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AFTER DOOMSDAY

IN A RECENT ISSUE of *Science* a student of population came to the conclusion that "Doomsday", the date when man's numbers would pass rational counting, would occur within three years of A.D. 2026. Few predictions offer so definite a date, but all authorities seem agreed that our day of reckoning is not far off, hydrogen bombs permitting. The usual excess of births over deaths is about 1.3% per annum for the entire world, at which rate the present population of three milliards will double in a generation. Already some two-thirds of the present total are undernourished, so that in most areas Doomsday may be said to have arrived, but for all of us the problem has serious political and moral implications.

To the dilemma of excess population there are obvious positive and negative remedies: to increase the food-supply; and to decrease the population. Let us consider the positive remedy first. Great areas in Asia and the New World are farmed or grazed extensively and, from the point of view of parsimonious land-use, wastefully. Marginal and heavy lands are often left under grass when they might, at a price, be set to producing human food. By raising the price of food we could increase production considerably. The chief sufferers would be the poorest, in whose budgets food bulks largest; but by shifting the burden of taxation, governments could spread the impoverishment evenly over the community. About six times the population can be maintained after a fashion by vegetable instead of animal husbandry, but much of the world has changed over to that already. Hillsides could be terraced, deserts irrigated. Eventually, however, if not immediately, the cost of all such construction must come out of the standard of living; but it is not impossible that by the extension and improvement of conventional agriculture we might increase the food-supply enough to feed mankind adequately for another generation.

Beyond that are dreams. Hydroponics, the growing of plants in nutrient solutions, was once looked upon as the answer but is now used only under special condi-

tions. The plankton of the sea is beginning to provide food for livestock, instead of for fish, and could become food for humans if they were less fussy. Algae grown in tanks for our carbohydrates, yeast grown on sugar-waste for protein, are at the edge of practicality. More fundamentally we may look forward to the artificial photosynthesis of carbohydrates and later to the synthesis of proteins, and it is possible that a break-through in this field of science might meet the deadline of Doomsday. But synthetic food would not necessarily be cheap or unlimited, and meanwhile the clock ticks off the seconds, and with every tick five more children are born into the world and only four people die.

There remains the negative remedy. Man need not continue a birth-rate developed to meet high mortality in an empty world. In 1798 Malthus brought the matter to public notice, asserting that population must inevitably overtake even an increasing food-supply. Since then, until recently, economists and sociologists have been proving him wrong, although "Nature, red in tooth and claw/With ravine, shrieked" agreement with his thesis. The simple remedy, then, is the planned family with no more children than will allow for replacement. In spite of church pressure, France has had a stable population for nearly a century; during the hungry thirties the birth-rate of Britain dropped to meet the death-rate; since the Second World War, Japan has halved its birth-rate. Why not everyone?

Perhaps a time will come when everyone will tailor his family to the needs of all, but we must not expect the whole world promptly to imitate the example of France and Japan. These are among the most highly educated and commercialized countries, in which habitual awareness of family and self-interest is strong enough to overcome instinctive and religious pressures in the opposite direction. Man's instincts are those of the apes, not contemptible for that reason, but poor guides to human destiny. Man's customs are those of a past rapidly becoming outgrown. Man's great religions have usually been developed in periods of stress when only religious duty would have encouraged parents to bring children into a hopeless society, and these religions have since been adapted as skeletons for civilizations. The great cults of China, India, and the West have different explanations of the dogma that more children should be born than there is room for, and it seems probable that these religions, which have already resisted centuries of misery, will continue to resist beyond Doomsday.

Local overpopulation is as old as mankind, but the overpopulation looming ahead is that of the world, and our governments are still national and competitive. Although nationalism is only approaching its peak in Africa and Asia, it is already out of date. In a crowded world it is uneconomic and dangerous. Competition

makes for change but also for waste, and the success of capitalistic combines and socialist states today suggests that the saving of waste is the more apposite. The World Wars proved that the states of Europe were too small to be defensible, and the coming of the hydrogen bomb and the intercontinental missile has made continents undefendable. A nuclear war would almost certainly lead to the mutual destruction of the antagonists and would destroy the neutrals only a little less rapidly. If any human responsibility remains in governments, hydrogen bombs will not be used, but in that case numbers of men will remain valuable pawns in the game of war. The more nationalistic the leader, the less he is likely to restrict population within his state, as witness Napoleon, Mussolini, Stalin, and Hitler. On the other hand, the experience of Mussolini and Hitler does not suggest that government can greatly increase the birth-rate against the economic interest of the people. But in vast areas of the world all this is academic, since there the birth-rate depends upon instincts encouraged rather than controlled by religion, and it seems unlikely that education and organization can spread fast enough to anticipate the Malthusian pressures of starvation, disease, and war.

Clearly the crisis calls for an organized world with a central government, a world of skilled and disciplined people capable of rapid adjustment to a difficult situation. But is this available? One's thoughts turn immediately to the United Nations, but that wrangling irresponsible body leaves one without much hope. History is full of efforts toward voluntary combination—the League of Nations, the Holy Alliance, the many leagues in which the obsolescent Greek city-states sought to build themselves into the larger units needed by their time. Always the military state has been stronger than the league, and unity has been brought about by "blood and iron", whether in the hands of Ch'in or Macedon or Rome. The odds are great that the unification of Doomsday will be brought about eventually by conquest, probably after the exhaustion of aimless wars. The prospect is highly distasteful, but so is Doomsday. In biology and in history the only alternatives offered to an environment or a civilization are to move on into a new and unwelcome phase or to fail to move on and so to die out. With Doomsday mankind reaches its climax.

In this sense, of course, our problem is not new. An environment is always, except locally and rarely, fully populated at the existing level of efficiency. North America was fully populated when Europeans arrived, and the Indian tribes had even developed internecine warfare on a scale adequate to control the population. Europeans, with superior efficiency and justified, when they felt any need for justification, by the consciousness of being God's elect, drove out the Indians and took their place. Today most people, in proportion to their civilization, have adopted

humanitarian ideals which reject the solution of the Domsday problem by the destruction of inferior (i.e. other) peoples, though we have seen in our generation enough callous exploitation and mass genocide to make us doubt that humanitarianism in most of us is yet proof against greed and ideological hysteria. Our popular ideals, such as democracy, humanity, and equality, have the insecurity of sentiments based upon emotion. In the name of humanity we save the unfit to clutter human heredity with undesirable genes; in the name of democracy we give equal voice in the state to the wisest and stupidest; and we talk of the equality of races when the very words are contradictory, since the distinction between races is that they differ in some respects and so are not equal. Mankind is run by mass-produced ideals and is likely to continue so to be run.

The more permanent human ideals take the form of religion, which serves mankind as an extension of instinct, a patterning of behaviour that is habitual rather than intelligent. Hunting man treated his game animals and plants with respect, even as gods, for by them he lived. Such gods were carried on into the religions of early agriculture and pastoralism, but they now became involved in the cycle of the agricultural year and the birth and death of vegetation. Morality had not yet emerged from custom, and tribalism was paramount. Egyptians and Assyrians and Hebrews did not question the excellence of killing those who did not belong to the "people."

The progress of human knowledge seems to owe more to religion and play than to utilitarian planning. Our great inventions began as gods or as toys rather than as tools. Writers of fiction have often described the discovery of fire, a tree burning after having been struck by lightning and a primitive genius seeing in this the possibilities of grilled steaks and central heating. But lightning-begotten fires are very few, and there were few early men to discover their possible use. The making of wooden and stone tools is as old as man, and the rubbing of wood and the chipping of stone are both likely to produce sparks. Even so, an unexpected flare among dead leaves would probably go out or run away disastrously. It would take much repetition and observation before the fire-makers would come to know what this new creature ate and how it could be controlled. Meanwhile it would be only useless toy or a source of magical prestige. With long experience fire would pass from religion into utility. This is a normal development of new ideas. Steam engines and aeroplanes were toys for centuries before they became useful. The change-over from alchemy to chemistry is barely two centuries old.

By the beginning of the Iron Age, agriculture was passing out of religion in practicality, and the increase of human population was throwing tribes together in

ever-increasing agglomerations. Tribalism, the concept that all those who do not share the same gods are enemies, was out of date in the new empires that had become possible. Through the long chain of civilizations stretching from China to the Mediterranean, new religions that discarded tribalism and concentrated upon morality, a generalization of the relationships of man to man, sprang up almost simultaneously and seemingly owing little or nothing to each other. The Second Isaiah, Zoroaster, Buddha, Socrates, Lao-tse, and Confucius—all these came within two centuries and sound often like echoes of each other. At these times ninety in every hundred of the most civilized people were still engaged in laborious agriculture, so that the refinements of prophetic thought had to be reduced to emotional patterns before they could become available to the overworked and undereducated. That is only less true today. People have never been more humane than at present, yet what proportion of our lives do we devote to mankind and what to "getting and spending" and nationalism, the stone-age food-worship and tribalism writ large?

The progress of religion is very like the progress of science, only slower. Old scientific works make very dull reading, for they are full of errors since corrected and tell only truths that have become commonplace. Vaillant estimated that the Aztecs spent three-fifths of their time in religious ceremonials which cemented the tribe; we spend very little time on this, and more securely nationalistic peoples, such as the English, spend least of all. The idea of the nation has passed through the intellectual concept, through the phase of religious enthusiasm, into practice and custom, and we can now use it as a stepping-stone to new things. Our internationalists are not anti-national but are merely seeking a greater nationalism. In the same way the religions of the Iron Age have become familiar enough for us to look beyond.

A fault of Greek mathematics, as Zeno pointed out, was that it dealt clumsily with time. The philosophers were aware of change; many of them discussed the origin of things; but even Lucretius, in spite of his acute guesses as to the steps of man's development, saw the whole in the convention of the decline from the Golden Age. It is only in this last century that it has become possible to see, even though incompletely, the past of mankind and to glimpse the possibilities of the future. Such glimpses inevitably add a new dimension of time and change to the morality of Iron-Age religions.

Science, to which we owe these insights, has turned our thinking inside out. In the Homeric world helpless mechanical men were pushed about by the whims of irresponsible gods, but the Greek scientists got the first glimpse of a world in which the gods played no part and every effect followed from a pre-existing cause.

Later we looked to authority for knowledge of everything that mattered; now, knowing many times more, we find ourselves without any authority except the observable facts, and from these we look outward into a chaos as yet unorganized and so unknowable. The world is no longer a garden created for man, but rather a tremendous complexity which is yet intelligible because of regularities that follow the lines of least resistance. To many it may seem that we have slipped back into the Homeric world of mechanical men obedient to the gods of physics, but this is only half true.

For the last century evolution has been the central strand of biology, yet the effect of this idea upon religion, politics, and everyday behaviour has been trivial. Since Darwin's generation, few biologists have questioned the reality of evolution, but most people today treat it either as a bad word or as a synonym for the Victorian idea of progress. In this they have the support of the modern genetical theory that evolution proceeds automatically from mutations and environmental selection of "pre-adapted" types, a concept which has much in common with the older idea of predestination. However, this is not the last word.

Years before Darwin, Tennyson had pointed out that "a thousand types are gone". For every species that has left descendants we already know fifty that left none, though the struggle for life pressed upon all. In the short run, the stronger individual is more likely to survive and to leave descendants; in the long run, the stronger and more abundant species is more likely to die out. There is a contradiction between immediate success and ultimate survival and evolution. Among the successful species the energy necessary for survival can be obtained positively by increasing food-consumption or negatively by decreasing wasteful expenditure. The negative path leads to retrograde evolution, to ascidians which, having started the climb of the vertebrates, turned back to become water-filters like the molluscs, or to pygmies which have found hungry environments in which they have little competition. It also leads to specialists which have discarded all the useless paraphernalia of their ancestors—to tapeworms reduced to alimentary and reproductive systems and nothing more; to mistletoe and dodder, without leaves or chlorophyll, reduced to sucking-roots and profuse seed-production. The positive development demands an ever larger and more stable food-supply and ever-increasing size to overcome competitors and enemies, and the end of this is in massive insecure dinosaurs fettered to their environment, since no other could supply the necessary volume of food. A change of environment comes, and giant and specialist alike disappear. Natural selection has prepared them admirably for extinction. Then marginal and interstitial species take over the earth.

Where does mankind fit into the biological scheme? Obviously man is the

greatest success in the world today, and the only rivals that have been suggested for him—the brown rat, insects, and diseases—are usually parasites and dependent upon him. Many biologists look upon man as over-specialized along lines of intelligence and as having discarded essential items such as tail and claws and fur and powerful jaws; others, notably Sir Julian Huxley, consider that man's intelligent approach to life is a new platform from which future developments must climb.

In history we recognize that the cycle of civilization parallels in form and phases the ecological and evolutionary cycles, but the time involved in the cycle of a civilization is a thousand times shorter than in a cycle of evolution. This is the measure of the superiority of plasticity in man's behaviour over the slow process of genetic change. By biological standards, man as a species seems to belong to the phase of static gigantism which ends the cycle of evolution. He has the comparatively long life and slow reproduction of gigantic species inimical to change; but as this has been characteristic also of man's ancestors for millions of years, the explanation must be that this physical equipment is of minor importance to man compared with the plastic behaviour made possible by his brain. The brain is physical, but the complex behaviour made possible by it is not implicit in it. Since the appearance of *homo sapiens* in the Upper Paleolithic, there has been no perceptible improvement in human equipment, and the Iron-Age religions with their stress upon equality seem well satisfied with man as he is. Today, however, it is questionable whether this self-satisfaction can continue. The collapse of civilizations seems always to be hastened by inadequate intelligence and morality among rulers and ruled alike.

The evolutionary reasons for a low birth rate in static species are twofold: over-reproduction would increase competition within the species and might lead to retrograde development which would place the whole species at a disadvantage; mutations in heredity occur with some regularity in each generation, and these are estimated to be ninety times more often deleterious than helpful. The longer the generations, the fewer the mutations.

All civilizations of which we have record have fallen before barbaric tribes of inconsiderable number. Usually these barbarians have reorganized the civilization and have led it to new heights of achievement, so that we have no reason to suspect them to have been inferior to the civilized peoples in physique or abilities. As late as the classic age, the barbarian was the typical man and the civilized the minority; but Gibbon pointed out two centuries ago that barbarians had become scarce and could no longer be expected to overthrow civilizations. Civilized man is now the rule, and mankind approaches the climax of Doomsday, which leaves him

the choice of three possibilities: self-destruction, the petrification of gigantism, and further evolution.

Self-destruction seems by far the most probable of these, for we are following three paths which lead to it: over-population, continued aggressive competition, and genetic deterioration. Over-population is a great destroyer of land and natural resources. What has become of the wealth of early classic times when Italy had forests and iron mines and wheat fields that were the envy of "less happier lands"? The social result of over-population is poverty, and poverty bears hard on social morality. One needs only to compare Rome as seen by Polybius with Rome as seen by Juvenal. The aggressive competition of societies in the form of war seems to be approaching a limit. At present the leaders of the thermonuclear nations are bomb-shy, but this cannot be expected to continue indefinitely, and a single beginning may leave the world uninhabitable. By comparison, genetic deterioration is probably a distant threat.

If we should escape a radioactive Doomsday, there remains the possibility of petrification, a world-state with its birth-rate limited to replacement, competition reduced to a minimum, defence reduced to policing, random activity reduced to passive entertainment. This fits the energy equation of the climax phase as neatly as did Brontosaurus. In such a community social change would cease, and technical change, because of its social impacts, would be discouraged. It is not probable that our needs will bring us such a world-state full-grown and functioning, Pallas-like. More likely there will be conquests and devastations, trials and failures, the usual fluctuations of the curve of equilibration. The final form, however, will not be a matter of chance or even of intention. The more successful trials will survive until the whole fits the mould of immediate necessity, which Darwin called Natural Selection. If we compare the Han, the Roman, and the British empires with the ideals of Plato, we find many similar factors. These are due less to direct influence of Plato's thought than to a similarity of causation, for the empires evolved through trial and error in action, while Plato set up in his mind an ideal state, subjected it to expectable stresses, and found the appropriate answer to each.

The essentials of a world-state are not very different from those of a city-state, and our modern society differs only in detail from that of classic times. After Doomsday the state would have to insist upon certain prerogatives in the interest of economy. Control of the birth-rate would obviously be one of them. An economy balanced precariously at the edge of starvation would be unable to afford government by amateurs, so we cannot foresee the survival of democracy. Education of everyone to the limit of his ability would be expensive and even dangerous, since it

would make for thought, discontent, and desire for change. Probably, to begin with, some form of examination would sort out the social classes, but in time the hereditary principle would probably take command, nepotism being instinctive.

Because a stable economy works always against a background of diminishing natural resources, economy would make specialization the rule. There would need to be a large administrative class, Plato's Guardians, whose training would be thorough, moral, and disciplinary, making them predictable in behaviour while leaving them intelligent. One suspects that this education would consist largely of the study and analysis of classic and sacred books, but the result would not be greatly different whether these books consisted of the Bible or the Upanishads, of the Confucian classics or the works of Marx. Poetry and rhetoric would be encouraged, science and technics ignored.

The vast majority of the citizens would belong to the Proletariat, who would be given enough practical training to make them efficient in society but would not be designed to develop in them any power of thought or desire for baneful change. They should be encouraged to pass their lives in an alternation between useful work and intellectual coma.

Plato's third class, the soldiers, would not be important, for the police would be a minor branch of the Guardians and similarly trained. But the continued survival of such a state would have problems that Plato ignored. In so dense a population epidemics would arise, crops might be threatened, soils damaged. The vast mechanical and distributional and engineering equipment of the world would need skilled supervision. For all this a highly efficient middle-class would have to be maintained. The efficiency of these would be proportionate to their free intelligence, so that their education would have to include scientific and technical fields quite unfamiliar to the Guardians. It is to be suspected that the Guardians would try to suppress this class as pernicious, dangerous, and unnecessary, but would come in time to recognize it as pernicious, dangerous, and necessary. Because the behaviour of the Scientists would be unpredictable in the light of the standardized morals of the Guardians, the group would be subjected to frequent and frustrating interruptions of their work and to random punishments intended to keep them cowed and loyal.

So we have our world-state with all the characteristics that we recognize in biology as foreshadowing extinction. The more perfect the system, the more certainly it would fail to meet changing necessity. But it would be the state which had evolved to its climax, while the people within the state would have degenerated very little from their ancestors. If the Guardians, *via* the Scientists, should master human

breeding, as in Aldous Huxley's *Brave New World*, they might succeed in writing the last chapter to the history of mankind, but, should breeding remain a family matter, further evolution would still be possible. In that case we might say that Doomsday, world-state, civilization, even mankind, were only environmental features of passing importance. If Olduvai man could return to the earth, he would probably lament the disappearance of his own chinless, foreheadless race and their idyllic life of hunting mice beside an African lake, whereas we see him and his life as important merely because they have given rise to our nobler selves with our hydrogen bombs and alcoholism and television wrestling. It is the evolution of the higher and more complex, not simple survival, that matters. Each generation is descended from a minority of the last, and true evolution lies in the hands of a minority of a minority.

In the breeding of live-stock on a large scale there are two approaches. There is the ever-important negative duty of eliminating the inferior, but this usually does no more than maintain the standard of the herd. The positive approach lies in the segregation and concentration of the best by a high degree of inbreeding and selection and then returning improved sires to the herd. Among humans, degeneration is slow but almost unchecked. A few states have passed laws toward the sterilization of the grossly unfit, and parents have often discouraged their children from marrying into families with records of insanity, disease, and insolvency. Polygamy and the *droit de seigneur* may have had infinitesimal positive effects, but, in general, mankind has tended to a loose monogamy which, like other human customs, seems designed to minimize degeneration rather than to seek anything better.

Human ideas evolve along the same lines as living species, by means of segregation and selection, and ideas have such power over human behaviour that they may provide almost complete segregation of communities within communities, so that we have inbreeding groups formed by caste or creed or custom. Dominant groups gain least by this segregation, for their least valuable members cling to membership for the sake of prestige. The most selfish and therefore the least valuable members of despised groups desert their fellows for the sake of advantages to be obtained elsewhere.

Every society that we know divides untidily into two groups: a majority of "good citizens" whose thought and behaviour conform to accepted patterns; and a minority of "bad citizens" who do not conform. The bad citizens, being deviant are difficult to classify (except to good citizens, who condemn them all equally), for they range from the selfish criminal at one end of the scale to the idealist at the other. In the first two centuries of our era the Christians were bad citizens, and t

good citizens persecuted them; after the fourth century the Christians became the good citizens and found it their duty to persecute the others.

In the stable world-state only two groups will remain as potential bad citizens and evolutionary material, for it is only through the bad citizens that change and evolution can come. These will be the peasants and the Scientists. Unless despotic government controls the world in uneconomical detail, there will always be a fringe of crofters living an unspecialized life for the sake of being their own masters. Since it will always be more profitable to leave that life than to remain in it, there will be a mild eugenic selection which should prevent degeneration but can scarcely prompt positive and intelligent advance.

By comparison the Scientists seem a very unpromising group, since they tend to be specialized in a somewhat conspicuous position in the state. These are dangers, but this position gives the Scientists access to knowledge and a duty to use their free intelligence as no other group in the world would be doing. Even in the world-state and long after Doomsday, some scientists may see the aim of life to be, not the triumphant overcrowding of the earth by man but rather the slow improvement of part of mankind, a road without imaginable end. Such a vision would make men secede from mankind in search of their new Jacob's Ladder. But, as it would be impossible to secede from the world, they could only build their Kingdom of Heaven within themselves, living in the world but not of it—phrases once describing bad citizens. They must realize also that, in order to become better people than they are, they must live according to the pattern of better people, since a species can only evolve to fit its behaviour pattern. Greater complexity must have more energy, so they must be productive and thrifty. Such people tend to be successful in their careers, but all apparent success is to be avoided, for success links people to things as they are instead of to things as they should be. They must prefer the hardest conditions of life, since these will dull the edge of persecution and repel weak or unconvinced companions. And they must never be antagonistic to the state that persecutes them, for mankind is their environment and their duty to it is symbiotic, to put in more than they take out that both may benefit.

Nature, like the government of *Erewhon*, punishes the defective and the unfortunate for the benefit of the race. The parallel of the complex ant-societies suggests that this will be the morality of the world-state. Humaneness, however, will be a part of the essential behaviour of evolving man, and, in a minority despised as bad citizens and tolerated only for irreplaceable usefulness, they will be free from the need to cast out undesirable members, since these will readily turn to the refuge among the respectable majority.

Such a minority group could be maintained only as a religion, and this would involve serious dangers. The addition of ritual would have a binding effect upon purpose; the creation of an imaginary universe would give comfort to inadequacies and outlet to the frustrations of subconscious selves and would add drive and tenacity to the holders; the definition of the common aim could be taught to children who might otherwise be captured by things as they are before reaching the wisdom to see beyond them. But the dangers would be even greater. The force of a religion gives the conviction of knowledge as against the sense of inadequacy which makes one seek for better things. An orthodoxy would grow up, a sense of self-satisfaction. Such a group might be very effective and might withstand persecution until the state crumbled around it, as states do periodically. Then, perhaps from simple humaneness, more likely from a consciousness of superiority, the members of this group would take command of the ruins and in so doing would bind themselves to immediate necessity and become good citizens, destined to persecute new seceding minorities for pursuing the vision which once had been theirs.