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LIBERTY, SCIENCE AND LAW
by
Vice Admiral H. G. Rickover, U.S. Navy
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To be a recipient of the award established in George Washington's name moves me deeply.

I was honored and pleased when I learned you considered my work worthy of the ideals of the Washington Award Medal, and of the high standards you established in selecting my distinguished predecessors. It gave me a special sense of satisfaction that could hardly be matched by any other recognition.

I have always felt that in honoring a person we must remember that all human achievement flows not only from individual effort but from associative effort as well. We, the living, are heirs to all the ideas and accomplishments of every human being who has ever lived. Nowhere is this more true than in the never-ending quest for new knowledge, and for new ways to put this knowledge to practical use. By its very nature, this is a cooperative endeavor.

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When I began my work in nuclear power a couple of decades ago, I was motivated by a belief that I might make a modest contribution. If I have made such a contribution in the past, I only hope I can continue to add meaningfully to it, and thereby more fully merit the honor you have so graciously bestowed on me.

In view of the current public, legislative, and engineering interest in our environment, I thought it would be fitting to speak on LIBERTY, SCIENCE AND LAW. I use the term science in its broad connotation which includes engineering and technology. My object is to show the implications of scientific and technological developments for human rights and fundamental freedom.

In 1966 I had the honor and privilege of addressing the Athens Meeting of the Royal National Foundation in Greece. I spoke on the Hill of the Pnyx, the place where the ancient Ecclesia had its seat, where men first practiced the difficult art of self-government, succeeding brilliantly for a time, but failing in the end. Our country, as you know, picked up the torch of liberty they had lighted and established the first representative democracy in modern times, even as Athens had established the first direct democracy in all history.

Twenty-four centuries separated these two great innovative acts in time, over five thousand miles in space. One took place in a small city-state possessing few material resources, the other in a huge country.

of great natural wealth. Yet there is a close inner link between them. They had the same objective. The principles they adopted to achieve their purpose were similar. Both sought to create--and did create--the political framework for a society of free men.

The framers of the American Constitution of 1789 drew upon Greek political theory and practice, adopting what had proved successful, ingeniously improving where the earlier structure had shown weakness. They were men of the Enlightenment, when classical rationalism sparked a new Age of Reason throughout the western world; when philosophers were inspired to mount an attack on every custom and institution that shackles the mind of man and arbitrarily restrains his actions--from superstition to class privilege, from tyranny by an established church to tyranny by a secular autocrat. The political institutions of all the nations of the free world today--beginning with ours--had their inception in the turmoil of that last phase of the Renaissance.

Western civilization is set apart from civilizations elsewhere, both past and present, by its dynamism, its extraordinary creativity, its intense preoccupation with things of the mind. All this started with the Renaissance. Not until modern western man rediscovered and retrieved his classical heritage did he begin to outstrip the rest of the world.

To borrow a Churchillian phrase, it can be said of Athens, of Greece in general, that never before or since did so few human beings leave so deep and lasting an imprint on so many others, differing in race and faith, distant in time and space from this cradle of western civilization. Their mark is on all our science, our art, architecture, literature, theater,

and on our political thinking and practice as well. The Athenians proved that free men could govern themselves; that it was possible to live in a civilized society without having to relinquish personal freedom.

This was an epochal achievement. In all his long life on earth, man has had but brief moments of freedom. His own nature is the cause of the paradoxical situation that civilization and liberty are interdependent, yet at the same time antithetical. One cannot be had without the other, yet reconciling them remains to this day what it has always been--the most difficult political, social, and economic problem.

Civilization and liberty are interdependent because basic to freedom is exercise of mind and spirit, of the faculties that set us apart from other living things and make us fully human. For this there must be a modicum of leisure which comes only with civilization, when men no longer need devote all their time and energy to appeasement of hunger and protection against the elements--as must the animals.

But release from endless toil for mere survival does not automatically set men free. Indeed, the very opportunity to cultivate mind and spirit which civilization opens to man lies at the root of the antithesis between civilization and liberty, for this opportunity is not seized to the same degree by everyone.

Always and everywhere, civilization results in much greater enlargement of the scope of human thought and action among the minority possessing high intelligence than among the majority of average people. Nature endows men with unequal capacities for acquiring knowledge and competence. More so in the realm of the intellect, which is all-important in civilized life,

than in the realm of physical strength and courage, which counts most in primitive society. Men become, as it were, more unequal as civilization advances.

Life grows complex, harder to understand for ordinary people, demanding competencies many are unable to acquire. In understanding and competence, the gifted swiftly forge ahead. What they achieve is beyond the capacity of the average. The result is that men grow apart, their interests diverge. Society tends to divide into segments according to superiority of competence or superiority of numbers. The temptation is great for each segment to use the power its particular superiority confers to bend the whole of society to its will, thus putting an end to freedom.

The Athenians were first to devise a political system that preserved the citizen's liberty by counteracting the natural human inequalities which are the root cause of segmented power centers. The basic principles of their system remain to this day the best protection of individual freedom. Government of the people, by the people, and for the people was their great invention; political equality their crowning achievement. They inaugurated the reign of mind over force by providing for resolution of differences in point of view and interest through public dialogue leading to consensus, instead of by the exercise of power. Perhaps the most remarkable feature of their polity was that it engaged the continuous participation in public business of a large part of the citizenry-- somewhere between one fifth and one fourth at any given time. It was obvious to them that only when the people are personally involved with their government will public officials be responsive to the popular will.

Citizens who shunned public service were called idiotes and considered useless; in some cases, failure to do one's public duty resulted in loss of civil rights.

To quote Edith Hamilton, the American classicist who was made an honorary citizen of Athens, "the idea of the Athenian state was a union of individuals free to develop their own powers and live their own way, obedient only to the laws they passed themselves and could criticize and change at will." This is the political ideal that to western man spells liberty and that is rejected in toto by all autocracies, modern as well as ancient.

The Greeks, I think, understood better than most of us what it means to be free. In his play, The Persians, Aeschylus who fought at Marathon puts his finger unerringly on what distinguished free Greece from unfree Persia. He has the Queen of Persia ask about the Athenians: "Who is their master?" To which she received the answer, "they are not subject to any man"; they obey only the law. When she is told of her son's defeat, the Queen remarks: "Even if he fail, there is no law can call him to account." How better could one express the contrast between the protagonists in today's cold war?

Liberty, never gained without enormous effort and sacrifice, is all too easily lost. Those who enslave their own people seem irresistibly driven to extinguish freedom everywhere. When we understand them, we are better prepared to ward off their aggression. More important still is awareness of the forces within free societies that endanger liberty. In both respects, there is still much we can learn from the Athenians.

I will discuss certain developments in modern democracies that have an adverse effect upon the liberties of the individual and the social and moral values cherished by free men. The causative factor of this new threat to liberty is science and science-based technology.

This new science-technological threat is but the latest version of the age-old conflict between civilization and liberty--a conflict that has no permanent solution but reappears perennially in new form.

Liberty is never gained for once and for all. Each generation must win it anew. Each must defend it against new perils. These perils arise because men, being endowed with free will, continually alter the conditions of life. Countless decisions made in pursuit of private objectives may so transform society that institutional safeguards once adequately protecting human liberty become ineffective. It is then necessary to return to first principles and to adapt them to altered circumstances.

The title of my speech--LIBERTY, SCIENCE AND LAW--expresses my conviction that unless certain practices in the technological exploitation of scientific knowledge are restrained by law, they will cost us our liberties.

Science and technology are, of course, of immense benefit to man. But they may bring about changes in our physical environment of greatest potential danger. Certain technologies admittedly injure man, society, and nature. Yet, even in countries where the people are sovereign and where they recognize the danger, efforts to bring these technologies under social control have had little success. Those who have the use of technology are powerful enough to prevent legal restraint, the main prop of their power being the esoteric character of modern science.

Much of it is incomprehensible even to intelligent and educated laymen. When scientific-technological considerations enter into public issues--as is often the case today--the issues cannot be understood by the electorate, frequently not even by the public officials who are directly concerned. There is then no recourse but to call on scientists for expert advice. In effect, the issue will be decided by them, yet they have not been elected, nor are they accountable to the people. What is left of self-government when public policy no longer reflects public consensus? And, when the public finds that it cannot judge and evaluate issues involving science, will it not become apathetic toward all public issues? Does this not spell the doom of self-government, hence of freedom for modern man? Though all the institutions established to safeguard his liberties may remain intact, the substance of freedom will have been lost.

By one of those ironies of fate beloved of Greek dramatists, this new threat to liberty has its source in the noblest Greek achievement, the freeing of the human mind to roam at will in pursuit of truth and knowledge. All things are to be examined and called into question, said the Greeks. Unless men understood the world in which they lived, and because of this understanding felt at home in it and could be useful citizens, they were not truly free. Never before or since was intellectual freedom valued so greatly. "All things were in chaos when mind arose and made order," said Anaxagoras, the mathematician and astronomer.

When Renaissance man recovered his classical heritage, the most precious treasure he found was freedom of the mind. With his mental powers set free, it took him but three and a half centuries to build on foundations laid in classical Greece the whole magnificent edifice of modern science. No one could have foreseen that in its ultimate consequences the Scientific Revolution might diminish human liberty.

But it has brought us back full circle. Science--the vital area of knowledge today--is for most of us virtually a closed book; again it has become the monopoly of a small elite. This is not the fault of the scientists. Unlike ancient priesthods, they have no wish to bar others from knowledge or to use it to enslave the ignorant. Many scientists make strenuous efforts to explain science to the lay public. Nevertheless, we find ourselves in much the same position as the ancient Egyptians whose very lives depended on knowing when the waters of the Nile would rise and fall--knowledge possessed by their priesthood alone.

As in the past, it is not the knowledge gap per se that is most detrimental to freedom, not the fact that the majority cannot follow scholars into the realm of higher mathematics and science; rather it is the effect ignorance of science has on public attitudes toward science and science-based technology. The impact of technology, in particular, on the individual and on society at large is profoundly

affected by prevailing concepts of what technology is and what purpose it should serve.

If people understood that technology is the creation of man, therefore subject to human control, they would demand that it be used to produce maximum benefit and do minimum harm to individuals and to the values that make for civilized living. Unfortunately, there is a tendency in contemporary thinking to ascribe to technology a momentum of its own, placing it beyond human direction or restraint-- a tendency more pronounced in some countries but observable wherever there is rapid technological progress.

It manifests itself in such absurd statements as that technology demands some action the speaker favors, or that "you can't stop progress." Personalizing abstractions is a favorite means of semantic misdirection; it gives an air of authority to dubious statements. Most people are easily pressured by purveyors of technology into permitting so-called progress to alter their lives, without attempting to control it-- as if they had to submit meekly to whatever is technically feasible. If they reflected, they would discover that not everything hailed as progress contributes to happiness; that the new is not always better, nor the old always outdated.

The notion is also widespread that, having wrought vast changes in the material conditions of life, technology perforce renders obsolete traditional concepts of ethics and morals, as well as accustomed ways of

changing political and social relationships. Earnest debates are currently taking place whether it is possible to act morally in the new technological society, and proposals have been made--quite seriously--that science must now replace traditional ethics! We have here a confusion that must be cleared up.

Through technology we are relieved of much brutal, exhausting, physical labor as well as boring routine work; we are provided with numerous mechanical servants who do certain kinds of work faster, cheaper, and more efficiently than people. Why should the ease and affluence technology makes possible affect moral precepts that have guided western man for ages? This may brand me as old-fashioned but I have not yet found occasion to discard a single principle that was accepted in the America of my youth.

Technology is tools, techniques, procedures, things; the artifacts fashioned by modern industrial man to increase his powers of mind and body. Marvelous as they are, let us not be overawed by these artifacts. Certainly they do not dictate how we should use them nor, by their mere existence, do they authorize actions that were not anteriorly lawful. We alone bear responsibility for our technology. In this, as in all our actions, we are bound by the principles governing human behaviour in our society.

Does it make sense to abandon principles one has lived by because he has acquired better tools? Tools are for utilizing the external resources at our disposal; principles are for marshaling our inner, our human resources. Tools enable us to alter our physical environment; principles serve to order our personal life and our relations with others. The two have nothing to do with each other.

This should be obvious, but erroneous concepts of science and technology abound because people tend to confuse the two. Not only in popular thinking but even among the well-informed, science and technology are not always clearly distinguished. Characteristics pertaining to science are frequently attributed to technology, even as science itself is confounded with ethics.

Science has to do with discovering the true facts and relationships of observable phenomena in nature, and with establishing theories that serve to organize masses of verified data concerning these facts and relationships. By boring into the secrets of nature, scientists discover keys that unlock powerful forces which can be made to serve man. It is through technology that these forces are then put to human use.

Science is a body of systematized knowledge; technology is the apparatus through which knowledge is put to practical use. The difference is important.

Because of the care scientists take to verify the facts supporting their theories, and their readiness to alter theories when new facts prove them imperfect, science has acquired great authority. What the scientific community accepts as proven is not questioned by the public. No one disputes that the earth circles the sun, or that atomic fission produces energy.

Technology cannot claim the authority of science and is therefore properly a subject of debate, not alone by experts but by the public as well. Little thought is customarily given to the possibility of harmful aftereffects by those responsible for technological exploitation of

scientific knowledge. In consequence, technology has proved anything but infallibly beneficial. Indeed, much damage has been done because no thought was given to the interaction of technology with nature. More of this presently.

A certain ruthlessness is encouraged, in the mistaken belief that to disregard human considerations is as necessary in technology as it is in science. The analogy is false.

Rigorous exclusion of the human factor is required by the methods of science. These were developed to serve the needs of scientists, whose sole interest is to comprehend the universe; to know the truth; to know it accurately and with certainty. The searcher for truth cannot pay attention to his own or other people's likes and dislikes, or to popular ideas of the fitness of things. What he discovers may shock or anger people--as did Darwin's theory of evolution. But even an unpleasant truth is worth having; besides one can choose not to believe it! Science, being pure thought, harms no one.

Technology, on the other hand, is action, often potentially dangerous action. Never has man possessed such enormous power to injure his fellow humans and his society as has been put into his hands by modern technology. This is why technology can have no legitimate purpose but to serve man--man in general, not merely some men; future generations, not merely those who currently wish to gain advantage for themselves; man in the totality of his humanity, encompassing all his manifold interests and needs, not merely some one particular concern. Technology is not an end in itself; it is a means to an end, the end being determined by man himself in accordance with the laws prevailing in his society.

A word may be in order concerning the disparate meaning of the term depending on whether it is used in the ordinary sense--which is also the original sense of the word--or by scientists.

Law, as commonly understood, refers to those rules of human conduct prescribed and enforced by society. Its purpose is to resolve human conflicts by the application of definitive rules. These rules are always debatable and can be changed when there is demand for a change.

The scientists have appropriated the term law to describe regularities exhibited by physical phenomena--the rules by which the universe governs itself. In the transition, the word has taken on a new meaning.

From the layman's point of view, what the scientist calls law is fact, rather than law--immutable fact. Or, if you prefer, it is law operating in a sphere where human beings can exercise no influence. We cannot alter the laws of the cosmos; we can only discover them. A law of science expresses mechanical regularity where no choice of action, no free will comes into play; it deals with constancy of behavior in nature. It has relevance for us because it makes the universe comprehensible and so enables us to utilize the forces of nature for human purposes.

We are bound by the laws that science has disclosed when we exploit these forces by means of technology. Likewise we are bound by the man-made laws of our society, for our actions affect fellow human beings. Technology straddles, as it were, the law of the universe and the law of man; it is subject to both.

Much confusion in popular thinking arises from this fact. The two laws are confounded. Or, to put it differently, they are thought to be part of a single system of law so that one or the other must perforce take precedence.

Ever since scientists discovered that the earth is not the center of the universe, as had been maintained by the highest human authorities, we have been learning painfully that the laws of nature cannot be overturned by human fiat. It has taken a long time to attain this rational attitude; we are now conscious of the consequences of intolerance in the past. Perhaps this is why we are so tolerant toward those who claim the right to use technology as they see fit, and who treat every attempt by society to regulate such use in the public interest as if it were a modern repetition of the persecution of Galileo!

The right to be protected by law against injurious action by others is basic to civilized society. Yet, opponents of legislation intended to restrain use of potentially dangerous technologies are often able to prevent or delay enactment of such laws by playing upon the layman's respect for science. It is their common practice to argue as if at issue were a law of science when, in fact, what is being considered is not science but the advisability or legality of the technological exploitation of a scientific discovery. The public would not be deceived by such arguments if it clearly understood the fundamental difference between science--which is knowledge--and technology--which is action based on knowledge.

To guard against being misled, one should cultivate an attitude of scepticism whenever the word science is used. Is it science that is being discussed or is it technology? If technology, the question at once arises whether the proposed action is legally permissible and socially desirable. These are matters that lie outside the domain of science. Just as the law of the cosmos cannot be overturned by human fiat, so is human law supreme

within its own proper sphere of operation. Technology must therefore conform to that most basic of all human laws, the maxim of the "mutuality of liberty," the principle that one man's liberty of action ends where it would injure another. Without this maxim, freedom would be a barren privilege.

Whether or not a particular technology has harmful potentialities should not be decided unilaterally by those who use it. The user is an interested party to the conflict between private and public interest that every potentially harmful technology poses. Nearly always he is also a practical man.

I think one can fairly say that the practical man's approach is short-range and private, concerned with ways to put scientific discoveries to use in the most economic and efficient manner. Rarely will he give thought to the long-range and public consequences of his actions, that is, to the effects that a new technology may have on people, on the nation, on the world; on present and future generations.

To illustrate the disastrous consequences of a narrow practical approach, let me give some examples of technological damage to our natural environment.

Carelessly emitted, the waste products of new technologies create a massive problem of soil, water and air pollution. We may be permanently damaging the atmosphere by changing its chemical composition.

Nevertheless, we keep right on building things that belch great quantities of junk into the atmosphere, with little or no regard for the consequences. Even now, living in Los Angeles or New York City means

...ing in the equivalent of five packs of cigarette a day! At the present time truly clean air can only be found at the middle of the Atlantic Ocean.

We take pride that each American is the "owner" of hundreds of mechanical slaves who do the backbreaking and disagreeable work in our society. But we do not give thought to the fact that each of these mechanical slaves produces about the same amount of wastes as a human. This is a sobering thought and should cause us to question what our so-called "progress" is doing to our environment, and its significance to our posterity.

New products, profitable to manufacturers and useful to consumers, are often themselves intractable pollutants. For instance, detergents which unlike soap do not dissolve in water, or pesticides and weed killers which, carelessly applied, will poison soil, crops, birds, animals, fish and eventually man.

Other technologies enable man to alter the very contours of the land--as with new strip mining machinery. Huge chunks of earth and rock with their topsoil and vegetation are gouged out, changing fertile country into a desolate lunar landscape--a land robbed not only of its irreplaceable mineral wealth but of its fertility as well.

Man now has the means to slaughter all the wild animals on earth and he is well on his way of doing so. Consider what has been done to the vast riches of the seas.

With modern techniques, deep-sea fishing is so efficient that a few enterprises could rapidly sweep the oceans free of commercial fish. And

is what fishermen of all nationalities wish to do. As practical men they have no other interest than to use the latest technology that will increase their catch, preserve it and get it to market as speedily as possible.

We witness at the moment the end of one of the saddest cases of misuse of technology by greedy fishing interests. Unless these interests are curbed by truly effective international action, the great whales--the blue, the finback, the sperm--will soon disappear, victims of man's "practical" folly.

These and other whales once populated the high seas in immense numbers. For hundreds of years whaling remained a reasonably fair contest between man and the intelligent, swift-moving mammals he hunted. Modern technology has turned it into brutal genocide. Blindly pursuing what they doubtless consider an eminently practical objective--maximum profit today--the whalers are wiping out the very resources that could insure them a profit tomorrow.

Last year, Norway's only whaling company announced that because the number of whales allotted to it was so few it would make the operation of its whaling fleet unprofitable; therefore they would not participate in whaling this year. Even in 1966, Japanese ships had to return home after only three of the normal five months at sea because they could find no whales.

Practical considerations aside, is anyone justified in using technology to exterminate a species that has existed on this earth for eons--the largest animal the world has ever seen? Are we certain our descendants may not at some future time have need of these mammals?

How we use technology profoundly affects the shape of our society. In the brief span of time--a century or so--that we have had a science-based technology what use have we made of it? We have multiplied inordinately, wasted irreplaceable fuels and minerals and perpetrated incalculable and irreversible ecological damage. On the strength of our knowledge of nature, we have set ourselves above nature. We presume to change the natural environment for all the living creatures on this earth. Do we, who are transients on this earth and not overly wise, really believe we have the right to upset the order of nature, an order established by a power higher than man? Let us not be carried away by our victories over Nature. It will take revenge for every such victory.

These are complicated matters for ordinary citizens to evaluate and decide. How in future to make wiser use of technology is perhaps the paramount public issue facing the electorates of industrial countries. It will tax their mental resources and challenge their political acumen. Certain measures suggest themselves:

Experience shows that by itself, the legal maxim of "the mutuality of liberty" will not prevent commitment to technologies that may later prove harmful. The maxim must be implemented by preventive public action--action of the kind that has long been operative in the field of public health. There is need for laws requiring that before a particular technology may be used, reliable tests must have been made to prove it will be useful and safe. A few such laws have been enacted; more are needed.

I suggest that, as a special public service, engineers take on the task of working for better protection against technological injury. This is a new and fruitful area in which they could make important contributions

human welfare--an area which requires no revolutionary change in the political or economic structure of society, merely greater precision and fuller implementation of the traditional principle that injuring the health or causing the death of human beings is unlawful. The term health should not be limited to physical health but should include psychic health and protection of the human personality as well. New technologies based on the uncertain "science" of the social sciences involve snooping into the inner recesses of the human mind, personality testing and pseudo-scientific manipulation of human beings. When they are imposed as conditions of employment or otherwise partake of an element of compulsion, these technologies should be regulated or outlawed entirely.

Much more thought should be given to technological interference with the balance of nature and its consequences for man, present and future. There is need of wider recognition that government has as much a duty to protect the land, the air, the water, the natural environment against technological damage, as it has to protect the country against foreign enemies and the individual against criminals. Conversely, that every citizen is duty bound to make an effort to understand how technology operates, what are its possibilities, its limitations, its potential dangers. The leisure modern technology makes available to ever larger numbers of citizens could not be better spent than in a determined effort to narrow the knowledge gap between those who understand science and technology and those who do not.

Since law and public opinion always lag behind the swift development of new technologies, there is need for more informed and responsible

making among those who control technologies. This might be achieved by professionalizing the decision-making process in technology. Experience has shown that in the hands of professional persons technology is managed with greater concern for human welfare than when it is controlled, as at present, by nonprofessionals. The classic example is medicine.

Of all technologies, that of the physician has benefited human beings most and harmed them least. The stringent standards set by the profession and by society for the education and professional conduct of physicians accounts for this happy circumstance. Not only is no one permitted to practice who has not given proof of his competence, but physicians must also be broadly, liberally, humanistically educated men and women. This gives them perspective in evaluating their professional actions, an ability to see these actions against a humanistic background. Moreover, they operate under a code of ethics which requires them to place the needs of patients above all other considerations--a code incorporated twenty-five centuries ago in the Oath of Hippocrates, an oath still taken by young men and women embarking on a medical career.

To Greece we owe the noble idea that special knowledge and skill ought to be used to benefit man, rather than for personal aggrandizement or profit or as a means of extracting maximum gain from those in need of the services of men possessing special expertise. This concept of a trusteeship of knowledge could well be applied to all whose knowledge of science and technology surpasses that of the lay public, as it now is to physician surgeons. I have long advocated that engineering pattern itself after medicine and law, thus becoming a truly "learned" profession. It has

believe, attained that status in some countries, though not in the United States.

As I see it, the most important aspect of the engineer's code of professional ethics ought to be the obligation to do nothing that will unnecessarily aggravate future conditions of life. To my mind his greatest task is to do everything he can to preserve opportunities for a good life to coming generations who will not be as rich in land and resources as we are today. This means, in particular: no needless waste of irreplaceable materials; no permanent destruction of good soil or of our shrinking water resources merely for the sake of immediate advantages; it means utmost ingenuity in substituting abundant materials for scarce materials, renewable resources for irreplaceable resources.

Above all, it means doing everything possible to preserve and protect our environment for our posterity.

These are my suggestions; others may have better ones to offer. What seems to me of utmost importance is that we never for a moment forget that a free society centers on man. It gives paramount consideration to human rights, interests, and needs. Society ceases to be free if a pattern of life develops where technology, not man, becomes central to its purpose. We must not permit this to happen lest the human liberties for which mankind has fought, at so great a cost of effort and sacrifice, will be extinguished.