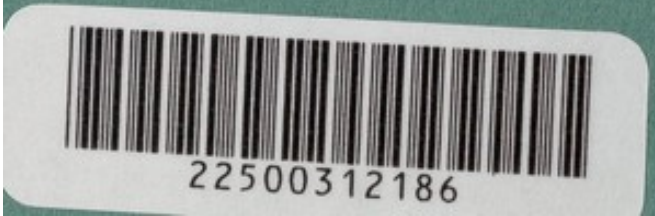
The genetics of society / C.D. Darlington.

THE GENETICS OF SOCIETY

C D DARLINGTON

March 1963



THE GENETICS OF SOCIETY

C D DARLINGTON
Magdalen College
Oxford

THE GENETICS OF SOCIETY

C D Darlington

1. History and Genetics

For a hundred years genetics and history have been within speaking distance of one another (1, 2, 3). But only during the last twenty years have advances on both sides brought them into direct contact. The contact is on a widening front. In dealing with human populations, historically or geographically, socially or medically, in examining the fossil remains of man and his works and their physical dating, in considering the effects of changes in climate, vegetation or coastline, in elucidating the origins of domestication in plants and animals and in following its consequences, in relating phonetic and linguistic evolution to the movements of populations, in all these directions we are no longer able to keep asunder historical and genetical interpretations of what has happened.

Recent summaries (4, 5, 6, 7) have put many new views in perspective. So also have the great recent advances in the genetics of human behaviour and disease (8, 9). We need to formulate new and explicit hypotheses putting the genetic and historical evidence into relation to one another. We have to expose and examine the assumptions that have been made in the past, often unconscious assumptions made on either side about the processes examined by the other side. I am here going to give a sketch - a preliminary sketch - of what seems to be wanted for these purposes.

2. Early Man

The study of early remains in South Africa has revealed a sequence of events in the evolution of man which was quite unexpected before their first discovery by Raymond Dart in 1925. It is now clear that the erect two-footed habit, necessary for the life of man in open country favoured a tool-using development of the hands; further that the handling of tools favoured the making of tools; and this in turn favoured a shift from a vegetarian to an omnivorous diet (10). The later sequence, the development of a more complex intelligence, the larger brain, the longer infancy, and the connected family with its almost continuous

sexual activity (shared only with the gibbon) had, of course, long been assumed.

In these sequences we have connections which are genetically intelligible. They suggest that at each stage man's own invention had depended upon changes in nervous and mental, muscular and skeletal organisation. Further, these changes had been favoured in their origin and in their maintenance by processes of natural selection. But, above all, these changes had themselves led to an exaggeration of the advantage which had given rise to them.

The principle of self-exaggeration leading to continued change in one direction has long been known in the evolution of the foot of the horse. But such orthogenesis for the man's head is of greater consequence than for the horse's hoof. With man each invention was due to hereditary ability. Each invention gave a greater advantage to more ability of a similar kind. It sharpened the selection against those who could not exploit it. Casting our minds forward we may note that this principle works today on a larger scale than ever before. Every advance in science increases the selective disadvantage of a lack of scientific capacity. It is not however one kind of ability, but rather hundreds of different kinds of ability, which are concerned. The environment has diversified the means of expressing for ability. And vice versa. Thus culture has been given the appearance of creating man although man undoubtedly created culture: man always came first.

Directed evolution has a second important consequence. Man expanded, as Coon has shown (11) perhaps half a million years ago to occupy parts of Europe, Asia and Africa. Here his races diverged. They became adapted to regional differences of climate, disease and mode of life. They diverged notably in skin colour, in skull shape and in the apparatus of their developing speech. These divergent changes affected temperament and physique. Accompanying them no doubt were directed changes which led to general increases in intelligence and hence to a parallel evolution of the European, Mongolian and Negro peoples that are living today.

A second great expansion came with modern man some 40,000 years ago. His skill in making tools then began to show itself in the variety of tools

he could make for hunting, fishing, woodwork, boatbuilding, basket work and so on. These opened up greater supplies of food and permitted exploration and colonisation which extended man's range. The main expansion, on Coon's view, came from South West and from East Asia. These new skills demanded, favoured, and enhanced the twin gifts of teaching and teachability. They favoured the further elaboration of vocal organs and of their nervous control, and they led to increasing regional diversity in speech (12).

3. The Breeding System: Inbreeding and Outbreeding

Speech combined with the spread of man over wide regions of the earth was bound to facilitate two important changes in human breeding. On the one hand, differences in speech always create barriers to interbreeding. They are bound to emphasise and particularise the tribal limits to mating. Today they have largely superseded the differences in smell, and in susceptibility to smell, such as still help to preserve the genetic integrity of the African pygmy (11). On the other hand, speech was bound to assist the recognition and also the definition of kinship. A crisis in the evolution of human breeding systems was then bound to arise. We have the evidence of its results.

Consider the development of human breeding. Originally man was in the same position of not recognising his kindred as all other animals. Now he recognised them and had a name for them. He was bound to be either attracted to what we call incest or repelled from it. If he was attracted he was bound to create homogeneous groups incapable of varying. Such groups often arise in animal and plant evolution. But being invariable they are incapable of adaptation and they never survive for long. They are dead ends (13). The human races which expanded were therefore bound to be those which by their genetic character, their instinct, were repelled from incest.

Survey of surviving human tribes and peoples shows that this instinct against inbreeding has been inherited by all of them. Being socially advantageous and instinctively correct it has become a part of universal human morality (14). It has created and maintained tribes which, even when homogeneous in appearance,

are genetically capable of releasing variation. This they regularly do when the size of the group expands or contracts. Such adaptations to the future needs of changing conditions is one which exists throughout sexually reproducing organisms. At the same time the rules for breeding, whose variations in detail are of little genetic importance, give a coherence to all primitive communities. They give them also an interest in kinship and descent which extends irrationally to the most advanced peoples today where it still supports the institutions of aristocracy and monarchy.

The coherence of primitive communities is due to their uniformity. They show no regular genetic differences beyond the difference of sex and the polymorphisms which they widely share with animal species. The differences in the work that individuals do derive only from differences in sex and age. In consequence inborn differences between classes are unknown and leadership is feeble or non-existent. The primitive people which have maintained their pre-human tribal character have done so by obeying the rules of outbreeding developed during the paleolithic period. These are superimposed on rules of inbreeding, mating within the tribe, which go back to the beginnings of sexual reproduction (15).

It was no doubt at this revolutionary moment that man, with infinite variations, reversed his mating posture and set in motion those processes of sexual selection first noticed by Darwin (16), processes which, as Haldane has suggested, transformed the Venus of Brassempouy into the Venus of Milo (17).

4. The Last Paleolithic Expansion

The last general expansion of man, which I prefer to call paleolithic rather than mesolithic, began perhaps in South West Asia about 40,000 years ago. It swept man outwards into South Africa, over the dry Bering Strait into America, and last of all into Australia (11). The movement continued until 1400 A.D. when the Eskimos colonised Greenland. The genetic adaptation to varied climates and diseases which accompanied this movement was successful in proportion to the variability of available populations. Thus it is evidently because the American colonisers had been filtered through an arctic zone within the last 15,000 years

that they have never had the pigment mutations of the negro, negrito and other black races of the Old World. America never had black people until they were brought over as slaves from Africa in 1520 A.D. Indeed native people on the Gulf of Venezuela still have to paint their faces black to avoid sunburn. This difference further indicates that the valuable mutations from brown to black are very rare in man.

A second aspect of local adaptation was the appearance of races adapted to resist malarial infection through the production of indigestible haemoglobins. These races carry genes which are fatal in the pure state but in the hybrid state prevent the propagation of the malaria parasite without incapacitating the human being. Gene mutations having such effects seem to have arisen in some variety, probably during the last paleolithic expansion. Since they were about as rare as the pigment mutations, different mutations have reached equilibrium in different geographical regions and races (18). It is not only from malaria and other diseases that such mutations protect human beings. They protect them from disturbance by other less well adapted human races. They have thus helped to maintain, together with their sharp geographical boundaries, a conservatism or backwardness (as we like to put it) in many tropical populations (19, 20).

Another evolutionary property revealed by the paleolithic expansion concerns the B blood group. This blood group is determined by the least frequent of the three balanced alleles or elements of the multiple ABO gene system. It has been lost in the gorilla. But in common with the chimpanzee most human populations still possess it. The B group however has been lost in the most rapidly moving of the expanding peoples, those which have spread furthest, into South America, South Australia and East Polynesia (21). Possibly this loss has been assisted by the concurrent loss of diseases such as smallpox and bubonic plague which the B group may help to resist (9). In any case we see that the genetic and medical sources of evidence, themselves independent, are independently attested by the archaeological dating of the paleolithic expansion.

5. The Origin of Agriculture

The latter end of this period of paleolithic movement from 10,000 to 5,000 B.C. was a time of rapid climatic change. The last ice age, after 60,000 years of relative stability, gave place to the warm or interglacial period we now enjoy (22, 23). The sea has generally risen about 400 feet; and locally where the ice lay, the land has risen up to 100 feet. America and Asia, Australia and New Guinea, Britain and Europe have been separated by ocean. The Alps have become passable, the Mediterranean impassable. Thus, breaking the great centrifugal movements of the paleolithic expansion there must have been great cross movements of men following the retreat of the ice. And there must also have been sudden stoppages.

Such situations of movement and crisis favour evolutionary change. In man, as in other organisms, a rapid alternation of mixing and isolation, of outbreeding and inbreeding, destabilises genetic populations. At the same time it is bound to accentuate selective processes and lead to the greatest racial diversity. Further, these movements and hence their effects were evidently concentrated in certain regions, at certain migratory crossroads. The most obvious of these are in South West Asia and in Central America. It is not surprising therefore that in these regions in the 8th millennium B.C. in the Old World, and, quite independently three millennia later in the New World, men using their wits should have discovered new modes of life. They learnt, in fact, how to propagate the grain they had formerly only collected and stored for eating.

The excavations at Jericho at the western end and at various places on the northern and eastern side have shown that the site was the Fertile Crescent, and wheat and barley were the living agents, to which we must attach the foundation of agriculture (24, 25). It was no sudden discovery: it was rather an evolutionary process, the last quiescent period of human history. Over a period of at least a hundred human generations (and this must always be the unit of our evolutionary measurement) groups of men slowly expanded and developed their settlements. As their agricultural production increased they came to depend less and less on

hunting and collecting. They began to make pottery and they learnt also to keep grazing animals for meat, milk and wool (26, 27). Slowly their settlements grew larger and they began to fortify them against their neighbours. War as well as trade added to the causes of mixture and instability.

These discoveries enable us to put a new face on what Gordon Childe called the Neolithic Revolution (28). Previously every invention of man had had, I would say, an autocatalytic effect. It had encouraged the multiplication of those who were genetically capable of using it. And these in turn were most likely to be kindred of those who made the invention. Man had therefore for many ages been unconsciously changing the conditions of his own evolution. He had been unconsciously selecting himself. Now he began unconsciously selecting something else, his chosen food plants. Instead of shattering their ears, and spreading their hulled grain with barbed awns, instead of cross-breeding and maintaining great variability with flowering and germinating spread raggedly over the season, they began to adopt a habit hitherto unknown, that of the cultivated crop plants. The crops of grain shot into ear on one day, the flowers opened all at once and often they began to be self-fertilising instead of cross-fertilising. The ear itself became tough; the grain thrashed out, the seed ripened and germinated quickly and together (29, 30).

These changes arose from the unintended selection inherent in regular sowing, regular tillage and regular harvesting. Hereditary mutations leading to these new characteristics, and also to increased yields of grain, favoured the propagation of each crop in turn as it came under man's care. And when the cultivator migrated into a new country he began to harvest the seeds of the weeds along with his crop. He had soon, without knowing it, created a new crop, rye instead of wheat, or one millet instead of another. Conscious and unconscious selection have thus worked together in the improvement, the acclimatisation, and the substitution of crops, processes which have continued over most of the world down to the present day (31).

6. The Neolithic Expansion

These processes led to the slow growth in numbers of the first tribes of cultivators. Supplied with regular and increasing sources of food, they began to spread east and west, and more slowly north and south, of their original territory. As they did so the conditions of the last paleolithic expansion inevitably repeated themselves, colonisation, adaptation, and diversification. But in addition several quite novel situations arose.

The new crop plants were dependant on man for their propagation. They were therefore unconsciously selected to prosper under these new conditions. They became domesticated races. But the reactions of crop and cultivator were reciprocal. The new cultivators were now dependant on their crops for their own propagation. They were therefore also being unconsciously selected to prosper under these new conditions. They too became domesticated races: they too became fitted for their new life, unfitted for their old life, no longer free but tied to their land and their crops; or, as they might have said, to the Earth Goddess who rewarded their devotions.

The change in the character of selection arising from the dependance of men on crops and crops on men is fundamental to the understanding of human history. Prior to cultivation the man and the future crop plant were separately selected in relation to the rest of nature. After cultivation each became overpoweringly important to the other and the interdependance gradually came to exclude most of the rest of nature. The combination became what it still remains for those most deeply involved: MAN-AND-CROP, a new symbiotic unit in evolution.

In this way after a hundred generations, with varying hybridisation but with unvarying selection, races of cultivators arose. They had been slowly selected for success. And success had depended, as those who are accustomed to cultivation know, on industry and patience, forethought and skill. The new cultivators had learnt to handle the seed, the plant and the soil. The novel abilities which distinguished them from other kinds of men are inherited by the

successful grain-growers of most of the Old World today. They continue everywhere to demonstrate a love of home, a feeling for the earth and the crops, and a sense of property, which were unknown to any who had gone before them.

An instructive control to this great neolithic experiment, for so we have to regard it, was run in the New World. There the cultivation of maize, beans, and potatoes led to the growth of similar races of cultivators (7, 32). But where, in both Old and New Worlds, the easier cultivation of the roots of lower protein content, of yams and manioc, was taken up, it always propagated peoples of a less industrious character (33).

The contrast between domestication of animals in the Old World, and its effective absence in the New, shows us several other aspects of the neolithic experiment. In the Old World animal husbandry followed agriculture after one or two millennia. Just as Abel followed Cain in the book of Genesis. First the sheep and the goat, later the ox and the pig, later still the ass (from the Sudan), and last of all the horse (from central Asia) and the camel, were taken into protection by cultivators who could offer them the security of accommodation. As with the crops, these animals were unconsciously selected for their usefulness to their keepers. And vice versa.

The farmers were now in a position to expand their activities and to diversify their means of livlihood, Coming to the edge of the drier steppe they were able to drop their cultivation and return partly or wholly to a wandering life. Hybridisation and selection in these new conditions produced new races of nomads who in the 4th millennium B.C. began to extend far beyond the limits of cultivation. These new kinds of herdsmen were more alert and enterprising than the soilbound cultivators. Just as the grain growers were more alert than the root growers so the horse and cattlemen were more enterprising than the swineherds and they were no doubt partly responsible for the more rapid expansion of the neolithic peoples in the Old World than in the New.

The rate of spread of the herdsmen over the Old World is not easy to record. But the spread of the new cultivators has been tentatively mapped and

dated. Their entrance into Egypt in the 5th millennium, and into India and Europe in the 4th millennium, is well authenticated. The first steps in China in the 3rd millennium still need to be more fully known. The character of the expansion in Europe has been sketched very clearly by Gordon Childe (34). The advancing tribes were at first homogeneous, socially undifferentiated, indeed paleolithic except in the density of the populations and the stability of their settlements. This expansion continued until the cultivable world was largely occupied, that is, until the Maori arrived in New Zealand and the Bantu in South Africa in the last millennium.

Wherever they went these new people created a stable market for the paleolithic peoples, the forest and steppe peoples, who everywhere surrounded them. Trade led to cooperation as it does between purely paleolithic tribes today. Sporadically, but inevitably, it also led to hybridisation and genetic recombination necessary both for acclimatisation to new latitudes and the production of new communities. There was an efflorescence of new trades, like flint knapping, salt panning, boat building, sea trading, and a multiplication of new peoples prospering in certain localities and busily or even furiously searching for fresh sources of supply and fresh chances of demand.

7. The Breeding System: Tribes and Castes

The new activities and customs arising in the new hybrid populations included specific inventions and discoveries. Some of these, like basketwork and pottery, were probably feminine inventions. They were copied, like the improvements of agriculture, and they spread through whole tribes. Others, beginning in the 3rd millennium B.C. with the discoveries of what could be done with metal ores, were probably masculine inventions. They spread by a method that was new and with results that were unparalleled in human or any other evolution.

For the processes discovered were kept secret; they were enveloped in magic; and they were propagated by their discoverers from father to son. What had happened? We may say that the instinct for inbreeding or assortative

mating which underlay tribal separation had received a sudden additional social and economic incentive. It was an incentive which has continued down to the present day. The result was that the inventive metal-working families multiplied proportionately to their success. They migrated wherever they could find markets for their work, that is, wherever the cultivators and the stockbreeders had preceded them and even beyond. The descendants of these people are still found as metal-working castes, over large parts of Arabia (35), India and Africa; and in Europe we know a branch of them as the Romany-speaking Gypsies.

This process of origin of new breeds, castes or races from inside old groups is a special case of what the experimental breeder knows as disruptive selection (36). The invention cuts off those who know it from interbreeding with those who do not. The inventors who know it are selected for skill in exploiting it. The rest who do not know it are unselected. The community is disrupted genetically and divided occupationally.

Usually the inventors prospered and spread and culture is said to have prospered and spread. Sometimes they died out and culture is said to have degenerated (37). When they prospered, the new castes of metal-workers provided, first of all, the tools, the hoe, the spade, and later the metal-shared plough, which were the means of increasing the density and distribution of the whole cultivating population. Secondly, they provided weapons whose use led to the next decisive steps in the evolution of society.

Paleolithic peoples, at least the men, had fought with one another, killed one another, and even kept their captives to be ceremonially eaten. But now with more effective weapons and more diverse employments, entirely novel opportunities arose. Captives could be kept alive. They could be used to cultivate the soil, to mine the ore, to row the ships, and generally to support and enrich their captors. They could be castrated and treated as expendable. Or they could be bred to form a new caste, or two new castes, pure and hybrid. Serfdom of indigenous populations and slavery of imported populations became the bases of civilised society. In an immense variety of genetic situations,

several of them described in Deuteronomy, XX and XXI, they have remained so until our own age (38). The patient peasants who had made the Neolithic Revolution found themselves in the Bronze Age at the bottom of society. There they have continued ever since.

How did this come about? Warrior groups arising by disruptive selection imposed their rule on peasant societies and were able to demand service in return for protection. They created feudal types of society. Such societies arose independently in ancient Egypt, and in mediaeval Europe, in China and Japan, and in many parts of Africa at many periods. They have been said to depend on the relationship whereby a man, a vassal, offers to serve his lord in exchange for protection. The man at the bottom of the system, bearing its ultimate burdens, was always the cultivator (39). This contract nominally kept the system going. What however called it into existence, and made it work and endure, was not a respect for force, for custom, or for an idea in law, but always a deeper principle. It was the inborn character of the cultivator, the character which made him prefer the security of cultivation to the hazards of freedom. It made him prefer his own land to anything else in the world. This inborn character is what was created by the long millennia of neolithic selection.

The metal workers were too scarce, too skilful, and above all too uncommitted to lose their status. They have wandered everywhere freely over the earth forming their castes but contributing also to other castes. Craftsmen and technicians everywhere are descended from the smiths of the bronze and iron age. And through hybridisation with the scribes and other inventors they have no doubt contributed to the origin of the most skilled profession of all, the priesthood.

Summing up: the origins of stratified societies with classes following different occupations, and exercising different skills, which they transmit by teaching and by heredity, is always to be traced to one genetic principle, that of a combination of different races, breeds or stocks. And the separation of their classes is always maintained by the genetic principle of assortative or discriminatory

mating, a continuation of tribal endogamy from the paleolithic time. But the combinations arose in various ways, either by inventive disruption, by friendly cooperation or by fierce conflict (40). And they are maintained in various ways, by various expressions of power, various modes of protection, balanced one with another. On the one hand, there was the strength of military castes armed with bronze and iron to conquer and to enslave by force. On the other hand, there was the peaceful guidance of priestly castes equipped only with their intellectual gifts and magical and ceremonial devices. Neither has ever been able to maintain itself for long alone; the political compromises and the genetic relations of the two have filled a large part of recorded history.

8. The City and the Nation

At the beginning of the bronze age there were no doubt already available on the rich alluvial lands of the Euphrates, Nile and Indus valleys, peoples with diverse skills, temperaments and instincts, peoples dependant on one another in the way needed for the creation of cities. Genetic diversity (and not, as Flinders Petrie once suggested, hybrid vigour) was and always has been the key to the prosperity of cities. But beyond diversity and interdependance other quite new faculties were wanted. The first was an ability to live in dense populations, a question of genetic adaptation to crowding and disease. A second was the ability to live together with very unlike people, a question of instinct and temperament. A third was the ability to breed under these unprecedented conditions. These properties are not to be taken for granted. They were not characteristic of paleolithic man nor indeed, we have reason to believe, of any of his ancestors.

One of the needs created by the new settlements was thus tolerance of mixture. Paleolithic hunters, fishers and gatherers are still in the habit of meeting and exchanging their goods. Early neolithic villages often bear witness to a similar arrangement. Two settlements are pitched next to one another evidently to facilitate a permanent exchange. The two groups of people meet but they do not freely mingle.

Animal experiments on the control of population show that this habit of keeping apart is as deeply ingrained in rats as in men. If two colonies of rats are mixed their fertility at once declines (41). It is not surprising that men and women, who are at least as sensitive as rats, kept apart and still keep apart, so far as the placing or construction of their dwellings allows, in the groups which work and commerce draw together. But the genetic causes as well as consequences of this keeping apart and drawing together are vastly important for the evolution of human society.

It was necessary by selective breeding to break down the reactions and instincts of primitive man in some of these respects. The Egyptians, for example, did not overcome the obstacles to city life for 1600 years, i.e. until after the invasion and, as I would say, hybridisation of the Hyksos people (42). People in cities have now for 150 generations lived under a continual pressure of selection which has favoured those who can survive and breed under these conditions. A partial and locally variable success has been achieved and the proportion of mankind capable of living and breeding in cities has, for better or for worse, slowly increased. Now there are even people who prefer it.

The ability to live in close proximity with other kinds of people than ones own, however, is a gift which has never been acquired in any society except under the selective elimination of slavery. The inability to meet in a full sense this requirement of living together is indeed the reason why social classes keep apart. People following the same trade live together, first in their own villages, secondly in their own quarters or streets of a town. They keep together and breed together: they keep apart and breed apart from others. Exceptionally or sporadically, illegitimately or polygamously, but in all cases selectively, they cross-breed between groups.

How often cross-breeding occurs depends on the degree and obviousness of the difference between the groups. What matters of course is the subjective difference, for colour of skin means much to some people, little to others. This is not a rational matter. It is largely a genetic and instinctive matter. Whether

it is communal or individual depends on the religious guidance which may be given by a priestly caste. The Priests and Brahmins have thus moulded the evolution of Jewish and Hindu society. The Priests of Delphi were less concerned with this problem. The governing classes of ancient cities however never forgot their breeding policy and it was only because the patricians of Athens and of Rome were willing to relax their rules that their republics could in the end become empires (43). Sparta and Venice by their glory and decay demonstrate experimentally the consequences of the opposite course of increasing exclusiveness.

The consequence of limited breeding, selectively limited, between social classes is to remove slowly the former racial distinction between them. Through a diffusion of genes, society becomes homogeneous in the socially irrelevant differentials. These include not only blood group frequencies but even sometimes body size which, in Archaic Egypt, for example, ceased after a few generations, to distinguish the foreign dynastic caste from the indigenous servile race (44). The different ecological niches in the structure of society created by racial differences continue to be filled adaptively when the superficial differences between classes have been submerged. But they are filled by a selection of genes in new combinations following interbreeding from the different racial sources.

Thus a young nation with physically contrasted classes becomes an old nation which is physically and temperamentally much more homogenous. This is what Livy means when he refers to the Roman people in Book II as developing in the course of many generations a sense of Community. The same kind of change had taken place in the Greek City States. It took place in England in the twelve generations following the Norman Conquest. Indeed the same process overtook all the nations of Europe as they crystallised in their modern and separate shapes during the Middle Ages. In these instances the spread of a common language established a breeding community and helped to confirm the feeling of belonging together which arises from even the most limited genetic exchange.

9. The Linguistic Expansions

The first achievements of the neolithic expansion were the establishment of the three valley civilisations by the combination with paleolithic peoples as illustrated in the epic of Gilgamesh. But the farming populations spread in all directions and wherever they went they encountered sparse hunting and collecting tribes, all of them nomadic. Wherever they went also, apart from the three valleys, they encountered a harder life. The Danube valley was rich but colder and wetter. Nubia, North Africa, Arabia and Central Asia were dryer and poorer. In all these places cultivators survived and increased by hybridising with native populations. The evidence consists in the mixed character of the skulls recovered (45) and in the mixed, diversified, and altogether new customs arising (46). Hybridisation, hitherto rare and localised at crossroads, was now and henceforward connected with all human movement. Inevitably it produced by genetic recombination new races fitted for new habits of life and marked by new languages, or families of languages.

The first two of these new peoples, the Hamites and the Semites, arose too early for their sources to be located except that they were probably on the borders of the Fertile Crescent itself. The third of the new peoples came from further away, from the Danube region, and we know them as Aryans. We know them by their separate linguistic inheritance, their common stock of words (47). Some of them like the words for grain crops seem to have been their own. Others, like the words for copper, for the socketed axe, and for domestic cattle, they owed to the Sumerians (48). It seems that men from Sumer, perhaps over many generations, had travelled among the mixed and developing peoples. These men had carried with them their arts, the things they made, and the words for them. They had helped to create new societies with a diversity of talents and skills which set them on their way to expansion.

In the third millennium these Aryans moved into Italy, Switzerland, Germany, Britain, Scandinavia and the Ukraine. To the archaeologist they may appear as secondary and tertiary neolithic people. The first were unstratified

agricultural tribes, the second primitive agricultural nations with bronze-smiths, priests and traders. These people where they moved north into almost uninhabited Lithuania, preserved unchanged their earliest ancestral form of speech. But where they met and subjected large paleolithic populations their language changed more. They gave rise to Celtic in the west, Hittite, Greek and Latin in the south, Persian and Sanskrit in the east.

Meanwhile, from Egypt and Arabia similar vast movements began which took the other new peoples, the Hamites and Semites, with their crops, their stock, and their languages, across North Africa to the Maghreb, up the Nile into Nubia, across the desert into the happy land, Arabia felix, the Yemen; and on into the highlands of Ethiopia (49, 50).

We know how these linguistic expansions took place since they were repeated in historic times. Place names show that the Celts covered Europe in their time from Galicia to Galatia, from the Don to the Dee (51). The Goths and the Slavs followed the pattern of the Celts a millennium later. So also on a smaller scale, and in their own way, did the Vikings (52). And in the historic period the great Muslim expansions likewise caused an enormous spread of Arabic language, culture and race (53). A little earlier had come the Indonesian and Bantu expansions (54). All these great movements, the early ones in the bronze age, the later ones in the iron age, arose from small groups, originally even single families, prospering by unusual gifts and becoming governing classes, multiplying polygamously and imposing their language on subject peoples.

The Indonesians subdued not people but the sea. They owed their success to their possession of yams and bananas (55) and to their skill in navigation which carried them over the Pacific, the Indian and even perhaps the Atlantic Ocean (56). But all the others owed their success to their ability by force, by diplomacy, and by priestcraft to organise and govern the peoples they overcame. Their habits meant that they were usually selected equally for their sexual fertility and for their warlike and technical skill. Breeding as much as fighting was a genetic condition of their sustained success.

Yet another condition of success of the new peoples had been their ability to maintain themselves by new methods and under more difficult conditions. One of their principal means was by exploiting animals: especially the horse in the Russian steppes and later the camel in the Arabian and African deserts. By means of these animals they were able to abandon settled life and to traverse immense distances with speed multiplied in secular terms a hundred or a thousand-fold. The Scythians and their horse-riding predecessors provided the link between the Danube and the nascent Chinese civilisation in the 2nd and 1st millennium. It was probably millets (first Setaria then Panicum) as grain for horses as well as for men that enabled them to take their flocks across Asia. And in doing so to carry the practice of agriculture and stockbreeding from South Russia to the valley of the Yellow River (31, 57).

Not only breeding and fighting, but also riding was therefore a genetic condition of success. In the end, for the Semites as well as for the Aryans, the horse was as much the conqueror as the man. And it became the symbol, as it had been the instrument, of their mastery of society. It is not surprising that where the horse came to its limit in Abyssinia civilisation also, for a thousand years, came to a standstill (49). Disease held back the advance of new races of men and new species of animals alike.

The nomadic herdsmen and horsemen, even those who had lost all use and all talent for agriculture, as we saw were derived by hybridisation and selection from the earliest settled cultivators. The evolution was formerly thought to have been the other way round but the reasons for the mistake are now clear. The nomadic life was simpler. In its movement it looked more like hunting life. And it covered an immense area of the world in advance of any cultivation. By the speed of its expansion it had run away from the evidence of its sedentary beginnings.

10. The New Peoples

The spreading Hamites, Semites and Aryans, although beginning as a minority of rulers, by dominating or assimilating the paleolithic peoples destroyed over a vast area the languages they spoke. Thus the numbers of languages in Europe, Asia and Africa, from the Atlantic to the Indian Ocean, continually diminished during the Bronze and Iron Age. In the new stratified societies arising the new governing class languages became the means of unity for larger populations and territories. Conversely the great diversity of local aboriginal languages still surviving in America is related to the absence of the great conquering expansions which flooded over the paleolithic Old World.

The paleolithic populations who adopted the new languages had their own racial character in regard to their vocal organs and mental structure. They naturally therefore changed the character of their new speech (58). For this reason in etymology and grammar, the languages of Europe, now Aryan, became split, as we saw, into Latin and Celtic, Teutonic and Slavonic. Phonetically also they diverged but this divergence demonstrably cuts across the linguistic divisions. The TH phoneme, critical in this respect, corresponds with blood group frequency contours of paleolithic and neolithic origin. It cuts right across the linguistic divisions between Latin and Celtic, and even between Aryan and Basque, which are effectively of post-neolithic and governing class origin. The linguist has naturally been baffled by these complicated circumstances and has used non-genetic terms such as "substrate" to explain the result (59).

The reciprocal aspect of mixture and hybridisation between neolithic and paleolithic people is seen not only, as we noticed, linguistically but also archaeologically. Neolithic arts were introduced to the hunting peoples on the arctic and tropical fringes of cultivation. Some of the introductions were merely by trade. But when they were genuinely incorporated in the activities of the people, as happened with pottery in Japan and in Africa, they were probably the result of hybridisation and they are appropriately classified by archaeologists as sub-neolithic (7).

The Hamitic, Semitic and Aryan expansions were, like earlier ones, centrifugal and in all directions. One side of them may therefore be seen as a continuation of the general outward neolithic movement. The other side however lay in the reverse and inward direction. The expanding peoples turned back towards the neolithic centre, towards the region of greatest resources and also of greatest resistance. The Semites from Arabia conquered and assimilated Sumer. The Nubians from the south briefly subdued Egypt. And when they were thrown out by the Assyrians they took with them to Meroe the men who founded the iron-working castes of Africa (60). From the north, on the other hand, the Aryans, coming as Hittites, Greeks and Persians, carved enduring kingdoms out of the whole northern edge of the Ancient East. These struggles resulted in new elaborations of government and more complex social stratification which were successively generated by the Persian, the Macedonian and the Roman empires.

This inward movement brought a new opposition into view which has often been noticed. Between the first cultivators who established agriculture on the Indus, the Euphrates and the Nile, in Lydia, Crete and Etruria, on the one hand, and the new Bronze Age races on the other, there was a contrast in the relations of the sexes. Among the first cultivators women were important. They took a large part in the work and worship of the community. The mother goddess and her priestesses later dominated their societies. Amongst them the myth of the Amazons came into flower and queens often ruled the country (61). The Aryans and Semites however were at first, and in their governing classes continued to be, dominated by the male. Whether the contrast between the new people and the old perhaps had its roots in a contrast between collectors and hunters of the paleolithic we do not know. Since however it commonly distinguishes animal species it is undoubtedly an adaptive and genetic contrast and one which can arise by natural selection.

This contrast between races still exists. We see it represented by the difference between matrilinear and patrilinear forms of inheritance and habitation in Africa. And, in India, the neolithic southern populations are

matrilinear and even matriarchal while the northern Aryan populations are dominated by the male (62). When, therefore, in the ancient east the incoming races became differentiated as governing classes it was the male predominance and the male gods of the Hittites, the Persians, the Greeks, the Romans, the Jews and the Arabs which displaced the female predominance of their predecessors. The religious ideas of the lower orders, as Fustel de Coulanges has explained, were little regarded in the Iron Age city. It was only much later, in mediaeval Europe, that the cult of the mother goddess emerged from the depths once more, perhaps through the influence of a peasant and celibate priesthood (63).

11. The Breeding System: Population Control

Let us now ask what the great increases in mere density of human populations in the neolithic and bronze ages meant for human behaviour. How did the expanding societies accommodate themselves to their unprecedented situation?

In all animal species the capacity for reproduction allows the population to increase quickly when the supply of food increases. Under ordinary conditions when the food supply is stable or diminishing, and the population is at or above its optimum density, the species restricts its numbers. This it does by reducing or postponing egg production, by killing off some of the young, and in general by individual actions under instinctive or physiological control (41, 64). These mechanisms are assisted by a variety of social devices which foreshadow human morality and also human social behaviour. For they depend on communication by sight and sound and on ceremonial gatherings where sexual markings and display are used for identification by the same sex as much as for admiration by the opposite sex.

The result of all this activity is that conflict as well as famine is avoided. The assertion of rights in territory for tribes and for families not only regulates reproduction; it also preserves the sources of food, that is the habitat. The regulating apparatus is continually in action without any threat of

starvation. It represents a genetically, instinctively and physiologically controlled property of the breeding system and one evolved by processes of natural selection. If we apply Darwin's terms, it also represents the basic animal morality. For all animals live by destruction of plants or of other animals. And this is a restraint of destruction which serves the double purpose of providing the right habitat for the parents while protecting it for their posterity.

The building in of genetic controls to the breeding mechanism is an example of the close mutual adaptation of all the materials and processes of heredity, variation and reproduction, extended in time and in space, which is characteristic of the evolution of genetic systems (13). The mutations and recombinations of genes in the cell and the instincts of individuals in mating are all related to the adaptation of one system in evolution. And in this system the regulation of territory, of social behaviour and of sexual fertility are all necessary parts.

What happens in Man? The situation was made clear by Carr-Saunders in man some time before it was understood in animals (65). Under paleolithic conditions the principles of restriction found in animals still applied. An instinctive feeling for territory is still indeed characteristic of civilised peoples. But amongst all paleolithic peoples control of propagation has been universally practiced. Before sexual life begins initiation is required. Afterwards infanticide is the best known method of limitation. It is always selective, usually against the female, when it has the further effect of promoting homosexuality or polyandry. Abortion is perhaps equally important. Human sacrifice, whether of widows or captives, was also formerly a widespread means of population control.

The agricultural revolution led to a change, indeed a reversal, in the selective situation which had operated throughout time. Settled farming made it possible to provide for increases, not rapid but still unprecedented increases, of the farming population. Most of the world was open to their colonisation. Two great evolutionary changes were therefore favoured during the long quiescent period of the neolithic and we know that they occurred. First, as Darwin

suggested (16), there was an increase in the natural fertility. Secondly, there was a shedding of the instinctive paleolithic restrictions on multiplication and on unlimited exploitation of the habitat. Slowly the brakes were taken off and the great population explosion began.

The shedding of the instinctive restrictions on multiplication was no doubt itself due to decay of these instincts with a decay of the selective pressures supporting them. Later however the change in attitude found religious expression and guidance. Great religions, we must not forget, have always been propagated by breeding. Their lasting success has been proportioned to the care and discernment with which they organised the survival and sexual reproduction of the faithful.

The founders of Hinduism and Judaism were explicit on these questions in both general covenants and particular laws. The founders of Christianity at first hesitated, but not for long, and their successors (in competition and in contrast with the rival exponents of Mithraism) learnt to direct their rules and rituals towards increasing the population, that is the Christian population.

And finally Islam may be said, in these respects, to have learnt its lesson from the successes and mistakes of its predecessors. Its miraculous expansion several times repeated, was the result of a well-balanced policy. First, then was the forbidding of abortion, infanticide, homosexuality, and internecine war. Secondly there was the replacing of these means of limitation by the grand devices of multiplication: foreign conquest, slavery and polygyny. And thirdly, there was the introducing of medically sound rules for cleanliness.

The biological successes of past millennia are not of course a guarantee of future prosperity. The standards of sexual behaviour established by Christianity which have fostered a cult of sin, and the untempered subordination of women established by Islam, have left both religions with a control of the breeding system which compares unfavourably with the parental Judaism.

All advanced societies were thus first stratified, and then selected for enhanced multiplication. This led to enhanced competition and even conflict.

Their equipment for conflict continually improved during five millennia. These societies have therefore always expanded to limits fixed by pestilence, famine and war. Up to the time of Malthus, advanced societies had been increasing unchecked either by instinctive or rational limitations. We were first clearly told this by Malthus and we know it now from our own observations. We must note therefore an historic misunderstanding. The idea of natural selection, which Darwin took from Malthus and applied to all plants and animals, he took, not from wild life, not even from paleolithic or pagan life. He took it from advanced man enlightened by the great religions. The idea of nature "red in the tooth and claw" came not from nature but from the most recent struggles out of which civilisation had been emerging (66).

12. Destruction of Habitat and Migration of Peoples

Not only limitation of the population but also preservation of the habitat was no doubt partly under instinctive control before the development of agriculture. But with agriculture far-sighted instincts suited to customary situations were replaced by short-sighted reasons and short-term solutions. And the results, earlier as well as later, were frequently disastrous.

The earliest cultivators took pains to preserve the soil and the water on which they depended for their crops. Probably before the fifth millennium the corniche ploughing, giving those terraces which were to girdle the earth, had begun to stretch round the hillsides of the Fertile Crescent. But as these structures grew they became more vulnerable. Every war led to their destruction. One people after another lost the soil on which it lived. Moreover irrigation had its own dangers. Sumeria was the first to suffer from these, salted and silted out of existence (67). With the domestication of animals, overgrazing destroyed the vegetation of much of Syria and Palestine, its effect passing later to Greece, Italy and North Africa. Finally, as the population grew, land became scarce. The felling of trees for timber and fuel was no longer made good. Forests were felled or burnt for arable space (Joshua XVII: 15). And ships had to be built. The Phoenicians felled their cedars to sell them to Egypt as well as to build their

own fleets. The Minoans ruled the Mediterranean by cutting down their forests to build ships.

As each society in turn destroyed its habitat, it lost its population. But the loss was always selective. It was the governing and technical classes which moved on to where the living was better. As the olive took the place of the cypress on the white mountains of Crete, modest farmers gathered their harvests. But the princes had departed.

The princes sailed to new lands taking with them, fortunately the vine, the olive and the alphabet, less fortunately the sheep and the goat. The movement has continued ever since. The Lydians, and some Cretans too, no doubt, established themselves in Etruria, the Phoenicians in Carthage, the Greeks in the Crimea, in Sicily and in Provence. Wherever they went they felled timber and grazed flocks and herds. And into North Africa, 4000 years after the goat, they brought the camel to complete its work. The climate fluctuated but it did not change for the worse in its physical foundations. It had changed earlier. The vegetation, however, which could have been a buffer against the effects of this change, was now devastated. The humus of these lands, accumulated over a whole age, was often washed away in a few centuries (68, 69).

The order in which civilisation advanced was also the succession of its decay, the decay of the soil, and of the society. After Sumeria, Crete through its small size suffered early. North Africa through its low rainfall suffered next. Hannibal's invasion of Gaul was already a recognition of the diminished resources of the southern side of the Mediterranean. The fall of Carthage in a sense foreshadowed the decline of Rome.

The one people which failed to ruin their foundations were the Egyptians. In relative importance, Egypt has, to be sure, diminished over its five millennia of continuous cultivation. Its citizens suffered a fearful encounter with the Arab invaders. For six centuries they endured the celibate Mamelukes. And their governing classes have risen and fallen. But the soil has never been spoilt. And the irrigation system has never needed to be seriously altered. Not, at least,

until it had to accommodate cotton as a perennial crop in the 19th century (70). The cultivators and the cultivation have therefore survived – almost unchanged.

Thus the impact of Semites from the south and Aryans from the north, herdsmen and horsemen, on the ancient east produced successively the first great multiracial syntheses of civilisation. But each collapsed when it exhausted its habitat. The governors, and the administrators, the priests and the craftsmen, then moved on. They moved away from the centre, northwards and westwards, from Assyria to Persia, from Greece to Rome.

13. The Carrying of Civilisation

In the earliest civilisations we do not exactly know where the founders came from. We merely guess that the first dynastic race of Egypt came from Syria or from Libya in 3200 B.C. But already with the Hittites we know they had assimilated Assyrian traders and craftsmen before they became famous (71). The Minoans were probably priests from Syria, nobles from Anatolia, seamen from the Cyclades and Phoenicia, and craftsmen from Egypt (72). The founders of archaic Athens were partly Mycenaean, partly Ionian, partly local and partly northerners. But new societies were always supplied with the artisans, usually with the priests, and sometimes with the governors, from older societies. The places, the names and the speech changed, but the people were in part, an indispensible part, the same.

There is thus a genetic continuity between the castes and classes who carry the culture from the old to the new. These castes and classes mix slightly, slowly and always selectively, with the governors above and the slaves and serfs beneath. We can see the effects of differences in these mixtures and rates of mixture, in the different Greek city states. For the mountain barriers between them made epigamia, or cross-breeding, difficult and soon law reinforced custom. In consequence, when migration ceased, the Greek societies increasingly diverged in racial character and social structure; indeed they diverged to the point at which their chief aim was to destroy one another.

These barriers between Greek and Greek as well as between Greek and barbarian were nearly broken down by the Persians. They were in the end broken down by Alexander when he introduced the Persian system of racial co-operation, the system of Cyrus and Darius, to the western world. It was a system which Alexander had capped with a Greek governing class. Or rather a hybrid governing class for one glorious day he married them all to Persian wives. The Greeks who thought they had invented this system blessed it with the name of homonoia (73).

Geographical and genetic conditions in their interaction determine not only static but also dynamic or revolutionary differences between societies. The good communications of Italy after six generations of effort allowed the Roman republic to expand and to absorb technical and governing classes from the Etruscan empire in the north, artists and scholars from the Greek colonies in the south, clerks, poets and writers from both. But it succeeded in doing so only because after a long struggle the patricians had admitted the plebs, that is the immigrant population of Rome, to a limited partnership and selective inter-breeding. A political system was established which was also a breeding system. It ensured the selective diffusion of the ancient civilised genetic materials into the Roman governing class who could have become civilised in no other way. This system expanded under the empire when the selective emancipation of intelligent slaves, mostly Greek-speaking, from the markets of Delos and Chios, fed the Roman administration with the people it needed for undertaking the government of the world.

We see the working of these principles of selective movement as much in the decline as in the rise of the Roman Empire. The dispersal of the administratively talented men to the provinces and their concentration in the new eastern capital both depended on the impoverishment of Italy and the consequent redistribution of the sources of food and raw materials. This led to the decay of communications and the re-establishment of regional breeding populations, first for the peasantry, now fixed to the soil, and then for the higher classes. The tetrarchy of Diocletian, acknowledged the advancing disintegration. The barbarian

invasions arose through the development of agriculture, the work of the iron axe and the iron plough in central Europe between 200 B.C. and 400 A.D., which fed and bred large new populations of Teutons and Slavs, the materials of the third Aryan expansion.

The invasions themselves broke down the barriers between the parts of Europe once again. They also opened the way for a new kind of movement. Owing to the administrative power and missionary momentum of the Roman Church, merchants, technicians and a new race of clerks, began to carry civilisation at last into the northern countries. All these processes were genetic and depended on the movement of people from the spoilt into the unspoilt country. But they were reinforced by intellectual and religious incentives.

The succession of empires is thus, in my view, due to the selective movement of people, the many different kinds of people, whose co-operation is necessary to make an empire, and whose separate breeding is necessary to sustain a diversified culture.

The principle, ubi bene, ibi patria, which the sedentary European has often applied to the eastern immigrant can be applied to any intelligent group in any unstable stratified society. Without it civilisation would have died where it began. For ideas do not fly on wings; they march on foot. Cultures do not multiply in a vacuum; they arise from the work of men: men who have to be fed by cultivation of the soil. It is these men who multiply and they do so by processes of sexual reproduction following the instinctive laws of inbreeding, outbreeding and assortative mating established in the earlier evolution of our species.

14. Religion, Race and Culture

The great collective problem of the bronze age was the reconciling of class separation with national unity. The differences between Sumeria, Egypt and India, in the intelligence and temperament of their priestly and other castes, as well as in their geographical conditions led to quite different approaches and successes in dealing with it. The military, priestly and kingly contributions to

national coherence were different. In India dense populations, sharply differentiated in colour were able to preserve a stable balance by making a religion of co-operation between groups which should keep a respectful distance apart and should never interbreed without penalty. It was a system invented by the priestly caste and it gave them a highly favoured position. Today it remains a system which has preserved Hindu society for 3000 years with less change than has ever been known elsewhere. And it is still capable of assimilating and preserving unlimited racial diversity (62).

Egypt shows us an almost equal conservatism for an almost equal period. But it was the geographical isolation of the country, the richness of its soil and the unexplained numerical stability of its people that preserved it. Sumeria by contrast passed down its inheritance of people and ideas not only to the outer Aryans but also, through successive empires, to the multi-racial societies of Assyria and Persia where worship or near-worship of the Great King united the whole community.

The contrast between these large communites and the small community of the Jews which they attempted to absorb or liquidate is instructive. For, as time went on, co-operation between races and respect for the King or for Caesar meant less and less to the Jews. They existed by virtue of their respect for their own God. It was the laws of this God and his prophets, the long historical and literary record of their relations with him, that mattered to the Jews and made them what they were. Those who did not respect their laws, their history, and their covenant, disappeared. They were the ten lost tribes and a great many more. Others who did respect these things were absorbed by the Jews to share their way of life (74, 75). So the Jews as a race have evolved under changing conditions, first as an independent nation, and later as a migrating caste fitted into multi-racial societies. Several times in different places they even indulged themselves with success in a missionary effort to convert the gentiles and absorb the converts into their lower orders. Through all these changes Judaism remains, even more than Brahminism, a system of ideas selectively propagated by genetic processes which it has itself prescribed in the ritual of circumcision. Only by

this means has the system preserved itself through the appalling vicissitudes of three thousand years.

Look now at the fruits of these contrasted religious and genetic habits. The Assyrian and Persian empires soon disappeared. The principles they used and the administrative and technical classes they employed were passed on to the Hellenistic and Roman empires and indeed to the Roman Church and to modern Europe. Yet the languages they spoke, the laws they invoked, the gods they worshipped, the names they gave themselves, were continually changing. Their history, oscillating between misery and glory, was continually interrupted by the breakdown of society. The genetic continuity was concealed by the confusion of cross-breeding. And parts of the culture were in consequence repeatedly lost. It is the same kind of loss for the same genetic reason as has happened again and again with primitive peoples (76).

Not so with the Jews. The disasters inflicted on them by the Babylonians, the Greeks and the Romans, by the exile and the Diaspora, in fact freed them from the peasant basis on which every other nation has rested. In spite of catastrophe, indeed on account of catastrophe, the strict and formal continuity of race has been preserved in the learned classes, first in the priesthood, later after A.D. 70, in the rabbinate. This preservation was due, of course, to the intellectual character of these classes, their ethical, literary and historic sense and their obstinate belief in the superiority of their opinion to those of all others. So it was that the Jews were able to preserve almost all the sublime literature they had created while the Persians and the Greeks lost a large part of theirs. So it was also, paradoxically, that in due course Judaism was able to inspire both Christianity and Islam with ideas which went even beyond homonoia in promoting the unity of mankind.

We may be grateful therefore for highly divergent systems of belief and breeding. Not least may we be grateful for the contrast in attitude or policy between Christianity and Islam. For the intolerance which Christianity derived from Judaism enabled it, having won Rome, to occupy the virgin soil of Northern Europe and keep it for 500 years without division. But, Islam faced with the most

ancient societies in the heart of its territory was forced to adopt a principle of religious toleration. The Caliph was content to make the Christians and the Jews pay for the cost of being governed by Muslims while keeping their own beliefs (53). It is for this reason that the ancient east today, chiefly under Muslim rule, contains within itself so many of the diverse racial minorities of its own past, each genetically preserved by its religion, and each preserving its differentiated crafts, skills and traditions.

The religious intolerance of Christians might have destroyed their civilisation if their beliefs had been uniform. But the racial differentiation of Europe progressing by local inbreeding during the Middle Ages inevitably led to rebellion against control from one centre whether political or religious. And when minorities within the boundaries of the old Roman Empire had to seek refuge in northern countries the effect was always beneficial. Spain, to be sure, lost much with her Jews. France lost less with her Huguenots, for she could afford to lose them. But to England, Holland and Prussia they both made a priceless contribution (77). They had those high technical capacities which seem to be genetically correlated, whether amongst Calvinists, Mozabites or Jews, with stem religious convictions (78). They continued the centrifugal movement of specialised talent which had played the crucial part in the development of all advanced societies.

15. Genetics and History

This brief sketch is enough to show the kinds of evidence, and the kinds of argument that can, I believe, be legitimately used, when we seek to establish the relations, often so intricate, between genetics and history. All previous evolution had depended on selection among varying individuals whose differences were revealed by the mode of breeding. In man the evolution of his mental character has, without his knowing it, controlled. diversified and continually disturbed the processes of both selection and breeding. Every invention he has made, whether technical or intellectual, has thus affected a change in his own character by its success. A vortex of hybridisation at a

critical moment in the Old and in the New World gave him his start, the chance of his most momentous series of inventions, the processes and creations of agriculture. It set him off on a new course of which he was quite unaware; for when he began to select his crops, they also began to select him.

Another entirely new course was taken when certain men made the discovery that they could co-operate with their enemies instead of killing them. They then invented stratified societies, a painful discovery which succeeded because, as Sorokin has shown (79), it proved to be indispensible for maintaining a diversified culture. Moreover these stratified societies have never arisen except by the related processes of disruptive selection and race combination. They have therefore created the basis of recurrent hybridisation which has released variation in all later societies. The continual new modes of maintaining class structure developed or adopted by governing classes, military or priestly, have in turn continually varied the modes of evolution of societies. Their purposes have been usually practical and often short-sighted. They have been usually unfortunate and often disastrous. But out of their immense diversity new successful elaborations, new inventions, have been selected.

The processes by which human societies evolve are thus in principle the same as those working at a pre-human stage of evolution. But the modes of working, the intellectual and social considerations which govern human breeding and selection are, for better or for worse, characteristically human, interwoven and multifarious. In no respect, however, are they to be regarded as outside the scope of genetic enquiry.

REFERENCES

1. GALTON, Francis — Hereditary Genius. Collins, Fontana, London. 1962. (1st ed. 1869)
2. FISHER, R.A. — The Genetical Theory of Natural Selection. Oxford U.P. 1930.
3. DARLINGTON, C.D. — Race Class & Mating in the Evolution of Man. 1943. Nature. 152. (Genes, Plants & People, 1950)
4. GRANT, Michael — Ancient History. Methuen. 1951.
5. COON, Carleton S. — History of Man. Cape, London. 1954.
6. ZIRKLE, Conway — Evolution, Marxism and the Social Scene. U.o.P. Philadelphia. 1959.
7. CLARK, Grahame — World Prehistory. Cambridge U.P. 1961.
8. FULLER, J.L. & THOMPSON, W.R. — Behavior Genetics. Wiley, N.Y. 1960.
9. VOGEL, F. — Handbuch der allgemeinen Humangenetik. Springer, Berlin. 1961.
10. ROBINSON, J.T. — Origin & adaptive radiation of the Australopithecines. Evolution u. Hominisation. Fischer, Stuttgart. 1962.
11. COON, C.S. — The Origin of Races. Knopf. N.Y. 1962.
12. BROSNAHAN, L.F. — The Sounds of Language. Heffer. Cambridge. 1961.
13. DARLINGTON, C.D. — Evolution of Genetic Systems (2nd ed.). Oliver & Boyd. Edinburgh. 1958.
14. DARLINGTON, C.D. — Instincts & Morals. Rat.Annual. 1961. 23-34.
15. DARLINGTON, C.D. — Cousin Marriage and the Evolution of the Breeding System in Man. Heredity 14: 297-332.
16. DARWIN, Charles — The Descent of Man and Selection in Relation to Sex. Murray. London. 1871.
17. HALDANE, J.B.S. — Daedalus or Science and the Future. K.Paul, London. 1924.
18. ALLISON, A.C. — Abnormal Haemoglobins. Genetic Variation in Human Populations. Pergamon, Oxford. 1961.
19. LIVINGSTONE, F.B. — Anthropological Implications of Sickle Cell Gene Distribution in West Africa. Am.Anthrop. 60: 533-562. 1958.
20. MOTULSKY, A.G. — Metabolic polymorphisms and the role of infectious diseases in human evolution. Processes of Human Evol: 28-62. Wayne. Detroit. 1961.

21. MOURANT, A.E. Blood Groups and Anthropology. B.Med.Bull. 15: 140-2. 1959.

22. ZEUNER, F.E. The Pleistocene Period: its Climate, Chronology and Faunal Successions. Hutchinson, London. 1959.

23. GODWIN, H. Radiocarbon dating and Quarternary history in Britain. P.R.S. (B). 153: 287-320. 1960.

24. BRAIDWOOD, R.J. et al Prehistoric Investigations in Iraqi Kurdistan. Oriental Inst., Chicago. 1960.

25. HELBAEK, H. Domestication of food plants in the Old World. Science 130: 365-372. 1959.

26. REED, C.A. Animal domestication in the prehistoric Near East. Science 130: 1629-39. 1959.

27. KENYON, Kathleen Digging up Jericho. Benn, London. 1957.

28. CHILDE, V. Gordon What Happened in History. Penguin, London. 1942.

29. ENGELBRECHT, Th. Uber die Entstehung einiger feldmä'ssig angebauter Kulturpflanzen. Geog.Zts. 22: 328-334.

30. VAVILOV, N.I. Studies on the Origin of Cultivated Plants. B.App. Botany. 16(2) 139 248. 1926.

31. DARLINGTON, C.D. Chromosome Botany and the Origins of Cultivated Plants. (2nd ed.) Unwin, London. 1963.

32. DARLINGTON, C.D. Genetics, Psychology and the Process of History. Br.J.Psych. 52: (in the press) 1963.

33. BURKILL, I.H. The greater yam in the service of man. Adv.Sci. 7: 443-8. 1951.

34. CHILDE, V.G. The Pre-History of European Society. Penguin, London. 1958.

35. DOUGHTY, C.M. Travels in Arabia Deserta. Cape. 1921. (Abb.) Penguin. 1956.

36. MATHER, K. Polymorphism as an outcome of disruptive selection. Evolution 9: 52-61. 1955.

37. LORD RAGLAN Prehistoric men – what can we know of them? Rat.Annual. 1962: 31-41.

38. MENDELSOHN, I. Slavery in the Ancient Near East. Oxford U.P. 1949.

39. BLOCH, Marc La société féodale. Paris. 1949.

40. DARLINGTON, C.D. The Control of Evolution in Man. Eugenics Rev. 50: 169-178. 1958.

41. COON, C.S. et al Crowding, stress and natural selection. P.N.A.S. 47: 427-464. 1961.

42. MUMFORD, Lewis The City in History. Secker & W., London. 1961.

43. FUSTEL de COULANGES, N.D. La Cité antique. Paris. 1864.

44. EMERY, W.B. Archaic Egypt. Penguin, London. 1961.

45. COON, C.S. An anthropogeographic excursion. Am.Anthr. 60: 29-42. 1958.

46. ATKINSON, R.J.C. Stonehenge. Hamilton, London. 1956.

47. THIEME, Paul The Indo-European Language. Sci.Am. 199: 63-74. 1958.

48. PIGGOTT, Stuart Prehistoric India. Penguin, London. 1952.

49. SELIGMAN, C.G. Races of Africa. (3rd Ed.) Oxford U.P. 1957.

50. MOSCATI, S. The Semites in Ancient History. Cardiff. 1959.

51. TAYLOR, Isaac Words & Places. Macmillan, London. 1864-1905.

52. BRØNSTED, J. The Vikings. Penguin, London. 1960.

53. LEVY, Reuben Social Structure of Islam. Cambridge U.P. 1957.

54. WRIGLEY, Christopher Linguistic clues to African history. J.Afr. Hist. 3: 269-272. 1962.

55. SIMMONDS, N.W. The Evolution of the Bananas. Longmans, London. 1962.

56. HORNELL, James Water Transport: Origins and Early Evolution. Cambridge U.P. 1946.

57. WATSON, W. Archaeology in China. Parrish. London. 1960.

58. BALLARD, C.F. & BOND, E.K. Variation of jaw-form and oro-facial behaviour. Speech Path. Ther. 3: 55-63. 1960.

59. DARLINGTON, C.D. The Genetic Component of Language. Heredity 1: 269-286. 1947.

60. ARKELL, A.J. History of the Sudan. Manchester U.P. 1955.

61. SELTMAN, C. Women in Antiquity. Thames, London. 1954.

62. HUTTON, J.H. Caste in India. Cambridge U.P. 1946.

63. FLEURE, H.J. Natural History of Man in Britain. Collins, London. 1951.

64. WYNNE-EDWARDS, V.C. Animal Dispersion in Relation to Social Behaviour. Oliver & Boyd, Edinburgh. 1962.

65. CARR-SAUNDERS, A.M. The Population Problem: a study in human evolution. Oxford U.P. 1922.

66. DARLINGTON, C.D. Darwin's Place in History. Blackwell, Oxford. 1959.

67. JACOBSON, Th. and ADAMS, R.M. Salt and silt in ancient Mesopotamian agriculture. Science 128: 1251-8.

68. LOWDERMILK, W.C. Palestine, Land of Promise. Gollancz, London. 1944.

69. THOMAS, W.L. (ed.) Man's Role in Changing the Face of the Earth. Chicago U.P. 1956.

70. HUTCHINSON, J.B. History & relationship of the world's cottons. Endeavour 21: 5-15. 1962.

71. OZGÜÇ, T. An Assyrian trading Post. Sci. Am. 208: 96-106. 1962.

72. HUXLEY, G.L. Crete and the Luwians. Oxford U.P. 1961.

73. TARN, W.W. Alexander the Great and the Unity of Mankind. Raleigh Lecture. (Brit.Acad.) London. 1933.

74. ORLINSKY, H.M. Ancient Israel. (2nd ed.) Cornell U.P. 1960.

75. FISHBERG, M. The Jews. W.Scott, London & N.Y. 1911.

76. LORD RAGLAN How came Civilisation? Methuen, London. 1939.

77. WILSON, F.M. They Came as Strangers. Hamilton, London. 1959.

78. ALPORT, E.A. The Mzab. J.R.Anth.Inst. 84: 34-44. 1954.

79. SOROKIN, Pitirim Social Mobility. Harper, N.Y. 1927.

This article is reprinted from:

A Symposium on Race: an inter-disciplinary approach.

Ed: A. James Gregor, Hawaii U.P.

Honolulu. 1963.