struggles to see who shall first have reached a collection of five million specimens.*

The "guardians and promoters of botanical science" (as Darwin called them) have thus guarded it as it was. They have not gone so far as to promote it. What was then a roughly ploughed field has now, after a hundred years, been reduced to a very fine tilth. Again and again it has been ploughed and dunged and rolled and harrowed. And the whisper goes round that one day, if the weather keeps fine, the farmer may sow his seed. But we may wonder whether seed that has been kept so long will still preserve the vital spark.

Meanwhile our universities, hardly less than our museums and our industries, fortified with the recollection of their earlier achievements, were continuing to investigate what was easy and obvious and above all inexpensive (since research was in any case financially on sufferance), making a virtue of being able to get along with a shoe string. This virtue, coming in time to depend on habitual ignorance, was carried beyond its needful limits into the lucrative field of cancer research, where good microscopes could have been bought, but were as little

* "The obstacle which prevents the union of these rival institutes seems to be less serious than that which prevents the introduction of new scientific methods into either of them. It consists merely in an ingenious difference in the size of the paper which is used for mounting the dried plants" (Science in War, Penguin Special, 1940).
understood as anywhere else. Taken all in all, our universities managed to put on as bold a front against the intrusions of microscopic technique as they had against Darwinian theory.*

Those who are concerned with resisting the process for the encouragement of which they are supposed to be employed are of necessity much embarrassed in their own minds by the conflict into which the advance of science has forced them. William Bateson was almost the only genuine biologist of his generation in England. He was a man who habitually thought for himself and we might have expected him to be quite unafraid of discovery. Yet I recollect a memorable peroration of his latter days to the effect that: "The future of biology lies not in generalization, but in closer and closer analysis... every appeal must ultimately be to the mechanics of cell-division." †

In saying this, Bateson was being consistent with his life's work. Yet perhaps I may be permitted to reveal that, returning from this lecture, he bought an obsolete microscope for £40 to undertake his "ultimate appeal" and at the same time he thought it proper to spend

* To-day, in 1948, there are 300 microscopes in the whole University College of Wales (teaching and research laboratories) and not one with an apochromatic objective.
£300 on the eight volumes of Redouté’s *Lilies*, an ornamental work designed to entertain the hours of retirement of the Empress Joséphine. In Bateson’s mind there was evidently a conflict. And the need for security had come to predominate over the desire for discovery.*

For a long time now the resistance to new ideas and new equipment, especially those fundamental for biology, has been centred in our universities. They have the means to adopt living knowledge. They also have the means to resist it. But established, as they were, to promote dead knowledge, knowledge of no danger to society, they naturally choose to resist the living and cleave to the dead which is always unmistakably and unalterably pure. It is a choice which they inflict, so far as they can, on the schools and through the schools on the nation. In industry, patents, or rival companies or their employees, have to be bought up in order to destroy invention; but in university research inertia assisted by the shibboleth is usually enough. Thus we have the position in which a few water-tight iron-sided academic departments, with their old-fashioned curricula, succeed in keeping the

* The resistance of botanists and zoologists to the genetics which was to provide their salvation, is paralleled by the resistance of all early geneticists to the mathematical methods on which, in Mendel’s work, they rested their own foundations. Neither Bateson nor Morgan would tolerate a calculating machine in his laboratories.
whole nation in the dark for nearly a hundred years about the most important intellectual changes in human history: changes transforming man's knowledge of himself.

IV

Let us now turn to the opposition to discovery as it arises from outside science. Scientists and their discoveries are always publicly applauded by the world outside—however disagreeable both may privately be—and the applause reaches a climax in moments of national peril. In happier times, however, a normal attitude to the disturbing effects of discovery is restored. Scientists and their works become the objects of suspicion. This suspicion, when it is openly expressed, does no harm. It is the attempt to disguise it, required by convention, that has such an unfortunate effect both on science and on society.

Take as an example the position of agricultural research. The Ministry of Agriculture believes in agricultural research. It pays more and more for it. Moreover, it is anxious to see the results profitably applied. The Minister has even set up a special Improvement Council to see that the results are applied quickly. So much for what the public sees. Now let us find out what the public does not see. Let
us see if we can penetrate by a close examination the various disguises that resistance to scientific method and discovery can assume.

At the end of the eighteenth century our cattle, sheep, and horses were being improved by intelligent breeders who began to use scientific methods of crossing, inbreeding, and selection. Societies were formed largely by our landed gentry to multiply these better breeds and to keep them for themselves, pure and true to type. This they did by enforcing standards of physical beauty and a system of restricted mating and recorded lineage. Indeed they applied the same rules, embodying the same superstitions, that they used in their own breeding. The new breeds quickly rose in price. Consequently, instead of being used to grade up the whole livestock of the country they often became, like their owners, an exclusive caste distinguished from what we may call the common herd by their noble appearance, their great market value, and the sheltered lives they led.

The characteristics we had formerly been led to value in our aristocracy, both human and bovine, we can now see are not the ones we need in more difficult times. No profound knowledge of Darwinism or genetics is necessary to tell us that when, generation after generation,
a breeding stock is chosen for its good looks, and fed on the fat of the land, the real bread-and-butter characters, the milk-producing capacity, or the fertility, or the hardiness, which have not been the object of selection, are not likely to improve. Experiment shows that in fact characters which cease to be selected always deteriorate. For this reason, as its pedigrees lengthen the intelligence and fertility of human aristocracies always decline. And likewise the hardiness and fertility of our aristocracy of cattle, pigs, sheep, dogs, and even rabbits. Many of the best types of fifty years ago have now become either extinct or useless.

To arrest the decline of British stockbreeding and to put it once more on a sound foundation, the publication of scientifically compiled records of performance was the first essential. This the Board of Agriculture in a moment of inspiration accordingly undertook to do. It was in 1910 that it published in five languages the first edition of its handbook on British Breeds of Livestock.

When this daring work appeared, full of scientifically compiled information, British stockbreeders received a cruel shock. The facts which were stated as achievements, proved in foreign eyes to be the evidence of decline. They were facts which need not have existed if British stockbreeders had not been for so long,
and like so many other British business men, lost in admiration of their own superiority. It now appeared that, if we were leading the world in cattle breeding, we were leading it, like the Duke of Plaza Toro, from behind. Everything must be done to remove the offending facts. Remove them by reforming the rules of the British Breed Societies? Not at all. Remove them merely from the Ministry's handbook.

Anyone who follows the successive editions of this book will see what social forces were released by the imprudent initiative of this Government department. Passages which had given offence to particular breed societies and seemed likely to endanger the export trade were eliminated. Facts were cut out. But the Board girded up its still youthful loins and returned to the fray in the second edition with fresh facts, tables of weights, rates of growth and milk yields. Only after the 1914–18 war was the struggle lost. The Board, now encumbered with Ministerial circumspection and borne down by an overwhelming Conservative majority in Parliament, gave up the battle.

The last stage of deterioration had been reached. Among our war profiteers of 1918, pedigree cattle had acquired the same value that cattle in general have among certain East African tribes. It was no longer a question of the material use of the animal or its pro-
geny, but rather of the social prestige attached to its ownership. The steel magnate or soap-packer was just as keen to have his cow’s photograph (with the price in guineas) in one Society journal as he was to have his daughter’s photograph in another. And a discussion of meat or milk was as inappropriate for the one as for the other.

To-day if anyone cares to examine the Ministry’s handbook, no longer in five languages but expurgated in content and enlarged in type (to conceal the abridgment of the truth), he will find it in every way conforming to the requirements of a patent-medicine advertisement. Small wonder that, in the middle of the last war, on August 8, 1940, the Minister, Mr. R. S. Hudson, felt free to say in the House of Commons that scientific advice was not thought necessary in producing a book of this kind. The improvement of British livestock had been killed by the united labours of the Breed Societies and the Ministry of Agriculture—the two agencies that were set up to promote it.

One technical footnote deserves to be added to this story. During the early progressive years of the revolution, nearly thirty years ago, a technique of artificial insemination was invented in Russia which, if applied, was bound to transform the methods and the results of livestock breeding. It became possible to
make one bull do the work of a hundred. It also became possible to choose the best bull in the hundred to do this work. Thus at one stroke the feeding of a quarter of a million bulls could be saved in Britain and the quality of our cattle rapidly improved. Faced with the emergency of the war one might expect that this new system would have been rapidly exploited by an energetic Minister of Agriculture bent on conserving food supplies and increasing milk production. What happened? Artificial insemination was stowed away. And the Minister (who had thought scientific advice was superfluous) appealed to the farmers to raise more bulls. As the war years passed by and the food shortage increased the numbers of British bulls, pedigree and mongrel alike, steadily rose. And the price paid for them rose too. The farmer’s pet had become the nation’s parasite. Only to-day, after ten years of obstruction, is artificial insemination being allowed to develop its proper use in our stockbreeding.

It must not be thought that official objections to scientific research arise only from political pressure and economic interest. The Forestry Commission will provide an example in another category. The activities of this body are worth studying in order to find out what happens where the national interest is ostensibly para-
mount and unimpeded and where no base motives can possibly intrude.

Men who are growing anything, anywhere in the world, for their own livelihood will tell you that the one thing you must not skimp is the cost of the stock or seed. If they are working above a backyard scale, they will even try to use special means of raising stock or seed of their own by methods of choosing the best, methods that were well understood by the neolithic farmer. Not so the Forestry Commission. What it wants is cheap seed with which to plant the vast acres the nation has given it. And no research on raising the seed.

When I approached an official of the Forestry Commission with the suggestion that fundamental work in what we call genetics—that is, seed selection and plant breeding such as is done in Sweden, Denmark, or the United States—would greatly improve our forests, that £1,000 spent in this direction might save a million in others, he replied that we could let foreigners undertake such research and then in due course make use of their results as we wanted, without any trouble. I could not perhaps expect a timber scientist to know that that was just what we had done with the chemical and optical industries at the end of the nineteenth century. And that we had spent
an empire and a million men in getting them back.

Balked in this way, I then turned to a higher official, with the same suggestion, noting that his successors might regret that no such research had been carried out in his time. He replied (I may as well quote his exact words): *I shall be dead then, so it won't matter to me.* Any statement so shameless as this might appear to be candid. But even that I have to doubt. What both of these men really feared was that fundamental research would be so dangerously successful as only too quickly to expose them to new problems, concerning their whole system of management or, as I would say, mismanagement of our nation's forests.

Take another field of scientific method. Modern statistical methods, largely developed by Englishmen, have transformed our knowledge of how to extract information from numbers. They have become in recent years one of our most powerful and most general instruments of discovery. Our great Government departments are busy collecting for us numbers, so-called statistics, on a vast scale every day. On the understanding of these numbers policy should be based. Yet these departments go on using their figures (compiled from the forms filled up by busy but
obedient citizens) by the methods of fifty and even a hundred years ago. In consequence, what they collect is largely lumber. Nor have they any idea what to do with it. Instead of being the basis of policy it is merely the means by which one man who knows little can answer the questions in Parliament of other men who know less. Modern statistical methods would demand new activities of explosive violence. Faced with the tasks of new schemes of administration, that is the last thing that Government departments want. We therefore find ourselves launching a new Health Act at the cost of a vast effort and at the same time stultifying and frustrating it by the use of the scientific apparatus of a bygone age—apparatus that would disgrace a Middle-Western Agricultural Experiment Station.

We may as well frankly admit therefore that fundamental scientific discovery is inherently distasteful to the established administration just as it is to the established industry, or the established academy, or the established university. The conflict between the discovery and the organs of society that it offends is universal save for fleeting moments in the minds of individual discoverers.
It is against the background of conflict and confusion in the relations of science and society that we find ourselves confronted with a crisis in the history of mankind, and particularly in the history of human government. It is a crisis arising from the rapidly increasing power given to man by science. It is a crisis such as we are accustomed to leave to the arbitrament of sectional interests supported by shouts and cries. But it is one to which scientific inquiry can provide a solution. For the fundamental problem of government is one that can be treated by exact biological methods. It is the problem of the character and causation of the differences that exist among men, among the races, classes, and individuals which compose mankind. The little passions and prejudices we have been discussing so far fade into nothingness in face of the gigantic errors and illusions that can be, and are being, mobilized to defeat or pervert scientific truth in this field.

The notion of equality is one of the three chief illusions promoted by the great Semitic religions and it is perhaps the most comforting. Spiritually it has always compensated for those gross material injustices of class which materially it has always tended to augment.
It is some time since Lord Acton pointed out that a belief in equality was the foundation of tyranny, and now we have reason to believe that this principle is understood by one-sixth of the world—or a little more. When the missionary has said that all good Muslims or all good Catholics, all good Germans or all good Communists, are equally good he has taken the first indispensable step to convert the masses to his religion.

Christian or Muslim equality depends on an equality of souls before God. Germanic equality depended on an equally mystical race-theory. Marxist equality, on the other hand, springs from a variety of sources: from the economist's necessity for a standard unit of activity, the economic man, and from the revolutionary's need both for a means of cracking social systems based on inequality and for a mystical unity among the fragments he has broken off. It so happened that, at the time Marx and Engels were building up their system, the biological basis of the differences among men was completely unknown to biologists (such as Darwin). There was therefore no rigorous objection to assuming that they had no biological basis at all—that is, no material basis inside the living organism—that differences arise entirely, as economists, psychologists, and anthropologists still largely believe, from
differences in the environment to which we happen to be subjected. And so an edifice of political and economic theory, including the materialistic interpretation of history, has been built up and lately brought to perfection in Moscow.

But, while it has been building, Western science has filled up the yawning gap that existed in our knowledge in the time of Darwin and Marx. We now know the physical materials in the cells which are responsible for heredity. We can see the specific molecules whose changes are responsible for differences among men. We can even control and predict over a wide range the ineradicable inborn differences which determine the varying qualities of the individuals, families, classes, and races of mankind. It is therefore possible to establish a materialistic account of the whole of Nature of the kind that Marx and Engels dreamt of but could never achieve. But it is, alas, an account which lacks the king-post of Marxist theory, the political weapon, the theory of equality. Indeed, Marxism turns out (tell it not in Gath!) to contradict materialism in its very foundations.

This situation has been troubling important people in Moscow for the last fifteen years: to be precise, since Hitler came into power in 1933 and took a biological theory contradicting
their own to turn it, as we know, into a political weapon for himself. It was in 1932 that Professor J. B. S. Haldane, with unclouded vision, foretold the course that events would take: "The test of the devotion of the Union of Socialist Soviet Republics to science will, I think, come when the accumulation of the results of human genetics, demonstrating what I believe to be the fact of innate human inequality, becomes important." *

The Soviet Government, faced with this test, took a course that did some credit to their short-range political acumen, but rather less to their intellectual scruples. They had already discovered that first rule of government, that you need not practise what you preach. Or, to use the Marxist idiom, that the unity of theory and practice can suffer negation in practice without suffering negation in theory. As men were becoming more and more unequal in Soviet practice it had become more and more desirable to proclaim their equality in Soviet theory. The Government decided therefore to stick to Holy Writ.

Only one trifling matter had to be adjusted. It became necessary to reduce fundamental biological research to submission to Marxism. This policy, the absolute State had in fact

already embarked upon. The scientific research department and the labour camp had become acquainted with one another, under the first five-year plan. When the crisis came under the second five-year plan Professor Haldane’s test was applied in two different fields. The first was that of human heredity. In 1934 Volume 3 of the works of the great Medico-Biological Institute in Moscow appeared. Their investigations of some 1,000 pairs of identical twins led them to conclusions far in advance of those reached in the United States and elsewhere. The Russian experiments showed the decisive importance of hereditary, as compared with environmental, differences in determining the character of human beings. The implications of these discoveries were recognized by the Soviet Government soon after they were understood abroad. The Institute was suppressed, the leading members of its staff were put to death for espionage or treason.

The second of Professor Haldane’s tests came in agriculture. Obviously if human heredity was all equal, so must be that of plants. The laborious methods of improving plants by hybridization and selection used by Western plant breeders were quite unnecessary. A peasant, whose ideas corresponded roughly with what we in England call the “muck and mysticism” school, was put up to denounce
capitalist and fascist biology and to offer to revolutionize Soviet agriculture by applying Marxist theory. Wheat and other crops were to be brought up to collective-farm standards by the direct action of the environment. This rustic prophet was made President of the Lenin Academy of Agricultural Sciences while, to make room for him and his followers, the orthodox plant breeders, after confessing their incompetence, espionage, or treason, were put to death or sent to the labour camps.

The same methods of suppression are applied by the Soviet Government in all fields of scientific research. It is never by the newspapers but always by illicit personal contact that one hears of a Director of an Institute removed, or an Institute as a whole (whether of psychology, physics, or economics) liquidated. In other fields, however, downfall has usually come from personal intrigue. In genetics it came primarily from high policy.*

The conflict of science and society thus takes widely different forms in Russia and in Western countries. In Western society, as I have tried to show, obstruction or defamation, penalization or blackmail, may, in varying degrees, override the more legitimate forms of contro-

versy. And they arise from the opposition of vested interests both material and intellectual, both individual and collective. And, in addition, the great inertia of highly organized and highly departmentalized academic and administrative systems, especially in the larger and older countries, exercises a continual restraint on the direction and amount of scientific inquiry and hence on the esteem in which scientific method is held. We may also notice the paradox that these principles are true, and will remain true, precisely so long as they are thought not to be true.

But in Russia the course of events is different. Science is acclaimed in theory as the highest activity in the State. But in fact its control is in the hands of the State, the party, and the police.* The absolute State, like the medieval Church, must have absolute science, that is scholasticism. Hence, whereas Western science, as we saw, is continually moving back towards

* Those who prefer a happier vision will find it prudently portrayed in the pages of Professor Bernal (my italics): “Luckily, at the rate at which Soviet science grows, those personal struggles, which seem to be inevitable between scientists of different temperaments and beliefs, need not lead to the same embitterment as they do in other countries, because, owing to the rapid expansion of science, there is always the possibility of the aggrieved or misunderstood junior setting up an institute of his own.” (J. D. Bernal, 1939, The Social Functions of Science, London, p. 228.) But Professor Bernal could not have foreseen such expansion that in February, 1948, the Academy of Sciences of Prague would be required to offer a seat to a charlatan from Moscow.
the Middle Ages, Russian science has already got there: under the new gods Albertus Magnus reigns once more.

In spite of these great differences the important principle remains true, east and west, that although science always comes off worst in its conflict with society it is society in the long run which has to pay the piper. If the Russian people had sound plant breeding, they would have more wheat. If they had a sound investigation of human heredity, their medical and educational services would profit by it. And the same applies to ourselves.

VI

In standing by the practical politics of Marxism at the expense of its theoretical integrity Moscow has let itself in for the same kinds of inconsistencies on the question of the inequality of man that are so troublesome to Western thinkers. Marx did, after all, wish to dedicate Das Kapital to Darwin and there is to-day in Leningrad a philosopher enjoying the title of "Professor of Darwinism." And Darwin did depend on the natural selection of inborn differences between individuals, and between races, to account for the evolution of man. What does Moscow say about this now?
It is all laid down in the curriculum.* The application of the theory of natural selection to man is inadmissible: it is the Fascist error of "race perversion," an error which Marx would not have liked, an error of which Darwinism must therefore be purged.

Thus we have the following interesting situation: when Darwin asserted that men had descended from the lower animals by gradual evolution and still obeyed in his heredity, variation, and selection the same natural laws as mice and monkeys, the pontiff in Rome declared that his theories were the work of the devil. When anyone says to-day that Darwin was right, the pundits of Moscow declare that he is obscurantist, reactionary, or, worse still, an enemy of the Soviet people. The two religions speak different languages (both of them violent by intellectual standards), but the meaning is the same. Man being potentially a Communist or a Catholic is something altogether higher and nobler than an animal which can never be admitted to either communion. The ticklish question, at what point in evolution did man cease to obey animal laws and become eligible for a soul (or a party card, as the case may be), is one which the faithful hesitate to ask save in the most secret convocations.