his retirement at the age of eighty.

Though he published very little, he was a good scholar and a good teacher. He was an excellent administrator, with the rare gift of making people feel that he was deeply interested in their own particular affairs. He worked very hard, without any thought of self, and gave the impression of possessing that rare quality which I can only describe as saintliness. But he had his peculiarities. To begin with, he was an albino—not a full albino with pink eyes, but one with very pale blue eyes and white hair just tinged with straw-colour. As is common with albinos, he was very short-sighted and used to read with his eyes within a couple of inches of the paper. When, at the age of thirteen, I went up to stand for a scholarship at Eton, he was the examiner, and I shall never forget seeing him reading our exam papers in this fashion, every now and then putting the paper down on the desk and making a big mark with a big blue pencil on some mistake—

every time this happened I would always imagine that it was my paper he was dealing with. Then he was rather a small man with a strange, rather buttery sort of quality in his voice. And finally, he did say, and write, and do some very odd things. A neurologist would doubtless tell us that he had something a little wrong with some of the association centres in his brain, which led to his saying the wrong word, or in some way making the wrong association. The curious thing was that this did not make him any the less efficient in the varied intricacies of college business.

True Spoonerisms, in the dictionary sense, he very rarely produced. There is, however, a good deal of evidence for his having actually announced the hymn "Conquering Kings their titles take . . ." as "Kinkering Congs." And for his having said to a stranger who was sitting in his seat in chapel: "Excuse me, but I think you are occupewing my pie." But almost all the old favourites among Spoonerisms are pure inventions, which were afterwards tacked on to him. For instance, he never really said to the lady who asked him what happened to the cat which fell from a fourth-story window: "Oh, she just popped on her drawers and away she went." Nor did he ever say to the lazy undergraduate: "You have hissed all my mystery lectures. In fact, you have tasted two whole worms and you must leave Oxford this afternoon by the Town Drain." As I said, most of his actual slips were in the nature of what one might call "paraphrasia." I twice personally heard him make a slip of this sort. When the Oxford University Expedition was going to Spitsbergen, I had been explaining to him that the reason for our choice of that barren land was that, owing to the Gulf Stream, you could go so far north without great difficulty. When I called to say good-bye, he retailed this to his wife: "My dear, Mr. Huxley assures me that it's no farther from the north coast of Spitsbergen to the North Pole than it is from Land's End to John of Gaunt!" That was a typical false association. Again, once when I was going with him on some matter of college business to a village near Oxford, we passed a farm which I happened to know was called Bayswater Farm. And as we passed this he turned to me and, with his customary sweet smile, said: "A curious thing, my dear Huxley, but that farm's called Piccadilly." My only conclusion was that both Piccadilly and Bayswater are in the West End of London.

Then there is another one that I believe to be well authenticated. A Fellow of the college had been ill, and in his absence a piece of college business had been decided, in a way which went against his known views; a day or so later, Spooner, meeting the man's wife in

the street, asked after his health and then said: "But I'm afraid that when he hears what we did at the college meeting yesterday he'll gnash his tail!" That, I think, bears the stamp of truth. Then a very curious one, which a friend assures me actually happened. The Indian mystic, Krishnamurti, was, if you remember, taken up as a young man by Mrs. Annie Besant, who expressed the view that he was an incarnation of Jesus. He came up for admission as an undergraduate at New College. As the lists were being gone through, the Warden said: "Next we come to the name of Mr. Krishnamurti. I understand that Mr. Krishnamurti is supposed to be an incarnation of Our Lord, so of course we can't have him at New College." I think we all see what he meant, but he certainly put it in a rather curious way. As illustrating the way legends grow, that story afterwards had another—quite mythical one—tacked on to it, to the effect that Spooner added that he might have a better chance if he tried a certain other college, the President of which notoriously had a weakness for celebrities.

Then there is a story which I don't vouch for, though it rings true to type. Spooner was supposed to have been preaching one day in a village which was one of the New College livings, and gave a long sermon all about Aristotle. There were only about two people in the congregation who had ever heard of Aristotle, and their rather dim recollections didn't tally very well with what the Warden had been saying. He had finished his sermon and was half-way down the pulpit stairs when suddenly something struck him, and he trotted up again and said: "Excuse me, dear brethren: I just want to say that in my sermon wherever I said Aristotle I *should* have said St. Paul."

Then it is not generally known that he sometimes did the same sort of thing—committing what I called "paraphrasia"—in writing as well as in speaking. I once had a pupil—let us for the sake of argument say his name was Wilson—who, after he'd taken his degree, wrote to the Warden asking if he could stay up for a year, as he wanted to continue working under his tutor—in other words, me. He showed me the letter he received in reply. It began: "My dear Wilford"—his name being Wilson—"I think it would be a very good thing if you stayed up and went on working under your father." Here he had not noticed what he had done. But apparently he used sometimes to read over his letters and see that he had made a mistake. If so, he used to scratch out the mistake—but just with one line, so that you could still read the wrong word—and write the right word over the top. I was shown two letters of this sort by a tutor of New College. One of them was rather pathetic. It ended up "Yours very truly," but

underneath, with a line through it, "poorly." I suppose he was feeling poorly when he wrote the letter. Another was written to congratulate the same man on his wife's recovery from a serious illness. In it he wrote: "I am so glad to hear that you are at last relieved from your terrible burden of anxiety," and underneath, with a line through it, "debt"—an all too normal association!

Then he sometimes used to make slips in action. The wife of an Oxford Professor once told me that she had been dining at New College in the Warden's lodgings, where there is a very fine but very slippery old oak staircase you have to go down from the drawing-room. When she was going home the Warden said: "Oh, I'll come and turn on the other lights and see you safely down the stairs." But when he got to the staircase he turned out the only light that was on, and proceeded to lead the way down in total darkness. Luckily his daughter came to the rescue and switched the lights on.

With all these peculiarities, it was little wonder that the legend grew. Let us remember that legends grow very readily in old-fashioned University circles, especially if aided by the inventions of rather naughty colleagues. Anyhow, this certainly happened in New College in the 'seventies and 'eighties—with the result that the word Spoonerism—I cite the large Oxford Dictionary—"was in colloquial use in Oxford as early as 1885 and in general use all over the country before 1900."

By now, there are hundreds of these invented stories fastened on to the legend of Spooner—mostly silly, but some of them, I really think, have enriched our national stock of humour. Let me emphasize again that all these are quite certainly mythical. There is a familiar one which I like very much about his having (so the story ran) made an engagement to meet a man at a certain public-house in south London. He came back very, very tired and weary at the end of the day, without having been able to find the man; but it turned out the public-house that he had been vaguely looking for was the Dull Man, Greenwich, whereas really the appointment was for the Green Man, Dulwich.

Perhaps the best of all Spoonerisms are the very simple ones; the one I think I personally like best is the tale—again quite mythical—of Spooner having his hat blown off and running after it, saying, "Oh, please, will nobody pat my hiccup." But there is a very elaborate and ridiculous one that I rather enjoy. He and Mrs. Spooner—so the story goes—were taking a vacation in Switzerland, where he got interested in glaciers and had been studying books on the subject till he was full of technical terms like crevasses, and erratic blocks, and moraines, and

séracs, and all the rest of it. And then one day he had gone out for a long walk with his wife, who, by the way, was a handsome woman, considerably bigger than he was, and they hadn't come back for lunch. People were getting anxious, when at last he turned up. Asked what had happened, he said: "Oh, we had a very remarkable experience. We went far up the valley, right out of sight of the hotel, and as we turned a corner, we found ourselves completely surrounded by erotic blacks." He meant, of course, erratic blocks—the big boulders left standing about after being transported by an ice-sheet.

Then there is one so obviously made up that I need not labour the fact. It is also so subtle, or perhaps I should say so improbable, that many people don't think it funny at all. The story was that he went into an optician's shop in Oxford and asked for a signifying glass. The optician said: "Excuse me, I didn't quite understand?" "Oh, just an ordinary signifying glass." "I'm afraid we don't stock them: could we write to London for one?" "Oh, no, it doesn't magnify, it doesn't magnify" . . .

The legend grew in other ways too. I remember the story of a Scotsman being shown round Oxford by a don friend of his. He was always asking what everything cost and what such-and-such a position was worth. He having thus discovered the salaries of the Master of Balliol, the Rector of Exeter, the Dean of Christ Church, the Warden of Wadham, and so on, his friend saw Spooner and pointed him out—this was in the days before he became Warden—and said: "Look, there goes the albino of New College." "Very interesting," said the Scot; "and what may the Albinoship of New College be wor-rth?"

Spooner naturally knew of his reputation, though apparently he was not conscious of any of his actual lapses at the time that he made them. I think perhaps the greatest applause he ever got was once at a college Gaudy, when past members of the college come up for a reunion. He concluded one of his charming little speeches with the words: "And now I suppose I'd better sit down, or I might be saying—er—one of those things."

To wind up, I will tell one of his real utterances which I had direct from a distinguished historian who overheard it. Spooner after his retirement—though retired, of course he was still called Warden by everybody—had invited to some New College celebration the Head of another college where the title of the Head is *President*. The President was late—and everyone was waiting rather impatiently. At last in he came. Spooner was standing with his back to the door, and the President strode up to him, clapped him on the shoulder and

stretched out his hand. You or I would have said "Good evening, President," or "It's all right," or something like that, but what Dr. Spooner did actually say was "Good-bye, Warden." That illustrates very well the strange little kink which he had in his brain—which yet did not prevent him being an extremely efficient and extremely charming man. Good-bye, Warden—I'll close on that: good-bye to a man I am happy to have served under; a man who was the direct or indirect cause of a considerable addition to the world's stock of good-natured laughter: a man who became a legend in his own lifetime, and supported that somewhat embarrassing position with dignity and charm. So—good-bye, Warden!

BIRDS AND MEN ON ST. KILDA

REMOTE islands have a fascination for the biologist. Their inaccessibility makes them a sanctuary, both for rare species and for immense congregations of commoner ones. Their isolation has prevented many forms from reaching them at all, so that what they lack is as interesting as what they possess. And this same isolation, combined with the difference of conditions, has often encouraged the evolution of special local types.

St. Kilda has all these biological attractions. It is scientifically celebrated as the home of the St. Kilda wren, a subspecies of the common wren so distinct that it was for some time classified as a separate species. It is one of the few places in Britain where Leach's fork-tailed petrel nests—a beautiful little creature still more martin-like than its common relative the storm petrel. On one of its three main component islands there lives over a fifth of the world's entire stock of gannets—those most spectacular of all our sea-birds; while a conservative estimate of its puffin population would be a quarter of a million. It has a melancholy historical attraction as the site of the last recorded British occurrence of the great auk. In 1821, only twenty-three years before the final extinction of the species, a specimen was captured there on a ledge of cliff. It eventually passed into the hands of John Fleming, who kept it alive for some time on the vessel of the Northern Lighthouse Commissioners. Unfortunately, when they reached the Clyde, the bird escaped while being indulged with a swim in the sea, contriving to slip the cord attached to one leg.

St. Kilda also forms a part of a region where evolution can be studied in action. All round the north-west and north of Scotland, the islands harbour animals and plants which are slightly different from those of the mainland. To take but a few examples from birds, the Shetland wren is also distinct enough to be classified as a distinct subspecies. So is the Shetland starling, and the hedge-sparrow and the song-thrush from the Hebrides.

What is more, the distinctive types of the Scottish islands form part of a graded system, a field of change, which extends inwards to the mainland coasts and outwards to the Faeroes and Iceland. If you take measurements of the different local races of wrens, you find that they increase in size at a pretty definite rate with increasing north latitude—almost 1½ per cent. increase in size for every degree. The

blackbirds of the western Highlands appear to differ slightly from those of Britain as a whole, and the difference is in the direction of that seen in the more distinctive race of the Hebrides.

We cannot suppose that wrens and thrushes were able to support glacial conditions: so that the observed changes must have taken place since the end of the Ice Age, certainly less than 15,000 years ago —an infinitesimal period in the thousand-million-year perspective of evolution.

There is no necessity for the British biologist to go to the high arctic or to the tropics to study evolution: he has problems of the greatest interest on the doorstep of his own country.

So it came about that, looking for a holiday with a point to it, I attached myself to an ornithological party which was going to visit St. Kilda and other normally unvisited Scottish islands.

St. Kilda was unquestionably the high spot of the voyage, not merely because of its biological interest but for its astonishing scenery and its human history. It is forty miles to westward of the Outer Hebrides. Forty miles doesn't sound far; but it is a good way for a 25-ton yacht against the wind, and we were all night making the island after leaving the Sound of Harris. The one anchorage is Village Bay in the island of Hirta, and even that is unsafe with southerly or easterly winds. The first sight of this island is a little disappointing—a grassy coomb, a little like the head of Fairfield in the English Lakes, with the deserted village in its centre. After breakfast, we set off up to Conachair, the highest point, strung out in a line so as to cover more ground, as we wanted to make a survey of all the land birds—a survey later published in *British Birds* by Max Nicholson and James Fisher. An extraordinary fact was the number of snipe in and around the old village, although it did not look at all like snipe country.

Another peculiarity of St. Kilda is that the rock pipit, which is usually confined to a narrow zone along the sea cliffs, here extends far inland, into regions which would normally be the preserve of its relative the meadow pipit—and this in spite of the fact that meadow pipits also breed on the island.

This phenomenon, of changed habits toward the limits of the range of a species, or in other exceptional conditions, we encountered in several other birds elsewhere. The reed buntings of Lewis and the mainland opposite, in the absence of their usual sallow thickets and reed-beds, were nesting on islets in lochs, where, owing to the absence of browsing sheep, there were rather more trees and shrubs than on the mainland. Herons nest here in very small colonies, often on the

face of a cliff, the nests sometimes resting on the ground. On an island in a loch on the east of Harris, some of the birds in a herring-gull colony had made their nests among the roots of small trees—an astonishing situation for a gull.

Also on this islet was a reed bunting whose song differed so much from the normal type of the species that we were at first completely puzzled as to what the bird might be. But that is another story. The change of song that you find in many birds in the north is part of the general field of change in the region. The Shetland wren combines a distinctive rhythm and stridency of song with its larger size and darker plumage: the blackbirds of the north-west, though almost undistinguishable in appearance, have a feebler, less mellow song, more thrush-like in quality than their southern relatives.

Many plants, too, show changed habits in these parts. A cliff heronry we visited was in the midst of a sheet of bluebells running up into the heather. Bluebells grow in the open all along our western coasts, from the Scillies to Cape Wrath. It must be the lesser rainfall inland and to the east which there restricts them to woodland.

All over the western Highlands the spotted orchis, instead of growing in the sheltered and rather rich situations where southerners expect to find it, invades the moor and grows even among the heather. It was growing all over the bare slopes of St. Kilda.

Finally there were the primroses. Though it was June, they were in full bloom on St. Kilda wherever there was a moist sheltered place. They were all down the gullies of the southern cliff; one of the most unexpected items of natural history that I ever saw or am likely to see was a fulmar petrel sitting on its nest at over 1300 feet on the cliffs of Conachair, entirely surrounded by large primroses!

The primroses have brought me to the cliffs. These are quite astonishing. Those of Hirta are the highest in Britain, within a yard or so of 1400 feet. They are not, however, nearly so precipitous as those of Foula in the Shetlands or Hoy in Orkney. They break down to the sea in steep green steps, interrupted by sheerer clifflets of bare rock. The entire slope is dotted with white specks. The impression is of strange cliff flowers; but they are in reality fulmar petrels, many thousands in sight at once.

Across the sea, four miles away, is Boreray, the home of the gannets. It lies there, a green uprising wedge, with two fine stacks off its western face; through the glasses these are seen to be topped with creamy white—dense crowds of breeding gannets. Seen thus from a distance it looks romantic enough, but the closer view is staggering. I have been in a good many parts of the world: but I can only recall

two places which beat Boreray in immediate spectacular quality—the Grand Canyon and the Virunga volcanoes in the Western African Rift.

We sailed there in the afternoon. Landing is nowhere easy, but least difficult on the rocks at the foot of a steep grass slope. I measured the angle of slope on the six-inch map and found it exactly $45° - 1 \text{ in } \sqrt{2}$. To those who climb it on a hot June day it looks and feels like 60°. It is honeycombed with puffin burrows; we estimated that over 50,000 puffins were nesting in it. Some members of Lord Dumfries's party on Hirta had come with us to try to secure fresh meat in the shape of the sheep which run wild on Boreray. At the sound of a rifle-shot all the puffins flew out: they looked like a swarm of flies as they circled back from sea.

To the left the grass slope is bounded by a sheer rock wall about 800 feet high, plastered with gannets on every ledge. One of our party stayed to count them: his estimate was slightly over 4000 pairs.

The steep grass continues on and on at the same angle for 1200 feet. At its top is a range of pinnacles that might have been designed by Doré; and the other side of the island is a sheer rock face, crowded with sea-birds. One of our party was a great enthusiast for Foula: but he admitted that Foula was beaten by Boreray.

Getting aboard again was complicated by the problem of the sheep that had been shot and gralloched. With considerable labour it was brought down a thousand feet to the edge of the rocks: but then what? The old boatman shouted up to throw it in: the land-party averred it would sink. After much argument it was pushed off, and rolled, flailing its limbs, precipitously into the sea. It floated, and was safely hauled in over the dinghy's stern.

We cruised home under the western face. From below, the fantastic quality of the cliff was still more apparent, and the two stacks came into their own. You tend to discount the cliff scenery of St. Kilda until a near view or a special angle obtrudes its super-normal scale upon you and forces you to readjust your ideas. These two stacks, from the top of Hirta or to the approaching yacht, seemed just a pair of unusually fine rocks. As we rounded the southern point, we realized that we were confronted with dimensions new to our experience. A glance at the chart showed us that this was indeed true. The lower of the two, Stac Lee, is 544 feet high—30 feet higher than the top of Beachy Head. The other, Stac an Armin, rises to well over 600 feet, but has not quite the same grandeur of form.

Stac Lee must be one of the most majestic sea rocks in existence.[1] It rises out of deep water, and as you sail within a few yards of the black mass it gives you a gasping lift, like a cathedral or a flight of rockets. At one place it even overhangs. Its shape too is magnificent —a great blade of rock, somewhat longer than broad, yet not so thin as to convey any impression of fragility. Hosts of similes poured into my mind. At first I thought of the emerging prong of a sea-god's trident, the crude and gigantic emblem of some northern Poseidon. Then suddenly I had it—it was like one of the great stones at Avebury (those early megaliths to my mind so much more impressive than those of Stonehenge), magnified some fifty diameters and erected out of sheer bravado in the sea.

Its top is bevelled off diagonally, and this sloping plane is white with densely packed gannets; gannet ledges lace the black face obliquely with white, and guillemots and kittiwakes inhabit the lesser projections.

Gannets inhabit 21 distinct colonies, from the St. Lawrence to the Bass, from Iceland to southern Ireland. This single colony of Boreray comprises about a fifth of all the gannets in the world. Two separate estimates have given concordant figures—about 17,000 breeding pairs: with the non-breeders, about 40,000 of these enormous and spectacular birds.

Stac Lee looks wholly inaccessible. As a matter of fact, it was much more easily and more often climbed by the St. Kildans than Stac an Armin. There is a relatively easy landing, and a ledge leading diagonally upwards. They came there regularly every year to catch the young gannets for their winter provisions.

The human biology of St. Kilda is as remarkable as its birds. I should say *was*, not *is*, for in 1930 its entire population was evacuated, thus closing a chapter which had been begun before the historic period. Human and avian biology were indeed inextricably interwoven on St. Kilda. The human population was essentially parasitic on the birds. Fishing was never popular, and its results quite subsidiary. It is true that sheep also played a prominent part in the island economy, that there were a few cattle, and that barley, oats, and potatoes were grown; nevertheless, without the birds the human beings could neither have fed themselves nor paid their dues.

The total number of inhabitants seems never to have reached 200. It suffered a marked diminution in the early eighteenth century.

[1] Professor P. A. Buxton has since told me of Ball's Pyramid, off Lord Howe Island, between Australia and New Zealand. This is 1816 feet in height, but though immensely impressive, is rather a rocky islet than a single rock.

Between 1758 and 1855 it fluctuated between 87 and 120, and after that between 70 and 80. Inbreeding was avoided through the occasional arrival of refugees or of exiles banished from the mainland as undesirables. (In 1732 the unfortunate Lady Grange, whose husband disliked and feared her, was kidnapped, and after being detained on the island of Heisker near North Uist for three years, was spirited away to the safer prison of St. Kilda, where she remained for eight years more.)

The birds on which they chiefly relied were gannets, fulmars, puffins, and, to a lesser extent, guillemots. Puffins were sometimes caught in their burrows with the aid of a dog, but usually snared in a noose at the end of a long rod. They formed the chief meat diet of the islanders in summer. A puffin was generally boiled in porridge "to give the porridge a flavour"—an aim which was without doubt realized!

The gannets were very much sought after for winter provender. Young gannets, like the young of some other sea-birds, become extremely fat and at one stage actually surpass the adults considerably in weight. Their parents then abandon them. After living on their fat for some days, hunger prompts them to try their wings, and they throw themselves off the ledge to volplane into the sea.

Each year up to the 1870's the St. Kildans made an expedition to Boreray at the time when the "gougs," as the fat young are called, were most abundant. They knocked one or two thousand on the head, and brought them back to be salted down against winter. Later, the raids were not so regular, and fewer gougs were taken.

But the fulmar was the St. Kildans' great standby. Like the puffin, fulmars were snared in nooses; but unlike puffins, fulmars often breed on steep places, and great skill and daring was needed, as with the gannets, to obtain a full supply.

The carcasses were salted down for winter, the feathers were plucked and used to stuff mattresses, and the oil was employed to give light during winter. Both oil and feathers were also exported to pay the laird's rent.

The fulmar's oil is a very peculiar phenomenon. Fulmars feed on fish and plankton; the oil from these is retained in the stomach, whence the bird can bring it up and eject it at an enemy. The oil has a nauseous smell, and so potent a weapon is it that no other bird, not even the much larger bonxies or the formidable greater black-backed gull, will try conclusions with a fulmar. If it hits your clothes, they will stink for days. I must confess that when, as I was scrambling along some precipitous slope, I heard the disgusting retching noise

made by a fulmar bringing up her ammunition, I tended automatically to dodge out of range in a way not always conducive to safe foothold.

One of the most curious things about the fulmar's oil is its abundance. The average yield per bird is stated to be nearly half a pint. The St. Kildans, after noosing a bird, squeezed the oil out of its mouth into a bag made of a gannet's stomach, and so transported it home.

The island is dotted with little stone beehive huts, called "cletts." These served to store the carcasses and feathers of birds until they were needed, and also to hold turves, potatoes, and grain. We came on one at 1100 feet on a promontory jutting out from the great cliff-face of Conachair.

There are many curious and interesting facts about St. Kilda which one does not want to pass over. The great Dr. Johnson once told Boswell to buy the island so that they might live there for a time—a project which, perhaps fortunately, was never carried out.

One of Dr. Johnson's pronouncements concerned the famous "boat-cough" of St. Kilda, the disease, occasionally fatal, which seized the islanders every time that a boat arrived from the mainland. It is obvious enough to-day that this was due to the absence of germs on St. Kilda and the consequent absence of immunity to colds and flu among the St. Kildans. But even Seton, in 1878, with similar facts from Tristan da Cunha before him, could suggest, as an alternative to contagion, that the ailment might be caused "by a feverish excitement arising from the contact of a higher with a lower civilization"! So we need not be surprised that Dr. Johnson was sceptical. "How can there be a physical effect without a physical cause? . . . If one stranger gives them one cold, two strangers must give them two colds, and so in proportion." But he praised Macaulay, the chronicler of the islands, a great-uncle of the historian, for his broad-mindedness, as a Whig, in insisting on the existence of so miraculous and irrational a phenomenon.

In the early eighteenth century the women wore no shoes or stockings save a sock or feather-shoe made out of the skin of a gannet's neck and back of the head: such a shoe lasted four or five days. They were indeed bird people.

A curious fact about the St. Kildans is that they did not use real peat, but only turf. This may be partly explained by the peat-bogs being at a height of over 1000 feet above the village, but is certainly curious, since by cutting turf they damaged the grazing for their beasts as well as restricting themselves to a very inferior fuel.

The subject of grazing brings me to the Soay sheep. These are of

great interest as being in all probability the most primitive domestic breed in existence, showing the least modification from their wild ancestor. They are not so large, nor are their horns so fine, but in general their resemblance to Mouflon and other wild species is much closer than to any other domestic breed. They have the same long legs and small bodies, the same active carriage, the same general colouration (a light reddish-brown with light rump), the same short hair, only an inch or so long, with dense underwool, the same fringe of long hair on the throat. They are quite different from the Hebridean breed.

Nothing certain is known of their history, but it may be taken that they represent a very early stage in Western man's moulding of the wild sheep into a wool-bearing, mutton-producing machine, a stage which everywhere else was supplanted by improved breeds, but survived in St. Kilda because of its remoteness. To see them scampering about the cliffs and steep slopes of the islands is to be transported far back in human cultural history, perhaps to 3000 or 4000 B.C.

One of the most remarkable facts in recent European natural history is the steady spread of the fulmar. In the Faeroes, its arrival between 1816 and 1839 was followed by a period of rapid increase, which has continued until the present. In recent years about 100,000 fulmars have been taken annually for food in the Faeroes.

In Britain it was not known to breed outside St. Kilda. However, the wave of increase began to operate here too, and in 1878 it colonized Foula off the Shetlands. By 1891 it had reached the main part of the Shetland archipelago, and by the turn of the century was breeding in Orkney and Sutherland. To-day it is prospecting breeding-sites as far south as Land's End and the Scillies on the west, and Dorset and the Isle of Wight on the south, and is already breeding at Flamborough Head on the east.

There are now about 21,000 pairs on St. Kilda, while those on the rest of our coast are estimated at about 41,000 pairs. Looked at from another angle, the fulmar population of the British Isles has nearly trebled during the last half-century—a rate of increase a little higher than that of the human population of England and Wales during the first half of the nineteenth century.

At one time it was thought that this spectacular increase and extension of range was due to the decrease of human depredations consequent on the introduction of kerosene oil and tinned food. However, James Fisher's exhaustive study of the problem has made it clear that this is not so, and that though the drop in the human population of St. Kilda in the '50's and '60's may have had a local

influence, the main cause must be a biological one, some as yet unexplained factor favouring fulmar survival and spread throughout the range of the species.

The gannets, meanwhile, had not multiplied to the same extent. The young gannets were the St. Kildans' greatest delicacy and their capture the islanders' greatest sport. As the birds lay only one egg, and their total numbers were probably rather less than to-day, their numbers were held severely in check. But since about 1890 the gannet too has embarked on a period of increase—not so striking as that of the fulmar, but none the less definite. Two quite new colonies have been established in the Shetlands, and there has been a marked increase in the numbers of birds in the Irish and Welsh colonies. For the last quarter-century, the increase is in the neighbourhood of 15 per cent. In this case, too, there seems to have been a wave of biological increase affecting the species as a whole, in addition to any local effects caused by the St. Kildans' changed habits.

One of the chief aims of our party was to estimate the number of gannets on St. Kilda and two other rarely-visited breeding colonies. This was part of the scheme organized by James Fisher and Gwynne Vevers for the enumeration of the world population of gannets—the first occasion on which a complete census has been taken of any wide-ranging wild species.

The layman may well ask how gannets are counted. The first sight of a big colony is bewildering, and a census would seem impossible. However, it is eminently possible, as repeated counts by separate observers have shown. The simplest and best method of counting gannets is just to count them. Each observer takes a section of cliff, and goes over it with his glasses, ledge by ledge, counting the number of breeding pairs. One bird is always on the nest: when both are present they will be close together, so that a pair can be distinguished from the separate sitters.

Direct counting, however, is difficult or impossible from the sea, unless in a dead calm. You then have to count birds on some especially favourable section, and estimate the proportion which this bears to the total area occupied by nesting birds. In some cases a photographic method is the best—telephoto photographs are taken, and the birds counted on enlargements from them.

Experience shows that direct counts in favourable circumstances are accurate to 2 or 3 per cent.; and it can be taken that the world figure (which provisionally may be put at 166,000 birds) will be accurate certainly to within 10 and probably to about 5 per cent.

The other two gannetries which we visited were Sule Stack and

Sula Sgeir. They form part of a chain of small islands whose very existence is unknown to most people, strung out some twenty-five to forty miles off the northern Scottish coast—Sule Skerry, with its lighthouse, Sule Stack with 3500 pairs of gannets, North Rona, the greatest breeding-ground of Atlantic seals in Britain, of which Dr. Fraser Darling has written, and Sula Sgeir, with another 4000 pairs of gannets. Sule or Sula is, of course, from the same root as Solan in Solan Goose, the gannet's alternative name, and is the Gaelic for gannet.

Sule Stack is wonderfully impressive considering its small size—a bare 125 feet in height—or perhaps because of it. It is an outpost of the land, upthrust out of the hostile sea, teeming with life, yet a life alien (though not hostile) to ours, northern, remote, with its own quality and its own values. It reminded me of Tom's visit to Mother Carey in Kingsley's *Water Babies*—Mother Carey who made things make themselves—a workshop of animate nature.

The highest point rises up curved to hook over in an overhang, sheer above a sloping slab, like a wave immortalized in rock. The rock is black, with the white of breaking waves round its base, and its higher parts frosted over with the white of gannets.

It was too rough to land here, but on Sula Sgeir we managed to put one man ashore, though the swell was enough to warrant lifebelts for the dinghy party. Sula Sgeir seems to be the only gannetry in Britain whose numbers have gone down in the last seven years. This is without doubt due to the fact that it is also the only gannetry which is still raided for young birds: almost every year an expedition sets out from Ness, in the north of Lewis, and kills between one and two thousand gougs for food. It is to be hoped that public opinion and the County Council will put a stop to this practice.

Another objective of our trip was to fill in some blanks in the census of bridled guillemots. "Bridled" or "spectacled" guillemots differ from the normal in having a white rim with a hindward prolongation round each eye. They are not a distinct species or subspecies, as was at one time supposed, but a mendelian variety which interbreeds freely with the normal. In the books they are usually described as rare aberrations. So they are in the south of Britain: but about halfway along our coast their numbers begin to increase. On the Farnes they make up 5 per cent. of the total; on the Orkneys 10 to 13; in the Shetlands 23 to 26; while in Iceland and Bear Island they are well over 50 per cent., and thus constitute the normal type, while our normal is there the aberration.

What the precise meaning of the phenomenon may be is as yet

obscure. Either the bridled variety is a new and advantageous mutation which is extending its numbers and range at the expense of the normal (as has happened with the black variety of the brush-tailed opossum in Tasmania), or there is a balance of advantage between the two types, the bridled being favoured in cooler and more humid regions, the normal in warm and dry conditions (as occurs with the black and grey varieties of the hamster in Russia). The diminution in the percentage of bridled birds on the less humid north coast of Iceland seems to speak in favour of this latter explanation.

In any case, the first step is clearly to map the distribution of bridling accurately, and to see whether it changes with the passage of time.

St. Kilda was one of the places for which very few data were available. The guillemot ledges here are not easily accessible, but we managed to count nearly a thousand birds and to find that the percentage was about 16, much higher than anticipated. An intensive afternoon on Handa, just south of Cape Wrath, yielded a count of over 3000, and confirmed the previous estimate within 0·5 per cent.

The end of our trip deserves record as illustrating the difficulties of communication that still keep the western isles so remote. One of our party wanted to be back in London for a Monday evening meeting. We pushed across through the night from St. Kilda to reach the west of Lewis early on Saturday, caught a bus in to Stornoway—to find that there was no possibility whatever of arriving in time. No boat sails on Saturday night, as this would desecrate the Sabbath: and the Sunday night boat was too late.

We explored Stornoway and its wooded park, one of the only two woods in the Hebrides; slept aboard the boat, set off soon after dawn on Sunday, visited Sula Sgeir and North Rona, and sailed through the night to Loch Erriboll. There we found that a bus recorded on the time-table was in reality non-existent; cadged a lift on a road foreman's car to Durness; found a car at the local hotel (which had on its notepaper "Railway Station: Lairg, 58 miles"); caught the train at Lairg; explored Inverness between trains; and reached London before the letters we had posted in Stornoway.

Communications may be difficult: but it is very well worth while overcoming the difficulties. The north of Scotland and its western and northern fringe of islands constitute a region where the arctic fauna overlaps the temperate. Whooper swans and great northern divers and Sclavonian grebes have invaded it from the north, and the mainland forms have thrown out outposts to the islands and beyond them to the Faeroes and Iceland. It teems with life: the birds out-

number the human inhabitants many-fold, and their congregations on the bird rocks are not easily to be surpassed. Seals bob up wherever you anchor, and it is a poor day when you do not see a school of porpoises or small whales and some 25-foot basking sharks. It has a unique history and pressing human problems of a dwindling population, top-heavy with old people.

To the biologists and naturalists of Britain it is a laboratory on the doorstep of their own country where they can find an inexhaustible store of material for the study of evolution in action.

TENNESSEE REVISITED: THE TECHNIQUE OF DEMOCRATIC PLANNING

WE have often been told that over-all planning is incompatible with democratic freedom and individual initiative. That notion lingers on in considerable strength in the U.S.A. Planning, according to the enemies of the New Deal, is the thin end of the totalitarian wedge: once start to plan, and you have embarked upon the dangerous road that leads on inevitably to "100 per cent. planning" and the end of democracy. This is curious, because it is precisely in the U.S.A. that planning has been most conspicuously and most successfully democratic. The best examples are in the Tennessee Valley and in the North-West Region along the Columbia River.

In 1935 I made a special journey to study the working of the Tennessee Valley Authority. The TVA, one of the earliest fruits of Roosevelt's New Deal, was then less than two years old; but even in its infancy it was impressive in its size and scope. Its physical impressiveness is greater to-day, now that the grandiose series of dams and power plants serving an area nearly the size of England is approaching completion. But what interested me most when I revisited the area in the spring of 1942 was the technique which the TVA has adopted with the deliberate aim of reconciling over-all planning with the values of democracy.

For its specific task of building dams for navigation and flood-control, with the large-scale generation of electric power as a corollary, it was given precise terms of reference. But it was also assigned the more general aim of initiating experiments for the general development of the region—in other words, of making and executing a comprehensive over-all plan.

In such a situation, the planner's temptation is to believe so much in his plan that he insists on imposing it from above, as it stands, and as quickly as possible. This is the temptation which leads to "beneficent dictatorships." The planner, remembering that power corrupts, must resist it, as Christ did when the devil offered him power over all the kingdoms of the earth.

The TVA, thanks to the wise guidance of H. A. Morgan and David Lilienthal, has refused to yield to this temptation, and has increasingly set itself to devising techniques for planning by persuasion, consent, and participation.

Let me give some examples. In the agricultural sphere it was

essential that the appalling soil erosion should be checked. For this it was necessary to change the attitude and methods of the farmers. Mineral fertilizers must be used; check-dams built; contour ploughing adopted to prevent run-off; new crops introduced; the erosion-prone slopes put back to forest or laid down to grass.

The method adopted has been to persuade farmers to use their farms as demonstrations of TVA fertilizers and TVA methods. The County Agricultural Agent (who himself combines Federal, State, and County functions, and whose assistant is paid by the TVA) calls together the farmers of a community and explains the problem. The farmers themselves then select the farm of one of their group to be used as a demonstration unit. The work is done with the co-operation of the local farmers' Committee and the County Agent or his assistant. In return for this help and for the fertilizers provided by the TVA, the farmer agrees to carry out the programme for a definite period, to adjust his farming methods (for instance, by planting soil-protective crops and using contour terracing where there is danger of erosion), to keep records and report results, and to pay the freight costs of the fertilizers provided.

In such cases the test-demonstration farm becomes a focal point of community interest, a real community enterprise, carried on and to a large extent planned by the farmers themselves. After six years there were over 26,000 demonstration farms of this type in existence.

Sometimes a keen group will transform the methods of a whole county in two or three years. But elsewhere there may be more resistance. I was taken to one lone demonstration farm in an area where an enterprising young man was the only farmer in the community willing to participate in the TVA's programme. Five years ago he had bought his farm for $1200: as a result of TVA fertilizer, TVA advice, and his own initiative, he improved it to such good purpose that last year he was offered $4500 for it.

The neighbours had at first been wholly unco-operative, and his successes had been sceptically dismissed as mere luck. Now, however, after five years, conviction was creeping in, and they too were beginning to adopt the new-fangled methods. This is slow going; but it is sure. It is exasperating to see old error persisted in so long. But once the resistance is overcome, the new methods are taken over with enthusiasm.

Administratively, too, the TVA is careful not to tread on the toes of existing agencies. In agriculture, the TVA co-operates with County, State, and Federal Agencies. It works mainly through the "Land-Grant Colleges" of the region—State institutions backed by

Federal Funds, with which it has an over-all agreement embodied in a "Memorandum of Understanding." Thus the TVA might give funds for some special job for testing new phosphatic fertilizers manufactured in its great fertilizer plant at Muscle Shoals. If so, the Land Grant Colleges would carry out the tests and appoint the personnel, who would, however, have to be approved by the TVA's personnel department. Once adequate tests have been made, practical demonstrations are needed; for these, the TVA has entered upon similar agreements with the Agricultural Extension Services operating under the same Colleges.

The same sort of thing has occurred with regard to Wild Life Conservation. The TVA here operates under a formal agreement with the U.S. Bureau of Fisheries, the U.S. Biological Survey, and the Conservation Commissions of the various States in the Valley, and in informal co-operation with the State Universities and many local agencies.

Here is another example from quite a different field. As the result of one of the big dams, the little country town of Guntersville was left on the end of a long narrow peninsula jutting out into a lake. The TVA suggested that the town should set up its own City Planning Commission. It contributed funds to the Alabama State Planning Commission to pay for the services of planning consultants and a resident planning engineer, and has itself furnished much technical advice. By these means the invading water which threatened disaster was turned to advantage. The town was replanned so as to provide docks and facilities for fishing and pleasure-boating. As a result it has become both an important tourist and recreation centre (the local regattas now attract gatherings of 50,000 or more) and a point of trans-shipment for the increasing volume of water-borne goods now finding their way up the Tennessee River, on which navigation was previously almost non-existent.

Here and in many other fields the success of the TVA depends on having a sufficient staff of experts of first-class calibre who can be detailed to help in local problems in the field. But in all cases they help the local community to help itself. They do not impose their own plans, but they catalyse planning jointly with others.

The way in which central planning may be used not to suppress but to stimulate private initiative is illustrated by TVA's action over electrical and agricultural appliances. The big combines and other agricultural machines so essential on the Middle Western prairies would be useless, as well as too expensive, for the small and hilly farms of the Valley. The TVA accordingly set itself to design equip-

ment suitable for its own area. After extensive testing, agreements were drawn up by which manufacturers of farm equipment could make and sell the machines commercially, at an agreed price. A recent example is a multiple-purpose "furrow-seeder" for hilly country. This can be attached to a two-horse plough, ploughs furrows along the contours, and drops seeds and phosphatic fertilizer in the furrow, all in a single operation; and costs less than $25. A similar venture was the perfecting of a cheap refrigerator, selling at a few hundred dollars, to serve entire communities for the storage of meat and other perishable farm commodities.

The general aim of combining the efficiency of central planning with the sense of participation that comes from decentralization is well illustrated in the TVA's electricity programme. Generation and transmission are centralized under the TVA itself. But both the ownership and the management of the distribution are decentralized, and are in the hands of local organizations, either municipal or co-operative. Standards in regard to rates and other important matters are kept uniform by means of the contracts under which TVA provides bulk electric power to the local units; but the separate units have worked out the most ingenious methods for making the new resource available to the maximum number of people in the most fruitful way.

With all this and much of similar import, however, a basic problem remained—how to make the people of the region as a whole feel that the plan was *their* plan, not a scheme imposed from above by a remote authority, nor even a series of special schemes in which particular interests or communities could profitably participate. With this aim in view, a joint committee has been set up, representing the TVA and all the State Universities in the region, to see how best the educational system and its curriculum can be utilized to bring about a wider understanding of the aims and achievements of the TVA, and the general relevance of the plan to the life of the Valley. From the primary school to the University, interest is now being focused on the broad problems of the region, on the plans of the TVA for dealing with them, and on the need for popular co-operation if the plans are to be effective.

This scheme is still young, but it should be of real value in generating a social self-consciousness in the region and relating it to the central authority, which otherwise might remain in Olympian detachment from popular feeling.

In the North-West Region, where the Columbia River is being harnessed on an equally grand scale, popular participation in plan-

ning has been taken a step farther back, to the framing of the plan itself. Though I was unable to visit the Columbia Basin personally, I had the opportunity of hearing about the work there from one who had been concerned with it from the start, Professor Kenneth Warner, now at the University of Tennessee.

Planning in the region was begun by the Pacific North-West Regional Planning Commission—one of the two official planning bodies in existence, both of them under the National Resources Planning Board.[1] Some members of this were dissatisfied with the amount of local support for planning, and took the initiative in the formation of a non-official planning body, the North-West Regional Council. This has become a clearing-house for research on regional problems, and has done a great deal to present them to the public, both directly by books and pamphlets and articles, and indirectly through the educational system. In this latter field it conducts short week-end courses and longer "study workshops" for teachers, and has a panel of educational consultants which, as in the TVA, is getting a great deal of material into the curriculum. It also seeks to stimulate the interest of various professional groups. Any plans eventually adopted for this huge region will be more thorough for the work of the Council, and will command much more public interest and backing from the outset.

In specific cases, popular and local participation has already been achieved in detailed practical projects. The best example of this so far is Elma, in the State of Washington. Elma is a little community of under 10,000 people, which had been largely dependent on timber. Over-cutting of the forests resulted in the closing of its one big mill, and the entire area was faced with disaster. The local Chamber of Commerce asked the State Planning Commission to help in investigating their problems. The commission enlisted the further support of the two regional bodies we have already mentioned, the official Commission and the non-official Council, together with other agencies, and the Elma Survey was initiated. But Elma was not treated as merely a passive subject for investigation. Help was given on the express understanding that the community would participate —and participate it did, on the grand scale.

Picked High School students collected valuable information needed for the survey (incidentally educating themselves in the process); discussions of the town's problems in class led to discussion in the home; the local newspaper gave much space to the survey and its

[1] Whose appropriations have been discontinued by Congress since this article was written—a disastrous piece of political folly.

aims; the Chamber of Commerce enlisted the services of all the major business enterprises; and a series of public meetings (rather like the old Town Meetings in New England) were held.

The result was that the people of Elma were brought in from the outset. It was *their* survey and *their* plan; they were behind it, so thoroughly that the town was able to implement certain of the Survey's recommendations even before the report was published.

I cannot end better than by quoting from a recent address of David Lilienthal, the Chairman of the three-man Board of the TVA. The Board, he says, is convinced that "the way of doing the job and the results that have been achieved are inter-dependent"; and accordingly has been experimenting to discover the best means of achieving administrative decentralization as the only means of reconciling planning with democracy. They now feel that the three essential characteristics of a decentralized administration are these. First, it is "one in which the greatest number of decisions is made in the field. . . . An overcentralized administration is always characterized by the fact that its field officers tend to become messengers and office boys. . . . (2) A decentralized administration must develop as far as possible the active participation of the people themselves . . . and encourage the participation of local agencies in establishing basic national standards. . . ."

Thirdly, a decentralized administration must co-ordinate the work of all other agencies concerned, and "the co-ordination must be in the field."

To these we may perhaps add a fourth—the decentralization of the *idea* behind an administration so that its planning becomes a part of public opinion. This is to be achieved not merely through customary channels of publicity and public relations, but also through the educational system.

Britain is very different from the United States; but the principles and techniques worked out in the Great American planning experiments (not without considerable trial and error) are applicable wherever large-scale planning is needed. In the planned Britain of after the war, we must avoid a congestion of centralized planning in Whitehall, we must encourage the people to feel that it is their plan and that they are helping to make it. This can be done by using the democratic techniques of decentralization, co-operation with other agencies, and popular participation, both in action and in opinion and feeling.

COLONIES IN A CHANGING WORLD

THE world is changing under our eyes. To the accompaniment of much blood-letting, burning of crops, destruction of buildings, hunger, disease, and torture (but also much bravery, devotion, ingenuity, efficiency, and hard thinking), the institutions and ideas of a historical epoch are on their way into the discard. Unlimited national sovereignty, *laisser-faire* liberalism, unrestricted capitalist enterprise, neutrality, the police state, free trade, are swirling irrevocably down the cosmic drain.

In such a confusion of change, the colonies are bound to be involved. The world's conscience is beginning to grow a little uneasy over the fact of one country "possessing" another as a colony, just as it grew uneasy a century or so ago over the fact of one human being possessing another as a slave. The inter-war disputation between the "have" and the "have-not" powers is wearing a bit thin. It is beginning to dawn on us that the real "have-nots" are the colonial peoples themselves.

The mercantilist view of colonies as milch-cows to be exploited for the benefit of the metropolitan power, when looked at firmly in the light of post-depression economics, is seen to be as short-sighted as it was selfish; not merely to provide a moral basis for their dependent empires, but to increase general prosperity, the standard of living of the native colonial peoples (nearly an eighth of the world's population) must imperatively be raised. The principle of trusteeship sounded rather noble when applied to mandates in 1919; but now, even if it were to be adopted for all colonies, it would look inadequate. The only possible substitute for imperialism is seen to be the development —political and social as well as economic—of the areas now classed as colonies. What is more, the development must be undertaken internationally. The separate possession of colonies was an inevitable consequence or extension of the game of power politics as played by independent sovereign states; whatever international framework is superposed upon nationalism after this war, it must concern itself with the colonies as well as with the advanced nations on which the colonies depend.

Colonies in the broad sense of the word may enjoy the status of Crown colonies, protectorates, condominiums, mandated territories of various categories, and so forth. But they all share one essential feature—they are politically dependent territories, administered from

the capital of a colonial power. They have their own governors and legislative councils; but there is almost invariably an "official majority" on the Council, consisting of local Civil Servants and administrators; and there is normally little representation of the native population on the Council, and that little is in most cases indirect, often through a white missionary (as well as via the Commissioner for Native Affairs).

Colonies may be best classified by political type. In the first place, there are the relatively advanced colonies which are clearly destined in the near future to follow countries like Iraq and to emerge from political dependence into the condition of partial or complete self-government. Syria, Palestine, and the Philippines are obvious examples, while Ceylon (like non-colonies such as India and Burma) is a clear candidate for a fairly speedy attainment of Dominion status. Ethiopia, after its brief interlude as an Italian colony, has now been restored to independence, but (as with other somewhat backward territories) its independence will be qualified for some time to come by a certain amount of advice and help and tutelage from the white man.

Northern Africa constitutes a special area. Already before the war, Algeria and Northern Libya were for most purposes integral parts of France and Italy respectively: Algeria, in fact, was virtually a French *département*. In any case, the whole of the North African littoral, with its hinterland back to the Sahara, is historically a part of the Mediterranean economy and culture, and may be expected to become linked with increasing closeness to the general European system.

Among the remainder, a number have been retained as colonies wholly or mainly for strategic reasons. Gibraltar, Malta, and Hawaii are the most obvious cases, while Aden, Guam, Hong Kong, and the illicitly fortified Japanese mandates in the Marshall and Caroline Islands are other examples. Cyprus, British Malaya, Dakar, and many other territories are of value as much for strategic as for other reasons. The strategic importance of the West Indies and Newfoundland for the Western hemisphere has been acknowledged in the arrangements made for leasing bases to the United States, and the Anglo-American occupation of Iceland has *de facto* converted that island into a strategic colony of the United Nations, the Malta of the North Atlantic.

The future of strategic colonies will depend primarily upon the arrangements made after the war for guaranteeing international security. The most likely guess seems to be that they will develop, through a stage of pooled strategic strong-points shared by some or

all of the United Nations, into truly international bases at the disposal of whatever Security League comes into existence.

Even when the advanced and the strategic colonies are eliminated, the bulk of colonial territories remain to be considered—the whole of tropical Africa including Madagascar, the West Indies, the Netherlands East Indies, Malaya, New Guinea, Greenland, and various islands in the Pacific. They all share one characteristic—cultural, social, and economic backwardness; and the colonial problem is primarily the problem of abolishing this backwardness. Most colonial territories would never have become colonies if they had not been so backward.

In Britain during the war, in spite of all the urgencies of the military situation, there has been a great revival of interest in the colonial question. Different groups naturally arrive at different solutions; but the general direction of progressive opinion is remarkably uniform. First, it presupposes a necessary minimum of international organization, to guarantee security from military aggression, and to promote economic stability. Secondly, it rejects the pooling of colonies under an international body. Instead, it envisages the adherence of all colonial powers to a colonial charter, the raising of administrative and labour standards by a series of international conventions, and the general supervision of colonial administration by an international Colonial Commission. Thirdly, and most important, it regards the development of the tropical colonies as one of the major economic priorities before the world.

The question is how to raise their mode of existence at optimum speed toward a new level. I have deliberately used the phrase *optimum* in place of *maximum* speed. In the case of advanced societies it suffices to prescribe the desirable direction of movement; for tropical areas it is also necessary to discover the optimum rate of change. When the advance to be made is not merely from one level of civilization to the next, but from a pre-mechanical, analphabetic, primitive tribal society, operating in untamed natural surroundings, to a technological and highly educated civilization which has largely controlled and even created its own physical environment, it is extremely easy to move too fast: change, like food, must be provided in assimilable doses. Equally, it is easy for change in one field to get quite out of step with other sets of changes, so distorting and disturbing the whole process. Thus in some areas concentration on economic exploitation has resulted in enormous labour migrations which have not only drained

the native reserves of the menfolk needed for subsistence agriculture and a balanced life, but at the other end have brought into being a dingy, discontented, and atomized black proletariat, which, on any standard of ultimate human values, represents a regression from traditional tribal existence.

Let me begin with the political aspect. The favourite solution of idealist constitution-mongers has been the immediate pooling of all colonies under the administration of an international authority. This, however, is in reality not only impracticable but undesirable. No international authority which we can contemplate as possible in the near future could be adequate to undertake the full executive responsibility demanded of an administration, and the existing colonial powers would rightly refuse to hand over their responsibilities to such an organization. Furthermore, colonial administration is a difficult business, demanding a homogeneous staff with its own traditions and accumulated experience. The handing over of administration to a mixed international staff unsupported by strong central machinery would in many cases cause a retrogression in the handling of native problems, and this might well have quite serious effects in some areas. There is also the significant fact that articulate native opinion, backed by such bodies as the Aborigines Protection Society, is almost entirely hostile to internationalization: they feel that this might readily become a more dangerous and impersonal means of exploitation of blacks or browns by white than the existing system. Further, some of the more developed tropical colonies, such as the Gold Coast and the West Indies, have in fact developed a strong loyalty to their metropolitan country and would strongly resent any change in allegiance.

No, the detailed business of administration must for the immediate future remain in the hands of strong and highly developed nations. What is more, transfer of colonies from one power to another is to be avoided wherever possible. It makes for instability, and it treats the colonies as pawns in the political game.

Another widely mooted suggestion has been the universal adoption of a strengthened Mandate principle. After the last war, the ex-German colonies were transferred to other powers, not as outright possessions, but as Mandates from the League of Nations. The system involved the formal acceptance of the principle of trusteeship. The Mandatory Power was to administer the mandated territory in the interests of the native inhabitants until such time as they were capable of self-government, just as a trustee administers a ward's

estate until he comes of age. Largely under the influence of Lord Lugard, this simple idea of trusteeship was gradually replaced by what he called the Dual Mandate. Under this concept the trustee preserves a dual responsibility—toward the native inhabitants, to encourage their progress toward greater prosperity and self-government, and toward the rest of the world, to make the resources of the area generally available.

The Mandatory Powers had to give an annual account of their stewardship to the Mandates Commission of the League, a body which included representatives of non-colonial as well as of colonial powers.

The mandate system did produce certain valuable results. It has on occasion prevented undesirable action. The French, for instance, made one or two attempts to extend to their mandates their strongly protectionist imperial system, with the trade of the colonies tied to that of the metropolitan country, but this has always been successfully resisted by the Mandates Commission. The standard of administration demanded in a mandated territory has inevitably had repercussions on the colonies of the same power. It has always aided public opinion, both at Geneva and perhaps even more in the home Parliaments, in keeping Governments up to the mark.

The suggestion has therefore been made that all colonies should be given the status of Mandates, and that at the same time the Mandates Commission should be strengthened both in its research and secretarial staff and in its powers.

There are, however, a number of objections to this course. In many quarters, not only in ex-enemy countries, the Mandate system as introduced in 1919 was regarded as little more than a pious veneer for annexation. Then the term has become, rightly or wrongly, associated with the idea of transfer of territories from one power to another, which would be bitterly resisted by various colonial powers as well as being undesirable in itself. Again, in certain quarters, including the educated natives of various colonies, it has acquired a connotation of inferior status. And finally the principle of trusteeship itself is regarded as inadequate to modern conditions. Lord Hailey, the author of the great *African Survey*, has said in recent addresses that the idea of trusteeship is too legalistic and negative, too much a survival from the *laisser-faire* epoch. Government to-day must be positive, must take the initiative in an active policy of development and welfare. The trustee, in fact, must be replaced by the educator and the guardian, and the concept of trusteeship be supplemented by that of partnership.

For these and other reasons, it seems best, while perhaps retaining the mandatory principle for the existing mandated areas, to include it within a wholly new system. This system must be as comprehensively international as possible. It is no good blinking the fact that some colonial areas are by no means well administered, either in the sense of efficiency or in that of promoting the welfare of their inhabitants. The world's conscience will not long continue to tolerate any such gross inequality of standards. What is more, inefficient administration and insufficient development interfere with world prosperity. And inequality of treatment will, sooner rather than later, create a sense of political grievance. Malays, Negroes, Melanesians —all the colonial peoples are rapidly and inevitably reaching a level at which they are capable of a simple but heady brand of political thinking. In the so-called Dark Continent, for instance, fifty years ago the negro millions still lived their tribal lives as ignorant of the word *Africa* and its implications as were the vast majority of Indians a century ago of the implications of the word *India*. To-day, however, there is a rapidly growing minority who think of themselves first and foremost as Africans; and the Italian annexation of Abyssinia, together with the fact that the white men have fought two wars among themselves in the last twenty-five years, is now in the background of the native mind from the Sudan to the Cape, from Tanganyika to French West Africa. Africans can see just as far beyond their noses as other people: and inequality of treatment in neighbouring areas, perhaps more than any other type of injustice, is likely to produce a resentful and dangerous type of Africanism, in place of the healthy African patriotism and ambition which it should be the business of the colonial powers to encourage and to guide.

What system, then, should we aim at setting up? In the first place, it is desirable that the new conceptions of colonial status should be internationally expressed and publicly proclaimed. This would probably be best accomplished by the promulgation of a Colonial Charter, which would be for the colonial peoples what Magna Carta was to medieval England or the Declaration of Independence to the infant United States. Such a Charter should be jointly proclaimed by as many as possible of the United Nations; it would be difficult for any of the colonial powers to stand outside for long. It should be neither detailed nor lengthy, but need affirm only a few general principles. First, colonial dependencies are not possessions but are held in trust or guardianship. Second, the primary aim of the guardianship is to help the colonial peoples as rapidly as possible toward self-government. Thirdly, its other major aim is the development of the colonial

territories, first and foremost for the benefit of their own inhabitants, but also for that of the rest of the world. Fourthly, the guardianship is to be exercised jointly by all the nations adhering to the Charter, but its administrative responsibilities are to be delegated to powers with colonial experience. Fifthly, colonial status implies no inherent or permanent inequality: no such inequality exists, and equal status and equal opportunity for all peoples and races is the goal to be realized as quickly as possible. Sixthly, all posts in the permanent colonial services, up to the highest, shall be open to the local inhabitants, subject only to selection for efficiency; and the educational system of the colonies shall have as one of its prime functions the training of men of local race for such posts. Seventhly and finally, all nations adhering to the Charter shall have equality of economic opportunity in the colonies, and also equality of all other types of opportunity, subject only to the need for maintaining efficiency of administration, and to the primacy of the claims of the native inhabitants.

The best method of implementing the Charter will probably be by a series of international conventions. The organization for handling such conventions lies ready to hand, in the shape of the International Labour Office (though in some cases other types of international instrument, such as the Congo Basin Treaty, may be preferable). The I.L.O. already has a colonial section, which would merely require strengthening. If it be asked what the conventions would cover, we can answer: forced labour, labour conditions, social security, and welfare in general, and opportunities for employment and education. The great advantage of the method is that it is a progressive one, which can contribute to a steady raising of standards in relation to changing world conditions. Its effectiveness would be increased if means were found to associate local organizations, such as agricultural co-operatives, say, or bodies concerned with social welfare, with the detailed application of the conventions to particular areas.

Secondly, even if executive responsibility is left in the hands of powers with colonial experience, their administration can be to some extent internationalized. A small proportion of technical posts should immediately be thrown open to qualified men of any nationality, and the proportion should be gradually but steadily increased. The actual selection should be left in the hands of the power concerned, for otherwise it could not well continue to assume executive responsibility. As time went on and the system proved workable, it could be extended to administrative posts as well. Meanwhile an increasing number of increasingly important posts would become filled by inhabitants of the colonies themselves.

Thus there would be parallel progress toward international government and toward self-government; and even if in some cases international government takes the lead, its share in actual administration will all the time be growing quantitatively less and that of self-government quantitatively more.

International supervision and regulation will also be needed at the outset, both to ensure proper standards and also to give some degree of responsibility to the other powers and some outlet for their natural desire to participate in colonial affairs.

This could be provided in the form of a colonial section of whatever international political organization comes into being after the war: let us call it the Colonial Commission. We need not try now to define the detailed constitution and organizational machinery of any such body. What we ought to define are its broad structure and its main functions.

Structurally, the trend of informed opinion is in favour of regional decentralization, delegating most of the work of the Commission to strong Regional Councils. These would include representatives of the colonial powers in the region, of other great powers especially interested strategically or economically, of independent nations within the region, and of the colonial peoples themselves, and perhaps also of the smaller non-colonial powers. It would be responsible, within the framework of a world authority, for general security and economic and social development within the region, not merely with regional colonial problems. It would have its own international staff of experts and advisers and, let us hope, considerable funds.

Next we come to the functions of the Colonial Commission, as delegated to the Regional Councils. One major function should be planning. A second is advice. And the third is financial help. The experience of large-scale development organizations, such as the Tennessee Valley Authority in the U.S.A., shows that a set-up of this kind, although without executive authority (the TVA has executive authority only in connection with its dams and power plants, not in matters of health, agricultural improvement, education, recreation, and so forth), can be extremely efficient in supervising and guiding development along right lines.

There are various prerequisites. The whole programme depends on securing the co-operation of all executive organizations concerned. The regional authority must be prepared to act as a general catalyst and as an organizer of joint action whenever several separate organizations are concerned in a project. In the long run, it depends also on popular understanding and backing: for this, participation by local

bodies and communities and by the agencies of education and of public opinion is needed. Then the planning must be based on ample research and survey: the advice must be based on detailed field knowledge: and there must be an ample supply of men of first-class calibre to go where the problems are.

The separate colonial powers will no doubt have their own funds for colonial development and their own staff of experts and travelling advisers, such as Britain, for instance, is already building up. There should be no more difficulty in combining these with the resources of the Colonial Commission in a common programme than there has been difficulty in pooling the resources of, say, the Land-Grant Colleges, the State Universities, the forestry and agricultural services of the Department of Agriculture, and the Young Farmers' Clubs with those of the TVA in securing a sane agricultural development in the Tennessee Valley area.

There remains the function of reviewing progress and of detecting any failure of the colonial powers to live up to their executive responsibilities. It might be best that detailed review, including any inspection which might prove necessary, should be kept in the hands of the International Labour Office, which would then report to the Colonial Commission on any matters concerning general principles or demanding political action, or the Regional Councils might have their own travelling inspectorate.

I have left to the last the most urgent problem—the raising of standards of life in the backward tropical colonies. Though this is primarily an economic and social problem, it has its political aspects. It concerns the political future of the colonies themselves, since political aspirations toward self-government must be built on the foundations of prosperity and education. And it concerns the political future of the advanced nations, since in the joint development by them of backward areas is to be found the only possible substitute for imperialism in the tightly-knit unit world of after the war.

Let us first try to picture more in detail some of the hard facts which are included in the phrase "tropical backwardness." It is not easy, for the life of most colonial peoples is lived on a different level of history from ours, and is measurable by quite other standards. The tropics are in large part just emerging from primitive tribal existence; at the best, they are still mainly in the barbaric phase of culture —pre-scientific, pre-technological. They are almost entirely lacking in the apparatus of modern civilization. The task of development is immense—nothing less than the capital equipment of the tropics for civilized living. But if we can carry it through, we shall have bene-

fited ourselves as well as the native peoples of the colonies. While they are in their present backward state they cannot provide good markets for the manufactures of advanced countries; they cannot make any adequate contribution to the industrial and cultural life of the world; and even as a source of cheap labour they will be inefficient and unreliable so long as they remain unhealthy and uneducated. We need a complete reversal of the mercantilist policy.

Let us take a look at the extent of the job which this policy implies. In the first place, the idea of the tropics as a luxuriant region, effortlessly producing abundance and riches, is a fable. Almost the only tropical regions which are prosperous are some of those endowed with mineral wealth. Soil erosion, absence of necessary mineral salts, pests and parasites, are common. The tropics are to a large extent still physically untamed and unequipped. Railways, motor roads, ports, bridges, warehouse and storage facilities, processing plants, marketing services, dams and reservoirs, power plants, forestry, agricultural and veterinary services—in most areas these are in their infancy and must be provided on a generous scale before the colonies can take their proper place in world economy, where they can act as a stimulus rather than a drag. In addition, encouragement must be given to light and secondary industries, for only so can a reasonably balanced economy grow up in colonial areas.

But human resources are just as important as material resources. By and large the inhabitants of tropical colonies are miserably equipped with health, energy, education, and technical skill. The noble savage, the magnificent human animal endowed with the health of which civilization has robbed us degenerate whites—that is another myth. The tropical peoples as a whole are unhealthy peoples. In the tropics, vital statistics are very dubious, but we know enough to say that death- and disease-rates are of a different order of magnitude from those which applied science has made possible in the Western world. To take but a few examples: African infant mortality ranges from 1 in 4 to 1 in 2, as against the 1 in 15 to 1 in 25 of civilized countries; probably every adult negro is infested with one or more kinds of worms, usually including hookworm, and often with malaria as well; in some areas up to 90 per cent. of the population suffers from venereal disease; gross malnutrition as well as vitamin deficiency is frequent. The white man in the tropics curses the native for his laziness. But if the native were once rid of parasitic and infectious disease and given an adequate diet, he would not merely be more energetic: his entire personality would be transformed.

Improved health would provide the physiological basis for a new advance: education is needed to provide the mental basis. The tropics are as backward in education as in health. Over most of Africa, not 10 per cent. of the children ever go to any school; and not 10 per cent. of the schools are anything but the most primitive sub-elementary bush-schools, confining themselves to hymn-singing, the catechism, and the rudiments of the three R's. When the so-called primitive is given his chance, he can learn as well as anyone else. He can acquire mechanical skill, as exemplified in the workshops of the Belgian Congo; intellectual skill, as is to be seen in the Gold Coast; military proficiency, as has been demonstrated in Ethiopia during this war by the black troops from Nigeria and East Africa. For the realization of the people's latent abilities, home background and some general culture are needed as well as schools. But, given two or three generations of good education and of outlets for those who have been educated, the tropics would be as radically transformed in mind and capabilities as they would be in body and energies by proper health and diet. Tropical backwardness, economic, political, physical, and mental, is not an inescapable and permanent fact of nature; it is a temporary phenomenon which can be remedied if we are willing to make the necessary effort.

What measures should be taken to lift the tropical countries and their inhabitants out of this slough of backwardness? It is clear that the task is too large, too complex, and too long-term to be left wholly or even mainly to the free play of private initiative.

The British Government has, during the war, passed the Colonial Development and Welfare Act. This has not only increased five-fold the amounts available from central funds for colonial development, but has made social and educational improvements eligible for grants as well as purely commercial projects.

This is an important step, but it is not enough. Aid for colonial development must be on a much grander scale, and it must be in large measure international. The first prerequisite is an exhaustive survey of resources and needs, backed by adequate pure research. Anthropology, water-power, mineral and forest resources, soils, erosion, agricultural products, transport and marketing needs, home economics, health, population trends, the prospects of export and home industries—all need to be surveyed in a much more comprehensive way than has yet been done. Lord Hailey's *African Survey* has itself stressed the need for the expansion and co-ordination of research.

Next comes the financing of development. This can be done in

various ways. Colonial profits and revenues will only go a short distance. Loans and grants-in-aid, both from the separate colonial powers and from the international Colonial Commission, will be of importance. And private finance, largely guided into desirable channels through some international investment board, can still play a major role. Already the British and American authorities are considering ways and means for setting up international finance agencies, among whose functions would be the promotion of development in backward areas.

For the actual job of carrying out development, special agencies and methods will be needed. Existing colonial governments can continue doing much valuable work. Then we may envisage the setting up of more organizations of the type of the Empire Cotton-Growing Corporation in the Sudan, where co-operatives of native producers are organized with the aid both of private finance and government aid. We shall require a careful organization of marketing agencies for all products which are regulated by international schemes of commodity control. And we shall certainly need special long-term planning and development agencies of rather new type.

One valuable suggestion, which will apply to those numerous tropical regions where all-round development is needed for a longish period before commercial profit can be expected, is to set up agencies rather of the type of the TVA, but adapted to regions of greater backwardness, and under some international control. Their function would be social as much as economic, and would involve the transformation of every aspect of life—a task which obviously requires long-term planning as well as large-scale capital investment. We may call such bodies Regional Development Agencies.

For other regions where a profitable external market is already, or will shortly be, available, a different type of body is needed, which we may christen the International Public Concern. Their shareholders should be given a minimum rate of return on their investment by international guarantee. In return for this a maximum rate should also be laid down; all profits in excess of this must be returned to the area, and a certain proportion must be set aside for social, educational, and health improvement (somewhat as with the Miners' Welfare Fund in Britain). This compulsory ploughing-back of any excess profits is essential if the development of the area is to proceed at a reasonable rate: at present there is an undue and illegitimate drain of wealth from the backward to the advanced nations. Finally, as such concerns are bound to exert a dominant influence on all aspects of native life, it is essential that they should operate under

welfare and conservation regulations approved by the Colonial Commission. Existing private concerns (some of which, like the United Africa Company, are huge and powerful bodies) must clearly be subjected to similar regulation, social as well as financial.

There are many other aspects of colonial development which it would be interesting to discuss, but space forbids. I would, however, like to mention two. First, it is very important that there should be a well-thought-out population policy for backward areas. As health measures bear fruit, we may expect a formidable spurt of population growth in areas such as tropical Africa; and population pressure is one of the main causes of economic backwardness in countries like India. Thus the provision of birth-control facilities should be a recognized part of the colonial health programme.

Finally, we must do our utmost to secure a continuity of cultural growth, even for the most backward peoples of the world. At present, in most areas the old tribal society and its values and ideals are being rapidly destroyed, and nothing solid is being put in its place. The detribalized native too often gets the worst of both worlds, acquiring a rather unpleasant veneer of imitation white civilization over roots of tribal ignorance and superstition.

Is it not possible to combine the old and the new in a better way—to graft the better aspects of modern technology and education on to a healthy stock of native tradition and skill? There have been some interesting experiments in this direction, notably at Achimota College in the Gold Coast. Already the experiment has demonstrated the immense access of self-respect and vitality which accrues to the African when he finds he can produce by his own efforts something which is of high standard and useful to the community. The new policy of the Indian Bureau in the U.S.A. is bearing similar fruit. Only by such means can one encourage the native peoples to take pride in their own traditions and achievements, and enable them to make a distinctive contribution to world culture.

I can sum up the pith of the colonial problem in a brief final paragraph. This war is a symptom of a major historical transformation which will pursue its inexorable course whether we like it or not—a transformation toward a world that will be more socialized, more planned, more internationally organized than the nineteenth-century world that is fading out. But if we cannot prevent that transformation taking place, we can help to guide it. We can see that it is achieved either in a totalitarian, Hitlerian, way, or in a democratic,

co-operative way. In the former case the new world order will be based on inequality and on domination by force, in the latter on equality and on mutual help. In regard to colonies, nationalist imperialism, however enlightened, was inevitably tainted with inequality, exploitation, and forcible domination. The alternative is to treat the colonial peoples as human beings like ourselves, to be guided, helped, and developed toward future political and cultural equality; the responsibility for this rests not on the few colonial powers, but jointly on all the advanced nations. Once this alternative is chosen, all else is a mere matter of machinery and will follow in due course.

Nature and Origin of the Group-sentiment

OF all appeals to which human beings respond, few are as powerful as that of tribal, or—in a more advanced stage—of national feeling. Such sentiment is at the basis of life in the modern State. It is doubtless founded upon some form of the herd impulse, which receives satisfaction in social animals through the presence of other animals like themselves. In Man, however, this impulse, like other so-called "instincts," is not simple and straightforward in operation. The likenesses upon which this "consciousness of kind" is based are inborn in animals: but in Man they are very largely acquired, being the product of experience and social factors.

Very many human activities, aspirations, and emotions have contributed, either naturally or artificially, to build up the great synthesis that we term a "nation"; language, religion, art, law, even food, gesture, table manners, clothing, and sport all play their part. So also does the sentiment of kinship, for the family has extended some of its age-old glamour to that wholly different and much newer aggregate, the national unit. I would stress the contrast between family and nation, since the family is an ancient and biological factor, while the nation-state is a modern conception and product, the result of certain peculiar social and economic circumstances. The family has been produced by Nature, the nation by Man himself.

Before the Renaissance, that is to say before the fifteenth century, nations or national states in our sense of the word did not exist, though there were composite human aggregates related to the tribes of an earlier cultural stage. For the moment we will call the sentiment which holds tribes and nations together "group-sentiment." To call it "racial" is to beg a very important question which it is the purpose of this essay to discuss. It is, however, clear that even in the pre-Renaissance stage group-sentiment was a complex thing, certain elements being derived from the idea of kinship, certain others from local feeling, from economic necessity, from history, from custom, or from religion.

The transference of the idea of kinship to the "group-sentiment" of nations has been fateful for our civilization. For while the idea of kinship is one of the most primitive emotional stimuli, the sentiment which it arouses is also one of the most enduring. It is for this reason that the authors of moral and legal codes have frequently found it

necessary to protect the State against aspects of group-sentiment which induced hostility to foreign elements. The Bible is full of allusions to such checks. "The stranger that dwelleth with you shall be unto you as one born among you, and thou shalt love him as thyself; for ye were strangers in the land of Egypt: I am the Lord your God" (Leviticus xix. 34). "One ordinance shall be both for you of the congregation, and also for the stranger that sojourneth with you, an ordinance for ever in your generations: as ye are, so shall the stranger be before the Lord" (Numbers xv. 15). One of the most gracious parables of Jesus is devoted to the discussion of who is our neighbour (Luke x. 25-37), and the very basis of Christianity is the proclamation "There is neither Jew nor Greek, there is neither bond nor free: for ye are all one in Christ Jesus" (Galatians iii. 28).

Throughout the history of civilization the establishment and regulation of group-sentiment among those who are held together mainly by political bonds has been one of the chief aims of statecraft. To achieve this the idea of kinship has been pressed into ever wider service. It has been expanded beyond the family, to embrace the tribe, then the loosely knit federation of tribes, and the yet more extensive aggregate, the nation.

The Brotherhood of Mankind

When religions and philosophies have claimed and empires have sought to be universal, the idea of kinship has been extended beyond the limits of the nation-state. Prelates have been the shepherds of many flocks, and commonwealths have become families of nations. In all ages law, reason, and religion alike have laid emphasis on the brotherhood of all mankind. It was an ancient philosopher-poet who said, "I am a man, and nothing that is human do I deem alien from myself"; and a murderer who yet earlier asked, "Am I my brother's keeper?"

But the common elements that all men share have been especially the theme of the great spiritual leaders. Malachi's question "Have we not all one Father? Hath not one God created us?", the beautiful treatise on the love of God as inseparable from the love of our fellow-men, known as the *First Epistle General of John*, and St. Paul's assertion, "He hath made of one blood all nations of men for to dwell on all the face of the earth," have all been echoed by a myriad voices. The community of mankind is a sentiment which has particularly appealed to teachers. "The same sky covers us all, the same sun and stars revolve about us, and light us all in turn," said the great Czech educator Comenius.

Of all studies the most universal is that which we call science, and with its advent in the seventeenth century the unity of mankind became especially emphasized. Such was the principle which the French scientist and philosopher Pascal detected in the continuity of research in the sciences: "The whole succession of men through the ages should be considered as one man, ever living and always learning."

The Idea of Nationality

Mankind, however, has shown itself to be still unprepared to accept the idea of universal human brotherhood, and has often denied it most loudly when maintaining the universal fatherhood of God. Tribal, religious, and national sentiment have, time and again, overruled the sentiment for humanity. The idea of nationality has yielded as fruit that patriotism which has proved itself one of the strongest forces known to history, second perhaps only to religion. It is hardly necessary to emphasize the part played by patriotic sentiment in the moulding of Europe. The passionate desire for freedom from foreign domination—which we may note is very far from the desire for freedom itself, with which it is often confused—was one of the preponderating political factors of the nineteenth century. In Germany it broke the power of Napoleon and later created an empire; it freed Italy from the rule of Austria and made her a nation; it drove the Turk almost out of Europe and stimulated nationalist sentiments among the Greeks and among all the peoples of the Balkans. It has also been the main idea in the formation of the "succession states" since the War of 1914-18.

All the movements toward national unity that were so characteristic of the nineteenth century present certain features in common. Among these we would note especially the rise of a myth, so similar in all these cases that we must suppose that it is a natural way of thinking for peoples in like circumstances. Among all the newer and almost all the older nationalities a state of freedom from external political domination has been fictitiously supposed to have existed in the past and has been associated with a hypothetical ancient unity, itself considered as derived from an imaginary common inheritance. The implications of this unity are usually left vague. A "nation" has been cynically but not inaptly defined as "a society united by a common error as to its origin and a common aversion to its neighbours."

The economic movements of the nineteenth century gave rise to unparalleled social and political dislocations. The resulting conflicts have by some been interpreted as originating from an incompatibility

of "racial" elements in the populations involved. But such incompatibility, if it be a reality, must have existed for many centuries in the populations before these disturbances declared themselves. Such explanations therefore inevitably lead to an inquiry as to the extent to which the claims to "racial unity," which are involved in recent nationalist controversy, have a basis in reality.

A further question necessarily arises in this connection. Even if we assume that for any given national unit it were possible to establish a specific physical type—which it is not—would there be any evidence for the view that it were best that this type should be fostered and its survival encouraged to the exclusion of all other types? In coming to a conclusion we must remember that every people has ascribed to itself special powers and aptitudes. Such claims may, at times, assume the most ridiculous forms. There is not one but a multitude of "chosen peoples." Some of the most sweeping claims made for the British, by Kipling for instance, are closely similar to the claims made for the tribes of Israel by the authors of certain Biblical books.

> Truly ye come of The Blood; slower to bless than to ban,
> Little used to lie down at the bidding of any man.
>
> There's but one task for all,
> One life for each to give,
> What stands if Freedom fall?
> Who dies if England live?

With *The White Man's Burden* may be compared the forty-ninth chapter of the book of Isaiah:

> The Lord hath called me from the womb. . . . And he said unto me, Thou art my servant, O Israel, in whom I will be glorified. . . . It is a light thing that thou shouldest . . . raise up the tribes of Jacob and restore the preserved of Israel: I will also give thee for a light to the Gentiles, that thou mayest be my salvation unto the end of the earth. . . . That thou mayest say to the prisoners, Go forth; to them that are in darkness, Shew yourselves!

When, too, we read in Madison Grant's *The Passing of the Great Race* that the greatest and most masterful personalities have been of Nordic type, we can make a shrewd guess at its author's general appearance! A flaw in his line of thought is that the very same claims are made by many groups that are by no means predominantly Nordic. Passages claiming leadership of the world can, in fact, be elicited in abundance from French, German, Italian, Russian, and American literature, to say nothing of the literatures of smaller groups. Nations, races, tribes,

societies, classes, families—each and all claim for themselves their own peculiar, real, or imaginary excellences. This is a common human foible, but there are times and circumstances when it may become an epidemic and devastating disease.

The Meaning of "Race"

The term "race" is freely employed in many kinds of literature, but investigation of the use of the word soon reveals that no exact meaning can be attached to it. The word "race" is of Hebrew or Arabic origin, and entered the Western languages late. It was originally used to denote descendants of a single sire, especially of animals. Later in English and French it became applied to human beings, as in the phrase "the race of Abraham" in Foxe's *Book of Martyrs* (1570 edition, the first occurrence in this sense in English) or in a spiritual sense,—e.g. the "race of Satan" in Milton's *Paradise Lost.* The word was not employed in the Authorized Version of the Bible, where it is represented by the words "seed" or "generation."

The word "race" soon acquired a vagueness that it has never since lost. This vagueness has given the word a special popularity with a group of writers who deal with scientific themes, though they themselves are without adequate scientific equipment. From such writers it has descended to the literature of more violent nationalism.

It is instructive to look up the word *race* in a good dictionary. The vagueness of its usage will at once become apparent. *The Concise Oxford Dictionary* defines "race" in general as:

> "Group of persons or animals or plants connected by common descent, posterity *of* (person), house, family, tribe or nation regarded as of common stock, distinct ethnical stock (*the Caucasian, Mongolian*, &c., *r.*), genus or species or breed or variety of animals or plants, any great division of living creatures (*the human, feathered, four-footed, finny*, &c., *r.*); descent, kindred (*of noble, Oriental*, &c., *r.*; *separate in language* & *r.*;) class of persons &c. with some common feature (*the r. of poets, dandies*, &c.)."

A word is often none the worse for being inexact in its usage; many words indeed are valuable for this very reason. But it is necessary, in dealing with scientific subjects, to distinguish carefully between the terms that we use in an exact sense and those which are valuable for their very vagueness. The word "race," if it is to be used at all, should find its place in the latter class.

It has frequently been asserted that "race" is of the essence of nationality, and sometimes "race" and "nation" have been used as

almost interchangeable terms. So far has this gone that many nationals, if questioned, would reply that their compatriots were all of one "race," with a proportion, more or less insignificant, of "aliens," who, by some means or other, have acquired their national status. A very little reflection and knowledge will show that this view is untenable. The belief, however, survives in many quarters where it should have become extinct, sometimes with the idea of "stock" substituted for "race." Our statesmen, who should know better, often speak of the "British race," the "German race," the "Anglo-Saxon race," the "Jewish race," etc. Such phrases are devoid of any scientific significance. The speakers should usually substitute some such word as "people" or "group" for the word "race" if they desire to convey any meaning—and if they do not wish to play into the hands of Hitler and those who think like him.

It was a remarkable consequence of the Great War that, perhaps for the first time in history, peace treaties were directed toward the revision of the political map on lines which aim at having a basis in so-called "ethnic realities." For this purpose the "racial" argument was constantly put forward in terms of what, in the current phrase of the time, was called "self-determination," with occasionally some regard for the rights of the so-called "racial" (usually linguistic or cultural) minorities.

In the discussion which accompanied the settlement of the peace treaties there was inevitably much confusion of thought in regard to these so-called "racial questions." As an illustration of the lengths to which such confusion of thought may go, it may be mentioned that in the discussion on the Polish Corridor it was even suggested as a means of finding the "racial" affinities of the inhabitants of the area involved, that the question might be settled by consulting the voting lists of the last election!

"Race" and "Blood"

Associated with the vague idea of "race" is the idea, almost equally vague, of "blood." The use of this word as equivalent to "relationship" is itself based on an elementary biological error. In fact there is no continuity of blood between the parent and offspring, for no drop of blood passes from the mother to the child in her womb. The misconception is very ancient and is encountered among many peoples on a low cultural level. This false conception gained scientific currency from a mistake of Aristotle, who held that the monthly periods, which do not appear during pregnancy, contribute to the substance of the child's body (Aristotle, *De Generatione Animalium*, I, § 20). The

curious reader will find Aristotle's error repeated in a work in the Apocrypha, *The Wisdom of Solomon* (vii. 2). The modern knowledge of the physiology and anatomy of pregnancy disposes completely of any idea of a "blood-tie" or of "common blood" in its literal sense. Such blood is not "thicker than water." On the contrary, it is as tenuous as a ghost. It is non-existent. It is a phantasm of the mind.

But quite apart from this venerable misconception, and the widespread misunderstandings that arise from it, it is evident that the actual physical kinship, which is frequently claimed as "race feeling," must be fictitious. In many cases it is, in fact, demonstrably false even in the very simple and lowly forms of social organization. To speak of "kinship" or "common blood" for the populations of our great complex modern social systems is to talk mere nonsense.

We may take a familiar example of a lowly social organization from the Scottish clans. These, in theory, were local aggregates of families connected by kinship and each bound thereby to their chief. As an historical fact, however, these local units included settlers who came from other clans. This mixture of relationships would naturally, in time of crisis, entail a divided allegiance. Such a danger was overcome by the enforced adoption of the clan name. Thus when the MacGregors became a broken clan and the use of the name was forbidden, its members averted the evil consequences of their outlawry by adhesion to other clans. Thus Rob Roy, the famous outlaw and chief of the Gregors, adopted his mother's name of Campbell, and so became an adherent of the Duke of Argyll.

Similarly in Ireland there was a system of wholesale inclusion of entire classes of strangers or slaves with their descendants into the clan or into its minor division, the sept. Those so adopted regularly and as a matter of course took the tribal name. In the exceedingly ancient "Brehon Laws," which go back at least to the eighth century, there are regulations for the adoption of new families into the clan and even for the amalgamation of clans. Kinship, or rather what was treated as kinship, could thus actually be acquired. It could even be bought. A number of legends of early Greece and Rome tell of similar clan fusions. Adoption into the tribe thus constantly becomes a fictitious blood-tie, and among many peoples of lower culture the ceremony of adoption is accompanied by actual physical interchange of blood. Many analogies in more advanced cultural units suggest themselves.

If a Scottish or Irish clan is of "mixed blood," what likelihood is there of purity of descent among the millions that make up the

population of any great modern nation? How can there be an "Anglo-Saxon race," a "German race," a "French race," and still less a "Latin race," or an "Aryan race"? Historically, all the great modern nations are well known to be conglomerations and amalgamations of many tribes and of many waves of immigration throughout the long periods of time that make up their history. This may be well seen in southern France, where in Provence the Greek colonies of Marseilles and elsewhere became, at a very early date, integral parts of the population of Gaul. More familiar examples are to be found in the population of the British Isles, which has been made up from scores of waves of immigrants from the third millennium B.C. until the present time. Britain has thus been a melting-pot for five thousand years. Among the more modern waves was that of the Huguenot refugees, who fled from France to the eastern counties of England, and formed 5 per cent. of the population of London after the Revocation of the Edict of Nantes, and the Flemish settlers who came at a somewhat earlier date to South Wales. Both have long ceased to be separate groups, and those who number Huguenots and Flemings among their ancestors cannot be distinguished among the extremely complex mixture which forms the population of the country. In particular it may be stated that, from the earliest prehistoric times to our own, the wealthy and densely settled south-eastern part of England has been the recipient of wave on wave of immigration from the Continent. The existence of anything that can be called a "race" under such conditions is mere fantasy.

The special form of group-sentiment that we call "nationality," when submitted to analysis, thus proves to be based on something much broader but less definable than physical kinship. The occupation of a country within definite geographical boundaries, climatic conditions inducing a definite mode of life, traditions that gradually come to be shared in common, social institutions and organizations, common religious practices, even common trades or occupations—these are among the innumerable factors which have contributed in greater or less degree to the formation of national sentiment. Of very great importance is common language, strengthened by belief in a fictitious "blood-tie."

But among all the sentiments that nurture feelings of group unity, greater even than the imaginary tie of physical or even of historic relationship, is the reaction against outside interference. That, more than anything else, has fostered the development of group-consciousness. Pressure from without is probably the largest single factor in the process of national evolution.

"National Types"

It may, perhaps, be claimed that, even admitting the incorporation into the nation of many individuals of "alien blood," it is nevertheless possible to recognize and differentiate the true "stock" of a nation from the foreign. It is sometimes urged that the original stock represents the true national type, British, French, Italian, German, and the like, and that the members of that stock may readily be distinguished from the others. The use of the word or the idea of "stock" in this connection introduces a biological fallacy which we must briefly discuss.

Certainly, well-marked differences of "national type" are recognized in popular judgment—we all know the comic-paper caricature of the Frenchman, the German, etc.—but it is very remarkable how personal and variable are such judgments. Thus our German neighbours have ascribed to themselves a Teutonic type that is fair, long-headed, tall, slender, unemotional, brave, straightforward, gentle, and virile. Let us make a composite picture of a typical Teuton from the most prominent of the exponents of this view. Let him be physically as blond and mentally as unemotional as Hitler, physically as long-headed and mentally as direct as Rosenberg, as tall and truthful as Goebbels, as slender and gentle as Goering, and as manly and straightforward as Streicher. How much would he resemble the German ideal?

As for those so-called "national types" that travellers and others claim to distinguish, we may say at once that individuals vary enormously in the results of their observations. To some resemblances, to others differences, make the stronger appeal. Between two observers attention will tend to be directed to entirely different characters in the same population. Furthermore, a general conclusion as to the character of any given population will depend on how far the material examined is what statisticians call a "true random sample."

A traveller who lands at Liverpool and carefully explores the neighbourhood of the great industrial area by which that port is surrounded, would form a very different view of the bearing, the habits, the interests, the speech, in fine, of the general appearance of the population of England, from one who landed at Southampton and investigated agricultural Hampshire. Both would obtain different results from one who landed in London, and all three from the painstaking investigator who undertook a tour of observation from Land's End to John o' Groats. Observations in Normandy or in Bayonne will give a very different impression of the French from those made

in Provence, while a superficial anthropological observer from Mars who had landed in certain corners of North Wales might, for a time, easily imagine himself among a Mediterranean people, and even in some spots among a people of an older, "palaeolithic" type. Samples of the mixed population of the United States, formed from peoples of the most varied origin, might give an even more distorted impression of the general social and material conditions of its inhabitants, if the observations were confined to the east side of New York, to the Scandinavian belt of the Middle West, to the Creole population of New Orleans, or to the country districts of New England.

When, in fact, the differences which go to make up these commonly accepted distinctions between "racial stocks" and nationalities are more strictly examined, it will be found that there is very little in them that has any close relation to the physical characters by which "race" in the biological sense can be distinguished. It is more than probable that, so far as European populations are concerned, nothing in the nature of "pure race" in the biological sense has had any real existence for many centuries or even millennia. Whether it has ever had, since the days when man first became man, is a problem which is still unsolved.

Nationality depends on Cultural, not Biological, Characteristics

In considering the characters of different nationalities it will generally be found that the distinctive qualities upon which stress is laid are cultural rather than physical, and when physical, they are very often physical characters that have been produced or influenced by climatic and cultural conditions. Stature is certainly in part a function of environment. Pigmentation—fairness or darkness—unless submitted to scientific record and analysis, is illusory. How many Englishmen could give an accurate estimate of the percentage of dark-complexioned or of short people in England?—which is in fact a country whose inhabitants are more often dark than fair, more often short than tall. Expression must obviously be determined largely by the content and habit of thought. Men's faces have, stamped upon them, the marks of their prevalent emotions and of those subjects on which they most often and most deeply think.

In point of actual fact, the most crucial factors on which most observers' judgment will depend will be dress and behaviour. In dress, the use, degree, and contrast of colour at once attract the eye. In behaviour, facial expression, gesture, and speech attract much attention. These, however, are cultural factors, the results of fashion, imitation, and education. It is true that attitude and movement and

the use of the voice have physical bases. But it is, nevertheless, certain that in virtue of their patent transmission by imitation they must be regarded as mainly dependent upon a cultural inheritance. It is interesting to note that in Hitler's book *Mein Kampf* his "racial" characterizations and differentiations, more especially of the Jews, are based not on any biological concept of physical descent—as to the essential nature and meaning of which he exhibits complete ignorance—but almost entirely on social and cultural elements.

The Myth of an "Aryan Race"

Apart from these general considerations, certain fallacies of unscientific "racial" conceptions, and in particular the myth of an "Aryan race," call for separate discussion.

In 1848 the young German scholar Friedrich Max Müller (1823-1900) settled in Oxford, where he remained for the rest of his life. The high character and great literary and philological gifts of Max Müller are well known. About 1853 he introduced into English usage the unlucky term *Aryan*,[1] as applied to a large group of languages. His use of this Sanskrit word contains in itself two assumptions—one linguistic, that the Indo-Persian sub-group of languages is older or more primitive than any of its relatives; the other geographical, that the cradle of the common ancestor of these languages was the Ariana of the ancients, in Central Asia. Of these the first is now known to be certainly erroneous and the second now regarded as probably erroneous. Nevertheless, around each of these two assumptions a whole library of literature has arisen.

Moreover, Max Müller threw another apple of discord. He introduced a proposition which is demonstrably false. He spoke not only of a definite Aryan language and its descendants, but also of a corresponding "Aryan race." The idea was rapidly taken up both in Germany and in England. It affected to some extent a certain number of the nationalist historical and romantic writers, none of whom had any ethnological training. It was given especial currency by the French author de Gobineau. Of the English group it will be enough to recall some of the ablest: Thomas Carlyle (1795-1881), J. A. Froude (1818-94), Charles Kingsley (1819-75), and J. R. Green (1837-83). What these men have written on the subject has been cast by historians into the limbo of discarded and discredited theories.

In England and America the phrase "Aryan race" has quite ceased to be used by writers with scientific knowledge, though it appears

[1] The word *Aryan* was first used quite correctly by Sir William Jones (1746-94) as a name for the speakers of a group of Indian languages.

occasionally in political and propagandist literature. A Foreign Secretary recently blundered into using it. In Germany the idea of an "Aryan" race received no more scientific support than in England. Nevertheless, it found able and very persistent literary advocates who made it appear very flattering to local vanity. It therefore steadily spread, fostered by special conditions.

Max Müller himself was later convinced by scientific friends of the enormity of his error and he did his very best to make amends. Thus in 1888 he wrote:

> I have declared again and again that if I say Aryas, I mean neither blood nor bones, nor hair, nor skull; I mean simply those who speak an Aryan language. . . . When I speak of them I commit myself to no anatomical characteristics. The blue-eyed and fair-haired Scandinavians may have been conquerors or conquered. They may have adopted the language of their darker lords or vice-versa. . . . To me an ethnologist who speaks of Aryan race, Aryan blood, Aryan eyes and hair, is as great a sinner as a linguist who speaks of a dolichocephalic dictionary or a brachycephalic grammar.[1]

Max Müller frequently repeated his protest, but alas! "the evil that men do lives after them, the good is oft interred with their bones." Who does not wish to have had noble ancestors? The belief in an "Aryan" race had become accepted by philologists, who knew nothing of science—and the word was freely used by writers who claimed to treat of science though they had no technical training and no clear idea of the biological meaning to be attached to the word "race." The influence of the untenable idea of an "Aryan race" vitiates all German writings on anthropology which are now allowed to appear. If the term "Aryan" is given a racial meaning at all, it should be applied to that tribal unit, whatever it was, that first *spoke a language* distinguishable as Aryan. Of the physical characters of that hypothetical unit it is the simple truth to say that we know nothing whatever. As regards the locality where this language was first spoken, the only tolerably certain statement that can be made is that it was somewhere in Asia and was not in Europe. It is thus absurd to distinguish between "non-Aryans" and "Europeans."

There is no need to trace in detail the history of the Aryan controversy. It will be enough to say that while the Germans claimed that these mythical Aryans were tall, fair, and long-headed—the hypothetical ancestors of hypothetical early Teutons—the French

[1] Max Müller, *Biographies of Words and the Home of the Aryas*, London, 1888, p. 120.

claimed that the Aryan language and the Aryan civilization came into Europe with the Alpines (Eurasiatics), who are of medium build, rather dark, and broad-headed. The decipherment of the language of the very "Jewish"-looking Hittites—which was certainly Aryan—and the discovery of certain Aryan languages in North-West India throws a new complexion on the whole question of the origin of the Aryan languages.

Both the German and the French views cannot be entirely true, but both may be partially or entirely erroneous. In so far as the cultural origins of our civilization can be associated with any particular physical type, it must be linked neither with the Nordic nor the Eurasiatic, but rather with the Mediterranean. As regards the general physical measurements of the existing population of central Europe, the prevailing physical type is Eurasiatic rather than either Nordic or Mediterranean.

The Jews

A consideration of this "Aryan fallacy" leads us to two so-called "race problems" which are of immediate political importance—the Nordic and the Jewish. Beginning with the latter, we find that the Jewish problem is far less a "racial" than a cultural one. Jews are no more a distinct sharply marked "race" than are German or English. The Jews of the Bible were of mixed descent. During their dispersal they have interbred with the surrounding populations, so that a number of hereditary elements derived from the immigrant Jews are scattered through the general population, and the Jewish communities have come to resemble the local population in many particulars. In this way Jews of Africa, of Eastern Europe, of Spain and Portugal, and so on, have become markedly different from each other in physical type. What they have preserved and transmitted is not "racial qualities" but religious and social traditions. Jews do not constitute a race, but a society with a strong religious basis and peculiar historic traditions, parts of which society have been forced by segregation and external pressure into forming a pseudo-national group. Biologically it is almost as illegitimate to speak of a "Jewish race" as of an "Aryan race."

The Nordic Theory

The Nordic theory, which is a development of the "Aryan fallacy," is in another category. Instead of ascribing racial qualities to a group which is to-day held together on a cultural basis, it takes a hypo-

thetical past "race," ascribes to it a number of valuable qualities, notably initiative and leadership, and then, whenever it finds such qualities in the mixed national groups, ascribes them to the Nordic elements in the population. It then proceeds farther and sets up, as a national ideal, a return to purity of stock of a Nordic "race" the very existence of which is unproved and probably unprovable.

The real source of all these modern ideas of the innate inferiority of certain "races" is the work of the French Count Joseph de Gobineau *Essai sur l'inégalité des races humaines* (1853-5). This book is essentially a plea for "national" history. He advocated especially the superiority of the so-called "Aryan races" over others. The idea was carried to the most ridiculous lengths in the work of his countryman Lapouge, *L'Aryen* (1899), in which the "Aryans" were identified with the "Nordic race." This ridiculous Nordic-Aryan theory, launched by French writers, was eagerly developed in Germany and linked with anti-Jewish propaganda. In the beginning of the present century the East Prussian Gustav Kossinna took up the idea, applied it to prehistoric archaeology, and claimed to make German prehistory—to use his own words—"a pre-eminently national science." His naïve object was to show that throughout the prehistoric ages advances in culture had been entirely due to peoples whom he identified with the Nordic, Germanic, or "Aryan" peoples, these terms being regarded as interchangeable, though including not merely Germans but also Scandinavians. The "Aryan" cradle was conveniently located in the North European forest about the Baltic and North Sea coasts.

This theory is scientifically quite untenable on many grounds. Thus, to take a single point, the earliest of the rough stone monuments (of which Stonehenge is a late and highly developed example, *c.* 1700-1600 B.C.) go back, even in England, at least as far as 3000 B.C. The culture that they represent spread from the Mediterranean to the Iberian peninsula and thence through France into Britain and beyond to north Germany and Scandinavia. Yet these monuments, involving high enterprise, considered design, and complex social organization, were produced by a people devoid of metal implements and quite certainly not of "Nordic" origin. The skulls from the early English burials associated with these monuments are, in fact, usually stated to be of "Mediterranean" type.

Nevertheless, the Nordic theory speedily became very popular in Germany. It made a special appeal to national vanity and was made the basis of propaganda in the pseudo-scientific writings of the Germanized Englishman Houston Stewart Chamberlain and others in Ger-

many, and of Madison Grant and others in America. Hitler—himself anything but Nordic—is completely obsessed by this fantastic theory. Among the absurdities connected with the development of the theory it is perhaps sufficient to mention that Jesus Christ and Dante have been turned into "good Teutons" by German writers. The "Nordic theory" has had a very great effect, not only in serving as a basis for the "Aryan" and anti-Jewish doctrines upon which the Nazi regime is now being conducted, but also as the inspiring influence in a great deal of political agitation which claimed superiority for the "Nordic" in the discussion of legislation determining the recent revision of the immigration laws in the United States.

The facts of the case are as follows. The "Nordic race," like other human races, has no present existence. Its former existence, like that of all "pure races," is hypothetical. There does, however, exist a "Nordic type." This occurs with only a moderate degree of mixture in certain limited areas of Scandinavia, and is also to be found, though very much mixed with other types (so that all intermediates and recombinations occur), in Northern Europe from Britain to Russia, with pockets here and there in other countries. On various grounds we can be reasonably sure that this distribution is the result of the invasion of Europe by a group largely composed of men of this type—perhaps in the degree of purity in which the type is now found in limited areas of Scandinavia. This group in its original form was probably the nearest approach to a "Nordic race." It is not certain where it originated or when its important migration took place. Several authorities believe that it came originally from the steppes of southern Russia.

The contentions which ascribe to the "Nordic race" most of the great advances of mankind during recorded history appear to be based on nothing more serious than self-interest and wish-fulfilment. In the first place, it is quite certain that the great steps in civilization, when man learned to plough, to write, to build stone houses, to transport his goods in wheeled vehicles, were first taken in the Near East, by peoples who by no stretch of imagination could be called Nordic, but who seem in point of fact to have consisted largely of men of the dark, "Mediterranean" type. Secondly, it is true that great advances in civilization have sometimes been observed in history when invaders of a relatively light-skinned type have irrupted into countries populated by other groups—notably in Greece, though here round-headed as well as long-headed elements were included in the invaders. But, in such cases, both types appear to have made their contribution, and

the result can best be ascribed to the vivifying effects of mixture and culture-contact. Indeed, where the Nordic type is most prevalent, in Scandinavia, there is no evidence of any ancient civilization having been attained at all comparable to that of the Near East, North Africa, India, China, the Mediterranean, or the Aegean. In more modern times the greatest achievements of civilization have occurred in regions of the greatest mixtures of types—Italy, France, Britain, and Germany, to mention only four nations. In all countries of "mixed races" it is rare to find pure Nordic types. The great bulk of the population will contain hereditary elements derived from many original sources. In the highly complex populations of Britain or Germany the pure Nordic type, if it ever existed, is quite irrecoverable, for the population as a whole is an inextricable mixture. The Nordic type may be held up as an object of policy or propaganda, but this ideal is genetically quite unattainable, and will not affect the biological realities of the situation.

Furthermore, when we look into the facts of history, we find it far from true that men of pure or even approximately Nordic type have been the great leaders of thought or action. The great explorers of Britain displayed initiative, but hardly one of them was physically of Nordic type: the majority of the most celebrated Germans, including Goethe, Beethoven, and Kant, were medium or round-headed, not long-headed as the Nordic type should be. Napoleon, Shakespeare, Einstein, Galileo—a dozen great names spring to mind which in themselves should be enough to disperse the Nordic myth. The word *myth* is used advisedly, since this belief frequently plays a semi-religious role, as basis for a creed of passionate racialism.

"Race-mixture" is Beneficial

From what has been said, it will be clear that "race-mixture" has in the past been beneficial. The British contain strong Nordic and Eurasiatic elements, with a definite admixture of Mediterranean types. In the Germans there is a very large Eurasiatic element which includes the Slavonic, while hereditary elements from the Mongoloid peoples have crept in via Russia. Jews entered Germany in the first Christian centuries—long before many of the German tribes had emerged from what is now Russia—and it is quite possible that every man who to-day calls himself a German had some Jewish ancestors. In France the population is largely Alpine, especially in the centre, but there is a strong Nordic admixture in the north and a prevailing Mediterranean element in the south. The Jews are of mixed origin, and have steadily been growing more mixed. America is proverbially

a melting-pot. The Japanese are also a mixture of several ethnic types. India is as much a product of repeated immigration as Britain, and so on throughout the peoples of the earth.

In Germany to-day, in order to establish "Aryan blood," a man must present a pedigree clear of "non-Aryan," i.e. Jewish, elements for several generations back. The enormous number of cases in which one parent or grandparent or great-grandparent of the most thoroughly "German" citizens has proved to be Jewish shows how impossible it is to secure a "pure Nordic stock." Once more, indeed, the social and cultural plane is the more important. Germany has benefited a great deal from her Jewish elements—we need only think of Heine, Haber, Mendelssohn, Einstein. But during the economic depression the competition of Jews in the professions, in finance, and in retail trade was proving embarrassing, and in the revolution it was convenient to treat the Jews as a collective scapegoat, who could be blamed for mistakes, and on whom might be vented the anger that must be restrained against external enemies.

It is instructive to compare the treatment of the Jews in Germany with that of the "Kulaks" (that is, well-to-do peasants) in Russia. The Kulaks, by standing in the way of rural collectivization, were an obstacle to the Government's economic plans: they also provided a convenient scapegoat for any failures that might occur. Their persecution was in some ways almost as horrifying as that of the Jews. But at least it was not justified on false grounds of mysticism or pseudo-science. Their existence obstructed something which was of the essence of Communist planning, and they had to submit or be killed or expelled. The Jews could not even submit; because a false ideal of race had been erected to cloak the economic and psychological motives of the regime; they could only suffer at home, while some few have succeeded in going into exile abroad.

Culture, not "race," is, again, the crux of the American problem. The danger was that the American tradition might not suffice to absorb the vast body of alien ideas pouring into the country with the immigrant hosts, that the national melting-pot might fail to perform its office, and might crack or explode. When immigrants came in small numbers they could be, and were, absorbed, from whatever part of Europe they chanced to hail, and in at most two generations they became an integral part of the American nation. Their Alpine or Mediterranean elements stood in the way of the process no more than their previous Czech or Italian nationality. It was the size of the blocks of alien culture to be assimilated which constituted the problem.

Racialism is a Myth

So long as nationalist ideas, even in modified form, continue to dominate the world scene, the large-scale segregation of areas, each developing its own general type of culture, may be the policy to pursue. If unrestricted immigration seems likely to upset such a policy, restriction is justifiable, as with Asiatic races in Australia and the United States. But do not let us in such cases make it a question of "race," or become mystical on the subject, or justify ourselves on false biological grounds.

The violent racialism to be found in Europe to-day is a symptom of Europe's exaggerated nationalism: it is an attempt to justify nationalism on a non-nationalist basis, to find a basis in science for ideas and policies which are generated internally by a particular economic and political system, have real relevance only in reference to that system, and have nothing to do with science. The cure for the racial mythology, with its accompanying self-exaltation and persecution which now besets Europe, is a reorientation of the nationalist ideal, and, in the practical sphere, an abandonment of claims by nations to absolute sovereign rights. Science and the scientific spirit are in duty bound to point out the biological realities of the ethnic situation, and to refuse to lend sanction to the "racial" absurdities and the "racial" horrors perpetrated in the name of science. Racialism is a myth, and a dangerous myth. It is a cloak for selfish economic aims which in their uncloaked nakedness would look ugly enough. And it is not scientifically grounded. The essence of science is the appeal to fact, and all the facts are against the existence in modern Europe of anything in the nature of separate human "races."

EDUCATION AS A SOCIAL FUNCTION

SCIENCE can concern itself with education not merely in regard to the scientific content of formal education or to the inculcation of scientific method and of the scientific attitude in general, but by considering education itself as a subject for scientific treatment, as a function of human social existence. In such a treatment two contrasted approaches can be made: from the point of view of society as a whole, and from that of its component individuals.

From the first point of view, education is the function by virtue of which the social tradition, both in its general and in its specialized aspects, is reproduced and enabled to evolve. It includes the transmission of a common language, of a common minimum basis of knowledge and skill; of the common traditions and ideals of society, and of certain norms of behaviour. It further includes the transmission, via limited minorities, of specialized skills and techniques, craft and professional, and of certain general aspects of tradition via special élites. So from another angle education may be said to concern itself with the training of three sections within society—the élites, the specialists, and the residual mass.

The chief changes in educational theory which have emerged in the last half-century can be broadly summed up as follows: First, an increased emphasis on the evolutionary or change-facilitating function of education as against its conservative or change-resisting function. Secondly, and intimately connected with the first point, increased concern with the future, and with the possibility of approximation to ideal but scientific standards; and obversely a decreased concern with the past and with the imposition of ideal but non-scientific (philosophical or religious) standards derived from the past. Thirdly, a decreased stress on the rigid normative function of education, which aims at imposing, as early as possible in life, certain orthodox patterns of thought, morality, and behaviour; and conversely an increased stress on its liberating function, through the encouragement of the scientific spirit, of individual thought and development, and of independence of action. Fourthly, recognition of the need, in any developed democratic society, for education to help in providing a high degree of social stimulation and social self-consciousness. Fifthly, recognition of a sane relativity as against a sham universality, of the fact that education is not only inevitably conditioned by the limitations of time and place but should be

consciously related to the needs of the particular society of which it is a function.

In primitive societies such education as exists is in the form of a kind of apprenticeship to prepare boys and girls for adult tribal life, and is conveyed through ritual and legend. This is essentially static and conservative, subserving the reproduction of the traditional pattern; the evolutionary aspect of education, involving variation in the pattern transmitted, is accidental and slow. With the emergence of a class structure in society the general aspect of education alters. The stress then falls on the specialized education of an élite, whether that élite be itself the repository of power, as in ancient Egypt, or the favoured servant of the governing class, as in early medieval times.

The late Middle Ages marked the beginning of a new era. The invention of printing and other aids to the dissemination of knowledge made inevitable the gradual spread of mass education, while the growth of science and technology and of the scientific outlook not only made this mass education desirable in the interests of efficiency, but stimulated the evolutionary function of education. We are now entering on a further phase, in which a highly integrated and self-conscious society is the aim, and in which therefore mass education must not only attain a much higher level, but the educational system must itself be fully unified and deliberately integrated as closely as possible with the life of society. Variation from the previous norm is becoming regarded as something to be consciously planned.

Coming down to the particular, we may remind ourselves of the chief social characteristics of education in the phase from which the Western world is now emerging. The first striking fact was the class duality of the system. Long-continued education was confined to a small minority, and designed to train a ruling class together with its necessary appendages and agents—the administrators and civil servants, the clergy, and the learned professions. Mass education, on the other hand, ended in early adolescence, and was designed to transmit the elementary skills of reading, writing, and arithmetical calculation necessary to carry on an industrial society, the modicum of historical and cultural education necessary to transmit a patriotic tradition of the nationalist type, and a smattering of the facts of nature. Specialized skills below the professional level were catered for by a combination of apprenticeship and an increasing volume of technical education, this latter being regarded as somehow inferior to education based on the humanities, and provided by the public schools and universities.

There was also an ideological duality, in respect of religion. Much

pioneering work in mass education had been undertaken by religious bodies, partly from altruistic motives, partly to increase the influence of a particular church, and partly to introduce a religious and moral buffer against popular discontent with the glaring inequalities of the social system and the often shocking social conditions. This has influenced our educational system to this day, so that our elementary schools still consist in approximately equal numbers of provided schools wholly under public authority, and of non-provided schools, receiving grants from the State but belonging to various religious bodies.

As a result of this class basis the normative functions of education were (and are still) dispersed, and carried out by a patchwork of agencies. In regard to mass education the normative function remained largely in the hands of religious bodies, either in the non-provided schools or by way of Sunday schools, bible classes, and the like. In regard to the governing classes a strong normative influence was introduced in the new public school tradition initiated by Arnold at Rugby. In addition, the Church of England had at the outset a monopoly of religious influence in public school and university education, a monopoly which has been only gradually and partially broken down.

Throughout this period education has been predominantly conservative in its social function. The emphasis has been mainly on the past. There has been an intensive fostering of old-established tradition, support for existing prestige and status, suspicion of new ideas, and resistance to new methods. The long-continued education of the governing classes has always pretended to universality. In point of fact, it has confined itself largely to those portions of the past which had contributed to the establishment of our own tradition; but universality has been a deliberate aim. This is exemplified in the emphasis at the older universities on pure philosophy, and, once science had forced its way into the curriculum, on pure science. Any relativist theory of education has been frowned upon, though actually the urgent needs of society have compelled functional education at many points—highly specialized departments of science, even of applied science, especially in provincial universities; organizations like the Indian Institute at Oxford; and so forth.

The need for providing the trained élites of society will remain; but the nineteenth-century method of expensive public school and university education cannot continue to be tolerated in a democratic society, and in any case is destined to break down as a result of the incidence of high taxation on the wealthier classes.

More change has occurred in the universities than in the schools; the latter have in very considerable measure been thrown open to the less well-to-do. But the channel of approach to them is through a highly competitive scholarship system, and is both over-intellectual and over-specialized, with the result that the average of the young men and women who reach the university on merit instead of on money, are, in the view of many of those responsible for them during their undergraduate career, in many ways far below the standard to be expected of an élite—in all-round character and interests, in intellectual initiative, and even in general education.

This can be partly remedied by amending the method of selection—by reducing the almost ludicrously high specialist standards demanded of candidates for scholarships, by laying more stress on general knowledge and varied interests, and by adding other criteria of selection to the examination tests. In part, however, this state of affairs is the result of unsuitable background, and here the universities are dependent on the schools. The remedy is, surely, not to talk about abolishing the public schools or keeping those in difficulties alive by a bare minimum of State intervention, but to bring the public schools into the sphere of the national system, and to use them as training grounds for a certain type of élite (a functional élite based on merit and ability instead of a class élite based on property and privilege) for whom the corporate spirit of residential education is considered helpful.

This should help toward providing both background and backbone for the potential university student of poor family, who is now forced to overwork and over-specialize at the expense of health, character, and all-round interests. But the public school need not and certainly should not be the only channel of approach to the universities. No bar should be laid on candidates from the other secondary schools. A thorough overhaul of technical education is also required. It has been suggested in various quarters that types of technical school should be multiplied—that, for instance, building and agriculture, as well as industry and art, should be catered for. What is more important is that the whole status and prestige of the technical school should be raised, and the quality of the general educational background which it provides should be improved. There will then be a number of co-ordinate and equal channels of secondary-stage education.

There is further general agreement that education of some sort should be universal up to 18 for those not taking a whole-time secondary education. The precise form of this requires to be worked out, but the facilities provided will, we may hope, be linked up with the various

youth training and youth service organizations which are now assuming such importance.

With regard to the universities two main reforms seem indicated. One is the adoption of some system whereby students can move more freely from one university to another without impairing their chances of a degree, the other a closer linkage of our own university system with that of other countries. Approximation in general educational policy, increased facilities for visiting research workers of all ages, exchange of teaching and student personnel—all are needed. This in its turn has two facets, the international and the imperial. Internationally, while the utmost should be done to continue and extend the exchange of students, staff, and ideas between our universities and those of other continents, and especially of the United States, Europe will present a special and urgent need, for it is largely through education that we can expect to nourish the tender plant of super-national European patriotism. Naturally this European patriotism cannot and should not supplant national patriotisms; but its growth is indispensable to the future peace and progress of the European Continent. Higher education is bound to play an important role in the process, and we in this country must be on the alert and be prepared to take a position of leadership in providing a truly European system of universities for our Continent.

There are other international aspects of higher education to be considered. Among the most important of these will be the establishment of an international staff college to train administrators, both general and with specialist qualifications, for international work, whether in Europe, in the colonies, or elsewhere. Only so can we expect to provide the staff necessary to carry on all the complicated supra-national business of the world. The League of Nations secretariat and the I.L.O. have demonstrated that solidarity, standards, and *esprit de corps* can be produced relatively quickly in an international body; it is for an international staff college to add deliberate and specialized international training. There are many other international fields for education, such as the control of textbooks in the interests of international amity and general social development; but we cannot deal with them here.

On the imperial side, a great deal could be done toward bringing all institutions of higher education and research into a more unified system—by exchanges of teaching and research personnel, by special institutes at home, by ensuring that colonial colleges and universities should enjoy a higher status in their communities, and so on. A given expenditure from the Colonial Development Fund would probably go

farther and achieve more striking results in fostering a unified imperial (not imperialist!) system of higher education than in any other field.

So far I have spoken of certain trends and adjustments in our educational system. But a more general problem remains, that of adapting the system as a whole to new tasks necessitated by the recent trends and promises of our type of society.

Education must be part of the mirror in which society may see itself entire. It is also becoming, to change the metaphor, the most important part of the apparatus by which society projects itself into the future. There was a time when popular education was conceived of as having two main functions—to teach the poor to be contented with their station in life, while equipping them with the three R's and those other rudiments of learning necessary to fit them for their place in a primitive industrial or palaeotechnic economy. This is, of course, an over-simplification. It was tempered by the sincere desire of many public-spirited people to make all the benefits of culture available to the masses. But culture was conceived of in terms of the very selective culture adapted to the needs and ideals of the leisured and professional classes in a highly stratified community; and in any case such movements only touched a small fraction of the working classes. In recent decades this conception has been considerably modified, but the dual system of education is still in being, and the class stratification of nineteenth-century Britain has left a strong impression on our twentieth-century system of education.

Meanwhile, quite new problems have now arisen. The technological advances of the two decades between the two world wars have altered the nature of power in the sense in which the term is used in international politics. It is no longer sufficient to be able to equip hastily raised conscript armies with rifles and bayonets, stiffen them with professional soldiers and artillery, and rely on a wave of jingo patriotism for public support. To-day successful war depends on vast industrial potential; and this must be backed, not only by high technical skill and the ability to ensure the supply of key raw materials from many parts of the world, but also by the active allegiance of the rank and file of the nation, on whom depend both the high-speed production of munitions and the maintenance of supplies and services. For this, simple patriotism is not enough: intelligent and willing co-operation is necessary. The mass of working men and women must feel themselves an integral part of a united society, not primarily as the "working classes" with interests in basic opposition to those of

other classes. For this an obvious prerequisite is a unified educational system, with high standards, and aiming at what Sir Stephen Tallents has called the Projection of England—in this case its projection into the minds of the rising generation.

But we are now learning that a purely national point of view is inadequate to present conditions: it is necessary to have an international as well as a national point of view, a world consciousness into which our set of national feelings and ideas (though these still remain of the utmost importance) can be fitted. Our own country's history and destiny must be set in a more general framework, and for this a further revision of our educational system, notably in regard to text-books, as well as to the inclusion of certain new subjects, is required. Our education must become more closely and more consciously related to the needs and possibilities of our country at this particular time and in relation to the rest of the world. It must give up the pretence of being based on absolute or universal cultural values, and must abandon the false and inadequate utilitarianism which sees in education solely or mainly a method for securing a job or doing a job better.

It is a general rule, so general that we may almost call it a law of history, that threatened interests and institutions defend themselves with increasing vigour until a very late stage in the process of their decay or supersession. Now such a pattern of education as is here outlined involves a conception of society that threatens many various institutions which have been so powerful in the immediate past that they still have considerable reserves of power. The over-privileged classes, the rentier-gentleman class, and in general what is crudely described as the "old school tie" influence in Government, business, and the professions, see their privileges threatened—and not merely their material privileges but, perhaps more important, their privileges of prestige, their claim as a class to respect or even to subservience. The capitalist class, whether engaged in large-scale monopoly capitalism or in small-scale business, see themselves threatened in a planned society with increasing control by the State and increasing competition from public bodies and co-operative agencies. The Churches, in part because tied up with the old system, in part because their theological basis is no longer acceptable to a large and increasing section of the people, feel themselves threatened by the impending shifts in our class system and still more by the rise of an outlook more concerned with social planning for this-worldly improvement than with individual concern for other-worldly salvation.

They will, all of them, resist the transformation of our educational outlook. Those who uphold the relativist view of education as a

socially adapted function will increasingly be denounced as vandals, denying to the people access to the full universality of culture, while the advocates of scientific planning will be told that they are undermining individuality and initiative. Those who advocate a more international background will be accused of lack of patriotism, and those who look for an adjustment of the Churches' theological outlook and institutional basis to modern conditions will be branded as immoral and anti-religious. Such accusations are a measure of the fear which the vested interests concerned are feeling, and can all in the long run be adequately met by a rational presentation of the facts. What we must be on our guard against are attempts at turning the clock back in educational practice—not merely because turning the clock back means delay and waste of time and energy but because of the danger of introducing unreality into our educational system.

An educational system properly planned as a social function, in close relation with contemporary social needs and trends, and with the aspirations, conscious and unconscious, of the society which it is designed to serve, will be a powerful aid toward social unification, social self-consciousness, and social advance. The converse is also true; an educational system which is seriously unrelated to the society in which it is attempting to function will hinder social unification and advance. What is more, this lack of social relation will recoil back on to the educational system itself, and will invest it with a sense of unreality which will cause the majority of boys and girls to look askance at the education provided for them.

This applies in two main fields—that of ideas and that of material conditions. Let me take two examples. Attempts to introduce the children of working-class families to a so-called universal or standard culture, when this is essentially a culture of the leisured classes in past epochs, and there is scarcely a trace of a living culture in their own social environment, are doomed to failure. Apart from a few unusual individuals, and some temporary enthusiasts, children tend, by a perfectly healthy reaction, to reject contact with this sort of culture as having no vital meaning either for themselves or for the communities of which they form part. It becomes looked on as something highbrow and unreal, to be dropped as soon as school days are over, or at least as something to be kept to oneself, something to be rather ashamed of, when brought face to face with the prevailing standards and outlook of the hard and ugly industrial world. The values accepted inside the school do not correspond with those of the surrounding world; and not unnaturally the world's values generally prove the stronger.

In such a case, the chief movement toward relating education and society must come from the side of society. On the other hand, a considerable amount can be done within the educational system; more attention can be paid to contemporary culture, to self-expression and self-development by doing things rather than merely by learning about them and being told what ought to be appreciated. But the main emphasis must be on the social environment. It is here that adult education, enlightened town and country planning, and deliberate encouragement by the State and local authorities of living art, music, drama, and all other branches of cultural life, must be called on to do most of the bridging of the gap. Nor must we forget that purely material considerations weigh heavily. Until social security is a reality, and the bulk of the population is guaranteed freedom from fear and want, from ill-health and constant anxiety about the future, they cannot be expected to display much interest either in the masterpieces of the past or the cultural movements of the present. The environment must be related to the needs of the school every whit as much as the school and the education it provides are related to the needs of the society which provides its environment.

That is one example. Another comes from the field of religion. Of recent months the religious organizations of this country have been making a strong bid for a renewal of their influence in education. This has been embodied in a manifesto issued by the Archbishops of Canterbury, York, and Wales, with the concurrence of certain Free Church Leaders. The manifesto comprises five points concerning the teaching of the Christian faith in schools, which they desire to see incorporated in the law of the land. In brief, while urging that religious instruction shall be in the hands of "teachers willing and competent to give it," they ask that religious knowledge shall be promoted to the status of an optional subject for the teacher's certificate, that religious instruction shall come under official inspection, that religious teaching may be given at any hour, and that the school day shall open with an "act of worship." There are also rumours abroad of a demand that non-provided schools shall be eligible for full grant, instead of the present 50 per cent. of their expenses. Quite apart from the fact that these points are bound to reawaken most of the bitter controversies of the past, the strategy of attempting to enforce a particular form of religious belief by legislation, and of directing the attack upon children instead of upon the adult population, seems seriously mistaken.

If education is to be truly a function of society it should be given the vigour which springs from unity. There are at the moment two

dualities in our educational system—one created by the class-cleavage between rich and poor, the other by the ideological cleavage between religious bodies and society as a whole. Only by abolishing both cleavages can we achieve that unified (but diversified) system which we need.

It would cost less in the long run for public authorities to buy out all the non-provided schools than to continue paying full grants for an indefinite period, and the essential step of unifying all the elementary schools would have been taken.

The other demand is even more obviously to be resisted by those who look forward to an educational system which shall play a really vigorous part in vitalizing society and projecting its ideals into the future. It is a fact, which many may deplore but which remains obstinately a fact, that the interest of the people of this country in orthodox Christianity, of whatever complexion, has enormously declined during the last few decades. The Christian ethic and doctrine have played an essential role in shaping our civilization; but there are unmistakable signs that they no longer satisfy our modern societies, and that some new formulation, both in the moral and the intellectual field, is becoming urgent if we are to reach a common foundation of thought and values for our national life. The religious revival we hear about at the moment is clearly a temporary phenomenon, of a sort familiar to all sociologists, due to war emotionalism. It has been accompanied by a much larger revival of non-religious superstitions, such as astrology.

In such circumstances, the insistence on religious observances in schools when religious influence is declining in the world outside will recoil on the heads of its proponents. Children are infallible detectors of unreality. As with culture, they will feel the contrast between the artificial religious atmosphere inside the school and the irreligious or indifferent atmosphere outside. This will in the long run promote in most of them an even more suspicious or even hostile attitude to orthodox religion than they would otherwise have acquired. But the mischief does not end here. A sense of unreality attaching to one portion of formal education tends inevitably to spread to the remainder. The introduction of more religious teaching and observance into the schools at this particular juncture will seriously hinder the development of an educational system which is to be an effective and organic function of our general social life.

The remedy again lies outside the schools. The religious impulse is a strong and persistent force in human life. But it is a complex impulse, differing radically in emphasis and aim from age to age as

well as between one type of individual and another; and the doctrinal ritual and institutional forms in which it expresses itself are even more protean. We have witnessed the rise of two movements to which we must give at least the title of pseudo-religions—the Nazi and the Communist systems. It would appear of real importance that the existing democratic countries should evolve their own characteristic and powerful brand of religious impulse and means for its expression. This will not be achieved by a return to the traditional past. The Christian ethic and Christian doctrine, though they have left an indelible mark on our Western civilization in their insistence on the overriding value of the individual personality, on the necessity for sacrifice, and in many other ways, are no longer either a primary or an essential part of its framework. New attitudes, new values, new needs have come into being.

It is incumbent upon the Churches to recast their theologies in forms acceptable to the new phase of the Western world, and to readjust their social and ethical policies in relation to the needs of the new type of society which is in process of being born. If they attempt this with sincerity, it is incumbent upon society to meet them halfway. If this should be accomplished, organized religion in some new and at present unguessable form will come alive again as a social function, and could then rightly claim to have an important place in that other social function that we call education.

The approach to education from the individual end must also be considered. What has science to say on this? One cannot, of course, consider the individual in the abstract, but only as a member of a particular society. The question then is a double one: how can individuality be developed to the fullest pitch in our type of society, and how can the development of the individual be made to serve social ends to the fullest extent?

Recent developments in psychology and their educational applications have radically altered our approach. I am not referring only to psycho-analysis and the theory of repression and of the unconscious; we must also take account of the modern swing away from the overemphasis on reason and the intellectual functions of the mind, to a system in which emotional factors and creative activity are given their due weight. There are also the numerous studies, anthropological and other, in social psychology, which have demonstrated the strength of social conditioning.

The concepts of repression and of the unconscious, which we owe

primarily to Freud (whether or no we adopt an orthodox Freudian point of view), are cardinal and basic to the modern revolution of our ideas on individual education. In what follows I shall use the term mental energy in the broad popular sense, as denoting the driving forces of the psyche, emotional as well as intellectual, the capacity of the mind for getting work done, whether in the acquisition of knowledge or in the control and guidance of action.[1]

The essential implication of modern psychology is that through deep conflict an appreciable quantity of mental energy is either locked up and wasted, or distorted. Much of it is wholly bound, internally and at a low level, instead of being free and available for external or higher mental functions. A further quantity is bound in another sense by being organized, also at a low level, in such a way as to distort activity either into destructive instead of constructive channels, or into escape-fantasies instead of being related to reality.

The central problem of individual education can thus no longer be regarded as intellectual; it is a deep-emotional one, and consists in the adjustment of conflict and the abolition of repression so as to make available the greatest quantity of mental energy for the most fruitful activities. This statement needs amplification. Repression, in the technical psychological sense, can be abolished, but conflict cannot. Man, it should be remembered, is the only organism habitually subjected to psychological conflict. In animals conflict is normally obviated by an all-or-nothing functioning of reflexes and instincts or drives, the throwing into action of one being automatically accompanied, save in exceptional circumstances, by the throwing out of its competitors by a process of inhibition.

In adult man conflicting impulses can be simultaneously present in consciousness, and the resultant conflict can be resolved consciously in the light of experience and reason. This is impossible in the infant, who lacks the necessary experience. Biologically speaking, repression thus appears to be a device for preventing conflict in the early stages of human existence, when it would have a disastrous effect. The various "complexes" described by psychologists, and the general structure of the psyche as adumbrated in the Freudian scheme of ego, super-ego, and elements of the id related by repression to the super-ego, are permanent or semi-permanent resultants of this infantile adaptation carried on into adult life.

[1] Though perfectly aware that it is unscientific to employ the term *energy* in a wholly different sense from the sense in which it is used in the physical sciences, I shall do so because of the lack of any better term which is generally agreed upon. *Libido* is the nearest to such a term, but its use implies complete acceptance of orthodox psychoanalytic theory and has certain unsatisfactory connotations.

It may be possible for a few special souls, or by means of a special psychological technique, to abolish this primitive structural pattern of the psyche and to unite super-ego, ego, and id in a single and integrated entity; but, for the time being at any rate, this is impossible for the majority of human beings. What is possible, however, is to modify this primitive psychical morphology into something less wasteful for the purposes of adult human existence. This can be accomplished by minimizing the intensity and reducing the number of repressions in early life, and by substituting so far as possible conscious and rational suppression for unconscious and irrational repression as a means for the resolution of conflicts, old and new alike.

There is a general as well as a special approach to this question. The general attack will consist in relating the whole subject of ethics to scientific fact and method, as has recently been attempted by Dr. Waddington in *Nature* (1941, vol. 148, p. 270). Any system of ethics is the consciously formulated rationalization of a much larger system of compulsions and compulsive prohibitions, to which we may give the Freudian label of super-ego. This super-ego system, though essentially irrational and formed by the action of unconscious mental forces, is not arbitrary, but is related to the facts of the external world through individual experience, largely at a very early age.

We must also take into account the extraordinary differences between the ethical systems of different human societies. The fact that actions that are regarded with the utmost horror in one place or time are in another community or another century accepted as moral duties—this apparent interchangeability of ethical black and white has often given rise to a resigned acceptance of complete relativism and subjectivism in ethics and a denial of the possibility of general ethical standards. But the scientific approach enables us to discern that these differences in ethical systems can be partly related to the social and material environment of the society in question, partly explained as "accidental" divergences of the sort which we find also in biological evolution among small and isolated groups. Further, the adoption of the evolutionary point of view at once makes it clear that we cannot expect to set up ethical standards which are either universal or complete. Ethics are part of the adjustment between man and his environment (of which the social environment comes to constitute an increasingly important fraction); thus ethical standards not only inevitably change with changing conditions, but the idea of change, or rather of certain directions of change, must itself become part of our ethical system.

Perhaps the most important contribution of natural science to

general thought, after its demonstration of the regularity of all natural processes, and that they are in large measure both intelligible and controllable, is the demonstration of progress as an evolutionary fact. Biological progress existed before man, but man is now the sole repository of future possibilities of progress; further, progress is neither universal nor necessary, but merely one possibility among many. We can therefore say that there do exist general ethical standards, but that these are standards of direction, not absolute standards in the old static sense.

The ethical problem regarded from the scientific standpoint thus largely resolves itself into this question: How can the unconscious compulsions of very early life, which are generated primarily in relation to the infant's family circle and to the control of its biological functions, be rendered as little harmful as possible; and how can they be subsequently related, in a more conscious way, to the wider concepts of society and of evolutionary progress? As Waddington well puts it, "a child learns at its mother's knee that aggression must be controlled; and it learns a little later that taunting its younger brother's weakness is a form of aggression, but when does it learn that adopting an unscientific attitude to the social problem of nutrition is also aggression," and therefore unethical? The same applies to war and many other activities.

The problem is clearly one of the greatest complexity and difficulty, but the fact that it has at last been scientifically formulated (which has only become possible in the last few decades) is itself extremely important. One thing at least is clear, that it must be approached from the social as well as the individual angle. The more frustration or unmerited cruelty or hardship an individual meets with owing to the social conditions into which he is born, the more likely are his conscious ethical principles liable to be distorted in an undesirable way, and also to be overriden by undesirable unconscious compulsions, whether of aggression or of escape. What is more, so much of the emotional-ethical structure is laid down in infancy in relation to the child's family circle, that the distortions and repressions of one generation have a strong tendency to perpetuate themselves, though often in altered form, in the next. Educated and unfrustrated parents are a necessary part of the social mechanism for producing educated and unfrustrated children.

The problem of getting rid of undesirable repressions can also be attacked by specific methods. Of these, the method of encouraging self-expression through creative activity which is both free and self-disciplined is probably the most important. Creative activity can

take many forms, from play to poetry, from mud-pies to acting; it can and should be encouraged from the earliest years. It has two related but distinct functions. It may help to rid the child of haunting repressions that are inhibiting its healthy development. But expression can be normative as well as creative. It can help the child to find outlets for itself, and so avoid new frustrations; it can also in many cases relate the individual to larger social groups or to comprehensive ideas, thus providing channels for sublimation and helping the narrow, irrational, and unconscious emotional-ethical system of infancy to develop into the broader, more rational and more conscious system demanded by adult existence. I have no doubt that both the normative and the therapeutic possibilities of creative activity should be given a much larger part to play in our educational system.

Another special problem is that of the adolescent, and in particular the sensitive and gifted adolescent. At the moment, we do our best to make the worst out of our human material by ending mass education at 14 or 15, and demanding of the majority of our children that they shall begin facing the world and its problems in that most difficult and critical of all periods of life, early adolescence. The raising of the school-leaving age to 16 and the provision of part-time education up to 18 are probably more important on this than on any other account. Meanwhile, there is the special problem of the education of the élite. One of the major defects of the world to-day is the dearth of men of imagination, intellect, and sensibility in high places. In the majority of cases, such men seem to lack the drive and confidence needed for public life. The result is that the tough and blatant, the unimaginative, or the pushing types too often rise to the top. There are exceptions, of course—Dr. Nansen and Field-Marshal Smuts spring to the mind—but they are all too rare. In many cases it is during adolescence that the diffidence of self-distrust of the gifted but sensitive type either originates or becomes firmly established.

Can this unfortunate state of affairs be remedied? There is a good deal of evidence that it can, by means of measures deliberately designed for the purpose. First comes the need for confidence in one's physical capacities; then the need for confidence in one's capacity for perseverance and, in the process of success, for overcoming the fear of failure and of being found wanting; and finally the need for feeling oneself useful, wanted, appreciated.

Methods such as the Scout training and the revised County Badge scheme, with its "projects" as well as its all-round athletic tests and its expedition tests, go a long way towards laying the foundations of the necessary psycho-physical self-reliance. The all-round physical re-

quirements of the latter go a long way toward producing the desired result, and the individual initiative and patience demanded by a good project provide a superstructure. Also, it seems clear that some form of service, in which the adolescent is not playing at being grown-up, but is (and knows that he is) being useful to the community, is also required.

Meanwhile, to define the problem is the first step toward solving it. A scientific survey of education as a social function helps us to define the dynamic function now required of education as a transmitter of an evolving tradition; the need for education to contribute to social self-awareness and cultural unity; its importance in training an élite which shall be efficient and truly representative of the country as a whole; the importance of creative work and self-expression and of other special methods for overcoming repression and adolescent hyper-sensitiveness; the necessity of adjusting social conditions to educational ideals and practice, and vice versa. These are in the long run much more important than questions of curriculum or administration, however necessary and urgent.

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