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THE BACKGROUND OF HISTORY

WHEN WE ARGUE WHETHER history is an art or a science, we often forget the great overlap that is shared by these two indefinite cartegories, the basic purposes of which are largely the same. An art uses sensory material in an appeal to the emotions of an audience with the aim of leading the auditors or beholders into a richer intimacy with life. Pure science collects, selects, and organizes sensory material into patterns which in one direction bring into consciousness phenomena hitherto unnoticed and in another direction simplify this increased volume of material by reducing it to deterministic rules. Science enriches life by a process that is more roundabout than that of art, but not dissimilar. The aim of both art and science is to make comprehensible order out of the "booming, buzzing confusion" of life. Though they may differ in stress and method, they find their fields constantly overlapping and enriching each other. The complete scientist is apt to scorn the artist as a mere entertainer; the complete artist is apt to despise the scientist as a grubber of uninteresting facts, trying to reduce life and beauty to mathematical formulae. But these views express only the limitations of all people who divide life into watertight compartments. I find it hard to believe that great art can wholly disregard objectivity, and certainly there is no worse scientist than the one who thinks that he understands anything in its entirety.

The presentation of history is certainly an art, for it is effective only as it involves the reader's interest and imaginative co-operation, but too often the historian feels that he has done his scientific duty if he has cited the authorities for the statements that he has woven into an artistic fabric to suit his own emotional conceptions. Perhaps it would be better if he were more conscious of the deterministic substructure of history upon which the artistic presentation must be based. Unhappily an understanding of this substructure cannot be reached today along the ordinary paths, for history has become sterilized into a "discipline", which usually means that the subject is so thoroughly understood by the authorities that an approach to it can be allowed

only along accepted and traditional lines. The growing points of the study of history are along the fringes where it makes contact with economics, sociology, and anthropology. "History," as Gordon Childe said, "is a branch of biology."

Certainly history, considered as biology, fits unconformably into the traditional discipline. Life, according to biology, is a quest for energy, most of which is derived from food; so that energy must be the foundation of history. In essence this is Marx's materialist interpretation of history, and in a limited sense it has penetrated the general field. For a century it has been a popular, and contested, theory that the decline of the Roman Empire was due to soil erosion, and a glance at Mediterranean lands today will tend to support this view. But the reverse theory is less often noticed, that the greatness and the character of Rome was due to the fertility of the Campagna which fed the Roman citizens faithfully through the centuries while their institutions were hardening into an enduring mould. Has any conservative culture arisen without that basis of a lasting food-supply?

Man lives by the energy that he derives chiefly from his food, but he needs to do more than live. He must grow and reproduce and learn, and all these things need surplus energy. Earliest man seems to have differed from the apes in being largely carnivorous. No doubt most of his butcher's meat consisted of insects, as it does among primitives still, but even insects, though harder to catch than plant food, yielded more surplus energy owing to less waste upon digestion and so made available more possibilities for changes of behaviour. Wooden and shell tools gave way to stone, insects to big game. Stone-chipping led to fire, big game to skin clothing, and the conquest of the temperate zone became possible. But not civilization. Toynbee lists the Eskimo among his aborted civilizations, but, if he had used an energy concept instead of the qualitative one of "Challenge" as the basis of his grouping, he could scarcely have found more surplus energy available to this culture than to any of a dozen other fairly successful hunting situations. In biology we recognize that such predators are balanced precariously upon the pinnacle of the pyramid of life, so that any increase in their efficiency must result in a diminution of their food-supply and so in reduced total energy. They can expand laterally but not vertically.

It is a commonplace in biology that plants are the principal storers of solar energy, that the herbivores eat plants and convert part of this energy to their own use and store a small fraction of that, the carnivores eat the herbivores and use part and store part of their energy, and the parasites rob energy from the carnivores. Man's earliest known phase was high on the parasitic level; he stepped down to hunting and replaced most of the carnivores of the world; but it was only when he dropped to

the herbivorous level and set about replacing rival herbivores and ousting unutilizable plants in favour of his own hosts that his numbers gathered enough energy for the burst of specialization which we associate with true civilization. The total human population of the world was probably only a few thousand in man's parasitic days; various estimates place his population as between five and eight million in hunting days, yet the world was fully populated then as now; man's herbivorous phase is not yet completed and is complicated by the developments of agriculture and pastoralism; and the phase when man will drop to the plant level and synthesize his own food from the elements is still far ahead.

In the development of agriculture we find an illustration of another biological concept applicable to history. Every living thing, apart from the bulk of the green plants, lives at the expense of other life. The simplest form of such a relationship is *predation*, as when the hawk catches a mouse, or when the mouse nibbles grass-seed. We recognize predation as a necessary check upon the Malthusian tendency of each species to increase its numbers beyond what its food-supply can support, and we personify this as "the balance of Nature". But we are apt to overlook the wastefulness of predation. What proportion of the energies of mouse or rabbit or deer is devoted to avoiding its enemies? This is hard to estimate, but the fact that the behaviour and even the structure of each of these is concerned with enemy-avoidance to much the same extent as with food-getting, suggests that enemy-avoidance must rank first or a close second in the wastes of energy of such species. At times predation becomes specialized to a particular host, in which case we call it "parasitism". The perfect parasites become reduced to complete dependence and have no evolutionary future apart from their host, to whose advantage they contribute nothing whatever. A looser relationship occurs when a parasite attacks the food-supply and not the person of the host. This is called "commensalism", but from the point of view of energy it is often indistinguishable from parasitism. But there are also associations of different species which result in benefit for both host and predator. The lichen in which a fungus traps a wild alga and feeds it with water and carbon dioxide and robs it of sugar, the cow which eats the grass and spreads its seeds to new places, the ant which milks honeydew from the aphis but also carries the aphis to good feeding grounds and protects it from enemies—these are examples of *symbiosis*, a mutual dependence for the good of both. Marx lumped all relationships of the classes in human society as predatory commensalism and so reached his idea of the class-war. But usually the relationship is symbiotic to a greater or lesser degree, and measurement of this would add exactitude to history.

The domestication of plants and animals probably came about in several different ways, but most of these hosts of man have moved on into a symbiotic relationship. The ultimate effect of these changes was to increase the food-supply and to reduce the waste energy of hunting and gathering, but a by-product was the motive power of animals, which came into use by 3000 B.C. Human energy is by far the most adaptable and efficient form of energy, foot-pound for foot-pound, but the animals can produce energy from foods too coarse for human digestion and can be used under guidance to replace human labour in crude repetitive operations such as ploughing. Henceforth we must include animal labour in our estimate of the energy at the disposal of a civilization. In the same millennium sailing-ships added a small amount of wind-energy to the total, and this increased until the nineteenth century, since when it has declined. Water-power appears first as a factor of importance in pre-dynastic Egypt, in which the downstream current of the Nile, complementing the upstream winter-monsoon, made possible a great development of river traffic. Then came the undershot wheel, the overshot wheel of the Greeks, and recently the turbine. Modern times have added the steam-engine, the internal-combustion engine, and atomic power. In the energy-balance of a modern society the human contribution, roughly 750 watts per day per man, is of negligible importance, whereas in early civilizations it is necessary to assign it front rank. However, with all the difficulties of using energy as an historical yardstick—guessed quantities based upon guessed populations—it is applicable to all levels of culture and even to modern times, in which it is probably more significant than steel-production or Keynes's favourite, the pound sterling.

Students of history have taken from biology Pearl's logistic curve and have applied it to the extrapolation of population figures into the centuries before there were accurate statistics. But we need to remember that there are many other types of curve of population to be found among living things. Pearl's Curve, like an extended S, represents the gradual exhaustion of limited possibilities and is found in perfection only under ideally guarded conditions. However, approximations to it are very common in nature among populations in which each stratum of the Pyramid of Life increases in numbers less rapidly than the stratum upon which it feeds. This, of course, is not always the case. At times the predator increases in numbers (or volume) more rapidly than its host. In that case the curve of population shows a parabolic rise in numbers (suggesting Malthus's Law), and then a sudden catastrophic decline. I call this the Fairy-ring Curve, since I first noticed it in connection with that common *Marasmius* mushroom. Recently it has been plotted accurately for the populations of reindeer introduced on islands off Alaska. The reindeer feed

chiefly upon slow-growing lichens and increase rapidly in numbers when predators are few; they eat up the lichens, both interest and capital, and drop in population to the level which can be maintained by the annual increase of the plant life of the islands. A third familiar growth-pattern is the cycle or Sine Curve which occurs (other things being equal, which they rarely are) when predator and host have equivalent rates of increase.

Human civilizations show similar and intermediate patterns, and we can recognize that the causes must be similar. Civilized man is not cannibalistic, but only a fraction of the population of any complex society consists of primary producers, whereas the whole society must live upon their products. For society to exist there must be some machinery for depriving the producer of his product, whether by force or by exchange, by predation or by symbiosis. The jungles of the tropics are full of the ruined cities of civilizations whose ruling classes took too high a proportion from the primary producers, who in turn took more from the soil than they put back. However, this predation by the ruling class is not an unchangeable absolute, as Marx suggested, but a measurable scale between the extremes of predation and symbiosis. The first phases in the development of a civilization normally include gross predation of the population upon the environment, exceeding the balancing predation by upper classes upon the producers, but it is often overlooked that the immense gains in capital and population are due to predation as well as to production. The wealth of North America has been achieved at the expense of forests and natural wild-life, of topsoil and the more readily exploited minerals; the wealth of Britain was built by the industrial revolution which transferred the pennies of innumerable hand-weavers into pounds in the pockets of mill-owners and eventually of mill-workers. Such a transfer of capital increases wealth only locally.

A qualitative development familiar in ecology is very close in pattern to the development of a civilization as formulated by Spengler and Toynbee. The re-population of a devastated area follows a definite succession of plant species, variable in detail but regular in type. First come the *pioneers*, plants with mobile seeds, growing quickly, able to live under conditions of deficient humus and excess ash. Second, more enduring and taller plants, such as grasses, brambles and shrubs, crowd out or shade out the pioneers. Third comes a *sub-climax* of taller shortlived trees. Fourth, the *climax*, longlived trees that can rear successors of their own species in their own shade, may endure until a change of conditions or new enemies overwhelm them.

A similar pattern has been found in evolution. In studying the fossils of the Welsh coal-measures, David Davies found a sequence of types which marked the

development of the most conspicuous plant-groups. First, a small and unpromising group of species appeared in an environment, the phase of *Adaptation*. Second, some calamity overtook the dominant climax flora and opened the environment to the sudden expansion of these adapted small species, which now increased rapidly in size, the phase of *Exploitation*. Third, the environment became filled by the new species which then evolved into a wealth of specialized types, the phase of *Specialization*. Fourth, the few largest species that have continued unspecialized through the phase of Specialization, grow to enormous size and come to dominate the environment, the phase of *Gigantism*, and these may continue on until some change overtakes them as it overtook their predecessors. Davies recognized a fifth stage of Degeneration in which scattered remnants of the group live on into new periods in which they have ceased to be important.

Davies' Sequence and the development of a climax are not simply analogies to the development of civilizations: they are the same process and may be plotted on a graph to form the same Pearl's Curve, with time and weight of protoplasm for the area as the two factors. The qualitative phases of the curve correspond also. *Adaptation* is the pioneer or peasant phase; *Exploitation* comes with the mastering of the possibilities of the environment; *Specialization* is the urban phase resulting from intense internal competition; *Gigantism* is the organization of the whole society into a non-competitive machine. If we could graph the whole process in terms of energy, the result would be much the same as for population, and we might notice that the final result is built out of the summation of a number of almost independent smaller curves chiefly of Fairy-ring type.

Philosophers of history have usually defined history in political and qualitative terms. Marx saw history as a series of class-wars, the predation of one class upon another. Within capitalist society the trade-cycle of alternating booms and depressions must lead, he thought, to Gigantism among the capitalists. This must lead to the relegation of all the rest of society into the ranks of the proletariat which then by revolution would come to dominate the state. Then, since a one-class society could have no class-war, the state would wither away. (Marx's concept of the "state" seems to have been based upon the police-state of the Metternich era, the nearest parallel to which today is to be found in Marxist societies.) Flinders Petrie in his *Revolutions of Civilization* thought that he had discovered a Sine Curve in history, and he explained this eugenically as being due to the degeneration of man under civilization and the regeneration of the race as a result of hybridizing with more virile barbarian conquerors. Today we are apt to discount the importance of this factor. Spengler saw the span of a civilization as a Fairy-ring Curve like the life of

an individual, the civilization working out the possibilities of its culture to an end in tyranny (Caesarism) and aimlessness, with a warlike population transformed into servile "fellaheen", a far cry from the Utopian vision of Marx. I must confess that Toynbee's pattern remains, after many volumes, still far from clear to me, but I think that his main difference from Spengler is his stress upon the importance of religion as the bonding of the civilization, a view in which he was preceded by Vico and the Hindus.

The descriptive classifications of civilizations leave much to be desired from the biological point of view.Toynbee suggests that civilizations form a new "species". In biology the Linnaean concept of the species is working very badly among groups that lack sexual reproduction, as in apomicts and seedless plants, and in the mineral kingdom it has been discarded altogether. I fear that *Civilisatio humana* Toynbee will have to join *Aqua salina* Linnaeus. The phenomenon of civilization, an evolutionary emergent if Toynbee wishes, is better treated under physical headings. Civilizations, too, cannot be forced into one pattern. W. S. Lee has worked out Chinese history as a rather too perfect Sine Curve with a wave-length of eight centuries. Flinders Petrie thought of Egyptian history as a sine curve with a wave-length of some 1800 years, but he was using his long-dating system which has since been abandoned. The short-dating system is still not definitely fixed; but, even making all possible allowances, the sine curve of Egypt is very irregular. The Classic civilization can be interpreted as a Fairy-ring Curve, but its continuation since the Roman Empire suggests a Sine Curve. The Mesopotamian cradle of civilization can be divided into a number of overlapping Fairy-ring Curves or can be considered as a long-drawn Pearl's Curve lasting interruptedly over three thousand years. I suggest that all these patterns can be reduced to intelligible form in the light of the Predation-Symbiosis scale and an energy formula:

Opportunity X Efficiency	=	Growth plus Reproduction plus
(Food-getting plus Enemy-avoiding)		Random Activity

I am sure that I have not grasped Toynbee's concept of Challenge. He seems to consider that a difficulty to overcome is essential to a civilization. Certainly a basic food-supply protected by a difficulty is less likely to have been skimmed or populated to poverty in the early wasteful age of burn-plant-abandon type of agriculture; but a difficulty, such as the isolation of the Polynesian islands, could not result in civilization when the material basis was lacking. Where a lasting basic food-supply can be found, man is quite capable of creating his own difficulties.

Neolithic agriculture was a land-destroying process and therefore unprogressive. Irrigation solved many of the problems of soil-fertility, and the ancient irrigating cultures rose slowly to maximum population, evolving their institutions and techniques painfully as they went. Civilizations on rain-fed land, such as Phoenicia, Crete, and Greece, were land-destroyers and survived only by trading wood and oil and wine, pottery and mercenaries, with ever-fertile Egypt. This placed the importance of the state in the hands of the trading class, and resulted in unstable political realism and intellectual brilliance. Only certain fertile plains, such as Boeotia, Sparta, and Rome, had the permanence suitable for building the conservatism which is the basis of empire.

The growth of civilization is by no means automatic. The world is full of self-sufficient peasant societies, and there is a world of difference between these and civilizations. The basis of civilization is in food-production beyond the needs of the farmer's family. Such a surplus can be taken from him by force or by trade or by religion or by taxation, and this surplus can be turned to the creation of the superstructure of civilization. Crude predation depresses the primary producers and may even cause decline, but an intelligent ruling class normally develops symbiotic customs so that its existence redounds to the benefit of all. This relationship becomes formalized into "social discipline" compounded in varying degrees of carrot, stick, and custom.

Marx's "class-war" is an emotional term describing the tension that inevitably exists between the primary producer and the dominant classes. In history we see one type of dominance replacing another, but nowhere is there an example of dominance by the exploited class resulting from such a change. In English history the feudal dominance of lords over peasants was not ended by peasant revolts but by improving organization. This led to a money economy, the mutual slaughter of a gigantistic nobility of overmighty subjects, and the establishment of Tudor despotism and a new commercial nobility. The peasantry then entered upon a new phase of depression when "the sheep devoured the men". The industrial revolution and the enclosures broke up the regained stability of the early eighteenth century, and urban and rural labour dropped to a new ebb in prosperity. Gradually during the nineteenth and twentieth centuries a more symbiotic relationship between capital and labour has been reached, but again competition between capitalists has built up the overmighty corporation. The overmighty labour union is a new phenomenon added to the social burden. The shadow of Gigantistic organization to come hangs over the whole picture. But is this the stateless climax that Marx suggested, or will it be just another burden of organization to be carried, if not by the workers and

producers who are rapidly being replaced by machines, then by the basic natural resources which are never inexhaustible? Will not the producers at every level consider their share in the national product to be inadequate and will not the final judgement rest upon selfish force?

Man is the most inventive of all creatures, yet he invents slowly and copies easily. For this reason there can be no fixed period of development for civilizations. It takes long to establish a habit of thought and as long to break it down. To build up a civilization great numbers of men must share a common ideal, and this needs to be fixed by ceremonial and the unquestioning acceptance of custom. Once the pattern is made rigid, little energy is required to maintain it, and more energy can be diverted to growth, and such growth makes the accepted pattern obsolete. It took centuries to build up the city-state patriotisms of Sumeria and Greece and Italy, and this made possible a tremendous flowering of Specialization with consequent increased productivity and wealth, but it made impossible the co-operation of these cities with each other. So less civilized but larger units were able to copy their technology and to conquer them. Then these greater units—nations in the modern term—achieved patriotism and reached new levels of culture, usually less artistic and more scientific, and then were unable to burst the cocoon of nationalism and enter willingly into the phase of Gigantism or world-empire. We should expect this to be even less artistic, less scientific, and more organized, having copied successfully the technology of the nations.

There is an overworked generalization in biology and anthropology, that improvements spread outward from the centre like ripples, so that we expect the centre to be the most highly evolved point. This is only part of the truth. Change, a result of Random Activity, uses energy which must be taken from somewhere in the society with depressing results. England initiated the industrial revolution on a great scale and suffered socially in proportion to her economic advancement. Germany imitated the technology of the movement and the social adjustments as well and so skipped the period of painful waste. Evolution is easier and more rapid in a new environment than in the old one.

The rise and fall of classes, nations, and civilization arouses a feeling of the futility of human effort. Toynbee expresses the sentiment in his phrase, "Vain Repetitions of the Gentiles", but he suggests that this great waste of effort may be justified by the fact that the higher civilizations have produced the higher religions. If I had to define what is meant by a "higher religion", I could only say: "A religion that makes possible a higher civilization". One might irreverently note that higher civilizations also produce the higher sanitations and *vice versa*. All these are part

of the same development rather than causes and effects. But, because I do not agree that the climax forest is the ideal of land-use, or that Gigantism (dinosaurs and redwoods) is the aim of evolution, or that civilization is the justification of human life, I feel dubious about that term "higher" in relation to religion. In a temporary camp in the wilds a filtered, chlorinated, fluoridated, piped water-supply and main-drainage would not be "higher sanitation" but would be unsuitable and wasteful, whereas such things may be essential for efficiency in great cities. Religion, too, serves human purpose, and it is "higher" only in so far as it serves higher purposes.

Although the study of purpose belongs to philosophy rather than to science or art, we have from biology at least the incomplete but suggestive history of the evolutionary path by which man has come, as distinct from the path by which "a thousand types have gone". Darwin's idea of natural selection depended upon four factors: variability of individuals; overcrowding of environmental possibilities; survival of the fittest; inheritance of the variations. Science is limited by the fact that (like human perception in general) it can deal effectively only with the orderly and persistent elements in phenomena. There is therefore a tendency in science to overvalue those parts of a situation which most nearly conform to the impersonal inevitability of mathematics and to forget that any regularity is at best an abstraction from a complex whole. So Darwin's theory has become, by "scientific selection", even more mechanical in the hands of his genetics-minded heirs.

Genetics deals with heritable variations called "mutations". Mutations occur on the average in one individual in a thousand; one mutation out of a hundred may be favourable. Therefore the rate of evolution may be gauged by the birth-rate divided by the rate of selection. This is very simple and obvious, but unhappily it does not correspond to the observable facts. A pair of codfish produces up to ten million eggs a year, whereas a human couple averages less than four children in a lifetime. By formula the rate of evolution of the fish should be many thousand times more rapid than that of man, and the same would have been true to almost the same degree ever since the first primate developed hands. Obviously the pressure, process, or purpose that led towards codfish is somewhat different from that which led towards man, and the latter process is what most interests us.

Darwin, who was primarily a zoologist, was delighted to find how much more readily his theory applied to orchids than to animals. The difference seems to lie in the fact that Darwinism assumes that the raw material of natural selection is the variability of physical structure, whereas in nature physical structure is important chiefly as it implements behaviour. In simple creatures, such as plants, the two

factors are hardly to be distinguished, but in the mammals the structure often gives only the scantiest indication of the behaviour; yet the behavioural changes may have far-reaching effects. In the past five centuries the brown rat has changed from a steppe-rat of southern Russia to a household commensal, has shifted to a sea-going pest, and now has become probably the greatest nuisance to mankind among mammals. Yet the rat's physical structure has hardly altered. He has overrun the world with the general equipment common to many rodents. The competition that is of paramount importance in Darwinism was negligible in this case. Man was his opportunity, and he took it by a change of behaviour. The effective species are those that avoid competition by shifting from overcrowded to undercrowded but productive fields. Competition leads to specialization and on into an irreversible attachment to an environment which must evolve along the lines of Davies's Sequence and perish, or not evolve and perish. The only species with a possibility of constructive evolution are those engaged in the dangerous process of constant readaptation.

There have been several analyses of natural selection which are mathematically far over my head, but Sewall Wright's conclusions are at least intelligible. He suggests that very small groups have too few mutations and variants available to meet possibilities and so are liable to sudden extermination. Very large groups, on the other hand, have many mutations available but will need too long to diffuse these through so large a population. His ideal would be the group of intermediate size or the large reticulate species which is divided into many varieties separated by difficult but not impassable natural barriers. This pattern holds good also in civilization, in which heredity plays a very small part. In backwoods communities new ideas are very rare and unacceptable; in great societies new ideas are many but are powerless against mob-mindedness and practical realism. The great periods of cultural progress seem to belong to city-states and small nations, though even there prophets and inventors alike have usually been burned by mobs and institutions.

The study of evolution, then, suggests that civilizations are not the truly human way of life but are merely the techniques by which man wins the whole world and loses the mastery of his own soul. Nor does it lend much support to the theory that eugenic selection will lead to the superman. Intelligent behaviour seems to be the first necessity for the evolution of intelligence, which is one human characteristic. But are there others? Archaeology gives us a few glimpses of our Neanderthal ancestors or relatives. There was the toothless jaw of an old man who must have been fed for years by the kindness of the young; there was the skull of a child, polished by handling, placed on a shelf in a Spanish cave as we should place

the photograph of one loved and lost. Across the ages one senses that Neanderthal man felt for his family much as we do. There is also the skull of a young man, split into four for the easier extraction of the brain when he had formed a dinner for some of his neighbours. And there one's feeling of kinship vanishes. Our brains are no larger, though perhaps a little more complex, than those of Neanderthal man. It is not intelligence but behaviour that has changed, an extension of family kindness farther and farther beyond the limits of our own cave. Is that what Toynbee means by "higher religions"? In part, no doubt, for all religions preach kindliness. But I have a suspicion that religion, too, is subject to the moulding pressures of environment and evolves cyclically along familiar lines. It seems to begin in a return to the kindness characteristic of man's climb into humanity, and then, when it becomes the behaviour-pattern of the majority, it must compromise with and be moulded by the needs of every moment and end in intolerance and obscurantism. What is meaningful in history is the building of people who are more understanding and capable and kind, and it seems probable that progress along these lines must lie with small groups rather than with great ones.

So our dim view of history as it is lighted by science does not lead wholly to a sterile determinacy. Rather the predictable regularities in history, beset as these are by incalculable minor variables, throw into relief the great field of the unpredictable and, more important, the vital strain of human behaviour which is valuable in being indeterminate. Beyond the outer limits of regularity and familiarity in every subject there lies an infinity in which science, art, and religion have no empire and into which intuition gropes blindly.