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SCIENCE, ETHICS  
AND  
POLITICS



SCIENCE,  
ETHICS  
AND  
POLITICS

By

ALBERT SZENT-GYORGYI, M.D., Ph.D.

*With an Appreciation by*  
BERTRAND RUSSELL,

Earl Russell

O.M., F.R.S.

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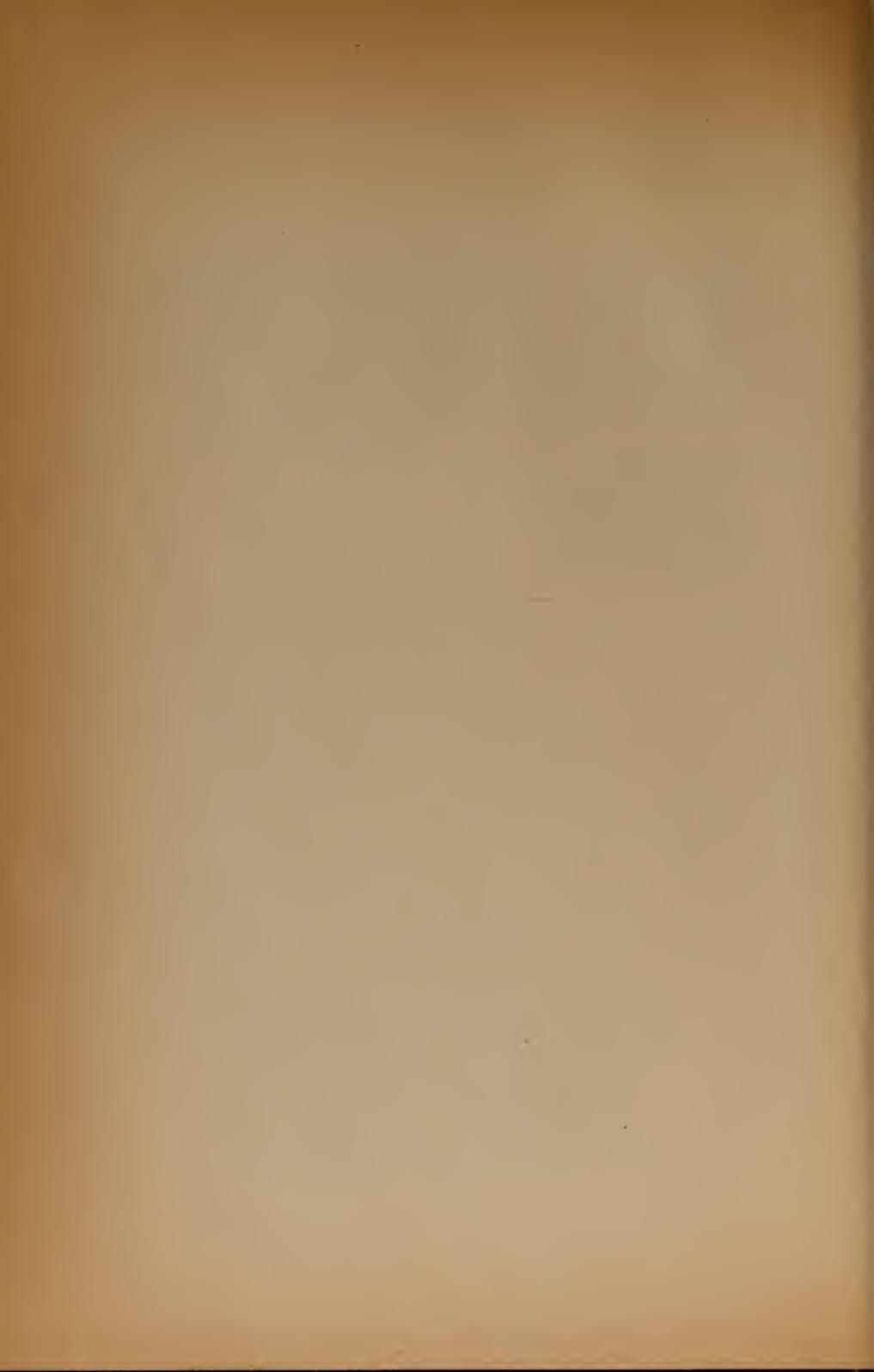
## *An Appreciation*

SCIENCE, ETHICS AND POLITICS is altogether admirable and is written with a clarity and simplicity that should give it a wide appeal. I find myself in agreement with everything Dr. Szent-Gyorgy says in this book, and I hope it may convince many readers.

BERTRAND RUSSELL

Plas Penrhyn  
Penrhyn Deudraeth  
Merioneth, Wales  
1 November 1962

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## *Foreword*

FOR the first time in history it is now possible for man to damage his genetic material or to wipe himself off his rapidly shrinking globe. However, likewise for the first time, it is also in his power to transform this globe into a place of peace and plenty. He is at the crossroads and has to choose the one or the other. His inherited rapacity, shortsighted selfishness and lust for power, and all sorts of petty vested interests pull him towards the road of self-destruction. In this deadly race between education and disaster the latter is far ahead.

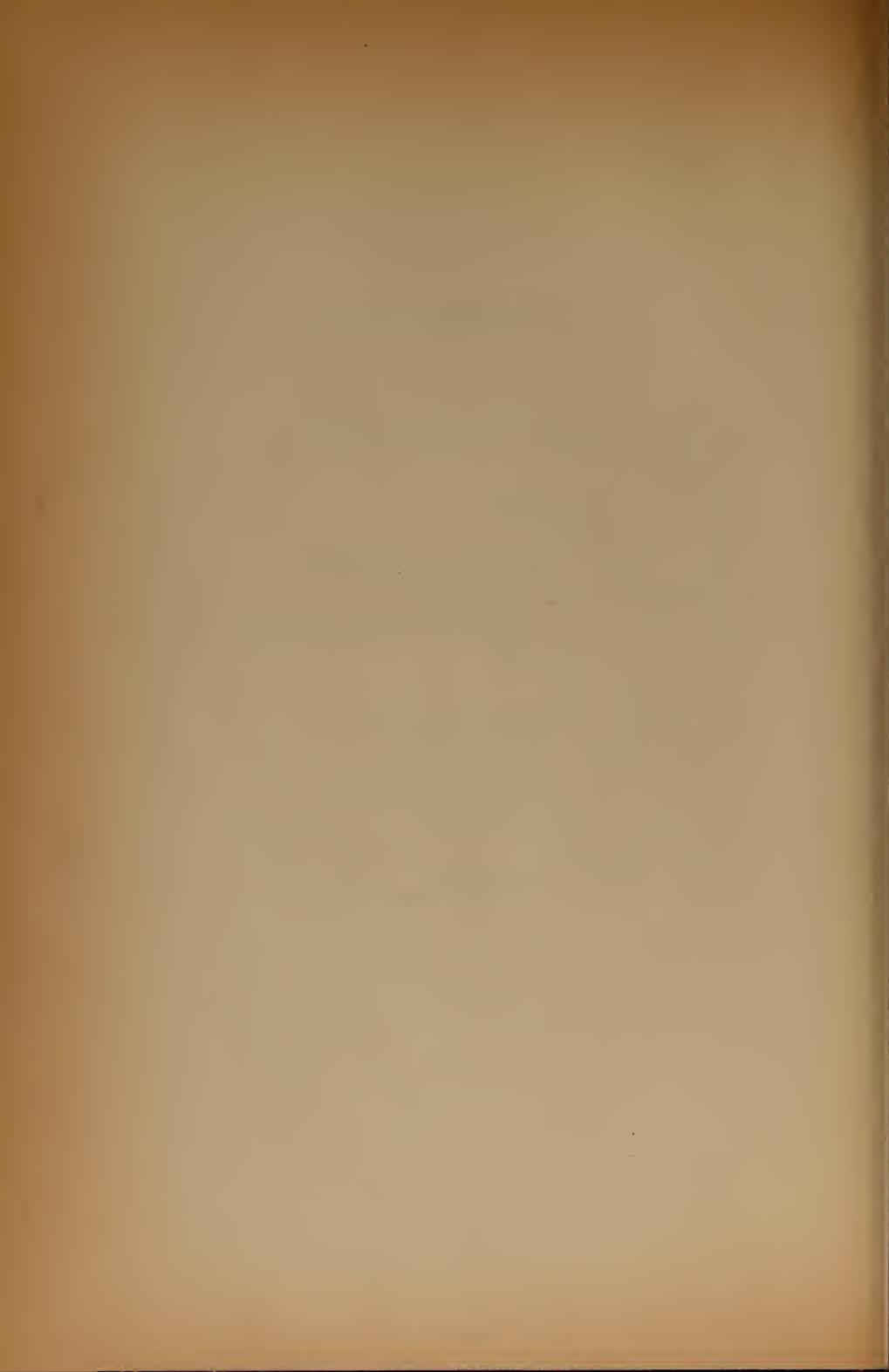
The author of this book is a biochemist who has no other ambition in life than to contribute to science, and live up to its standards. Once before, in his native Hungary, politics came into his life when Hitler forced him to take a stand by burning books and killing his Jewish friends. As a scientist he feels responsible for the approaching disaster with all its suffering, misery and devastation. He doesn't want his silence to make him an accomplice in this crime. He has, therefore, collected some of his public utterances in this little book.

A. S.-G.



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**SCIENCE, ETHICS  
AND  
POLITICS**



## *Solving the Unsolvable*

OUR history knows of various problems which man was unable to solve; eventually, they solved themselves. A few hundred years ago, Western history was dominated by religious differences. In those days it must have seemed most logical for a Catholic to kill a Protestant, and vice versa. There could have been no way to explain why they should not do so. Today, we hardly understand what it was all about, can only smile about it, forgetting the endless suffering these ideas caused, depopulating Europe to a great extent. We can only bless fate that atomic bombs were not known then, or else we would not be here. These problems exist no more; they solved themselves. We have grown out of them.

I could quote analogous, though less extensive, phenomena from my own experience. In my youth, in Hungary, dueling was the only way to settle a personal dispute. I can still remember asking myself in vain: what other way is there? There seemed to be none, a duel seemed the only logical one. We may smile, today, about this too, but it should be remembered that Queen Elizabeth of England had to forbid dueling because the “golden youth” exterminated

itself. We look back on dueling today as a children's disease of our history.

I can quote a similar example from the recent past of the U.S. This example bears, perhaps, more closely on our present problem: disarmament. The example relates to the Southwest eighty years ago, when everybody had his gun. There could have been no possible way to explain that everybody would be safer without a gun. Dropping it must have been paramount to accepting one's death sentence. The result was that the most densely populated parts of communities were their cemeteries. Today nobody wears a gun and everybody is much safer. Total disarmament has been achieved—again, not by logic. We have grown out of it.

We are faced, at present, with an apparently insoluble problem, disarmament. Both we and Mr. Khrushchev have taken a position which seems entirely logical for the respective frames of mind, and there seems to be no way to bridge the gap. I feel certain that within a century or so people will look back on our differences with a smile and may be unable to understand. The problem will solve itself, we will outgrow it; the only question is how we can insure that there will be another century, that we do not wipe ourselves, prematurely, off the face of this globe.

There are two things which can and should be done. First, play for time. This involves avoiding provocation, as well as acceleration spirals which end in doomsday.

The other, equally important, thing to do is to speed up our process of maturation. There are

various ways in which this can be done. One is spreading enlightenment. Another is promoting contacts with our opponents. Our policy is dominated by fear. We are afraid of what we don't know. If the "man on the street" could get a chance to find out for himself that the Russians are not monsters but humans, just as we are, we would be halfway to peace. The same holds for the Soviet people, now afraid of us. This means speeding up all sorts of cultural exchanges, personal contacts, business relations. We have so many problems in common on which we could work together. Disease is our common enemy, space our common problem.

What deeply worries me is not only that our differences are not eliminated, and that not enough is done for speeding up the maturation process (which may even be positively held up in some quarters), but also that the agitation and creation of hatred and mistrust is still going on unabated.

Till the mind is prepared for a wider human solidarity, political approaches to disarmament must be barren of results and have to remain empty propaganda moves.

*(Letter to the Bulletin of the Atomic Scientist, October 1962.)*

## *To Avert Atomic War*

I AM disturbed by the short range of our planning in foreign policy. Science and technology have changed

the face of human life and are dominating the problems of international relations, but science and technology themselves are in a rapid revolution which is still gathering momentum. Problems which seem important today may be of no interest tomorrow, and it is the morrow we have to plan for.

It is evident to most scientifically thinking men that after we reached the level in armaments which makes an attack on the United States unattractive, every additional bomb only adds to insecurity, making a "war by accident" more likely. The probability of such a war is slowly rising toward 100 per cent.

Our most serious danger, however, lies in the spreading of nuclear arms. It is easy to see that, if present lawlessness continues, within a few years most states will have atomic bombs. In any case, China and its allies, like Albania or Cuba, will have atomic bombs, and one single bomb of unknown origin, dropped on an American or Soviet city may start up the holocaust.

It is to the interest of China to see the United States and U.S.S.R. wipe each other out, leaving a power vacuum behind. How devoid of all reason petty nationalistic groups can be has been amply demonstrated by the O.A.S. in Algeria. With one single bomb they could take the fate of mankind into their hands.

It is to our vital interest to reach an understanding and alliance with the U.S.S.R. in the hope that, together, we might be able to arrest the spread of nuclear arms. It is equally to our interest, for the same reason, to accommodate China in the human community.

Very soon the United States will be surrounded by U.S.S.R. atomic submarines, carrying hundreds of Polaris-like missiles, which can destroy our country from close range within minutes. Under these conditions a possible cheating with underground tests in an uncontrolled test ban seems entirely irrelevant.

Our foreign policy adjusts itself to actual situations, forgetting that the present is but a point on a rapidly rising curve. The 1000-megaton bomb is clearly in sight, capable of wiping out six of our states in one bang, or destroying our whole East Coast with one tidal wave. With the formidable cosmic forces of atomic energy released on our rapidly shrinking little globe, there is but one possibility of staying alive, and this is by building new, better and wider human relations with a new political world structure and mentality.

Our government seems to be caught in the net of petty moves and countermoves. Even scientists who

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had a clear vision before seem to get lost in this maze once they join Government or its committees, losing sight of the woods for the trees.

(*Letter to the New York Times, Sept. 2, 1962.*)

## *Man, Science, Politics and Armaments*

IN a democracy like ours the Government and its foreign and military policy should reflect the basic characteristics of the people. The American people are characterized by clear, simple and honest thinking, straight dealings, a regard for human rights, and a blend of idealism and realism. Our foreign policy and military planning show the opposite characteristics. We dislike dictators, thus help Franco; dislike Communists, thus help Tito; want a strong UN, thus do not admit the oldest and greatest nation. We pretend that China is not the 700 million Chinese but a fellow hiding behind our warships. We have God-Almighty on our lips but deny his existence by trusting bombs only. We pretend to be Christians, but talk of overkill and hoard grain while others are starving. We sacrifice the lives of thousands of other peoples' children to improve our arsenal which is, anyway, superior to that of others.

We arrogantly deal with space as if it were our private backyard, and foul up the atmosphere, the common property of man, spreading lawlessness. While the majority of mankind needs help we spend

untold billions and ingenuity to buy a ticket to doomsday. The existence of mankind is already dependent on correct functioning of countless hands and buttons, while both humans and machines are known to err, which makes our own bombs into a threat to our existence equal to the bombs of our adversaries. Never before has high politics gambled so irresponsibly with the very existence of mankind. Morals seem to be something reserved for Sunday, when we go to church, but to be of no use on weekdays, when we make decisions.

We are on the wrong track. Our main question here is not how we got on it, but how we can get off, and make a fresh start.

Whatever man does he must first do in his mind. The machinery of the mind is the brain, and any machine can do only what it is made for. So if we want to understand ourselves and arrive at a plan of action, we must understand what sort of thing this brain of ours is.

Looking at this question as a biologist, I see that in their struggle for life animals have grown various weapons. Some species have grown claws, others fangs, tusks or horns. Man has developed a brain which turned out to be superior to all the rest and assured our supremacy.

This leads me to my first conclusion: the brain is an organ of survival. It was built by Nature, not for the search for truth, but for finding food, shelter and the like—that is, to find advantage. So most human brains, unable to distinguish between truth and advantage, accept as truth that which is only advantage. This is a most important point, if we want to

understand human action. We do or desire what our nature commands us to do or desire and we use our brains only to find ways to get what we want and, simultaneously, to produce the thoughts and arguments which justify our feelings and dealings.

If I had shelters to sell, my brain would start worrying about our National safety. If I had bombs to sell, I should raise a commotion about a missile gap. If I were in the army, awaiting for my promotion, I should be concerned with the inadequacy of our defenses, give big contracts to the firms which I hope will choose me as executive when I retire. And if I were in the Senate or the House, I should be more concerned with the next election than with the next generation and should ally myself with the military-industrial complex to get big contracts for my constituency in order to be re-elected; and if, at the same time, I were forced to produce a disarmament proposal, I should produce one which would look good to our side but could not be accepted by our opponents. If I were a millionaire, I should be convinced that the world is just right as it is and my hatred of communism would know no measure.

I do not pretend to be better or worse than any of you. I am just a human, but I have the advantage of being a biologist and of knowing the working of my brain, and so I can be on my guard not to be tricked by it.

Let me return to biology.

Animals may live in water, on land or in the air, so there is but one rule of how an animal should be built to survive: it must be adapted to its surroundings. Our species was not built yesterday, but hun-

dreds of thousands of years ago, and probably has not changed during the last couple of tens of thousands of years. So we are adapted to the conditions of life in those long-gone days, and, to understand ourselves, have to consider the conditions which must have prevailed, say, fifty thousand years ago. So let us pay an imaginary visit to our honorable nth-degree great-grandfather, who lived in those days.

At night we will probably find him huddling with his family or clan in his cave around the primitive fire which was the greatest natural force he knew and handled. We will have to be a bit careful when we enter because his main motivation is fear, and he might strike us down since we do not belong to his small clan. In the daytime we will probably find him hunting in the vicinity of the cave, because even ten or a hundred miles must have seemed an infinity to him—the greatest speed known to him being, probably, that of some animal.

If we could talk with him, we should probably learn that he has not the least doubt that what he sees and thinks is the ultimate truth and reality. Of course, he knows that there are superhuman forces in Nature and so he accepts the existence of superhuman beings created in his own image, with whom he tries to stay on good terms.

This world did not essentially change up to the first half of the last century. I am often amused to think that if Napoleon and Julius Caesar could meet they could discuss all their military and political problems without difficulty. The two thousand intervening years made no difference. They could even have invited Hannibal, Hasdrubal, or Darius. The

world seems to have stood still through thousands of years.

Science has suddenly changed everything in a few decades without giving us time for adaptation. It has replaced the speed of the horse by the speed of jets, missiles or radio waves, abolishing distance. It has replaced fire by atomic energy, one of the terrific cosmic forces which are shaping the Universe. We were clever enough to release these forces but we have no machinery in our heads which would enable us to comprehend, to imagine them, so we talk about them as if they were the old-type energies. I am afraid of hot water, but laugh about 15 million degrees which means nothing to me. We get completely mixed up between the cosmic and petty human dimensions, and prepare to unleash, here on our little globe, the cosmic forces, and then try to hide from them by digging little holes in the ground which we call *shelters*.

This creation of new dimensions, and the inability of the human mind to comprehend and handle them, pop up with the corresponding confusion at every turn. We are deeply moved by seeing a fellow-man in danger, or suffering, but we talk, with a smile, about pulverizing our principal cities, killing a hundred million of our countrymen, leaving the rest in unimaginable misery to envy the dead. We are simply unable to multiply individual suffering by a hundred million. If the tens of thousands of people crippled bodily and mentally, cancer patients and leukemic children, who have already been produced by atmospheric tests could march in a silent procession before the leaders of Governments, those tests

would never have been ordered. The small clans of the past consisted of Jacks and Jills. Science, by creating death control without birth control, has made the human masses swell enormously, and countless hundreds of millions of people are, for their leaders, no longer Jacks and Jills but abstractions. So the leaders are prepared to sacrifice lives by the hundred million for abstractions like ideologies or National Glory. The silent procession I mentioned before would turn abstraction into reality, statistical murder into straight murder.

In the pre-scientific period the human masses were safely separated by distance. Science has abolished distance and is now rubbing the enormously swollen human masses directly against one another, enabling us, at the same time, to destroy each other without leaving our own backyards.

From the elevation of modern science we see that not only are our senses unable to reveal the real nature of things—they are made for the purpose of *not* revealing it, otherwise they would be unfit to guide us alive through one single day. What science has done is to find out more about the real nature of things, thereby creating a new world for which we are not equipped, in which we are unfit to live. For our primitive thinking and sentiments are very similar to those of our above-mentioned honorable ancestors, and, like them, are dominated by fear, distrust, and narrow egotism—of which nationalism is but one expression. To survive in this new world we must build entirely new human relations, an entirely new world structure, and the question is, who can build it? How to build it?

One's thoughts turn, first, to one's Government, Senate or Congress. Our Constitution dates from the days when the country had to be built up and a citizen's first duty was to build up his little corner, and the Representative's duty was to represent the interests of this little corner. Our Representatives still represent their little corners and seem to be unaware that our globe has shrunk incredibly, until the whole globe is now everybody's little corner. Their minds, which represent, also, the minds of their electorate, still have all the traits of the minds of our primitive ancestors, including an absolute trust in the correctness of their—and our—primitive thoughts and feelings. What we see white, *is* white, and what we see black, *is* black.

Can science help us? It is reasonable to expect that science, which, with technology, created the new conditions, and has brought us to the rim of extinction, may help us. One might think that the forces released by science can be governed without mortal danger only by the same principle which created them. There may be truth in this, but what is science, and what can we expect from it?

Of course, science can help us some by trying to explain to the people how formidable these new forces are which threaten to gobble us all up and open the way only to suicide, not to victory. But there is not much that science can do on this line, because the human mind is unable, in any way, to grasp the terrific nature of these cosmic energies. Of course, we can tell people that a 30-megaton bomb will wipe out all life within a radius of thirty-five miles or so. But this will make little impression for

we are unable to imagine such hell on earth. And what numbers shall we quote? 30 megatons? The bombs double in size every year, and the 1000-megaton bomb is clearly in sight. It will wipe out all life in six medium-sized American states in one bang, shelter or no shelter.

But is this all that science is: data, books and tricks? Certainly not. If anything, modern science is, in the first place, a way of thinking, a new way of thinking which created technology, and a whole new world. What is, actually, this scientific thinking? It is simple. Science tells us that if we have a problem, we must approach it as a problem: collect data, then try to fit them together and find the best solution, with a neutral mind, a cool head, unbiased by short-range interest or sentiments like fear or hatred. If politicians could approach the great international problems with this spirit, instead of dealing from a narrow nationalistic angle, with one eye on propaganda, trying to get tit for tat or tit for nothing, we might get on the right road.

But science is even more than a way of thinking. Science, with its sister, art, is the result of the selfless work of an intellectual community which knows no boundaries in time and space. I am a member of this community. Its basic rule is uncompromising intellectual honesty, equity and mutual respect. This takes us into the sphere of morals, the bridge which can lead to a better future.

My last, and perhaps most thorny, question is where does this new spirit have to be implanted to bear fruit? The politicians? In a democracy it is the people who elect their representatives and they elect

them in their own image. Politicians are not leading the people, they are led by the people, listening carefully to the voice of the voter. So it comes down, eventually, to educating the people. But here we stumble on real difficulty. Education is a very slow process and there is no time. And who should educate whom? It is the adults who educate the children, and so we are all moving in the same circle. It is probably for this reason that Dr. Szilard is trying to take a shortcut and to influence, directly, the Administration, the Congress and the Senate by establishing a "scientific lobby,"—a most hopeful approach.

There is perhaps also another approach. If Senators and Congressmen can be influenced by votes only, if they care more about the future election than about the future generation, then we have to seek out a group which cares about the next generation and has votes, too. There is such a group: women, mothers. Women have, also, more common sense than men. They have learned that high energy radiation damages children and they refuse to swallow whatever we tell them about "permissible limits." They simply want none of it. I place the highest hopes in peace groups of women. However, if the women were to come to me and say: "We believe you. For whom shall we vote? Where is the party which has your thoughts on its banner?" I should be in the greatest trouble. I should have to say: "There is no such party. There is no real difference between our two leading parties. They are both headed for doomsday. Essentially, we have but one party with two sets of people, the ins and the outs, and our political liberty is limited to choosing between these two."

I do not want to finish on such a negative note. Perhaps there is one little shortcut I could advocate. If we still have the caveman's mentality and cannot change it, then, perhaps, we could avoid catastrophe if we could understand only one thing: that science has abolished distance, that we are all living in one cave now—a cave that takes in our whole little shrunken globe. In this cave of ours there is room for one family only—the family of man—and we may at least gain time by simply tacking up a notice: "Playing with atomic bombs in this cave is strictly forbidden."

(*Speech given at the Congress of Scientists on Survival, New York, June 15, 1962. Part of this talk was printed under the title "The Persistence of the Caveman" in the Saturday Review, July 7, 1962.*)

## *Disarmament and Economics*

THE ultimate goal of disarmament can be only total disarmament. This would eliminate, also, the difficulties involved in inspection, since Mr. Khrushchev is ready to throw his country open to any amount of inspection once there is nothing to hide.

However, it is believed that the United States is unable to disarm completely without creating havoc on the stock exchange and creating massive unemployment. For this reason the United States has proposed a gradual reduction of armaments, spread over a long period, such as twelve years, in which time its armaments industry could shift to peace production.

I venture to propose a simple way which would enable the United States to disarm completely, in one stroke, without any disturbance of its economy. It is the following: We continue to vote our military budget and the Pentagon goes on passing out all contracts, obliging the single firms to pass out all sub-contracts, and pay all its workers—but all this under one strict condition: that nothing is produced. We could then reduce the military budget as rapidly as the war industry adapts to new production, stretch-

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ing this reduction over a period of, say, twelve years. What we do gradually is thus not disarmament, but a reduction of the budget. This would eliminate all economic difficulties and would mean an enormous economy in valuable raw material.

(*Letter to the Bulletin of the Atomic Scientist, June 1962.*)

## *The Legend of Hiroshima*

(A Book Review)

EDWARD TELLER\* is an outstanding scientist who has made many valuable contributions to physics. I would accept his opinions about this science with the utmost confidence. During World War II he turned to weaponry and nuclear technology, and he has become, with his remarkable versatility, a leading authority in this field. I would accept his opinions about these applications of science with the same confidence. The main theme of the present book, however, is from neither of these two fields. The book is essentially a vehicle for Teller's political ideas in their relation to armaments.

Science and technology produce new tools and release new forces, but the question of what use these tools and forces are put to—construction or destruction—has little to do with science or technology proper, and so Teller's ideas and opinions in this field are as good (or as bad) as yours or mine.

One of the most puzzling characteristics of the human mind is its ability to produce coherent thoughts

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\*Edward Teller with Allen Brown, *The Legend of Hiroshima*, Garden City, N.Y., Doubleday & Company, Inc., 1962

in one field and to be irrational in another, once biased by sentiment, ambition or interest. Louis Pasteur, for instance, who was one of the clearest scientific thinkers the human species has produced, said himself that in matters of religious thought he was on a level with the peasant women of Brittany. I have often had to smile at the childish nonsense about communism uttered by some leading English physicists, who were sentimentally biased in favor of this doctrine, about the application of which I have had a firsthand knowledge.

Teller's political opinions seem to be biased by his hatred for the Russians and his love for his children, the H-bombs, whose father he is said to be. He would like to see more bombs and better bombs, bigger and deeper shelters. He would like to see our children brought up underground and in underground schools. What gives undue weight to his opinions is that he has become the "voice" of the military-industrial complex, with its enormous vested interest in political tension and distrust, its political influence and virtually inexhaustible means. President Eisenhower sounded a warning in his "farewell address" about this complex, which amplifies the voice of Teller and magnifies his figure, while the public takes the political opinions of Teller with confidence and homage due only to Teller, the scientist or military technologist, and not to Teller, the politician and strategist.

All this makes Teller's book recommended reading for those who would like to see a world of hatred and distrust, with more bombs, bigger and better bombs, deeper shelters, and with mankind marching under the deepening shadow of mushroom clouds.

Those who would like to see the U.S. find its idealistic self again and assume the moral leadership of our fragmented world, and who would like to see mankind marching toward a brighter future, will put this book aside with saddened hearts.

The book is well written and easy to read. The authors try to discuss all the problems of relations between the U.S. and the U.S.S.R., and to give all the answers. They forget only one possibility: an honorable peace.

The first chapters of the book deal with the story of atomic energy and armaments and make interesting reading, flavored by anecdotes and firsthand personal experience. Nonetheless, the reader is left, so to speak, empty-handed, not being told what the problems really were. Here the authors were evidently limited by secrecy. Some of the later chapters, such as the one on education, deserve full attention, although I prefer that education be discussed for its own sake, without an edge turned against the Russians.

In at least one way the authors are guilty of an unscientific attitude. They deal with their problems from the standpoint of current technology. They seem to forget that the present is only a point on a rapidly rising curve. This curve expresses itself, for instance, in the steady growth of the destructive power of nuclear bombs, which has increased 2,500-fold since Hiroshima, a rate of growth that shows no sign of slowing down. The authors also make the improbable assumption that in a world conflict there will be a winner and a loser. To support their argument they give a distorted picture of the biological

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effects of ionizing radiation, and they deal with world conflict as though it were a storm that quickly blows over, leaving social structures unchanged and the atmosphere cleared, with every problem solved.

So far as I am aware, Teller's political opinions do not represent those of the great majority of scientists. Science is the fruit of the work of a group of people, who form a unified intellectual community that knows no boundaries in time or space and knows no limitation by color, creed, race or passport. The basic moral rule of this community is uncompromising intellectual honesty, good will and mutual respect. Most scientists would like to see this spirit extended to political relations and wish for a wider human understanding that would mark the way toward higher levels of human existence. Some of us even believe that the formidable forces released by science can be handled without catastrophe only by the same mentality that created them. Teller sees the final solution in the establishment of a world government after a full democratic or communist victory. He seems unable to visualize a family of man with its temporary chasms bridged, and so he takes us back to the mentality of the religious wars, the problems of which must have seemed, in their time, as insoluble as ours.

(*The Scientific American, May 1962*)

## *Arriving at Test Ban*

WE have been told repeatedly that we have to resume atmospheric testing because the value of underground tests is very limited. All the same, we allow the Geneva conference to bog down on the difficulty of monitoring underground tests. The control of atmospheric tests is no problem. They can be detected without establishing specific observation posts. All Soviet atmospheric tests have been detected by us by our existing means.

The failure of the Geneva conference may be fatal, starting up a new cycle of the arms race. Could we not, in view of the secondary value of underground tests, agree with the Soviets to a ban of atmospheric tests, leaving underground ones, for the time being, out of consideration?

*(Letter to the New York Times, April 8, 1962.)*

## *The Testing Issue*

PRESIDENT KENNEDY's speech, in which he announced the resumption of atomic tests in the atmosphere, was an exemplary specimen of oratory, logic, sincerity, consciousness, and responsibility. It deserves all admiration. What disturbs me is that after our tests Mr. Khrushchev could deliver exactly the same speech, almost word for word, substituting only "Soviet" for "USA." He would deserve the same gratitude of his people for it. His fears and responsibilities are the same as President Kennedy's. So after our tests, the Soviet could, with equal justification, resume its testing again, answered by renewed tests by us, and so on, *ad infinitum*, or, rather, *ad* the grand finale of man's history.

Our position is quite logical: we want to reduce armaments under controls. Mr. Khrushchev's position is equally logical: controls would destroy the secrecy of the remaining army, and secrecy is one of the main factors deciding the value of an army. So he proposes unlimited controls but only after complete disarmament, when there will be nothing to spy on. Neither of us is willing to accept the other's proposal and so

we can both act as angels of peace while continuing, undisturbed, the fatal spiral of armaments.

I wonder how all this must look to simple-thinking new African nations, who are hungry for food and knowledge—to see the two great powers squander their untold treasures on means of destruction. To them, President Kennedy and Mr. Khrushchev may appear as closely allied partners, each frightening his people into this fatal course, playing poker for big stakes.

Though I am not a moralist but a scientist, I strongly believe that what decides human history is not gadgetry but morals, and testing in the atmosphere is, in the first place, a moral issue. The question is: has any group of people the right to foul up the atmosphere for the rest, once it is strong enough to get away with it? I am afraid that our new series of atomic tests, while giving us some temporary lead in atomic gadgetry, will definitely take from us any chance of moral leadership. Morals, as far as I can see, carry no weight in politics. Morals seem to be something reserved for Sunday, when we go to church, and are useless on weekdays when we make our decisions.

I am not a jittery fellow. I faced Hitler. He screamed my name at the top of his voice and sent his whole Gestapo after me, and I was not frightened. I faced Stalin, too, and was not frightened. Now I am frightened. I am even afraid of the current disarmament talks because their failure will make the situation worse.

We will throw away weapons only after they have become superfluous, after minds have met. Not long

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ago I proposed the setting up of an International Institute for the Study of Peace, where we could sit down with our adversaries in a neutral atmosphere for honest study, free of propaganda, where minds could meet and all these problems could be spread out and approached with a cool head. I know this was but wishful thinking, there being no vested interest in peace. There is little hope that the modest means for its international study could be found, though peace may be a more difficult problem than war or armaments.

(*Letter to the Saturday Review, March 31, 1962.*)

## *Social Responsibilities of Science*

I AM not a politician or a public speaker of any kind. I am a biologist, living in the solitude of Woods Hole.

What drives me to you today, with a suffocating feeling of anxiety, is this:

The devastation you can buy for a dollar in the form of an atomic bomb becomes cheaper as the bomb gets bigger. This makes the bombs grow. From the 20-kiloton bomb of Hiroshima in 1945 to the 25-megaton bombs which our planes carry, the bombs have grown more than a thousand-fold, that is, have nearly doubled their size every year. This growth goes on unabated. Mr. Khrushchev already brandishes his 100-megaton bombs, and the 1000-megaton bomb is clearly in sight. Exploded in the atmosphere, this latter can be expected to scorch six big-size states, wiping out all life in one bang, shelter or no shelter, melting the topsoil to a lava-like crust.

I am equally disturbed by the fact that bombs become cheaper by the day. Soon, everybody will be able to afford and have them, big and small, be it China, Cuba, Albania, or anyone else. So the statistical chances that somewhere someone will fire one,

or that one will go off by mistake, are gradually increasing to a certainty.

I am equally disturbed by the fact that there is an enormous vested interest in armaments and none in peace. Armament's industry is clamoring for more armaments, that is, more and bigger orders. Allying itself with Madison Avenue (advertising business), it influences public opinion and tries to widen the breach between us and our adversaries, and makes armament appear as the only alternative. It is making itself immune to criticism, which it construes as disloyalty to the country. So it is gradually transforming the U.S. into a warfare state—a road which has led many a great country to its ruin.

Lastly, I am worried about the genetic material in our gonads which has been developed and preserved by nature through millions of years, with infinite care. If there is anything holy in life it is this material, which has mankind's past and future written into it in a mysterious language. It is not our private property. We have it in trust to guard and transmit, during our short existence. An atomic war would most gravely damage this genetic material for all future ages. Even prolonged testing would do so.

At present, everybody can test as much as he pleases, fouling up the atmosphere, this common property of mankind. He can do so without asking the rest, provided, naturally, that he is strong enough to get away with it. Moral concepts seem to carry no weight in politics. There is perfect lawlessness.

Summing up: we are on our way to doomsday, and the question is what can be done, what is being done to avert this catastrophe? What is our answer

to the most awesome question of all human history?

Our government's answer is expressed in its budget, which, by increasing arms appropriations, adds one more turn to the spiral of the suicidal armaments race, while the American people's answer is to brace itself for the catastrophe. That it has unconsciously realized that there is no safety in bombs is evidenced by the jittery way in which it tries to dive underground. Meanwhile, a very gallant attitude is growing: "If die we must, die we will for liberty." The trouble is that we have no possibility of dying for liberty. The scientists who convened at the last meeting of the A.A.A.S. (American Association for the Advancement of Science) at Denver, clearly stated that they expect that if there are any survivors after an atomic war they will form a "primitive barbaric society," which will have to be under some very crude dictatorship. By dying we cannot save liberty, we can only destroy it. If we want to maintain freedom we must live for it, choosing the only alternative to war, which is peace—a proposition much more complex and difficult than war.

Within the walls of this time-honored scientific institution, as we witness the birth of a new chapter of the Society for the Social Responsibility of Science, I think it fitting to discuss three problems with you:

1. Has science anything to do with all this trouble?
2. Is science responsible for it?
3. Can science do anything about it?

1) *Has science anything to do with our troubles?* Certainly, it has. Troubled periods of history are

periods of transition. Ours is the most troubled period of history, so there must be, underlying it, a most profound transition. There is no doubt in my mind what this is: a transition from the pre-scientific period to the scientific one. Science has changed the face of human life and has changed all its parameters. One of the main decisive factors of history was always distance, which benevolently separated the various human masses. Science abolished it. By lengthening human life science has made these masses swell enormously. With the distance eliminated these masses are now jostling one another.

Science has opened the way to unforeseen wealth and dignity, which has fallen to the lot of only a minority of mankind, awakening the "revolution of expectations" in the rest. Science is killing the time-honored superstitions on which social structures were built and challenges man to take, with his intelligence, his own fate in his own hand instead of being the toy of divine whim and the prey of his primitive instincts. In the present transition, as in all the earlier ones, the new is mixed with the old, and so we are meeting the great problems of the new age with our primitive instincts, narrow sectarianism, egotistic nationalism—and the most deadly instruments ever created by science in our hands.

2) *Is science responsible for our troubles?* My most emphatic answer to this question is NO. Science has two aims: to increase knowledge by penetrating into the secrets of Nature and to elevate human life. We scientists cannot be made responsible if the fruits of our work have reached only a minority of our kind. As to the murderous weapons which

threaten our existence, I must also decline responsibility. Science creates new knowledge and new knowledge creates new tools, and any tool can be used, both for construction and destruction. It is regrettable that moral progress has lagged behind scientific progress and that the new tools created by science are made into instruments of murder and destruction. We cannot be blamed if groups of people snatch the discoveries from our hands, run away with them and use them contrary to our intentions. Will you reproach Pasteur because his discoveries have been distorted into means of bacterial warfare, which is said to equal the horrors of an atomic war? Will you reproach Lavoisier because chemistry has led to the possibility of chemical warfare? Will you reproach Rutherford, because his discovery of the atomic nucleus has led to atomic bombs, and will you reproach Clark Maxwell, if TV does not spread beauty and knowledge but is the handmaiden of advertising? The blame is with those who debase our discoveries and try to solve political problems with bombs, forgetting that no problem can be solved by bombs, but only by intelligence, allied with good will.

Perhaps you are raising, here, two objections. Some of you may ask: was it not scientists who actually built the first atomic bomb? Certainly it was. Our best scientists were involved! But do not forget that the problem, then, was to prevent Hitler from having the first bomb, which would have meant his final victory. Hitler was defeated before the bomb was ready. When it was ready the scientists who built it formed the Committee on Social and Political Implications. This committee took a

stand against the dropping of the bomb on Japan and advised an international demonstration of the power of the bomb. They outlined, with remarkably clear foresight, the enormous dangers which the dropping of the bomb would entail for our country and for mankind, describing exactly the troubles and dangers in which we are floundering. Their efforts were of no avail. Politicians and the military ran away with the bomb and dropped it, procuring for us the doubtful honor of having been the first country to use an atomic bomb against a civilian population.

You may also ask, are there no scientists, even scientists of repute, who clamor for more, bigger and better bombs? Let me answer this objection indirectly, and ask you, "Are there no priests who preach murder?" Recently on our television screens we saw a priest and heard him tell us to shoot our neighbor if he came to our shelter asking for help. Does this mean that churches are for murder? Certainly not. Neither does an isolated scientific opinion express the consensus of scientists.

Now let me answer my third question: *Can science do something to help us out of this pre-doomsday course and save the situation?* Certainly it can. More than that, perhaps science alone can save us. The reason is clear. We scientists have brought to this globe this cosmic force, nuclear energy, which threatens us now with extinction. Maybe such a force can be handled only by the same scientific mentality which created it. Maybe it is impossible to create such forces by scientific thinking and then handle them with primitive instincts like hatred, fear or narrow national egotism, without being de-

voured by these forces. Maybe, too, the other problems created by scientific progress can also be solved only by the scientific mentality which created them. What, then, is this scientific thinking, which has created this new world with all its hopes and dangers? The answer is simple. The basic prescript of science is this: *If you have a problem, meet it as such—as a problem. Collect data and then try to find the best of solutions with a neutral mind, with a cool head, unbiased by sentiment, hatred, fear or profit, with an uncompromising intellectual honesty, with good will and equity.* This is plain enough, and I should like to go through this prescript word for word.

“Meet your problem as such.” What is our basic problem now? The problem is that science has changed within a few decades all major factors of human life, while political thinking and structures have remained unchanged, dating back to the eighteenth century. A new political world structure has to be built, with a new way of thinking which is in line with scientific progress. If one wants to get somewhere, the first thing one has to know is where one wants to be. So then, where do we want to go? What sort of world is it we want to build? This is the basic question. This is not a problem of current politics, occupied with problems of the day. While we are spending untold billions for armaments and the study of new weapons, we do not have a penny for the study of peace, that is, the impartial study of the structure of the world which has to be built. So my first and modest proposition to my government would be to use the 700 million dollars which are ear-

marked for an initial step toward a senseless shelter program, for setting up an *International Institute for the Study of Peace*, where we can get together in a neutral atmosphere with both friends and adversaries —where minds can meet.

Till such a meeting is achieved, all disarmament proposals and conferences have to remain barren of results. We will throw away arms only when they have become superfluous, when minds have met. No use trying to put the cart before the horse. Moreover, war has been, through the ages, one of the main political instruments, an instrument of equalization. It cannot be *abolished*, it can only be *replaced* by something better and more intelligent.

Now let me discuss the words: “*with a neutral mind, with a cool head, unbiased by sentiment, hatred, fear or profit.*” Do politicians ever meet in this spirit? Are we not meeting our adversaries with sentiments, with fear, hatred, distrust and a narrow national egotism; prepared to give only tit for tat, or give nothing at all; dealing from a position of force (all being stronger than all the rest), meaning by *force*, the strength of arms and not the force of arguments. What would have to be done is to spread out with our opponents all the problems and together search for the best solutions with a cool head and a neutral mind, as we do in science, where even our adversaries are our allies in the search for truth.

I have arrived in my prescript, now, at the fateful words “*with an uncompromising intellectual honesty.*” No doubt we are making progress on this line. At the time of Machiavelli, four centuries ago, murder was the main instrument of international politics.

Today it is untruth and half-truth which have taken the place of murder as a political instrument. This is, no doubt, progress, but still a poor foundation for a better future. Only the "whole truth" is truth. Half truth, upon which most of the propaganda is built, is no truth at all. Nor are ideas true which would not stand the light of the simplest logic. *Magna est veritas.* Great is the truth, you cannot compromise with it. It will crush him who resists it and structures built outside it will collapse, for truth is the only solid foundation. We all—the whole world—have a deep longing for decency and honesty. I often wonder whence comes the enormous attraction of the figure of Lincoln, which still holds us spellbound. I think I know: he talked the clear and simple language of truth. If any big nation would talk this language again, it would become the unquestioned leader of men. We should not be afraid to use this language.

"*With good will and equity*" also brings me back to Lincoln, whose words "with malice toward none; with charity for all," express best what I mean, though the meaning of the word "charity" has changed since then. Perhaps he would say "with kindness and mutual respect" today.

Summing up: I think that scientific thinking shows the way towards the solution of the problems it created. All the same, science and scientific thinking occupy a very poor place in our government, if any place at all. Our Constitution was written at a time when science was still in its infancy and its later development could not be foreseen. At that time the problem was to build up the country, and so the

main democratic duty for everyone consisted of building up his own little corner. Accordingly, Representatives were sent to Washington to represent the interests of those little corners. Since then two great changes have taken place. Science has become the leading principle of current history and the U.S. has been thrust upon the scene of world history as a great power, co-responsible for the fate of the rest of mankind. In spite of this development, the government has remained unchanged. It gives no place to scientists in policy-making and calls them in only for expert opinion on technical questions.

The dangers of the day are so great that ways must be found to catalyze the spread of scientific thought and enlightenment, its spread to the people and its penetration into government. International lawlessness has to be ended, if we want to stay alive. Something has to be done and done fast.

Not long ago, a scientist, for whom I have the greatest admiration, proposed that a scientific lobby be sent to Washington to remedy the situation. I am all for it but have to admit that this is patchwork only, an emergency measure, and for a final solution we will have to go deeper, to the roots of democracy. If democracy means a "government of the people, by the people and for the people," and if we are *the people*, then we are all responsible for our government, which has to represent us and our opinions. This implies that we all have to take a stand in all vital issues as conscientiously as if our opinion would decide the issue.

The foundations of democracy were well laid by our Founding Fathers, and there is no need to change

them or to give them new content. We have only to adjust to changes, to the fact that now it is science which is molding history and that the whole globe has become our "little corner" which we have to build up.

Democracy is inseparably connected with peace. Peace and democracy will have to live or die together. Neither is something ready-made, prefabricated. Both mean a permanent struggle, a struggle for the knowledge and enlightenment which enables us to fulfill our duty to our country and to mankind, make the right decisions, produce and find the right representatives, extending to all men our constitutional right for the pursuit of happiness.

In this struggle, we scientists, who are spearheading progress, have a double responsibility which makes it, for me, a very great honor to have been allowed to address you at the cradle of a new chapter of the Society for the Social Responsibility of Science.

*(Talk at meeting of the Society for the Social Responsibility of Science at Harvard University, February 13, 1962.)*

## *My Difficulties with the Atom*

HERE I must come back once more to my personal problems. I will not attempt to convince you of anything and again I will start with the idea of democracy. Living in a democracy means to me that I am responsible for the actions of my government, have to take, thus, a stand on all vital issues as conscientiously as if I were the President himself.

The most vital issue of our age is the ATOM, which has offered us a clear choice: either undreamt of wealth and dignity, or misery and extinction. Thus, I have to take my stand on our Atomic Policy, and I have the greatest of difficulties. I am not an atomic scientist, I am a biologist. During the 45 years of my research career I have worked a great deal on energy, and my basic tenet was that there is no difference between energy and energy. But atomic scientists tell me that atomic energy is different from all other forms of energy, and I have difficulty in seeing why this should be so. It is only lately that I have begun to understand.

I have two points on which I can start building my own thoughts. I can begin by considering the

energies with which I was hitherto acquainted. There is, for instance, the energy which drives my car, which comes from gas; there is the energy of oil, which heats my home; there is electricity, which lights it and is produced from coal. Last, but not least, there is the energy of my foodstuffs which drives my own body. What are all these sources of energy: food, gas, oil, and coal? As a biologist, I can answer this question. They are, essentially, scraps of the energy of the solar radiation which reached our globe and were picked up by plants, which then converted this energy into chemical energy, linked to various substances which the plant is building or has been building for countless years.

There is one more experience on which I can build. I know that if I am too close to my fireplace, in front I scorch while behind I freeze. If I move away, the heat received falls off very rapidly, with the square of the distance; that is, if I move away from one foot to ten the radiation energy received by my body will fall, not to one-tenth, but to one one-hundredth, and will become negligible. This is a very important experience, because I know that the sun is at a distance of 100 million miles from our globe. I can thus conclude that the radiative energy reaching our globe is only an infinitesimally small fraction of the energy emitted by the sun. All the terrestrial energies known by man before the atomic age were, thus, these infinitesimally small fractions of the radiative energy of the sun. The sun itself must emit energies the magnitude of which I am entirely unable to imagine. I am unable to imagine a heat of 15 million degrees, the temperature at the center of the sun.

How does the sun produce these enormous amounts of energy? What sort of reaction is capable of producing them? They are energies of the atom. Atomic energy is thus none of these tiny terrestrial energies, laboriously collected by plants. It is one of those cosmic forces, shaping the universe in which our whole galaxy is but one of the millions of galaxies, the dimensions of which are infinite as compared to all terrestrial dimensions.

Thus, what man has done by discovering atomic energy is to bring to our little globe one of those cosmic forces which are shaping the universe, compared to which human existence on our earth, or even the whole solar system, is but a toy. With these energies we can already wipe out all life on this globe and will be, very soon, capable of blowing it to kingdom come, consoling ourselves with the idea that, after all, it is only a second-rate planet.

I am entirely unable to imagine these cosmic energies or dimensions. If you tell me that the sun is 100 million miles away, it means nothing to me. I simply cannot imagine this distance any more. Nor do 15 million degrees mean anything to me, and if an atomic scientist calculates the force of the twenty-five-megaton bombs our planes carry, it just leaves me cold. And so does the devastation they produce. I think I am a decent fellow, and if I see a man suffering it moves me to deep compassion. I would even risk my own life to save any fellow man whom I see in danger. I find death and suffering awful, and all my life I have battled against them. But the death of 100 million people, whom our bombs might wipe out, means nothing to me. I can square 10 or 100, but not

suffering. I even talk lightly, if not frivolously, about the wiping out, the pulverizing, of our own cities with the tens of millions of people in them. These dimensions are beyond me.

I am faced here with a very queer problem. Why is it that the suffering of one man moves me, while the suffering of millions makes no impression on me whatsoever? This is a biological problem in which I am more at home than with atomic energy, and I think I can give you a clear answer. The answer is simply that my brain is not made to deal with such dimensions. It is made to help me to keep alive in my immediate surroundings. My brain is my instrument of thinking; and, like any other instrument, it can do only what it is made for. My brain is made to help me to get through the petty problems amid the petty dimensions of my everyday life. It was not I who built this brain. I have inherited it from my nth-degree great-grandfather, who was an honorable cave-dweller. While other species have grown fangs, claws, and tusks to face the struggle of life, my honorable grandparent has grown a brain which, eventually, proved to be superior to fangs, claws, and tusks and assured him the supremacy among his fellow creatures. This brain enabled him to make simple decisions, make tools, use fire, kill other animals, find food, safety, and sexual mates. It is this sort of thing my brain is made for and, even if all these propositions have become more sophisticated in our complex society, essentially they remain unchanged. Never was my brain intended to cope with cosmic dimensions or forces. It is simply not made to deal with anything beyond the dimensions of my petty

surroundings, and this is why the death of 100 million people, or 100 million miles, or 15 million degrees mean nothing to me. So when man "discovered" atomic energy, and brought to our globe cosmic forces, he worked himself into a queer situation. He was clever enough to create conditions in which these cosmic forces can be released, but he is no longer clever enough to imagine them, to understand what they really mean, and he tries to fit them into his petty thinking. So it is natural that the politicians should deal with these forces as if they were but new pawns in the old chess game of power politics, and readily go to the brink beyond which lies the holocaust. They also think that they can find protection against these all-devouring forces by petty means, by digging holes in the ground which they then call shelters, and in which they hope to hide.

This is where the mortal danger lies, which threatens us with extinction: we have in hand cosmic forces which we are clever enough to release but are not clever enough to comprehend. Our brain is made to deal with the primitive fire in our caves, but not with the cosmic fires with their 15 million degrees.

I have talked to you about the brain, which, as a biologist, I somewhat comprehend. So I would like to tarry for another moment on this subject because I see, also, another danger. As I have told you, the brain is an organ of survival, an organ made for finding advantage, but not made for finding truth. So, it will always have a tendency to accept as truth what is merely advantage. We mostly do what we want to do and then use our brain for finding excuses, justification for our deeds and desires. It is only very ex-

ceptional brains (you may call them pathological) which can put truth before advantage. Their owners usually end on the stake or in a chair, electric or academic. These people became the great scientists—like Galileo, Newton, Pasteur, and Einstein—who lifted human existence to higher levels.

I can illustrate this point with an example from my own life. I am a scientist, so I, too, have some of this pathological disposition to value truth above advantage, but even so, I suspect myself all the time of mixing up the two. When, some twenty-five years ago, unexpectedly, a big hatful of money was given to me in the form of a Nobel Prize, I had to do something with it. The simplest way to drop such a hot potato was to buy shares. So I went to a broker and asked him to buy shares for me, but told him to buy only shares which, in case of war, would go down, and not up. Knowing the make-up of the human brain, I was afraid that should I have shares which would go up in case of war I would, unconsciously, wish for war, and accept as truth any argument which promoted war. I did not want to fall into this trap, having worked all my life for peace and the welfare of man. War came, all the same, and I lost my money, but saved my conscience.

I have talked about this point in such detail because it brings out a danger we are faced with as a nation. I hear that more than 10 per cent of the total population of the U.S. have already become directly dependent for their subsistence upon armaments, and with growing armaments the 10 per cent grows. I am frightened to my bones, because, unconsciously, these 10 per cent must wish for more and more arma-

ments. If we do not do something about it, the U.S.A. will be converted into a warfare state. Part of the world is already looking upon the U.S. as warmongers, and even our Allies are afraid of us—perhaps not without reason, because one cannot heap up bombs indefinitely without having one go off and start the holocaust.

You must have noticed, by now, that behind these many words of mine is the simple fact that I am in serious trouble when I try to take a stand on our national problems, among which the first is the ATOM. You must also have discovered where my real difficulty lies: I have to take a stand on problems which are beyond the dimensions my brain can handle. Science has abolished distance. It has reduced the Atlantic and Pacific to ditches, and, in the wake of science and industrialization, enormous human masses have developed which now rub elbows with one another, the benevolent buffer—distance—having fallen out from between them. There are nearly 200 million Americans and about as many Russians, and thrice as many Chinese. These numbers mean nothing to me, they are abstractions, and I have in my hand cosmic forces which I am unable to comprehend, and so am in danger of making a wrong move which may wipe us out altogether. You are fortunate that, being foreign-born, I could never become your President, but I could become your Congressman or Senator, who would have to deal with these problems. And then I might get mixed up between the cosmic and the petty human dimensions, and I might get mixed up between truth and my personal interests. I might give your money away for digging holes instead of

finding a cure for your diseases or improving education. I might vote billions for making bombs more devastating and have no money left for the study of peace (an equally difficult problem), the study of the question of what the political world structure would have to be in order to be in line with the present development of science and technology.

I think I am a decent fellow, but I am a decent fellow only as long as I am moving in my petty surroundings for which my brain is made—while the people, for me, mean Jacks and Jills. If I should have to decide on a question of global scale, if I should have to deal with the lives of hundreds of millions of people, these people would no longer be hundreds of millions of Jacks and Jills, but would become, for me, an abstraction. I would begin to talk about other abstractions such as National Glory, and I might vote for moves which might eventually mean the mutual wiping out of the Americans and the Russians. The thus vacated world would be left for the Chinese to occupy. All this would be my brave fight against communism, by which I would hope to get votes. I might also subscribe to statistical mass-murder, reading, with satisfaction, reports according to which a certain global fallout will increase malformations from 3 to 4 per cent only, a petty 1 per cent which we can easily take. I would forget to calculate that 1 per cent means nearly 30 million ruined human lives per generation. I might do a great variety of such things.

Please do not get alarmed—there is no danger of my becoming your Senator or Congressman. And so I will come back to my personal problem: how can

I take a decent stand on national problems with all the shortcomings of my mental make-up, which is out of tune with the dimensions of my problems? My scientific experience comes, here, to my aid. As a scientist I am accustomed to working with imperfect instruments. I do not mind their imperfections so long as I know them and can take them into account. So I think that, eventually, having realized the imperfection of my brain, I will be able to take a decent stand. I will simply have to be on the lookout, all the time, not to be tricked by these imperfections, which will tend to waylay me as soon as I have to deal with national or global problems.

Now, for a conclusion, I would like to answer a question which some of you might have asked while listening to my arguments: what about morals? Have we given them up entirely as factors of our thinking? Can they be of no help in our difficult situation?

What are morals? In my opinion they are simple rules of conduct which mankind established in the hard way, and which make living together possible. They have no intrinsic content and are strictly adjusted to our environment. One of our main moral commands is "Thou shalt not kill or steal." But, it would make no sense to preach to a tiger "thou shalt not kill," or to a mouse "thou shalt not steal," for to kill and steal are the moral laws of the jungle.

My honorable great-grandfather, whom I mentioned before, living with his family or small clan in an isolated cave, had to lead a primitive human society, and must have developed as the basic tenet of his morals the command: "thou shalt not kill inhabi-

tants of your own cave." Our present moral command is "thou shalt not kill those who wear the same uniform, have the same passport, or the same social system." Only our cave seems to have become wider—not our morals. I fully accept this moral, with one qualification. Science and technology have so thoroughly abolished distance that we humans are all living, now, in the same cave—our little globe—in which there is room for one family only, the family of man. So I feel I will have to put up a notice in this cave of mine: "playing with atomic bombs in this cave is strictly forbidden." Man has brought, with the atom, cosmic forces to this globe, which means that we have to put a full stop behind the first pre-atomic period of the story of mankind, and must start building up an entirely new world with new rules, and stop, in time, those forces which seem to be carrying us, now, inexorably towards doomsday.

If we give up our peace race, then our name may not go down in history as that of the people who prepared the atomic war, only because there will be no history at all—only lunar desolation.

*(Speech to Falmouth residents, January 1962.)*

## *We Must Share the Responsibility*

I AM not speaking to you as an expert, as an atomic scientist, which I am not.

I am going to speak to you as a citizen, a citizen of Falmouth, Massachusetts, which I am. I will not try, either, to convince you of anything. I will talk, solely, about my own personal problems, thinking that you may have problems similar to mine.

My problem is this: There is a world crisis, and as a responsible U.S.A. citizen I feel I have to take a stand. To be able to do so I must first think.

I am a biologist, a medical research man. My biology comes in at only two points. The first one is: All my life I have labored to relieve human suffering, and at present I am trying to build a cancer therapy, but have serious doubt whether all this has any value. Why try to prolong the life of sick old people, when we are planning to kill millions of healthy people, both young and old? I have serious doubts, which disturb me in my work. This is part of the moral degradation which we are all gradually undergoing.

We are not shocked anymore, at the open discussions of whether we should kill our neighbor with machine guns or just regular guns if he asks for refuge in our bomb shelter. We can discuss this openly, even in the press, without being stoned or ostracized. A high degree of moral deprivation, indeed!

The other point at which my being a biologist comes in is this: I have profound admiration for the way in which Nature has stabilized our material of heredity. As you all know, men have in their testicles, women in their ovaries, the genes which are the seed of all future generations. We got this material from the distant past and have it in trust as its temporary bearers. Nature stabilized this subtle material in a most wonderful way. It was not affected by starving, heat or cold. For the first time, man has found a means in high energy radiation to damage it forever. This, in itself, would be a satisfactory reason for avoiding any increase in high energy radiation, be it by testing in the atmosphere, or any other means.

My problem is: What am I, as a citizen, to do? There is widespread agitation that I should dig myself in, build a shelter. My problem is: should I? In such a situation I like to use the brains of others and spare my own. I am listening to experts.

The other day I opened the newspaper and found Dr. Libby's opinion. He told the American people that by building shelters they can have a 90-95 percent chance of survival in an atomic war. Dr. Libby is a fine scientist—Nobel Prize and all that. That's fine. But a few days later I also read that there was a forest fire in California—a petty fire as compared to the

fire-storms of an atomic attack—but, all the same, Dr. Libby's shelter burned out. So I become doubtful. Then I find in the paper the opinion of Dr. Van Allen, the discoverer of the Van Allen Radiation Belt in our atmosphere. He is an equally fine scientist, and he may know even more about my problem, for Dr. Libby is a laboratory scientist. Dr. Van Allen knows what is "outside," and he tells us that shelters are of no use at all. So, I am nowhere.

Then I listen to Dr. Teller, the "father of the H-bomb." The H-bombs are his children. He is not only a good scientist but also a good family father, who would like to see his children dominate the whole world. More bombs, more shelters. But then, I read Dr. Condon's opinion. Of Condon, as a scientist, I have the highest opinion, and he tells us that shelters are a delusion.

The scientist I appreciate most of all is Dr. Szilard, because he is not only a scientist, he is a moralist, too. He thinks that we should stop all this lying, lying to ourselves and others, and start on the honest road of peace. Peace is the only safe shelter.

Though it is a point I will come back to later, I want to mention another opinion because it comes from a very high authority and has been published in a widely circulated journal. I mean the article by Mr. Strauss, the former Chairman of A.E.C., in the *Reader's Digest*. Mr. Strauss thinks we must resume testing. But, at the same time, I read articles by military authorities who state that we can overkill the Russians with our present means, so there is no need for further perfecting our bombs. I profess to be a Christian, that is, a follower of Christ, and I am con-

vinced that Christ himself would be satisfied with overkill and would not ask us to over-overkill.

So, in summing up, I am nowhere among all these conflicting expert opinions and am faced with the sad necessity of using my own brain. I should think that, with the accurate and reliable calculations available of what a bomb does, I should be able to figure out what I really have to do. We have just reviewed some of the results of all these calculations. Now let us look at them from the different angles. Let us take, first, the size of the bomb.

A reasonable size to consider would be 10 megatons. The Hiroshima bomb, in 1945, had 20 kilotons. This means a 500-fold increase in 15 years, that is, an average two-fold increase every year. There is no reason to think that this will stop, so, maybe, next year I will have to consider 20 megatons; in two years 40 megatons instead of 10—this creates an entirely different situation. So I do not know what to consider because war need not be this year; it may be next year or even later.

Let us consider the time factor. The Holifield report assumes that within an hour all will be over. But we know that we, as well as the Russians, have many more bombs than launching sites, and launching is a slow business, not just like loading a gun. So this means that launching will have to go on over long periods, probably, also, after all alarm systems have been destroyed. So this leaves me nowhere again.

As to the nature of the bomb. We know the half-lifetime of the fissionable material produced, but this depends on the nature of the bomb. We know nothing of future bombs. I just read a calculation about a

cobalt bomb which would keep us in our shelters for six years, and I doubt that I could equip my shelter for six years and I don't know who would pay and feed me during that period.

As to the place hit by the bomb, there are extensive calculations about a bomb exploding on Columbus Circle, New York. But what if a bomb happens to fall into the sea, say 100 miles from here, and explodes in the deep? According to the calculations, a 50-foot tidal wave will be generated. At Falmouth, we live, so to say, in the ocean, and Cape Cod is low, so I can expect that it will be covered with water, which means that I will get drowned in my shelter, and this I don't like. So, I come to the conclusion that I will not build a shelter, however loud the voice of those who want to sell me concrete and make a fast buck.

All these simple thoughts relate to physical factors, but as a U.S.A. citizen I have to consider, also, wider moral and political issues.

Looking at the Cold War from a higher point of view this is a struggle between two nations—the U.S.A. and the U.S.S.R.—not a world issue. The possible war of the two becomes a global problem only because the high energy radiation generated in their war would hurt all people on this globe, the atmosphere being a common property of mankind. I feel that no two nations have the right to poison life for the rest of the world, and they have to find some other means to solve their problems. Younger African nations begin to be tired of all this. This is a moral issue, and since we have already put aside morals, let us leave them out here, too, and just consider more direct national interests.

Where I get into trouble on this line is that I have many English friends, because I have learned what science is in England. As a U.S.A. citizen I am responsible also, for the actions of my government. I have made my English friends, and England, into a target for U.S.S.R. atomic bombs by means of our bases and other military installations there. I also know that my English friends will not dig in. They have no money for it. We have. I have. But what will my English friends think if I dig in and feel safe and leave them outside after I have made them into a target? I will tell you what they may do: they may court the friendship of the U.S.S.R. and drop the U.S.A. Then we will be alone.

As a U.S.A. citizen I have always had a vague feeling that my country is destined to lead the world, and as a native Hungarian I have always hoped that the U.S.A. will set a limit to Communist expansion. Now, what will happen if we dive underground, leaving the rest of the world exposed? Evidently, from underground we cannot lead the world. So, digging in means abandoning the world, leaving it, wholesale, to Communist leadership.

You may object to all this and say: leave the whole thing to the government. We have only to produce the \$200 billion needed for a serious shelter program—about ten or a hundred times as much as would be needed to lift all undeveloped nations and feed, for a long period, all those who are starving. This would give us more security than the deepest shelter. I think that we cannot leave all the responsibility to our government. We must share it, for, in the last analysis, it is we, the people, who have to decide,

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since our government is a government of the people, by the people, and for the people. All of us have our individual responsibility.

(*Speech to Falmouth residents, published in The Falmouth Enterprise, Dec. 8, 1961.*)

## *The Three Faces of Science*

SOME time ago, I had a letter from a friend asking me to write an introductory chapter for a book of essays of his. It is difficult to refuse a friend, so I simply said Yes. After receiving a reminder that my contribution had its deadline, I looked up previous introductory chapters to see what they were about. To my dismay, I found that they were all, more or less, obituary notes. More precisely, they were autobiographies, written by old research workers who were expected to die soon. They were, so to say, obituary notes written by the deceased himself. They reminded me of the saying that the cheapest funeral you could get consisted of taking a candle in your hand and betaking yourself to the churchyard. This had to be something like it: an obituary note written by myself. Once having said Yes, I had to write it.

In order to write it intelligently, I had to review my own life in order to understand it better myself. The first thing I found was a complete dichotomy, a complete splitting between its inner and outer course. The inner course was simple, if not dull, my sole ambition in life being to contribute to

science and live up to its standards. Nothing could be simpler and smoother. Not so the external course, which was exceedingly bumpy, full of troubles. I was born in a feudalistic country, and feudalism is very nice—if you happen to be born on the right side of the fence. This I did, and I had no worries about my future, but I had not finished my studies yet when I had to waste five years in a war, after which I lost practically all I had. Some time afterwards I find myself working in Hamburg with a slight edema due to starvation, ready to sell myself for some colonial service. Some time later I find myself in a war again, this time on the right side but in the wrong place, involved in underground activity.

At one point, I find myself in Istanbul, entangled in secret diplomatic actions, in a setting fit for a cheap and exciting spy story. I am warned that Hitler has found out about it and has summoned the governor of Hungary and, screaming my name at the top of his voice, has demanded my delivery. Some time later, I find myself in Moscow, treated by the Soviet Government in the most royal fashion (caviar three times a day) but it does not take long before I am declared a traitor again. This time I betrayed “the people.” I had the honor of acting as the villain on the stages of Budapest. It is a very high political career, indeed, for a scientist to be declared officially a traitor twice within the short span of a few years! At the same time, the U.S.A. refuses admission because of my Soviet sympathies. Eventually, I find my haven at Woods Hole, where my research is most generously provided for by the United States Government.

But, all the same, my troubles are far from over, for I am plagued by doubts about the usefulness of my work and must ask myself, as so many other scientists must do, whether scientific research has any value if it takes mankind to the brink of extinction. Should it not be stopped till man matures sufficiently to be able to handle the formidable tools of science without danger of self-destruction? I have a drawerful of treatises on philosophy, science and politics, written for the sole purpose of clarifying my mind about this question. I have mentioned only a few of my bumps, but I hope that they will suffice to convince you that my outward life was full of trouble.

All this, in itself, would have no special interest if it did not reflect the troubles of our age. We are living, undoubtedly, in the most turbulent period of human history, with dangers unparalleled before, because scientific progress has far outstripped moral development. So my personal troubles, being somehow connected with the troubles of our age, make me attempt to understand current history: what does all this turbulence mean and how is it related to scientific research?

Erasmus of Rotterdam, that sage of the early Renaissance, gave much thought to the question: What causes the trouble, *tumultus*, in man's history? He came to the conclusion that human history had its repetitive pattern: man develops a certain philosophy and creates his institutions in line with this philosophy. Then his philosophy changes, and the new outlook has to fight the old ideas and old institutions with all their vested interests, and there is trouble, *tumultus*, till the new ideas win and create

a corresponding new order which again assures a period of peace.

The troubles and dangers of our days are greater than those of any earlier age, and so it follows that, if Erasmus is correct, the change in our thinking must be more profound than any earlier change. Not only is the change more profound, it has come more suddenly than any earlier one. Our world is changing at a terrific speed. If Caesar and Napoleon could have met, they could have discussed their military and political problems without difficulty. The 2,000 years separating them made no difference. Today, 150 years later, they would both be equally strangers. I am not so terribly old, but I still remember a paper, presented at the Academy of France, which proved, definitively, that flying is impossible. I expect that when I fly home from Europe next year I will not have to adjust my watch.

There is no doubt that the change in our thinking which underlies all our troubles corresponds to the transition from the pre-scientific to the scientific period. I would like to illustrate this point by the story of the two stones, linked to the name of one of antiquity's greatest natural philosophers, Aristotle, and the name of one of the first modern scientists, Galileo.

Aristotle said that a big stone falls faster than a small one. What is so noteworthy about this statement is not that it is wrong but that it never occurred to Aristotle to try. Probably he would have regarded as an insult any suggestion that he make an experiment. His mind reigned supreme and gave him all the answers clearer than any crude experience could do, while his senses, which he thought perfect, in-

formed him about the ultimate reality. If he touched something, it felt wet or dry, hard or soft, so these had to be the elements out of which the world was built. Starting with this way of thinking, it was only a small step further to suppose that even human feelings are perfectly safe guides. If man resented death, there could be no death, and so a "beyond" was created, be it Hades, Hell or Heaven. To solve problems outside the realm of experience man simply had to extend his experience.

I met an example of this thinking a few years ago, when in the discussion following a popular lecture, my disputant said: "If I go home and find order in my room, I know somebody must have made it. There is order in the universe, so somebody must have made it." The whole universe had to be made by somebody, somebody more powerful than man. So man populated the world with gods and spirits created in his own image, and codified the rules of this world in the form of countless different religions, all with exclusive rights to the last and ultimate truth, all based on faith, that is, accepting things without evidence. They satisfied man's fears and hopes and shifted much of his responsibility into his gods' shoulders.

This way of thinking led man gradually into an imaginary world, run by divine whim. Each of us is, by necessity, the center of his own universe, so there could have been no doubt that man was the center of the universe which rotated around him. Since he was the main concern of the gods, they did not interfere with his central position.

What is characteristic of this pre-scientific think-

ing is man's absolute self-confidence—his conceit and subjectivity. Science calls this thinking autistic. This is one of the two main ways of thinking, deeply founded in our mental make-up.

Two thousand years after Aristotle something must have happened to the human mind because, here and there, men appeared, like Copernicus and Keppler, who simply put two and two together, while a boisterous young man, Galileo by name, went up a leaning tower from which he dropped two stones, a big and a small one, bidding his companions to observe which one hit the pavement first. This meant an entirely new, humble attitude. It meant that our thinking is not infallible and, if we want to know something of the world surrounding us, we must modestly ask questions of Nature (do experiments) instead of simply sitting in judgment over her. This same man, Galileo, did not trust the perfection of his senses either and built, later, a telescope with which he discovered the satellites of Jupiter and the rings of Saturn, never before seen by man, clearly indicating that the universe could not have been created solely for man's enjoyment or temptation. Galileo's trail was followed by a steadily increasing number of people thinking in the same manner and, as a result, we see modern science, today, in full development, in explosive expansion. The foundation of this science is a new way of thinking, characterized by a profound and true humility. It tells us *not to accept anything without evidence, to approach problems, as such, with a cool head, with uncompromising honesty of thought, unbiased by hope, fear or interest.* This

way of thinking is the foundation of science—its first face, to which I alluded in my title.

The second face is made up of the natural fruits of this new approach, the *results* of science. Science has created the most powerful tools, eliminated the miasmas which decimated mankind before, extended the life span and lifted man from sickness, dirt and stench to a new dignity.

It is an entirely new world which science has created. Man is no longer living in the center of the universe but on an insignificant planet of one of the million stars of one of the millions of galaxies running away from one another with an increasing speed, approaching the speed of light. It is a cold and lonely place, this expanding universe, run by rigid quantum laws instead of a loving father. We cannot feel quite at home in this universe and do not dare to let the old world go. We still have God on our lips and our coins, but no more in our hearts. We may still pray, when taken ill, but take penicillin alongside to be safe. We pray for peace but heap up enormous stores of H-bombs. We profess to be followers of Christ but talk overkill. Our confidence is shaken. We are like the curate who wrote home: "God willing, I will be home on Thursday, but on Saturday, in any case." We are right in the middle of the most profound transition in human thinking that history has ever known. The symbol of this muddle, to me, is that colossal and beautiful statue of Christ, standing on a hilltop in Spain, and stretching out his arms to mankind. On his head he wears an enormous lightning conductor, to protect him should his Almighty Father want to smite

him by lightning. We are mixing up divinity with electric potentials. To put up with these contradictions we have learned to lie to ourselves, that is, to put up with thoughts which would not stand up to the simplest logic.

Do not misunderstand me. I am not depreciating the pre-scientific philosophy. It has led, for centuries, to stable structure, and I cannot listen to Bach's music without the deepest reverence for that profound religiosity which was his driving force. Nor could I look at the Cathedral of Chartres or the Sainte Chapelle in Paris without being overwhelmed by the force of the faith which built these structures. In its time this solid faith created a stable world order, but we cannot go back to it and are living right in the middle of the transition with one foot in the old world, one in the new. We ourselves do not notice how impossible, ridiculous and immoral this situation is. Is it not ridiculous if one big nation spends a great part of its labors on sending astronauts into space to reach distant stars, while raising ten-foot concrete walls, here on earth, to separate man from man? Is it not immoral that one-third of mankind invests a great deal of its excess production in murderous weapons, produced in secret against one another, while another third is starving? These contradictions force governments to make lying the standard tool of power politics. We are too much accustomed to these lies to see them as such.

All this would not matter, could we have time to adjust to the new situation, had science not produced the most formidable tools which threaten us with extinction. It is impossible to mix the two worlds,

the pre-scientific and scientific, without mortal danger; to have megaton bombs produced by scientific thinking and then run them with outdated eighteenth-century sentimental, egotistic political thinking.

Where is the way out? Can we go back? We cannot. The new way of thinking has undermined the old world in our hearts. It has undermined all earlier hierarchies, gods, princes, barons, and so forth; haves and have-nots, hungry and well-fed, developed and underdeveloped. A new wind is blowing which has awakened the hopes and desires for a brighter life in the hearts of billions of people. They are clamoring for a better fate and reject the idea that they have to live in the valley of sorrow.

History is a one-way street. We can only go forward, and the solution of today's grave problems does not lie in retarding science, but in applying it in full measure, both of its facets, its results *and* its way of thinking—in approaching the problems of politics with uncompromising honesty of thought, with a cool head, unbiased by hopes and fears and egotistic, sentimental nationalism. Our globe has shrunk too much to be inhabited by more than one family, the family of man. If we want to stay alive, we have to build up a real United Nations—a single great human society.

At this point you may raise a serious objection. Human relations are decided by morals, and our present troubles may be due to the fact that scientific and technological development has outstripped moral development. Man has had no time to adjust his moral code to the new conditions created by science, and science cannot help, simply because it has no

moral content. But, is this really so? Has science really nothing to do with morals? It depends on how we look at it and what we think science really is. If we look upon an experiment merely as a measurement, then we may deny it a moral content, but, in the same way, we may deny a religious content to the Holy Communion, which consists of eating bread and drinking wine. Religion, if cleansed of church imperialism, is, in essence, identical with science, it is a search for truth and understanding. It differs from science only in its methods and approach. But why give preference to autistic thought and deny science a moral content because it works with more reliable tools? And what is science? And what are morals? Morals are the simple rules which make living together possible. They are the foundation on which human societies are built. They have no intrinsic content, vary according to conditions, and have a meaning only in relation to society.

It would make no sense to preach to a tiger that "thou shalt not kill," or teach a mouse "thou shalt not steal." In the age of the cave-dwellers the moral command probably was "thou shalt not kill dwellers in your own cave," a moral level at which governments still keep us (only their caves have become bigger, not their morals). If morals are linked to societies, can science then have morals? The question is: is science really only a collection of data, formulas, books and laboratories? Is it not a society, too? To me, science is, in the very first place, a community of men, a community which knows no limits in time and space, the citizens of which are all those who have sought truth with a scientific mind. This so-

society is a part of a still wider society which comprises all those who have sought truth and beauty throughout the ages and lifted man above his fellow creatures. I *am* living in this society. Lavoisier and Newton (and Bach, for that matter) are my daily companions, and a Chinese or Indian scientist, whether dead or alive, is much closer to me than my own milkman. This society has its very strict moral code: *intellectual honesty, mutual respect* and *good will*. This is the third face of science to which I have alluded in the title of this talk. So I can try to answer, now, the question which I asked at the outset: Should science be promoted or retarded?

In a way, the question has no sense, because the mainspring of science is human curiosity, which is one of man's fundamental traits and cannot be quenched. But there is no need to quench it because, if there is a way out of our present troubles, it is only in going forward, in applying science in full measure, applying all three of the facets which it offers to mankind as the foundation on which to build a better future. A way out can be found only in accepting responsibility for our own fate and spreading scientific thought and morals till they become strong enough to create their own world.

There is one question left open which I will have to answer before leaving the subject. In the pre-scientific world man was the center of creation, the sole concern of his gods. Science has demoted him to the rank of a dweller on an insignificant satellite in an expanding universe. Can we really accept this humiliation without becoming discouraged? Can we accept the idea of being made of dust, to which we will have

to return? My first answer is: *magna est veritas*, (great is the truth) and, whether pleasant or unpleasant, it is the only foundation on which one can build. But, looking deeper into things may lead us to a broader evaluation. I felt one of the greatest shocks of my life when visiting the magnificent castle of the powerful Dukes of Ghent. Those dukes must have lived in their magnificent medieval castle in stench, dirt, draft, darkness and disease—in conditions which none of us could support for more than a few hours. Science has lifted us to a higher level of existence and dignity. Do not forget that the Republic of Athens was wiped out less by the Peloponnesian War than by an epidemic, probably lung-pest. I cannot think of a greater humiliation for a man than to be serving as food for senseless bacteria. The most splendid human mind I ever knew was that of my friend Johnny von Neumann. This mind was wiped out by a senseless cell, starting a senseless proliferation. This is a real humiliation, and not the fact of being a small part of the big Nature. While pre-scientific thinking made man feel like the master and ultimate judge, he really was the toy of natural forces. Science is making him their master, and we no longer share Bach's idea of a great privilege when we keep one half of our children alive. Our wives can bear children without fear, and there is no reason why we should not share, in time, all our advantages with all men. In the pre-scientific world the only possibility of expansion lay in robbing and subduing our neighbor. Science has opened the way to an unlimited new expansion and, if only we all could join hands and

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minds, we could open a future, the splendor, dignity and beauty of which cannot be pictured today by the keenest imagination.

*(Talk given at The Medical Circle of New York  
October 11, 1961.)*

## *An End to Tumult*

ACCORDING to the reliable calculations of a few years ago, the reserves of the world's coal and oil were to give out in half a century, threatening our civilization with collapse for want of energy. Science has saved mankind at the eleventh hour by discovering atomic energy, promising the fulfilment of the age-old dream of universal wealth and human dignity. But tragically, the dream is turned into the nightmare of total extinction. Why?

Erasmus of Rotterdam, the great thinker of the Early Renaissance, distinguished between calm and troubled periods of history. Trouble, *tumultus*, is the sign of transition. History is molded by ideas which create a certain order, and order creates tranquility. The ideas change, and the new ideas have to fight against the partisans of the antiquated order; there is trouble until the new ideas are generally accepted and a corresponding new order is established. The greater the transition the greater the tumult. We have to burst our skins to grow. The faster the growth, the more painful the process.

What is this scientific thinking which has brought about all these changes and troubles? There is no

mystery behind it; it is quite simple. Scientific thinking means that if we are faced with a problem we approach it without preconceived ideas and sentiments like fear, greed, or hatred. We approach it with a cool head and collect data which we eventually try to fit together. This is all there is to it. It may sound simple and easy. What makes it difficult is the fact that our brain is not made to search for truth; it is but another organ of survival, like fangs or claws. So the brain mostly does not search for truth, but for advantage, and it tries to make us accept as truth what is only interest, mostly short-range interest, allowing our thought to be dominated by our desires. Our social theories, therefore, are made mostly to justify our actions, not to lead them.

Since the Second World War the U.S.S.R. and U.S.A., together, have spent about \$1,000 billion on safety (a sum too great to imagine) and with it have bought fear and jitters and the risk of mass-extinction. But, in spite of this total failure, we still continue on the same lines, heaping arms on arms, developing missiles, anti-missiles, and anti-anti-missiles, knowing that somewhere and sometime a bomb will go off, starting the general holocaust.

Where is the way out? Which way should we go? What is the political, economic, and military structure in harmony with the progress of science? Nobody knows, but there is a way to find out. First, the question has to be asked. The men to answer it are the men of good will who know more than how to be elected or make war, men who can think scientifically. They can be brought together to discuss the problem.

To my mind the situation is, essentially, simple. One of the main factors deciding the relation of man to man is the distance separating them. While man was scarce, there was no problem. When his numbers increased, there must have been a great deal of killing. As he congregated in more compact groups, tribes, or nations, and distances became smaller, individual killing had to be stopped within the groups. But it continued between groups. It went on until lately but was not too dangerous for the race, because one of the contending parties always had the chance to survive. Science has brought two new factors into this picture. It has abolished distance, fusing mankind into one single compact group. We have seen the English Channel and the Atlantic shrink before our eyes to two ditches. The other factor is that, due to the atom, in the future both contending parties can expect to be wiped out. So fighting has to be stopped. Armies have to be abolished altogether. The only world which is in harmony with science is a world with no armies. The society of nations, if it wants to survive, has to go through the same development individual societies had to undergo, replacing lawlessness with law, arms with police.

The first argument usually brought up against such a reorganization is that it is impossible. It is not. It must have seemed equally impossible to any gentleman to drop his sword three centuries ago, or to any Texan to drop his gun eighty years ago. How could arguments be settled otherwise?

But how can we disarm completely, if we are unable to make even the smallest progress towards disarmament, in spite of the desire on both sides? This

failure indicates that no partial solution is possible. The present political structure is a self-contained system of which no single brick can be removed without the collapse of the whole building. It is based on power, the balance of power, and not on intelligence. The two don't mix.

Of course, there are always criminals, not infrequently even among the heads of states, and so there would have to be a police, a strong international one, commanded by some international body like the UN. Naturally, it would have to be a truly supranational UN, built with scientific objectivity, and not a UN which—for example—can ignore the existence of the huge nation of China. This police could also see to it that no minorities get into power anywhere, that no state is run against the wishes of the majority of its people, and that local revolutions or wars are not used as instruments of big-power politics.

But how can we disarm, if we cannot trust our opponents, and if there seems to be no way to establish an effective system of inspection? The problem of inspection becomes an easy one as soon as there are no armies and therefore no military secrets to hide. There need be no limit to the number of “inspectors” any country can send to the other, and there need be no closed doors before them.

I often see headlines about the “survival race.” The hard fact is that there is no such race, for we have to live or die together. But there is a third possibility: that the Cold War be made into a noble competition to the advantage of both parties. We Americans praise our bipartisan system, as compared to a one-party system. One of the greatest troubles of this

world is that there was a one-party system during the past century, the one-party being that of the Westerner who dominated the whole world. The rapid progress of the Soviet Union and China created a bipartisan world structure, and American science and education already feel its beneficial effects. It could become a general blessing.

The dangers of the present situation, as well as the gains which could be made by disarming, are enormous. Why, then, do we not disarm? The reason lies, at least partly, in a minor human shortcoming. The human mind is so constituted that once a statesman gets to the helm he stops seeing his country as the sum of its people and starts thinking of himself as a guardian of some abstraction, a theory or a state, glory or sovereignty. This leads to paradox. Instead of guardianship, the governments become the enemies of their peoples, willing to have them killed or poisoned in the service of their abstractions. The contending governments are, in a way, members of the same trust, allied against their peoples, each government playing its part in frightening its people, keeping fences erect and impenetrable.

A recent editorial of *The Saturday Review* calls for two billion angry men, unwilling to be killed or poisoned, to tear down these fences. I would prefer to see two billion men, capable of thinking with a scientific clarity, establishing a new world order in harmony with scientific progress, and making an end of the tumult.

(*Guest Editorial published in The Saturday Review, May 10, 1958.*)

## *Science, Ethics, and Politics*

WE are often told that science has no moral content. Certainly, if I measure the respiration of a tissue, I have little to do with morals or ethics, but on the same ground one could deny a religious content to the Holy Communion, drinking wine and eating bread not being, in themselves, religious acts. If there is a Creator, then scientific research would be tantamount to worship, there being no greater compliment to a creative artist than an effort to understand his work.

The scientist is searching for truth for truth's sake and, if it is found, he processes it without fear of consequences. This demands the highest ethical standards and brings him into line with the religious and moral leaders of mankind. What the scientist really wants to know is the internal laws that hold the universe together with all that is in it. Morals are the laws that hold human societies together. So science is not devoid of relationship to ethics and morals.

Morals are practical prescriptions that tell us how to live to be able to live together. The moral outlook of a scientist has to be wider than that of the average human being simply because his society is wider, not being limited by time or space. The community

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in which I live has Galileo, Newton, and Lavoisier as its active members, and I cannot help feeling more affinity to Chinese or Indian scientists than I do to my own milkman.

As to politics, up till lately, there was no need for the scientist to take cognizance of its existence. However, lately, politics has penetrated not only into science but also into the private lives of individuals, forcing the scientist, too, to make a stand. That science, in certain countries, is dictated by political dictators is so crude a matter that it demands no discussion.

A subtler question may be asked about the aims of science. The main driving force of researchers is mostly some sort of a curiosity, the gratification of a mental need, which makes research a selfish occupation. However, from a higher point of view, scientific research is one of the human efforts aimed at elevating man. Within the last decade, science has created the most powerful tools, which, like any tools, can be used for construction or destruction. The scientist cannot remain a neutral spectator and refuse all moral responsibility when he sees the politician run away with these and turn them into tools of destruction.

We all have had the bad luck to be born in an age of a moral crisis, and, according to Dante, the hottest places in Hell are reserved for those who remained neutral at times of a moral crisis. So we all have to take a stand, simply as human beings. Humanity has its well-established moral code on which human relations are based. It is these moral laws that enable man to live in a society, and the problem is whether

these morals apply only to the individual or also to groups of men; whether crimes which are punished by death in one country should be suffered to be practiced on a big scale as a matter of routine by governments in another country, because they are internal affairs. This is more than an ethical problem. As a society could not exist without a moral convention among its members, so countries cannot exist, side by side in peace, without a moral code. I am deeply convinced that this is the simple root of all our political troubles, the whole political superstructure being but a pseudo-problem.

I also believe that there cannot be two moral codes, an individual one and a political one. There is but one, and this one is very deeply written into our minds by our education. It is so deeply engraved that we see no need to restate it every time we make an agreement, and we tacitly suppose all written agreements to be based on this unwritten moral code. For instance, if we make an alliance, we see no need to state explicitly that it is made so that we may help one another and not to enable us to stab our ally in the back, as we were advised to do by Lenin.

It is natural that any system can achieve a great temporary advantage by rejecting the moral code that is written so deeply in its adversary's mind that he will believe and fall, over and over again. How often the world believed *ad nauseam*, when Hitler called every demand his last one. The Hungarians fell for the famous "salami technique" (one slice at a time). We saw just the other day a boring repetition of the way all leaders of a revolution could be trapped and marched to jail by an invitation to a "discussion."

There is but one moral code, and, if any government rejects it inside its borders, it will reject it in its international relations as well and create disorder. The question is whether any deviation from moral convention should be suffered by the rest of mankind. There are international laws to control pestilence, for fear that that pestilence may spread across borders. Why not the same for moral pestilence?

For most of my colleagues, these questions may seem so crude, and the answers so self-evident, that discussion of them is superfluous. But, political questions can come into the scientist's life also in subtler forms, making decisions more difficult. Let me illustrate from my own experience.

Before the war, in Hungary, my home country, the government often invited from abroad scientists whom I was glad to receive, until I found that the invitations followed a political pattern and were thus a part of a political plot, of which I was made an instrument. After the war I was treated by the Soviet Government with the utmost kindness and respect, which won my deepest gratitude. What was I to do later, when I found the methods of the Soviet rule based on moral principles contrary to my own? Was I to trade morals for gratitude? A difficult choice, indeed, for gratitude itself has its moral aspect. And finally, should I accept the invitation to see my colleagues and discuss, say, the origins of life and accept the hospitality of a government when I know that it will make out of that conference political capital, and when the dealings of that government recall, not colonialism, but the darkest days of African slave trade?

These are subtle and difficult questions, but we have to set our minds in order and make a stand to avoid being made into tools of politics with which we may disagree. Everyone will have to answer these questions for himself. What I wish to do here is to call the attention to three psychological factors that may make the choice difficult and obscure the issue unless we have recognized them.

The first of these can be summed up by the saying, "things are not as we see them, but we are as we see things." An honest man will think the world honest; a dishonest man, or government, will think that the rest of the world is made of criminals or warmongers. This is natural. We really know only our own mental machine and are likely to suppose that it represents *the* mental machine of man. So, if honest people hear and read about crimes committed in other countries, they just do not believe it, or may believe it with their minds only, not with their hearts. How far this is true is shown by the Communist trials in which Stalin had most of his comrades executed. The whole world listened to the confessions of guilt, and it occurred to nobody that all this may be just the result of a new invention, brainwashing.

Another peculiarity of the mind is that man likes to commit his crimes and gratify his animal instincts, or craving for power, in the name of high-sounding principles. So, we cook up such principles and appoint ourselves their defenders. Men of good will thus are sidetracked, giving their honest consideration to the principles instead of to the crimes. Even good ends do not justify bad means, so follow the advice, "watch deeds, not words." In politics, I observe *acts*

and lend a deaf ear to *principles* until my moral standards have been satisfied by the former.

My third, and last, remark concerns the fact that the brain is not an organ of thinking, but an organ of survival, like claws and fangs. It is made in such a way as to make us accept as truth that which is only advantage. It is an exceptional, almost pathological constitution one has if one follows thoughts logically through, regardless of consequences. Such people make martyrs, apostles, or scientists, and mostly end on the stake or in a chair, electric or academic.

In my home country, in the turmoil of the last decades, it was almost impossible for anyone who followed thoughts through to their bitter end to survive. Those, for instance, who took Christian doctrine seriously and refused to kill were themselves killed. I myself had the great honor of being declared a traitor by my Government twice—in opposite directions—within one decade. I have seen men of good faith believe the craziest *nonsense* once it brought jobs. So the scientist, when trying to make up his mind, should not give too much credence to the words *faith* or *creed*, either in himself, or in others.

Another difficulty may lie in the fact that moral laws are not always unequivocal. If morals are the rules which make living together possible, then they may change according to the conditions under which we have to live together. Bigamy is regarded as a crime in one country, while in another it may be the rule for any self-respecting gentleman. Even the most basic rule, "Thou shalt not kill," may change from age to age. At the dawn of mankind it might have read, "Thou shalt not kill inhabitants of your own

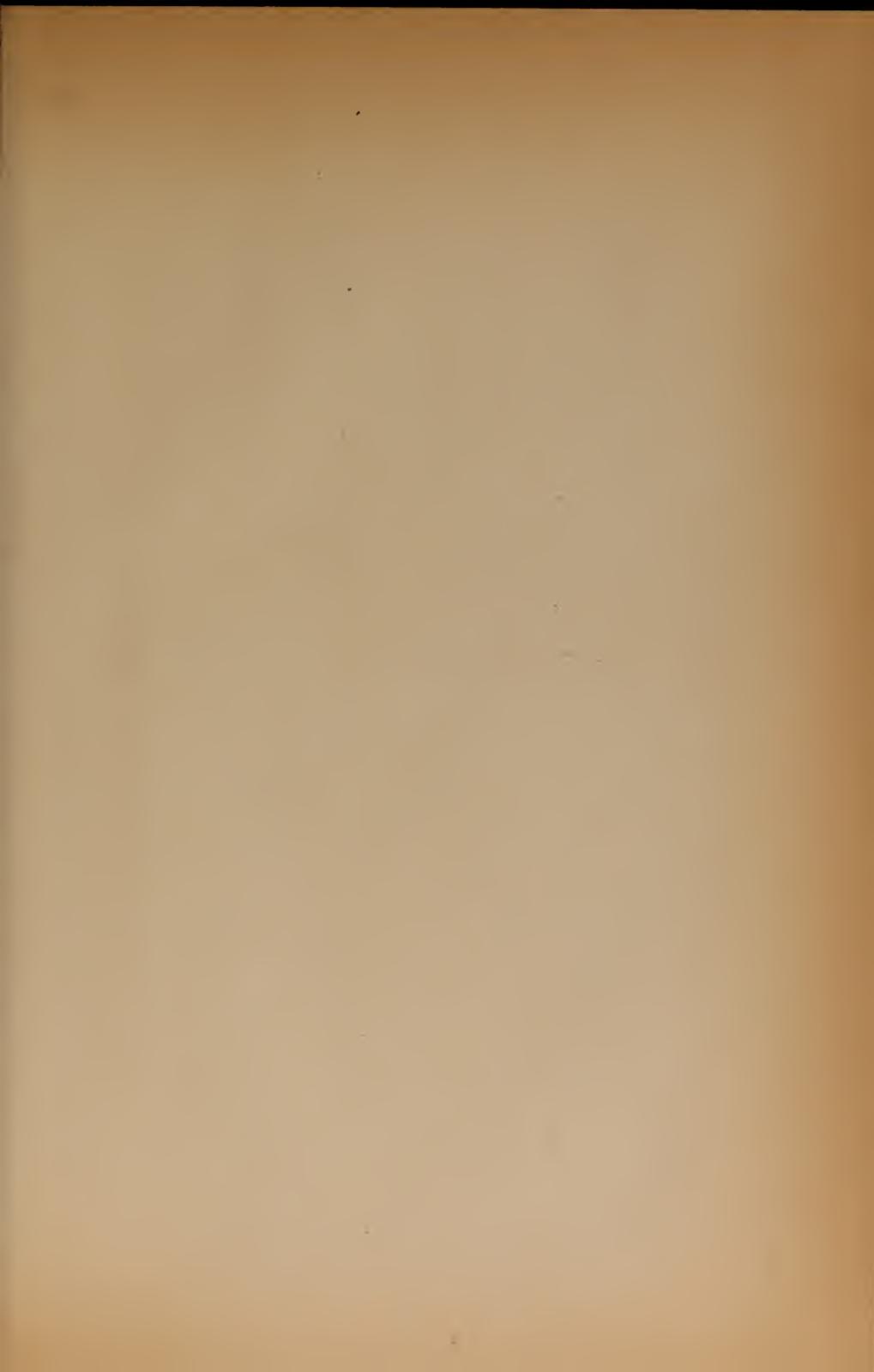
cave." Politicians would like to keep it at this level.

So, what is really needed is an international "bureau of moral standards," passing out "weights and measures." If these were generally enforced or accepted, we would march toward a more hopeful future and would not have to find consolation in the fact that, after all, our globe is but a second-rate planet and so its blowing up does not really matter.

(*Article in Science, February 8, 1957*)

AUTHOR'S NOTE: This article was written after the suppression of the Hungarian revolution. The congress referred to is the Congress on the Origin of Life, held in Moscow.

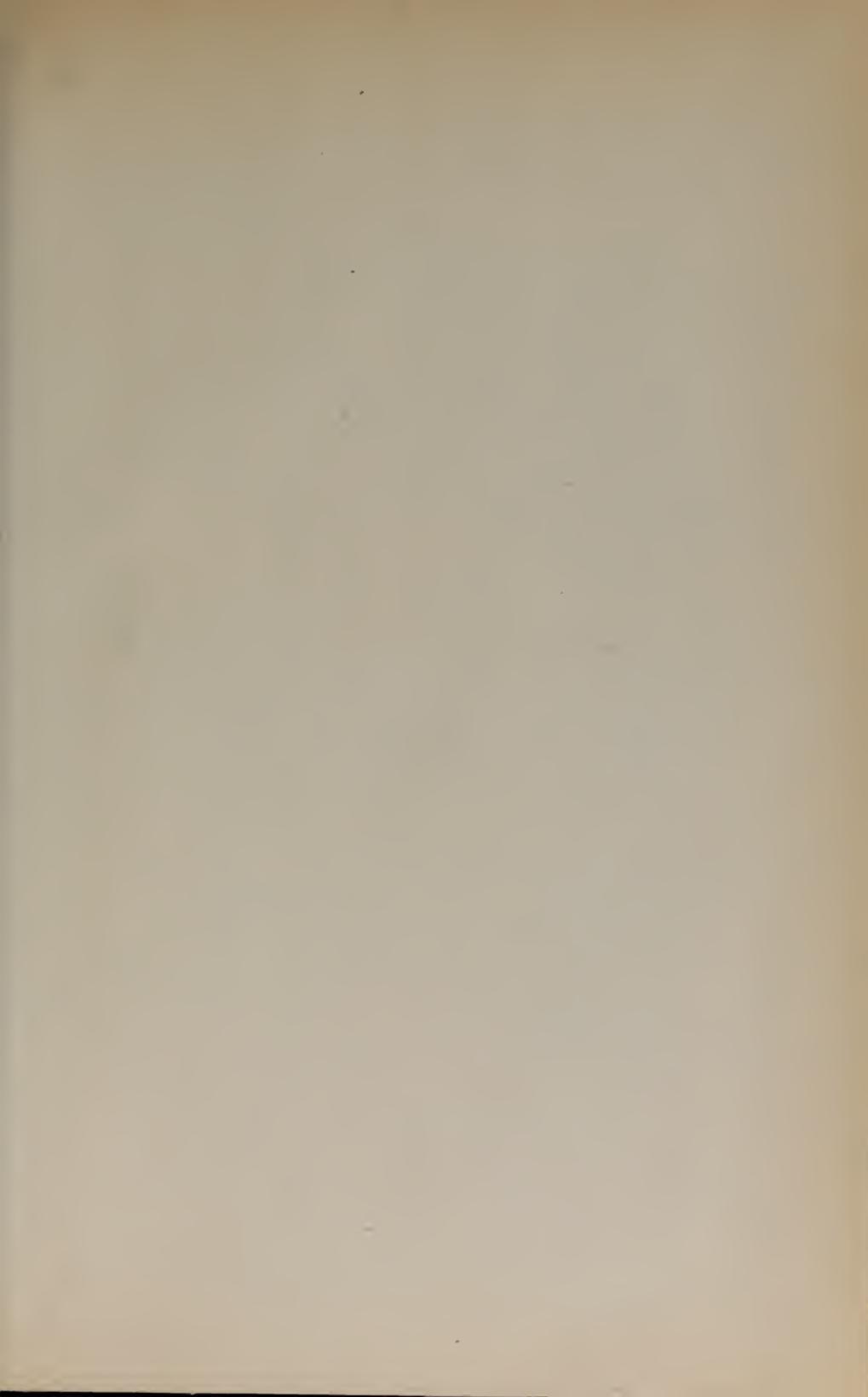


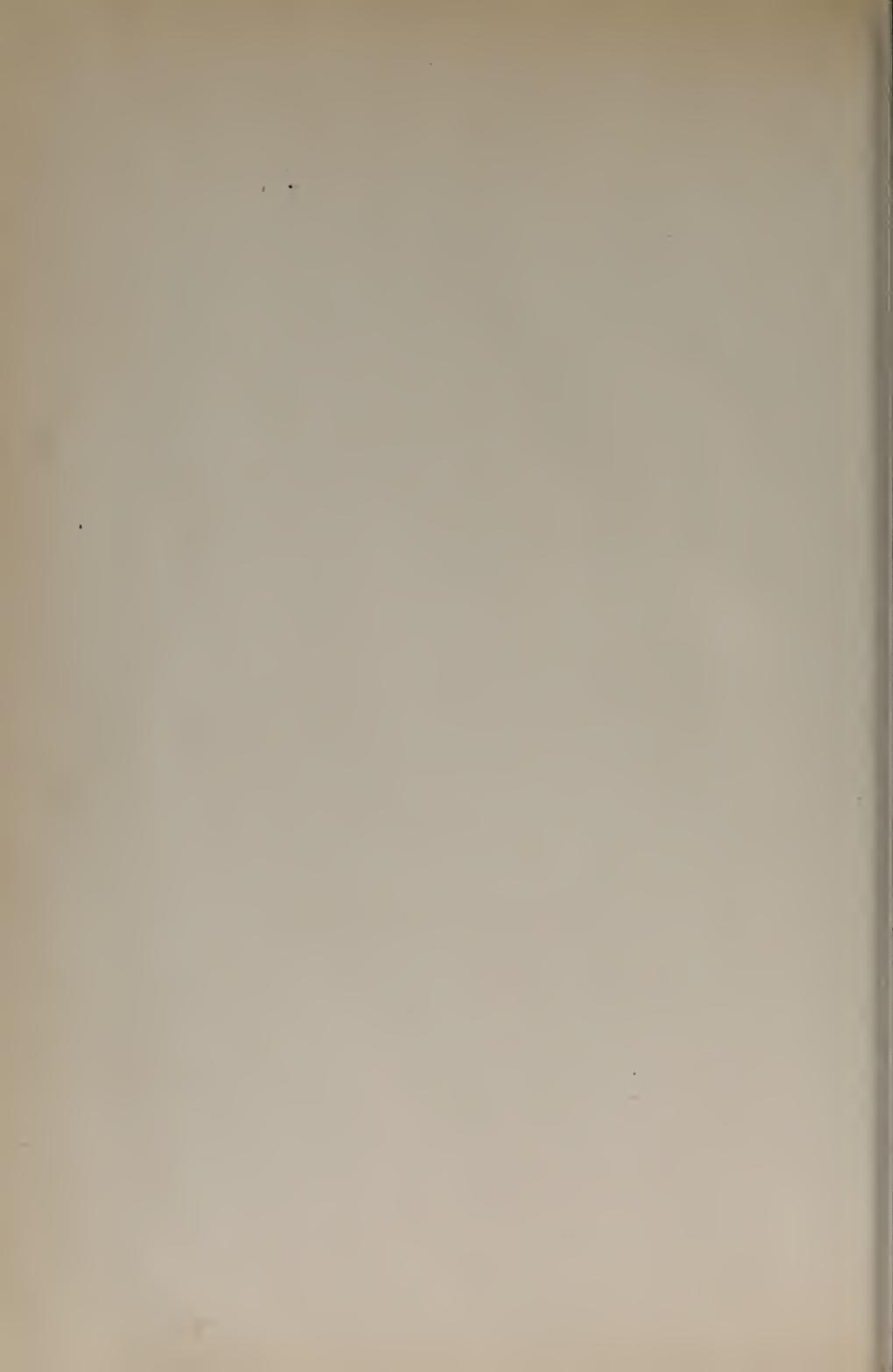












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