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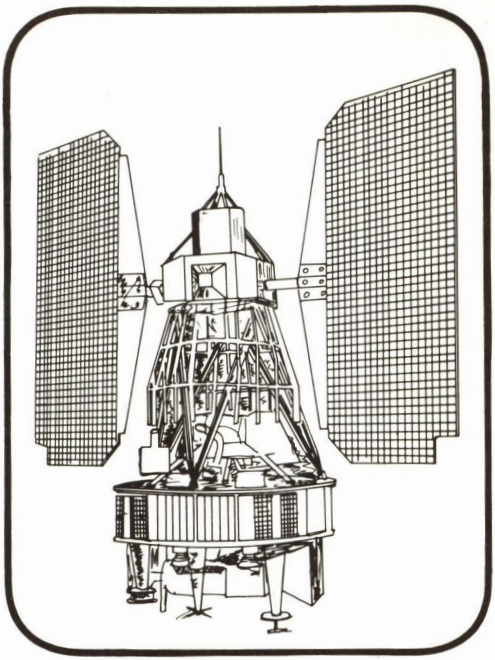
satellite technology and deterrent strategy



Clifton C. Carpenter

THE camera rolled, and the North Georgia landscape lay exposed to the probing fingers of the remote sensors sweeping overhead. From an altitude of 570 miles, ground phenomena revealed much of its intimate character. With the launch of the National Aeronatics and Space Administration's (NASA's) first Earth Resources Technology Satellite (*ERTS1*) in July 1972, a first step was taken in the merging of space and space phenomena into a system centered around remote sensing technology. This successful launch by NASA introduced a technological system that was destined to have a profound influence on the nature of America's defensive strategy.

From the moment the first photographs arrived from the laboratory, it was obvious that a powerful new device for landscape analysis was available to us and to scientific groups in other nations as well. In viewing the photographs, we saw remarkably striking types of detail: folding and faulting lines, soil mantle, vegetation and even a break in the Brunswick Bridge. It forewarned scientists of a volcanic eruption, a shifting glacier and set up a land-use map for some of our northern states. [1]

At the present time, plans exist to launch *ERTS2* sometime this year. Hopefully, after this second launch, we will be able to determine worldwide crop yields and to perform such tasks as locating underground deposits of oil and water—and all this in such macroscopic terms that all our resources and traumas will be available for all to see. But it was what we saw by implications that was ominously significant: the need for a new strategic deterrent concept.

The Need for a New Deterrent Strategy

The problem of deterrence has been a novel experience. But, in the nuclear age, when victory is without significance, the preservation of peace has become basic to our survival. Accordingly, we seek to deter war. The con-

cept of deterrence is elementary—we prefer peace to combat. It is in the implementation that problems arise. In a policy of deterrence, we seek ways of preventing an enemy taking a certain course of action adverse to our well-being. It is essentially a strategy for peace.

Failure of this strategy can result because of a miscalculation of what the aggressor considers a minimum damage level which the victim is willing to accept, or to what extent he is willing to go in order to repel the aggression. A first strike can be preemptive; it can result from fear and can continue if the retaliatory force of either side cannot impose unacceptable damage on the other. Then, there are accidentally initiated actions (fail-safe), misunderstandings and irrational acts.

To deter or prevent these conditions is a hope as old as war itself. In reality, it is a psychological restraint. When weapons were more conventional and combat was between soldiers, governments could employ deterrence as a concept, with all its risks, and logically conclude that any success in this realm would be a plus. And, if failure threatened, there would be time for countermeasures and corrective actions. But, as nuclear weapons became more sophisticated and reaction times decreased, deterrent strategy in most all its previously useful forms diminished accordingly. It was never considered to be a guarantee against war.

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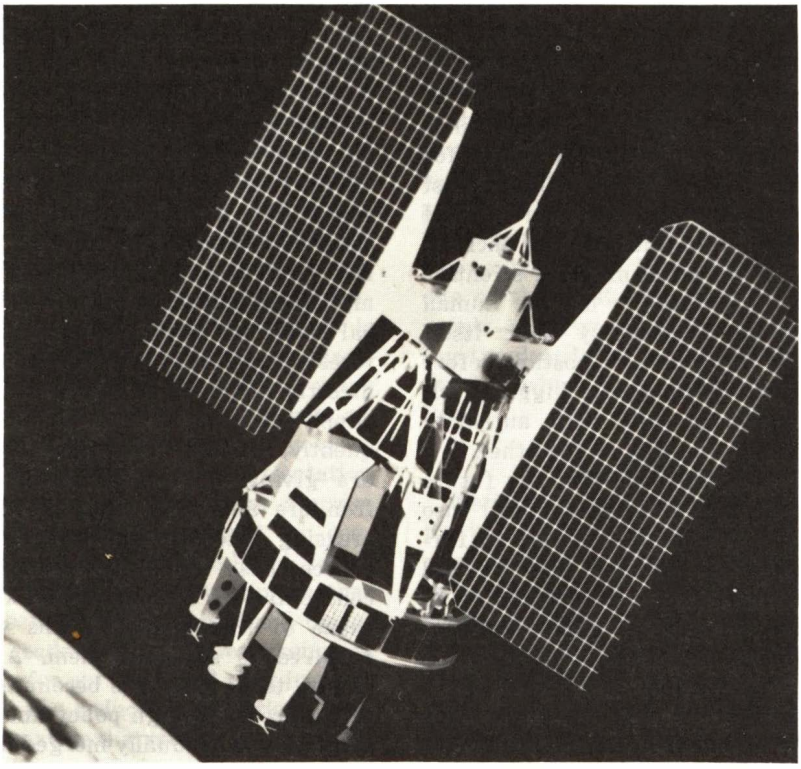
Now, technological advances allow the deterrent concept to be modified and resurrected on a stronger foundation than in the past. It is now possible to prevent wars, except those that are deliberately initiated, because we now have the technology suitable for doing it. Deterrent strategy may now exist on a realistic basis. This discussion is to argue for this point and to treat it with some of its far-reaching implications. To prevent major wars completely is the thrust of this article.

Scientifically, we have an improved sensing system. In the annals of science, much will be recorded with obvious pride concerning the functions and capabilities of this new technology. Because of it, mankind has been advanced much further along the road to the supertechnological age than may be realized. It is the staggering implication derived from what has now become the ominous trilogy—nuclear energy, computer technology and remote sensing—that prompted the above remark concerning our defensive strategy.

Nuclear power is three decades old and computer technology equally so, but it was the recent development of

NASA



Artist's concept of the Earth Resources Technology Satellite-A (ERTS1 in orbit), first United States' satellite program devoted exclusively to the study of earth's natural resources. The "butterfly"-shaped observatory will carry revolutionary "eyes" called remote sensors for photographing such resources as agriculture, forestry, geology, geography (land use), hydrology, oceanography and meteorology.

the remote sensing technology that has given full range to that awesome concept we call nuclear deterrence. Man and machine, culture and all our boastful ideologies are caught up together in the vortex of an upward spiral toward a machine age, as of now, only dimly seen or understood. Already on the horizon, the dawn of an age of supertechnology is arriving all too soon. Consequently, we should move quickly to consideration of a new deterrent strategy suitable for some years ahead.

It is the intent of this article to demonstrate the need for such a realistic modification in deterrent strategy by pointing to recent changes in remote sensing technology. Each new branch of science impacts on human beings for both good and evil. But, beyond this, the writer has been deeply impressed with an additional dimension of this new science. The idea that, in addition to the contribution made by sensing technology in its own right, a profound influence would be felt in that this technology would probably be the means whereby nuclear weapons and computer science

would be released to assume dimensions beyond that which they now enjoy. This is more than conjecture; it is a reality. In this light, war must be deterred, and technology maintained under human control. Therefore, for the sake of mankind, our defense must be a deterrent strategy, and it must be brought into line with the incredible power potential of these scientific endeavors. Unless we do, the human race could conceivably find itself standing in submissive posture before a threatening computer, juggling nuclear warheads, with little authority to control it one way or the other.

It must be assumed that any future enemy of our Government will also possess this potential power. It further must be assumed that we will have to meet such a threat and do so efficiently in order to assure the continued existence of the Republic. This logic is elementary, but it presents a devastating truth, and the truth leads us to some haunting conclusions. Two of them are treated briefly. The first one is that a deterrent strategy for the 1970s and 1980s must be modified to comply with a more pragmatic-realistic approach to defense—that is, a more efficient and faster reaction system, a social acceptance of the reality of such a war and the gearing of our resources' base to support the demand of such a response and to give consideration to the scientific ideas suitable for instant implementation once a decision has been made. In short, we have to accept the escalating technological realities of the last decades of the 20th Century. The other conclusion is that the mechanizing of human beings in the interest of survival seems to be looming larger on the horizon. This seems inevitable if we are to take advantage of all the technological systems available to us. If wars are to be deterred, there seems little choice except to travel this road.[2]

The greater concern is the proper utilization of the most advanced scientific techniques available to us in the 1970s. This strategic concept of deterrence lends itself readily to such necessary modifications. Foreign policy has now become scientifically based and technically oriented toward natural resources as its ultimate goal. Interest in ideologies, in general, decline directly proportional to the dwindling supply of food on the table. Consequently, interest in political ideologies are giving way to interests in oil, iron ore and food supplies with increasing intensity as the global resource base is being reduced. As confrontations become more likely because of this, greater skills will be required to suppress them. As time passes, those skills are becoming more scientific. As foreign policy and global strategy are gradually merged into the same frame and structured on the same foundation, these confrontations can be technically controlled if the deterrent concept is brought up to date.

A Realistic Approach

Civilization has fully embraced the nuclear age. In the beginning, some nations rushed to grasp it with the enthusiasm of an Olympian claiming his laurel reward. Others gave pause for sober appraisal of the consequences that may accrue to them and to mankind with the opening of Pandora's nuclear box. In the course of time, all learned caution, and, one by one, they began passing over the threshold leading to their nuclear destiny. Thus, the nuclear age arrived and is here to stay. We must learn to live with it and all its potentialities.

As a result, national power is assuming some interesting new aspects. In consideration of national power, the classical definitions of war are no longer adequate, still valid to some extent, but not capable of coming to grips with the offspring of World War II—that is, the Cold War and of the worldwide revolutionary activities. In the last decades of the 20th Century, a strategic-realistic approach to foreign intervention and subversion is evolving based on a more pragmatic method postulating the relative value of all political institutions. To rule effectively is the basic test of government. An antitheoretical orientation is generally concluded from a pragmatic approach because it is concerned with survival and not ideas, with practical administration rather than abstract arguments. Such orientation leads toward power concepts suitable for survival, and this, in turn, leads to the reduction of national policy and national strategy to a common state. In such circumstances, more practical ideas, springing largely from military considerations, will come to the fore and, in times of stress, become the point of the javelin—a javelin with the strike of a lightening bolt and a launcher controlled by computers.

This is a time to be practical because the age of supertechnology is with us, and it needs a strong guiding hand. This is the real value of representative government. In the final analysis, democracy in action is practical people looking to their own well-being, and, if left to their own devices, they can succeed. The total involvement of a free electorate is essential, but there is concern that such interest is on the wane. If this lack of interest continues, and if practical considerations are neglected, then national defensive power in the more advanced nations will be transferred completely to the control of machines; man will have lost, and war will result.

How man's position of preeminence in policy matters is to be retained vis-à-vis the steadily increasing mechanization of man is a problem for which there is no ready solution. The apparent contradiction here is going to be one of the most important enigmatic points to be resolved by society during the decade of the 1980s. This is a contest which man cannot afford to lose.

The Nature of National Power

National power is always what people believe it to be, and it is always relative until it is used. Combat is the only effective test of such strength; short of this, there is no absolute measurement. Consequently, a nation's power potential, when given a deterrent posture, can involve several things. It can be military, involving a counterforce idea, or it can take the form of bold political decisions flavored with a certain amount of psychological bluffing. In any form, the use of power is as much a reality in the 1970s as it has always been—more subtle perhaps—and its conceptual base is technological. Over the centuries, technical improvements in weapons and weapons systems have always encouraged new modes of thought in the realm of strategic doctrines. However, the exponential escalation resulting from the industrial revolution came as something of a national shock. Consequently, it became difficult to maintain the increasing psychological parity in national thought and, at the same time, to keep the intellectual pace demanded by the increasing technological thrust. But the traumatic experience had to be sub-

jected to the consideration of greater concerns because technical advancement, in order to have meaning, must always be paralleled by progress in cultural thought. If such a balance is established and assured, science can approach the infinite.

Moreover, industrial systems have not been left unaffected. An interesting evolutionary process has been at work modifying their importance in strategic thought. The same technical advances that inspired the industrial revolution and gave our industrial potential such strategic import in World War II has now achieved such a level of excellence in both quality and quantity output that, in present-day deterrent thinking, industrial production rate in time of war has become insignificant. In this decade, weapons and their control systems must be in a state of readiness and in sufficient quantity to offset any thrust leveled against us. Whatever contribution an industrial complex may make, it must do so before the conflagration. And this industrial production base must be so powerful that, when properly utilized, it can be decisive without being employed. This is the fullest meaning of a deterrent strategy. [3]

When an assessment of our power potential is completed and fully comprehended by any would-be aggressor and, when in contemplation of it, he is deterred, then the deterrent strategy has worked. If, in the present decade, we have to commit our power fully, then this strategy has failed. It is necessary at this point to add an additional input, and that is the overwhelming magnitude of destructive power that can be brought to bear swiftly at a given point in support of national defense policy.

Plans for the prevention of attacks are no longer simple affairs as they virtually incorporate the sum of our technology. As a consequence, strategies against nuclear attack are considerably more complicated than those designed against conventional weapons. In the mechanical aspects of nuclear-age strategies, recent technological innovations have become essential elements of any planning process. Also, political and strategic theories abound, and separating the wheat from the chaff in such a bundle of ideas is certainly no small task. Nevertheless, to do so, and do it properly, has become a problem that consumes much of our strategic thinking.

A Modified Deterrent Concept

It is clear that, in a nuclear age, nuclear weapons are going to be present and the possibility of their use will be a constant threat. Therefore, a completely nonnuclear strategy is impossible. Even in conventional wars, a nuclear establishment must be available, and, being nearly absolute as a weapon, it must be employed to the limit as a "force in being." It would seem that the most significant modification in such a strategy would be to accept the aid of technology and allow machine to oppose machine. Even if we do not accept such aid, the enemy probably will, and we cannot match a human brain against a computer bank in an emergency situation, nor can our sensate organs match our most sophisticated sensing instruments. Therefore, it can be argued successfully that our course is clear and we have now reached a point in the history of the science where man must bow to his swifter efficiently functioning offspring—the machine. Thus, man has been dethroned, and the deterrent strategy in a nuclear age has been transformed into a completely

mechanistic system. Certainly, there is considerable argument for a deterrent plan of this nature in the political realm.

Strategic arms limitations in this area is a possibility. SALT I has been confirmed. More definitive agreements on the quantitative aspects are hopefully in the making, and, if both the offensive missiles and the antiballistic missiles can be restrained, then we can probably look to better things. Relations in the family of nations, however, do not exist in a series of isolated segments but, rather, on the sum of all its parts. Treating with one aspect of a would-be policy at the exclusion of all others is not practical. Accordingly, when we talk of limiting offensive missiles, we are really talking of such things as "good intentions" and the "will to power" of all concerned. In the final analysis, the SALT talks may not live up to expectations.

All aspects of international relations are interconnected and mutually supporting. In fact, military and diplomatic consideration in recent decades merge at every point along the line. But all this has assumed the maintenance of a bipolar world. There is another global view—the multipolar world. The concern for a multipolar nuclear arrangement is an honest one and treats with an ever-increasing problem. The question of whether the deterrent restraints imposed over the last two decades will continue, in either world, is a hope that strikes at the chords of all our human emotions. In all reality, deterrence was never suitable as a strategy in other than a bipolar world. The anatomy of this particular construction did not possess the essential ingredients rendering it capable of coming to grips with a multipolar nuclear world, the simple reason being that it was not designed for that purpose. [4]

In SALT I, it was believed that deterrence, in the spirit of the argument, may have found a useful place because of a belief that any technological breakthrough could upset the balance, and war might result. There seems no realistic way to hold the nuclear power in any kind of nuclear equilibrium for any considerable length of time. It is largely for this reason that deterrence, in order to remain an intellectual concept viable with others being introduced from time to time, must, in the latter quarter of the 1970s, assume a new personality. The reason is simple—it must prevent war completely. This absolute quality is a new characteristic of deterrent policy. When we speak of nuclear war, there is an automatic built-in assumption that it will be with victory for someone because concepts of victory are usually absolute; one side wins and one side loses. If victory of any kind no longer results from any war, except small localized conventional wars, then the all-encompassing purpose of war is pointless. It will be the function of a modern deterrent strategy to give assurance that nuclear war never gets under way.

Due to the nature of nuclear power as a weapon, it will probably be used only once, and its effect will be global. Therefore, the preventive factor must be an element in the anatomy of any such strategy, and it must be completely effective. There is no reasonable alternative. We cannot afford even a one-time adventure.

A Modified Deterrent Strategy

The basic idea is that a strategy for the prevention of war should have an equal place with those designed to

win wars. Assuming this to be a valid view, a modified form of deterrence seems to provide the best single hope of man struggling with this titanic power which threatens to overcome him. Even though it is still in the early stages of development, technology for the physical control of nuclear weapons is available. Physical systems with the capability of preventing a nuclear holocaust do exist. However, the ultimate measure of effectiveness of any deterrent system is related directly to the ability of policymakers to employ them properly.

Fortunately, in treating these systems, we no longer have the problem of the "think-tank" people who had to translate ideas into the real-world situations. This was often complicated by the introduction of several worthy ideas at the same time. The culling process seemed to assume staggering proportions.

In retrospect, the strategies of the 1950s and 1960s served a very useful purpose. Each of them, in its own way, possessed significant character to recommend it as a strategic concept suitable for the times. And yet, by the 1970s, each had experienced its demise either by being replaced or by having its identity merged into some more advanced idea. Gradually, as the 1970s became history, these strategies became less viable as intellectual constructs because they were devised by man for use against men within the conceptual framework of a less technical age. But the 1970s brought with it the awe-inspiring mechanistic age whose phenomenal thrust has astounded us all. Consequently, these concepts were not able to stand against the onslaught of machines. Now, all these have been reduced to one basic condition exhibited in one massive force of raw power facing another massive force of raw power in several zones of confrontations over the earth. The suddenness of its arrival and the nature of the power have been overwhelming and have caused most people concerned with this matter to return to the concept of deterrence in some form applicable to the present time.

Deterrence, one of the earlier concepts to offer hope to so many, was replaced by the concept of limited war. And, in the course of time, limited war was replaced by arms control. There were others, each in its turn giving way to a newer mode of thought inspired by improved weapons systems. All had had their day by the time of full commitment in Vietnam. All of these assured military action, and political control was guaranteed in the application of any force to any threat; proper balance between the two was assured. Now, we may have come full circle, for it seems that we have returned once again to a modified form of the deterrent concept for our national security. [5]

If one looks carefully at these six or seven intellectual concepts which form the basis of our strategic thought, it can be shown that a certain amount of military action was considered to be in the normal course of things. All we have been saying is that we keep our wars small and under close supervision. We have been saying by implication that preventing them might not only be difficult but, in reality, the small ones may be desirable under some circumstances. Indeed, in the last 4000 years of history, overwhelming documentation can be assembled to support the argument for retaining them.

Probably, we should retain them as an instrument implementing foreign policy on those special occasions when

other techniques fail to achieve a desired result. There seems to be no substantial body of theory posited on unquestionable logic pointing to the contrary.

The Mechanization of Mankind

Time's inevitable forward thrust has been accomplished by the compounding of technological developments on an unprecedented scale. Science has progressed with Lydian measure to a point of unparalleled preeminence in the exercising of its influence over the destiny of man. Considering this, we may ask with all due candor, "What hath science wrought?" And from the unfathomed depth of our consciousness may come the answer: the mechanization of the human being! Mankind has created machinekind, and, because of it, he has extended his will over more people and broader areas of the earth's surface than could have been dreamed of only a few years ago. [6]

As the machine has become more sophisticated, it has become more humanized, and, accordingly, man has gradually become more mechanized. We are now in the process of surrendering our surveillance capability and our decisionmaking prerogatives over friend and foe alike to the unemotional and unerring predictability of machinekind. Human beings are slowly being downgraded to a more biological state. In the process, a more artificial civilization is evolving around machines, replacing the more human form.

Progress has now brought us to a point along the thrust line where deterrence as a strategic concept must be viewed in a new light. Numerous indications point to our emergence from a woodland maze of strategic thought to show that our clouded sylvan perception of such matters is beginning to clear. In our new technical environment, the concept assumes a new dimension. Surveillance of landscape anywhere on earth, in day or night, sunshine or fog, and in all seasons, is now a stark reality. [7]

The probing of alien lands for their most prized or esteemed secrets is now possible through technology available to the general public and as a matter of course. Deterrence has not only assumed a new meaning but is also becoming, with amazing rapidity, about all we have since most all other intellectual tools, from which we previously have been able to choose, are now being reduced to a common denomination; at best, they are left with very little identity of their own. There can be no doubt that our new technical capabilities are irrevocably being merged into a more mechanistic society, with conclusions drawn and decisions made on the basis of high-speed computer analysis.

This is due, in part, to the inability of one to ingest the voluminous amounts of data usually necessary to arrive at a more suitable solution and, in part, because the mechanizing of social organizations is becoming increasingly unsympathetic with the more emotional human approach traditionally characterizing our problems and solutions. Machines have no way of sensing and absorbing human values. Print-outs are coldly logical and represent programed data, not human feeling and aspirations. The two simply are not in one accord. No matter how much we may wish to return to more traditional patterns, the nuclear age is not going to vanish, and computer technology is going to be increasingly a part of our lives. The lowering profile of a human being as controller of his own destiny is be-

coming increasingly obvious, and his command over such is being swept from him and passed on to the machine.

Deterrence, as a concept, is not so much a casualty in all this as one might conclude but, rather, a mutation; it has experienced a rather notable change in some of its inheritable characteristics. This has resulted in brighter consequences of a more practical nature because nuclear power and all that it implies, along with governmental controls and all that they require in order to hold the world's nuclear force in dynamic equilibrium, demands that the former, as well as the latter, be grounded in some very realistic and pragmatic thinking. Unromantic and unidealistic as this may sound, it just might be the proper approach of avoiding international confrontations of the type paralleling the Biblical apocalypse.

Blessings in disguise are not uncommon. It may well be that our machine age will possess an adequate amount of unembellished quality capable of maintaining this international equilibrium. This offers a ray of hope and a most significant one when we consider that all our human generations apparently have not been so successful in this task.

The Age of the Sensors

In synthesis with the deterrent concept of the 1950s, an added dimensional quality of the concept will begin to dawn. It will be lacking the intellectual élan that characterized its earlier phase but will be striking in the stark reality of its mechanical techniques. Being divested of its elitist milieu, a more comprehensive technology will dominate landscape analysis and utilization. The computer cannot collect data. Data collecting must come from a different family of machines which are extensions of our sensate organs. The remote sensors can extend our control over vast areas of space on a magnitude considerably beyond our comprehension, making the computer in final analysis the master of us all.

Data collecting has now become a major field of endeavor in scientific circles. Machines employed in this new science have become highly sophisticated, and their utility in all forms of landscape research are increasing with amazing rapidity, performing operations in data collecting with surgical precision. It can be postulated that, within a reasonable span of time—a few years at most—neither man nor the fruits of his labor can be hidden from the prying eye of the camera. A variety of sensors are being developed, and others improved, that will widen the surveillance capability of techniques other than the camera. In all cases, however, the technique is remote, and remote sensing is a fact of the future. Our biological sensors are being mechanized.

Unilateral verification of ground activity involving modern weapons systems can now be offered with a high degree of credibility. Such things as construction work for installation and transport activity associated with it can be scanned by area-surveillance and close-look photography with a high degree of resolution. Where camouflage exists, long-wave infrared sensors can search out and pinpoint sources of heat radiation, and, where there is appropriate multispectral photography, a technique for making pictures simultaneously and at different wavelengths is useful.[8]

The future holds great possibilities in the area of satellite surveillance through the joining of the separate

functions and techniques in a single observation vehicle. The fourth-generation satellite (*Big Bird*) weighing more than 20,000 pounds offers visions of future strides in earth-monitoring technology. In one mechanical package, we have a system that can photograph at night when visible light is not available, and we have a vehicle that can alter courses to take advantage of a special situation and even stay aloft a sufficient amount of time to take advantage of a break in the weather or the shifting of cloud cover.

It is recognized that deliberate concealment tactics are possible or at least may impede adequate observation as, for example, that specified in the SALT I accords. It seems highly unlikely that, with the continuous monitoring of transportation and factory systems, clandestine activity could succeed. Even inside activities, where no sensor or camera can reach, are usually related to a set pattern of conduct which would change in response to the change taking place inside. Such a shift in routine outside activity can be observed, compared and analyzed.

As an insight to more sophisticated techniques to come, there are line of sight land-based radars. These systems can observe lines of flight, reentry vehicles and their impact areas. The over-the-horizon (OTH) radar reflection on the ionosphere reaches beyond the curvature of the earth to a launch site. Now, the "forward scatter" OTH radar can detect disturbances in the ionosphere by the ionization of jet gases. "Since each type of missile disturbs the ionosphere somewhat differently, a detected missile can be identified by its characteristic signature." [9]

Research in the various remote sensing techniques are restricted at present to their practical use in analysis of the geographic elements of landscape—that is, things that are mineral, vegetable or animal. And it is properly so as the dwindling supply of earth resources need to be properly inventoried and preserved. Among the researchers, little interest is shown for any practical utility which these sensors might have in the military realm as it is a general belief among them that the use of most sensors would offer a meager return because of the low resolution for detail at the surface. And this opinion militates against their employment.

Scientists are a highly moral and patriotic group. Their interest in America and America's security is as deeply rooted as any. As a general rule, the nature of their training causes most of them to think technically, whereas the influence of sensors tends to be of a more profound nature. Consequently, interest among them does not generally extend to things military and strategic and, in many instances, is characterized by something approaching ambivalences toward it.

There are many exceptions to the general rule; some very notable exceptions can and do think in both dimensions. To the extent that such people can play a dual role, strategic thinking can be advanced. But such scientists, around whom strategic and scientific thought can merge on a common articulate level, are few indeed. As of now, if the literature is any indication, the two worlds tend to be miles apart.

Technology has now reached a level in the state of the arts where, because of it, a radically different world is evolving, and, as of now, it is only vaguely apparent. The impact of technology on strategic thought is going

to be deeply felt, and the influence will be fundamental because, in the last two decades, technological advances have brought us to the brink of a new age.

Conclusion

The human eye reacts to certain emitted or reflected electromagnetic radiation even though not in contact or coupled with the object under observation. Thus, the human eye may be regarded as a remote sensor. Machine sensors are now extending man's seeing and hearing powers into such diverse fields of investigation as meteorology, geology, geomorphology and oceanography—to name a few. International diplomacy and global strategy are becoming irrevocably intertwined with the sensing machines. Decision-making requires them; policymakers are blind without them; and, when functioning in combination with computers, game theory is given full range. Under these circumstances, man is being relegated to second place.

There appears to be a general lack of concern for such technology in the area of strategic thinking. The need is of such magnitude that its proper employment could possibly prevent unlimited wars or restrict them to limited instruments of foreign policy. But, in the current flow of literature treating with the general subject of national strategy, technological developments that will bear significantly on our strategic defense structure are brushed with extremely gentle strokes. As long as this situation continues to exist, our strategic house will rest on a rather unstable foundation. There is a compelling need for a marriage of technological and strategic thinking at the highest level, and then all the way down the line. It needs to become a national point of view, a national will and a better comprehension of our scientific state of the arts. The need for this marriage is so urgent that our usual circumspection regarding such matters cannot be ignored with impunity vis-à-vis the problem of human survival.

One might infer a rather ominous conclusion. This need not be the case. It will, however, require considerable adjustment to a change in the traditional system creating national policy. We are not the first to have such experiences. Marcus Aurelius, in the 2d Century A.D., counseled future generations to expect such change. We can and must conclude that mankind is rapidly losing his ancient position of preeminence in the conduct of affairs. Machines have become the new gods of war.

NOTES

1 Lucy Justus, "Georgia From 570 Miles Up," *The Atlanta Journal and Constitution Magazine*, 24 February 1974, pp 12, 17, 18 and 20.

2 William W. Bunge, "The Geography of Human Survival," *Annals of the Association of American Geographers*, September 1973, pp 275-77. Dr. Bunge is breaking new ground in his straightforward treatment of the mechanization of man.

3 *Problems of National Strategy: A Book of Readings*. Edited by Henry A. Kissinger, Harper & Row Publishers, Inc., N. Y., 1961, pp 3-7.

4 Henry A. Kissinger, *The Necessity for Choice*, Harper & Row Publishers, Inc., N. Y., 1961, pp 15-40.

5 Harry L. Coles, "Strategic Studies Since 1945: The Era of Overthink," *Military Review*, April 1973, pp 3-16. For the ideas stated here, I am indebted to this excellent article. It is a brief survey of the development of strategic thought during 1945-73.

6 Bunge, *op. cit.*, p 276.

7 Robert D. Rudd, *Remote Sensing: A Better View*, Duxbury Press, Belmont, Calif., 1974, p 5.

8 Ted Greenwood, "Reconnaissance and Arms Control," *Scientific American*, February 1973, p 20.

9 *Ibid.*, p 22. There are other effective remote sensing systems. Those mentioned here are some examples employed at present. Those interested in the technical aspects of this matter should look at the side-looking airborne radar (SLAR), an imaging radar, which can produce, scanline by scanline, an image of a scene that can be produced as a photograph. This system is not affected by the clouds.