Strength, Interest and New Technologies (1968)

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I

In what ways will technical change alter the interests that join or divide various nuclear and non-nuclear countries, and how will it alter the likely outcomes of potential conflicts among them? In particular, how will new techniques transform the interest and ability to project strength to distant places, and so the worth of nuclear and non-nuclear commitments there? What do they suggest about the realities that will confront some American and many European hopes for stable regional autarkies, including the hopes of the new isolationists?

II

The Receding Technological Plateau

These are large and uncertain questions. They raise a prior one: will there *be* major changes in military technology? During much of the last decade many theorists have presumed a plateau in the arts of nuclear offense and defense. They believed that a protected strategic force was not endangered by future changes in offense technology, that it would be threatened by a ballistic missile defense, but that such defense fortunately was unfeasible. Estimates of the unfeasibility of this supposedly destabilizing measure bolstered arguments against any investment in new active defense systems. But in fact major changes have been cumulating in both offense and defense. The plateau was a mirage.

In the early 1950's, estimates of the unfeasibility, and if feasible, the lack of any strategic utility for the H-Bomb, had been used in

much the same way for an opposite end: to support arguments for active defense and against a focus on offense. It is a minor irony that many of the ardent defenders of defense in the 1950's are among those most offended by it now. Nor can the conversion be explained by changes in the technology.

In both the early 1950's and early 1960's, judgments on the technology as well as its strategic consequences were faulty. Fusion weapons were not merely feasible but had very large implications for delivery systems, their protection and mode of operation. And the 1960's have witnessed major changes in the arts of offense and defense that will be operational in the 1970's. Moreover, no simple hard and fast distinction divides the effects on stability of offense and defense, making offense changes good or innocuous and defense changes bad. The complexities are particularly apparent if one looks at the consequences, not for a hypothetical two-nation world, but for the real one with a great many non-nuclear countries and a handful or so of countries with nuclear weapons and grossly different resources and strategic situations.

The impending widespread appearance of civilian reactors is one of several important developments that will impose the need for more complex and varied policies than relying solely on international inspection against diversion of plutonium or simply deterring direct nuclear attack on oneself. For civilian reactors will greatly diffuse much of the essential material and knowledge and so reduce the extra cost and time to acquire nuclear weapons. By the end of the 1970's civilian reactors, on some official though uncertain estimates, will have as by-product about 10,000 bombs' worth of plutonium; in the following 20 or 30 years, perhaps a million bombs' worth doubling every ten years.[2] Drafts of nonproliferation and other arms control treaties specifically allow for parties to the agreements to exercise their sovereign national rights to withdraw, if on their own estimate extraordinary events endanger their supreme interest.[3] But policies that will keep this estimate of danger low among non-nuclear countries will involve responsible commitments on the part of at least some nuclear countries to non-nuclear countries that feel subject to coercion. Nuclear weapons will not make small and large powers equal, but they will increase the possibility of mischief, particularly in the coercion of non-nuclear powers.

The technological plateau in nuclear offense and defense has been assumed wishfully by many who hoped for early extensive

disarmament and opposed the spread of nuclear weapons. However, the supposed plateau also encourages advocates of nuclear weapons in countries that do not now control them by suggesting that a force of super-power quality is a static goal, that it might be obtained at modest cost or perhaps by one supreme effort, and that then it is possible to rest. It isn't.

Technologies relevant for nuclear war have reached no flat level. They have been altering steeply, and affecting them unevenly. And technologies affecting interests and capabilities in classical engagements are changing too, significantly if less suddenly.

III

Some Technical Changes

Rapid changes in finished military systems stem from even more rapid changes in basic elements of these systems. For finished systems affecting the conduct of classical wars, I shall refer particularly to the large changes in communication, in control systems, and in transport. In the nuclear field, I shall refer to antiballistic missiles, to systems for gathering, processing and transmitting timely data on adversary offense and defense, and especially to the multiplication of armed offensive re-entry vehicles carried in a single launch vehicle (MIRVs), and the great improvements in offense accuracies and reliability. There are, of course, other changes in military technology, some with related implications, but the ones I have selected for brief analysis are perhaps the most immediately significant.

First, however, the basic elements of finished systems. Changes here, in themselves, make quite implausible the assumption of a plateau in finished military systems. Take computers, for example. They are essential instruments used in the process of designing weapons systems or their elements, such as nuclear warheads, and in designing logistics management for classical wars. Computers are also critical components of the weapons systems designed. They are essential parts of the airborne inertial guidance systems that keep offensive missiles pointing at targets. And they are parts also of the radars and defense missiles that might be used to shoot them down. The computer art changes at an extraordinary rate. Computers have and will become faster, cheaper, and more reliable. While terminal ends, the input-output

units that mate the computer to its user, permit fewer economies of scale and have improved much more slowly, the hardware for the highly repetitive central processing and memory has been multiplying in speed ten-fold every four years and costing only one-tenth as much every four years or less. They took one-tenth as much room after the last ten years and, in the next ten, they may shrink by a factor of one thousand.[4]

These improvements in computers result in good part from still more basic changes—massive changes in the art of solid state and micro-electronics. Order of magnitude improvements come even more swiftly in the tiny elements that form essential parts of computers, sensing and communications systems. It has been suggested that, as in nature, gestation periods shorten with decreasing size; and sizes are decreasing very rapidly. It appears now, for example, that it may be practical soon to pack as many as one hundred thousand transistors on a quarter-inch wafer. Such startling densities are promised by the techniques known as LSI or "large scale integrated circuitry." The packing not only cuts size, but perhaps more important, increases speed, and by reducing the number of wafers and critical interconnections, may vastly increase reliability and make new ranges of complexity workable. By "discretionary wiring," even if fewer than a third of the potential gates are working, paths of connection on the wafer may take advantage of the many alternatives to detour faulty gates. LSI and related techniques will affect almost every phase of electronics and, ultimately, the shape of military offense and defense systems. Antimissile systems, for example, greatly advanced in recent years, may be expected to become still faster-reacting and more effective for a given budget. Moreover, such improvements tend to reinforce each other. Improved missile-borne computers decrease guidance errors. Geodetic errors, another important component of missile inaccuracy, diminish with new basic data obtained by satellite. And satellites, of course, supply much precise information about target systems. Lighter guidance equipment and increases in explosive yield per pound of payload make it possible to cut the size of a re-entry vehicle that can destroy even resistant targets. This makes it possible in turn to carry on each launch vehicle many armed re-entry vehicles directed at widely separated targets.

The new technologies make it possible to do new things as well as to do the old things more cheaply or better. And while they make doing the old things accessible to more countries, this

does not mean closing the gap between the largest countries and the smaller ones. In some respects they increase the disparity. For instance, the tremendous improvements in satellite, sensing and data processing technologies and reductions in their cost make feasible world-wide information gathering facilities where they were not possible at all before—but on a scale of resource expenditure not likely to be undertaken by medium or smaller size powers.

Transformations in finished system reliability, accuracy and destructive payload may be less rapid than in the small components of these systems: they are nonetheless impressive. Roughly speaking, over about a decade—depending on where one starts and how one measures the changes—failure probabilities of missile guidance systems have decreased by a factor of ten or more. So also has the resultant of intercontinental delivery errors of all types. When combined with increases in the number of armed re-entry vehicles carried in a launch vehicle, such order of magnitude changes have large strategic consequences. For a significant range of circumstances the number of weapons needed to destroy a target varies essentially as the square of the delivery inaccuracy and only as the two-thirds power of target resistance or megaton yield. Improving accuracy ten-fold or increasing yield 1,000-fold then amount to the same thing. To put this in perspective, the shift from the largest high explosive bombs of World War II to the Hiroshima fission weapon was roughly an increase of 1 or 2 thousand in yield. The important improvements in antiballistic missiles have been accompanied by less noticed but in some ways more dramatic changes in the advanced offense systems of the major powers.

IV

Changes in Nuclear Offense and Defense

Discussions of "offense" in general compared with "defense" in general yield slogans like "The best defense is a good offense" or the reverse; but almost no understanding. Offense and defense serve overlapping but partially distinct and important functions, and adversaries differ. U.S. defense against a Chinese offense in the 1970's or the viability of a French strategic force in the face of Russian offense and defense are quite different matters from the mutual relations of Russian and American strategic offense

and defense forces. Adversaries not only differ in resources, but also in the state-of-the-art of offense or defense available to them at any given time and in the marginal costs to buy and operate a given offensive or defensive unit. Given the high research and development and other capital costs of modern weaponry and the so-called learning curve effects, the small forces in particular are likely to have much higher unit costs than large ones. For such reasons, the "exchange ratios" of attacking vehicles expended as against those they can destroy, or the analogous offense to defense "exchange ratios" of an increment in the cost of attacking vehicles as against the extra cost of defense to knock down the attacking vehicles, all need to be used with a caution seldom observed in popular literature. In the space available here I can indicate only a few essential implications of the recent and impending changes for relations among the varied nuclear and non-nuclear nations.

First, an offense force with such increased accuracies and reliabilities and with an extensive use of MIRVs is very much more efficient in attacking the fixed offense force or the important fixed elements of the mobile force of an adversary. For some relevant circumstances which I shall illustrate, these offense improvements can drastically reverse the ratios of attacking missiles to missiles destroyed which in the hypothetical missile duels that fill the strategic literature are always shown to disfavor the attacker.

Second, one result of this sort of change in Russian offense forces is to make improved antiballistic missiles (rather than simply more hardening or more missiles) an economic way for the United States to protect the hard fixed elements of a strategic force. More hardening is outpaced by the offense changes since target resistance affects weapons requirements only as the two-thirds power. Simply adding more vehicles is costly and more destabilizing than an active defense of these hard points since increasing vehicles also increases the capacity to strike first.

Third, at a minor increment in the modest cost of a hard point ABM defense, it is possible to make available a light ABM for defense of civil societies against a small submarine or land based missile force or part of a large one launched by mistake or without authorization.[5] Its possessor can keep substantially free of damage from a desperate small attack issuing out of a crisis of escalation and can do this without starting nuclear war. By protecting against desperate acts, it reduces the effect of desperate threats, and so decreases the cost and increases the worth of commitments to third countries—especially those doubtful of

their importance to the committed power. A light defense, as Robert Oppenheimer perceived years ago, can also help stabilize arms control arrangements against small non-signers or violators of the arrangements. It would leave essentially untouched the two principal powers' ability for major retaliation against each other, even if they failed to make minor adjustments in their offense. And, contrary to some claims, each of the major powers is quite capable of assessing the difference between an actual thin defense and a thick urban defense oriented effectively against each other. Moreover, given the very large disparities in resources available to the two largest powers on the one hand and to such countries as China on the other, they can continue to preserve offense capabilities against each other without an arms "spiral" and without becoming nearly as vulnerable to attack by such smaller powers. Arguments that an adversary is more likely to respond to defense improvements than to an increase in offense capability are implausible in general, and especially so as applied to the Russians, who have said exactly the opposite many times and have behaved as if they mean it. I agree with the Russians. Moreover it does neither the Russians nor the Americans any essential harm if each is defended against China, *as they are now*. Even more obviously, I should think, it does no harm to a country protected by the United States against Chinese nuclear threats if the United States can execute its commitment more safely, and hence more reliably. Relations of arms and arms control are not two-person games in which improving the position of one participant necessarily worsens that of the other.

Fourth, reliable mutual deterrence between the great powers and reliable commitments to protect other countries, to be stable in the face of changing technologies, cannot be technologically static. Trying to stop qualitative change would be like King Canute commanding the waves. Qualitative improvement does not, however, entail—in the uncritical stock phrase—an "ever-accelerating spiral" in arms budgets. The American strategic offense and defense "package" from 1961 to 1967 greatly improved in second-strike capability and in responsible control while its budget declined by at least 40%, from 11.7 billion to 7.1 billion in current prices. (In constant prices the decline was about 50%. The strategic budget was more than 2% of the GNP of 1961, less than 1% in 1967.) The stereotype repeated throughout the early 1960's that the strategic budget was accelerating while our actual security decreased is grossly in error on both counts. The annual cost of a

useful ABM system that defends hard points and provides a thin shield for American civil society, when averaged over a ten-year period, comes to about one-tenth of the 5 billion dollars that the United States was spending annually on anti-bomber defense at the end of the 1950's. The thin defense of civil society, taken as an increment to the defense of hard points, will average about 200 million dollars annually out of a GNP approaching nearly a trillion.

Fifth, a smaller country, spending much less on research and development, conceivably might achieve technological equality with a much larger power. But the upshot of the foregoing is that there is no rest. So far, the smaller forces lag in performance as well as in size. Given advances in adversary offense and defense technology, the planned three generations of the French force, for example, may be negated by a few percent of the Russian resources devoted to strategic offense and defense.

Arguments for smaller strategic forces in large countries, or favoring the spread of nuclear weapons to medium and small countries, purport to show that even a small nuclear force is intrinsically capable of retaliation after attack by the largest nuclear countries. Typically these analyses take a simple model of a duel between two countries with sheltered forces. The attacking side launches its entire force against the force of an adversary who replies by launching the undestroyed remainder of his force against the attacker's cities. To have a high confidence of destroying the force attacked, it is usually said, sometimes as the result of calculation, that for every vehicle it destroys, the attacking force must expend many more of its own strategic vehicles. In the more euphoric versions of these attempted stability proofs, particularly those advanced in support of new national military nuclear programs as "equalizers," the exchange ratio of attacking vehicles expended as against those they can destroy is taken to be over 60 to 1 (25,000 vehicles to destroy 400). Or over 25 to 1. Or 16 to 1. In the last six or seven years these hypothetical duels assume more modest odds against the attackers: 5 or 3 to 1.

These highly simplified duels of vehicle against vehicle have many shortcomings for a realistic estimation of the complex problems of nuclear attack and response. (1) They omit completely attacks on the more concentrated but critical elements of a responsible system of deterrence, such as command, control, and communications; and in actual nuclear forces a good many even of the vehicles have been concentrated without adequate warning

and unsheltered. (2) Given appropriate costing, exchange ratios may tell what adversaries have to spend to achieve given results, but not whether they can easily afford it. (3) Even in their own terms, the calculations seldom reflect the actual current technological, operational and cost factors. It is worth illustrating some of these points, since hypothetical demonstrations of the invulnerability of small forces have maintained a kind of invulnerability of their own by sticking to pure hypotheticals.

According to the press, the first generation French strike force consists in 62 Mirage IV bombers and 12 KC 135 tankers. The force is unsheltered and without any tactical warning of ballistic missile attack. In the unwarned state the operational part of the force is concentrated on about 10 points in the south and southwest of France. The probability that any of this force will survive can be made extremely low with a high confidence by reserving a force of about 20 early generation Russian missiles with a strategy of attack that uses extensive and timely information as to which attack vehicles have failed, but without MIRVs or advanced accuracies. The second generation French force was to add to the 10 soft points on which aircraft are concentrated 30 additional points, each with a single missile sheltered to resist 300 psi. Recent press reports[6] indicate that the addition will amount to 75 rather than 30. However, 20 or so attacking launch vehicles, each equipped with 10 reentry vehicles and an advanced guidance, could destroy the first and second generation forces with a confidence of .9. And higher confidences are quite feasible. In short, the changes taking place in the offense cancel these additions to a small nuclear strike force. Much more important than the offense-to-defense exchange ratio, 20 or 30 launch vehicles might be a bit more or less than 2 percent of the number of vehicles in a Russian strategic force.[7]

The part in movement underwater of a small third generation missile submarine force is not subject to straightforward ballistic missile attack. And submarines are hard to hunt and kill. However, a small missile submarine system taken as a whole is not immune to interdiction, in particular by an adversary with a large, varied and sophisticated offense and defense. A large adversary can launch missiles at the fixed elements: at the sizable fraction of the small submarine forces in port, and at the fixed command, control and communications that are a key element of a responsible strategic force. He can muster a much larger destroyer and submarine force to hunt the few submarines at sea and aid his hunt with complex mixtures of various sensors, data

processing and communication. Finally, most important in the 1970's, he may interpose a thin antiballistic missile system that is extremely effective against small numbers of incoming objects.

In sum the theory that nuclear weapons are "equalizers," that, equipped with them, any country, no matter how small, can surely retaliate against any other country, no matter how large, is in error. The small forces we have examined would have little chance to survive a modest attack, much less a major sophisticated one. Neither past nor future technologies bear out the equalizer theory.

Sixth, subtler theories that take small nuclear forces, not as equalizers, but as "triggers," are also put in doubt by any concrete examination of technologies, operations, and costs. A triggering force too small in itself to deter a great power enemy is supposed to be able to release an unwilling strategic force of one of the principal nuclear powers against the other. Unlike the equalizer, such a triggering force then is not a substitute for alliance or unilateral commitments for protection, so much as a way of making these commitments operative. The trigger theory seems to be replacing that of the equalizer in Europe and perhaps also among advocates of national nuclear forces in India and Japan. While a subtler theory, it is less consistent and usually vaguer. Intuitively it would appear that a small force, prepared especially to compel a major ally to use nuclear weapons when that ally thinks it unwise, might *loosen* alliance bonds. It might offer some incentives to the ally to tie its fate less closely with the small power. And it might, on the whole, suggest to an adversary that the identification is less close. The mechanism linking the small trigger to the large force is extremely obscure and very seldom explained in operationally meaningful terms.

Where it is precise enough for close analysis, it may be rendered doubtful by the same technological and operational facts that call into question the equalizer theory. For example, the more rigorous formulation offered by Arthur Lee Burns covers two kinds of trigger, a passive and an active one. The passive trigger, while small, is supposed to be so protected that a major nuclear adversary could destroy it only by expending so much of his own force that he could no longer deter the small power's major ally. An active trigger could, by pre-empting, reduce the force of one of the major powers enough to make it vulnerable to attack by the other. The prospect of either sequence of events would deter the major adversary. But the small forces we have examined would be grossly inadequate in both an active and a passive role. They

would add little to the force of a large nuclear ally attacking a big nuclear adversary, and their destruction would require their large adversary to expend only a tiny fraction of his total retaliatory force.

A force able to vie with or even to trigger a major nuclear strike force must change rapidly enough to keep up: the forces now planned by the smaller nuclear countries conceivably might, but do not accomplish this. In short, there is no rest.

Seventh, even if a small nuclear force were able to protect any country that had it, either because it was a trigger or an equalizer, this would still leave unsolved the problem of protecting non-nuclear countries from nuclear coercion. A small triggering force seems particularly inadequate for extending guarantees to non-nuclear countries. If it is unclear how it can protect its own possessor by manipulating the two largest nuclear powers, it is still more obscure how a triggering force can maneuver one of them to protect a fourth power against the other; or to protect any of some 130 non-nuclear powers.

Proponents of the equalizer theory on the other hand proceed from the assumption that commitments for nuclear protection by others are not merely unnecessary, but impossible, that no country will risk responding to a nuclear attack on someone else. In principle, if not always in practice, proponents of equalizers must conclude that either no sovereign country must have nuclear weapons or all of them should. Yet permanent and total nuclear disarmament hardly seems at hand. And even if a few intrepid proponents of nuclear equalizers might be ready to distribute nuclear bombs to everybody, to most of us the perils are plain in a spread of nuclear weapons rather less than world-wide.[8] Still, a country without nuclear weapons that feels menaced by a nuclear adversary is likely to seek nuclear weapons of its own unless it feels assured of nuclear protection by someone else. Moreover, since any country, nuclear or non-nuclear, is likely to have interests affected by the coercion of some non-nuclear nation, perhaps a neighbor, perhaps a more distant country, the issue of guarantees, of formal or informal commitments for nuclear protection, cannot be avoided.

In particular, long-range commitments and defenses that make the risks of commitment commensurate with what is at stake will continue to be essential for stability on the international scene. But in recent times distant commitments have become increasingly unpopular. This has been manifested in many diverse and incompatible ways in the United States as well as in Europe: rising

nationalisms, a continental regionalism, a resurgence of moves towards protection in trade, disillusionment with foreign aid and with the turbulence and frustrations of the Third World, and a weariness with distant wars that affects hawks, doves, and some that fly dead center. But hopes for regional or national insulation ignore features of technology that have long been current and that will be greatly emphasized by developments in the future.

V

Distant Classical Wars, Old Geopolitics, and New Isolation

Revulsion against distant commitments may be based on an understandable fatigue or on unanalyzed feelings of the irrelevance of remote troubles; and sometimes on the estimate that an air or naval power can do little to affect remote land powers; or on the theory, as expressed by Mr. Kennan, that "the effectiveness of the power radiated from any national center decreases in proportion to the distance involved." Geopolitical theories of spheres of influence and stable balances of power between widely separated large and small countries frequently presume such proportional or linear decreases of military strength with distance.

Yet the relation has never been so simple. Logistic support by water has in general been cheaper and easier than over land. References in earlier geopolitical writing to continental land masses, islands and the like, have been in fact a crude means of characterizing some of the differences between water and land combat logistics. In discussing geography, geopoliticians at best have been talking about the technologies of communications or transport or weapons range. Maxims so derived, however, are not eternal. These technologies have been changing at a rapid clip.

Nonetheless the agonies of Vietnam have revived some rather old-fashioned geopolitics. Whatever one's view of Vietnam (and I have substantial differences with U.S. policy there), the isolationism it has encouraged receives no adequate support from such theories. Distance bears no simple relation either to interests or military strength. For nuclear relations, the defects of the old geopolitical treatment of distance are striking. However, its defects for describing variations in non-nuclear military strength with distance are also crucial.

It was rather common until recently to talk of the comparative disadvantage to the United States in fighting eight or ten thousand

miles from home against an adversary whose home base is near the scene of conflict. While these dramatic long-haul distances catch the headlines, neither in current nor in past technology do they determine the matter of comparative disadvantage. This has been documented in detailed studies of the comparative logistics at present levels of technology in several areas of possible non-nuclear conflict—in Thailand, in the Himalayas, in Iran and in Lebanon—and in the *actual* conflict in Korea.[9]

The most striking fact displayed by these studies is that the long-distance lift capacity of each side massively exceeds their short-distance lift inside the theater, especially in the very short ranges in which the battle would be joined. These bottlenecks inside the theater are to a very considerable extent determined by local factors: climate, terrain, harbors, port unloading facilities, railroad and road capacities, etc. They are not a function of the long-haul distances. The specific local circumstances may favor the combatant that starts from far-off; or the one that starts from nearby. (Moreover, the local circumstances may be more or less susceptible to change by the distant combatant, depending on his resources, technical level and the physical geography he confronts. They are likely to be changed by local, less-industrialized combatants, in any case with their further industrialization. But the supporting or combatant external powers will vary, before or during a war, in their ability to construct harbors, roads, etc.) On the Thai-Laos border the United States can lift, from 8,500 miles away, four times as much as China can from 450 miles off. Various potential combat areas in Iran would show a logistic standoff between the neighboring Soviet Union and the United States. In the Himalayas, support for Chinese and for opposing forces would be measured in tons per day: the 200,000 tons per day the United States might deliver over the long haul from U.S. ports to Calcutta are not the critical matter.

The figures above describe the rate at which supply can be lifted steadily after the initial build-up. If one looks at various rates of deployment and build-up, where stocks are accumulated in advance in a potential trouble area, the conclusions are not altered. Moreover, if one looks at the matter in cost terms, as distinct from capacity, the minor importance of the long haul appears even more vividly. Adding several thousand miles to the distance at which remote wars are fought increases the total cost of fighting such wars by only a very tiny percentage. It appears, for example, that if the support of U.S. forces in Korea had been

2,000 miles further away, it would have meant adding less than three-tenths of a percent to the total annual cost of the war.

The studies cited deal with recent past technology. The 1970's technology will decrease military communication and transport costs further, but especially long-distance costs. As in the case of computer technology described earlier, the terminal ends permit fewer economies of scale. Larger payload transport both on the surface and in the air will greatly reduce costs per ton-mile. Fast deployment logistic ships might (Congress and the established shipbuilders willing) combine with the planned massive increase in air cargo capacity to offer more efficient mixtures of pre-stockage and rapid deployment of men and material for the initial build-up. The C-5A will be operational in large numbers in the 1970's; it will have a ton-mile cost one-tenth that of the DC-3 and will carry 2-1/2 times the payload of the largest jet now flying. Synchronous communications satellites make the point even more clearly than improved transport.[10] It has long been true in telephony, for example, that a very large part of the costs of long distance service is traceable to such elements as local switching, operator charges and local lines. Communications satellites make unimportant the distance between transmitting and ground stations so long as both are within line of sight of the satellite, whereas undersea cables vary in cost directly with length. Such satellites may be on station over 50,000 miles above the earth. The difference will be negligible in miles, not to say elapsed travel time between electro-magnetic signals traveling between various pairs of points on earth by way of an over 100,000 mile trip to and from a satellite.[11] Satellites spanning the Atlantic and Pacific will greatly increase the capacity and reduce the costs of sending messages to far-off and isolated locations, and so will make possible a much more detailed and centralized control of classical wars in distant theaters.

If future technology reduces further the difference between fighting a war close by and far off, it can do this of course not just for the United States, but for other nations as well. This is only one reason that the technical developments should fortify no illusion of omnipotence. We may contest some sorts of war badly almost anywhere, in particular revolutionary wars where recently improved weapons technologies seem to me largely irrelevant (though no more so in Vietnam than they might be in Colombia or even in Cuba). Military strength is frequently a very poor and self-defeating way of protecting or fulfilling interests.

This applies to military strength used nearby as well as military strength used far off. It is plainly better not to have to fight at all. Even more plainly, an ability to fight with formal military force cannot be directly translated into political authority. Limits in the usefulness of American military strength are clear in relation to countries hostile in varying degrees to the United States, such as tiny nearby Cuba. Perhaps even more in relation to America's allies. In spite of rhetoric about slavery to American despotism, General DeGaulle always struck me as a rather masterful slave, long before he had even a façade of a *force de frappe*. The point can be made in reference to those allies most menaced and least able to defend themselves. Polemists using words like "puppet," Mr. McGeorge Bundy has said, have never been on the other end of the strings. It is rather more, I should think, like pushing than pulling strings. The fact that military technology can be projected by the United States and by others at great distances displays some critical connections between remote parts of the world, but lends no support to the mechanical extension of American political hegemony.

Furthermore, though we can affect matters in some places close to us or far off, we frequently have no discernible interest in doing so. And even where we do, improved technologies may not be the best vehicle for the influence we want to exert. In the last year, the isolationist debate has shifted somewhat from capabilities to interests. A good many places interest none of us very much, and some that interest us can take care of themselves. That's almost always better. No one on either side of the debate is for intervention all over or for total escape. The genuine issues concern the right extent and places of commitment. They cannot be clarified wholesale. And they have not been by the endlessly tedious repetitions and denials of the phrase "policeman to the world."

A great many things—historic, political, ethnic, cultural, sentimental—affect national interests, including a residue of past technologies like the methods of ocean transport that linked Great Britain, Spain, France, Portugal and the Netherlands durably to some of the remotest parts of the world. But future technologies will affect interests too; and on the whole in a direction that makes the new isolationism pure nostalgia. Let me say something on interests of nations in cultural contact, in trade and the movements of capital, and in national safety.

VI

Distant Cultural and Economic Interests

Cultural interests have never fallen off directly with distance. Englishmen and North Americans find Australians and New Zealanders quite accessible culturally, and are sometimes greatly puzzled by their immediate neighbors. French contacts with some parts of North America were always considerable and lately seem to be much on the increase. The vast improvements coming in long-distance communications and transport will multiply remote cultural contacts just as they will increase the capacity to project military strength. They will extend processes of education, learning and possibilities of cooperation in research. Civilian supersonic passenger planes, the subsonic high payload 747 stretch jets, a possible passenger version of the C-5, and the commercial satellites neatly parallel in the civilian field the military equipment that make the problem of getting to a theater of war small compared to getting about in it. Travelers are already used to the sharp contrast between the speed with which they can hurtle between distant airports and the maddeningly slow pace for getting to and from the airport, and queuing up for tickets, taxis, baggage, porters, and traffic lights.

High payload jets will cover great distances still more quickly and cheaply; but may increase the queues. Supersonic jets will be economic only on long trips. Their principal result will be to bring the remote places closer. It has been pointed out that if sonic booms prevent supersonic aircraft from flying over land, once again, as in the time before the building of the transcontinental railroad, New York will be closer to Europe than to Los Angeles. Passenger traffic in the Pacific should increase still more strikingly. Travel time from Los Angeles to Tokyo may be cut by nearly two-thirds. It will take perhaps forty minutes more than from Los Angeles to New York.

For civilian communications as for civil transport, the right map cannot be drawn in kilometers or miles, in what Francois Perroux calls "banal distance." Buenos Aires is closer now to Europe or the U.S. than to Caracas or Santiago. Telephone calls from Buenos Aires to Caracas go through New York. Calls between two points in Africa may go through switch points in both London and Paris. The new communications will alter optimal switching

points and help local traffic, but in particular will bring together widely separated points.

From the standpoint of economic and strategic interests one important result of improvements in communications and transport will be to increase the geographical extent of interests and simultaneously to reduce the specific importance of what are now critical bottlenecks on transit points. Suez is an example: reducing very long-haul costs cuts the added expense of a detour.

Indeed, most of what I have said about effects on cultural contacts applies quite directly to economic interactions, that is, to the movements of commodities and capital and possibly seasonal labor. Air freight capacity has been increasing rapidly for high value commodities; the huge cargo aircraft coming will make distant air transport economic for new ranges of less valuable commodities. For bulky primary commodities, those that are lowest in value density, like oil, the development of super tankers drastically reduces long-haul costs. While there are diminishing returns to scale, the economies of scale are enormous. A tanker with a capacity for 150,000 dead weight tons can move crude oil 5,000 miles at $1.69 per ton compared to $7.29 for a 10,000 dead weight ton tanker. Construction costs decrease with increasing tanker size from $220.00 per ton at 20,000 dead weight tons to less than $70.00 at 300,000 dead weight tons. Operating costs decrease, too, in particular with increased opportunities for automation. In fact, the *Tokyo Maru*, a tanker of about 135,000 dead weight tons, will be operated by a crew of 29, while tankers of 50,000 dead weight tons may use 35 men or more. The Japanese in the early 1970's will be constructing 500,000 dead weight ton tankers, something like ten times the size of the largest tankers available during the Suez Crisis of 1956. As a result of such changes, not only are detours around gateways like Suez cheaper than they were; they may, because of the limitations of the gateways themselves, be cheaper than the direct route. Suez at present can handle fully loaded tankers only up to 70,000 dead weight tons.

There is a fruitful analogy with the discretionary wiring in micro-electronics to which I referred earlier. Just as the multiplication of gates on a tiny wafer permits a detour around ones that are not working, and so reduces the number of critical interconnections, so the lowered costs and increased capacity for both long distance transport and long distance transmission of messages increase the number of economic alternatives

available and make it feasible to go around choke points. These communications and transport developments reduce interests in specific gateways to remote places, the points traditionally called "strategic," but not the interest in remote places themselves. On the contrary, to the extent that they make links to distant points more reliable, they spread interests more evenly but farther. For example, Japan's growing trade in manufactures with Europe will risk less from arbitrary interruption. In reducing the risks of war or peacetime interruption, these technical changes counter one of the chief traditional arguments for economic autarky.

One argument for autarky current in many variants for nearly 150 years rests on technology. Robert Torrens[12] predicted that the industrialization of additional countries, population growth and diminishing returns in primary products would reduce the basis for foreign trade. This hypothesis of course entails *as corollary* the declining importance of trade among already industrialized countries in particular. It is not an argument for intra-regional trade but for the autarky of nations even within the same region. In fact, it suggests reduction of trade among regions within a single nation as these "converge" in economic structure.

This venerable argument[13] has several essential theoretical flaws. Except in some extremely simplified economic models, a convergence in over-all average efficiency of trading countries does not entail a lessening of the possibilities of specialization in particular products. Some advantages of specialization flow not simply from economies of scale at fixed techniques, but from such other matters as the gains from learning which come with cumulatively great output. The argument neglects technical changes like the global extension of communications that tend to create world markets for specific products, and neglects techniques that increase the advantages of trade such as reduction in freight and communications costs. Increasing income itself creates a demand for variety and for products of higher value in which transport costs are in any case less important. Finally, like some sounder theories that oppose it, the Torrens and related hypotheses say nothing in principle about the way the benefits of trade vary with geographical distance, and in particular how transport costs as a complex function of distance may change and flatten over time with changing techniques. Even if in the absence of trade countries had marginal costs in identical ratio for their many highly differentiated products, there would be a basis for specialization and exchange, so long as some short or

long run costs declined and transport expense did not wipe out cost differences. However, such identical ratios are implausible; the increased output permitted by specialization and trade almost surely for some commodities would be accompanied by a decline in costs in the short or long run; and transport costs are decreasing, especially for distant places.

Aside from its theoretical lacks, the belief that technology would reduce the role of trade does not square with available data, even though the benefits of trade are hampered by government barriers. World trade in manufactures in the 90 years after 1876, in spite of setbacks in the protectionist and depressed interwar period, increased per capita two or three times. Between 1950 and 1966 it has been increasing even faster than world production of manufactures—7.3% compared to 5.3% *per annum*.[14] For the United States, in spite of claims to the contrary, from 1879 to 1960 neither exports nor imports declined relative to GNP in real terms.[15] Similarly within the United States, interregional trade, as Richard Cooper has shown, has grown more rapidly than total output, in spite of an apparent "convergence" in economic structure of the various regions.[16]

What is true of trade seems true also of the movements of capital, when not constrained by artificial barriers. Improvements in long-distance travel and telecommunications encourage distant foreign investment by making it easier to manage. Large-scale data processing may stimulate organizational innovation and in any case makes feasible much more detailed and far-flung control. All of this should continue to encourage the already significant growth of international corporations whose interests extend far beyond any narrow geographical region, and make economic autarky more inappropriate than ever. Distant interests should not be taken, however, as applying only to the capital-rich countries as an attribute of "imperialism." The underdeveloped world has perhaps even more obvious interests in distant developed countries as a source of aid and as a market for exports. Indeed, as Edwin Reischauer suggests, one of the more disturbing aspects of some of the new isolationism is an implication that "Asians, having their own distinctive cultures and special problems, should go their own way, presumably in poverty and turmoil, while we of the advanced nations go our own prosperous and peaceful way."

The revolution in transport and communications casts doubt not only on the new isolationism of a growing minority but also

on the more respectable but rather mechanical regionalism that may frequently be found in both the Democratic and Republican establishments: the grand designs for Latin American common markets, Asian common markets, African unions, economic unities spanning the Middle East from Morocco to Afghanistan, and others. The composition of some of these groupings suggests how poor a criterion mere proximity is for association. Some have higher cost communication and transport links among themselves than to the outside world. They may be mainly rival exporters of the same commodities, those in which they have the greatest comparative advantage. Yet a mechanical regionalism is not exclusively American. The head of the Commission of European Communities recently expressed his conviction that the world will inevitably organize itself into continents just as it organized itself into nations five centuries ago. And there are crasser forms of isolationism in Europe as well.

At the start of World War II it was the isolationists like Charles Beard, Jerome Frank, Stuart Chase and many others who urged a self-sufficient, "continental" American policy. They argued in fact that elsewhere than in the United States continental integration was the wave of the future and the only way to peace in the world. Interventionists argued for the primacy of overseas links in cultural, economic and military terms. Naturally they had a great deal of support from the future allies overseas. It is remarkable that having successfully countered arguments for regional self-sufficiency, so many interventionists ended the war supporting one regionalism or another, and as technology moved further in the opposite direction, espoused regional solutions for more and more of the world.

Reducing trade barriers inside a region may permit important economies of scale and indirect benefits to future growth as well as direct gains in efficiency at a given time. But this applies also to reducing trade barriers among countries that are not contiguous and that may be very widely separated. From a cosmopolitan view, the direct gains from a customs union depend on whether the increased trade and specialization within the union would outweigh the decrease in division of labor as between the union and the countries outside; whether in short it involved a net shift to higher or lower cost sources. Some unions might represent a gain; some would surely be a loss, particularly if their composition were determined solely on the basis of criteria as unrelated to economic efficiency as contiguity. Many groupings of countries outside the

West seem little more than a literary or touristic convenience for Europeans and Americans, or a bureaucratic convenience for dividing up the work in their Foreign Offices. Various members of such a "region" may otherwise have had rather little economic or political interest in each other. Nor much interest in military cooperation.

Neighborhood, in international relations, as Jacob Viner has pointed out, has never guaranteed neighborly feelings, and often has prevented them. Writings on international relations in the 18th century and later often took proximity as one of the natural conditions of enmity. Indeed one of the largest defects of regionalism in the post-war period has been a frequent neglect of the hard truths of differences in political interest inside regions and the varying bonds of interests with countries outside. Regionalism which has seemed a half-way house between nationalism and a utopian universalism has itself sometimes been a kind of utopia for hard-headed *Realpolitikers*.

The historic antagonisms that divide a geographical region of course may be the very reason offered for a focus on regional association. But the network of conflicting and common interests extends far beyond a single region, and so do problems of conciliation. Today Germany is not the greatest menace to the English or the French. Just as generals are said to prepare always to fight the last war, so statesmen and social scientists may be prone to prevent the last war, but not the next.

The future increasing ease of communication and transport should not be taken as simply irenic, leading only to harmony and peace. On the contrary, it means an extension of the "neighborhood" to more remote areas, and such larger neighborhoods need not mean neighborliness any more than the small ones. The possibilities of coercion as well as cooperation increase. Which brings us back to the third interest, that of national safety.

VII

Interests in Safety

National safety is the most critical matter and perhaps the least understood by those who think of it in terms of 19th century and earlier technologies, or by those who conceive of it exclusively in terms of bilateral nuclear deterrence, the preoccupation of the mid-1950's. One essential here is that improvements in the technol-

ogy of combat delivery and logistics support affect not merely one's own capabilities and those of one's friends, but those of potential adversaries as well. These changes then drastically extend the range at which potential adversaries can do harm. This is most obvious in the case of the technologies for nuclear war. Not only nuclear capabilities of the two largest powers, but also of others, will extend far beyond any single region, and will permit coercion if unopposed.

But improvements in technology extend the range at which classical, not just nuclear, conflicts may be fought. And as in the case of nuclear technologies such improvements apply to potential adversaries too. While neither for the nuclear nor the classical case is distance without effect, the effects are complex; and very much more complex than is recognized by linear theories of the weakening of strength with distance.[17] Nonetheless, the upshot of these considerations of 1970's technology is that basic interests in safety will extend farther out than they ever have before. And a great many of the new isolationists in the United States were interventionists in World War II because they recognized that even then interests in security extended far beyond one's hemisphere.

A second essential is that bilateral mutual deterrence is not enough to prevent the international system from deteriorating. A small nuclear force, we have seen, is hardly likely to make any country that has it the equal of any other in deterring attack on itself. And the technological defects of small nuclear forces limit their potential for protecting their possessors indirectly by triggering one major power against the other. However, even if these defects did not obtain and any country with nuclear weapons could thereby get direct or indirect protection for itself, there would still remain the need to protect non-nuclear countries from nuclear coercion. And giving bombs to everybody hardly seems the way to do it.

On the other hand, getting stable isolated nuclear balances in Asia or the Middle East or other areas that comprise diverse antagonisms and varying interests with respect to countries outside, will not be easy. Simple balances involving nuclear commitments from one or two member countries will be hard to make persuasive, and some of the members may feel more menaced by the regional nuclear capabilities than assured. Multiple regional nuclear balances would by definition involve an extensive spread of nuclear weapons with the attendant problems of a still further spread by a chain reaction with countries in and

out of the region and increased probabilities of nuclear war by accident or design. Multilateral nuclear forces (MLF) for such diverse "regions" as Asia seem much less feasible even than the European counterpart. And an Arab-Israeli MLF seems rather far off in the future. Or even a Saudi-Hashemite-Algerian-Egyptian one.

While a variety of forms of cooperation among countries in and out of a particular region may be useful, long distance nuclear commitments by great powers have been essential at the very least to cancel long distance threats by others. The growth of new long distance nuclear forces like that of China will emphasize these.

Long distance commitments confer no perfect stability. But neither does any other alternative. I do not think that the deterrence between the United States and the Soviet Union is unconditional.

In a many-nation world including so far 5 countries that have exploded nuclear devices and about 130 that have not, unconditional deterrence, I would stress, is not a sensible goal. If each of the nuclear countries could unconditionally deter any other, this would mean the instability of nuclear peace, not stability. Any nuclear power could then threaten or safely use nuclear weapons against any non-nuclear one within range.

Commitments for protection against nuclear coercion or attack, whether tacit or explicit, formal or informal, unilateral or in alliance arrangements or in the form of a United Nations collective security agreement, are a necessary element of stability on the international scene. Long range commitments and defenses that make the risks of commitment commensurate with what is at stake are essential.

The word "commitment" may perhaps be traumatic, given all of the remote and uncertain conflicts in which so many of us have been engaged. A commitment, moreover, lessens autonomy in one way or another for both the party committed and the recipient of the commitment. The United States commits itself in NATO to regard an attack on Europe as an attack on itself. It has extended commitments in varying degrees to other allies and to some non-aligned countries. This is frequently painful but it is not quixotic. If we do not commit ourselves and keep it plain that the configuration of our interests and capabilities make the sacrifice smaller in fulfilling the commitment than in not fulfilling it, the countries in question would have to preserve their safety by their own means; and to try to obtain nuclear safety by nuclear means.

In a great many cases these are likely to be even less perfect than the long distance commitment. And the failure to make long distance commitments would reduce options by changing the international environment adversely.

In sum, neither military capabilities, nor economic interests, nor interests in cultural contacts, nor in national safety seem likely to be narrowly circumscribed by geography, to be contained, for example, by continents. Neither national nor regional autarkies look sensible in either strategic or economic or political terms. Orwell projected for 1984 a world split into a few huge blocs. I find such a prospect neither attractive nor likely to improve the chance of peace. Even inside a single nation sharp regional lines dividing the country into groups with different political, sentimental, ethnic, and economic interests make civil war more likely. On a world scale it would be more ominous. Orwell showed his insight by having his huge continental blocs constantly at war. The fact that, so far as technology is concerned, the 1970's do not seem to be marching toward 1984 strikes me then as all to the good. There are many forms of cooperation including, I would stress, some regional ones that are useful for specific and limited purposes. But perhaps it's just as well that the useful sorts of association are "cross-cutting," likely to vary in membership from one purpose to another.

We all believe in the importance of preserving options, of being able to defer decision in order to make a final resolve on the basis of the utmost information about alternatives. We feel uneasy about getting involved, "contracting in." Nonetheless, contracting out isn't genuinely feasible. Commitment, foreclosing some options, is essential if we want to keep others open in the future. Speaking here at Elsinore, Denmark, in Hamlet's shade, I find it appropriate to emphasize that decision cannot be postponed indefinitely, that putting off the awful day frequently makes things still more awful; that we must commit ourselves. The technologies of the 1970's suggest that many of the essential commitments will continue to be long distance.

ENDNOTES - Wohlstetter - Strength, Interest and New Technologies

1. Presented at Elsinore, Denmark, September 28, 1967, as the opening address of the 9th Annual Conference of the Institute for Strategic Studies on Military Technology in the 1970's. I am indebted to Paul Armer, Michael Arnsten, Dan Ellsberg, Malcolm Hoag, Oleg Hoeffding, A. W. Marshall, David McGarvey, Richard Nelson and Charles Wolf for their comments on an earlier draft, and to Miss Janina Bonczek for research assistance.

2. See Victor Gilinsky, "Fast Breeder Reactors and the Spread of Plutonium," RM-5148-PR, Santa Monica, CA: The RAND Corporation, 1967.

3. *Cf.* Leonard Beaton, "Nuclear Fuel-for-All," *Foreign Affairs*, Vol. 45, No. 4, July 1967, pp. 662-669.

4. This describes the changes only very grossly. For the source of these three estimates and for more detail, see Paul Armer, "Computer Aspects of Technological Change, Automation and Economic Progress," printed in "Technology and American Economy," the report of the National Commission on Technology, Automation and Economic Progress, Appendix, Vol. I, *The Outlook for Technological Change and Employment*, Washington, DC: U.S. Government Printing Office, February 1966, pp. I-205 through I-232.

5. Since this paper was written, the United States Government has announced that it will deploy a thin ABM system.

6. William Beecher, "Small Atomic Arms Being Developed by France," *The New York Times*, April 14, 1967.

7. The Institute of Strategic Studies, *The Military Balance*, has for some time now attributed to the Soviet Union well over 2,000 medium and long-range manned and unmanned strategic vehicles.

8. See Hedley Bull, *The Control of the Arms Race*, New York: Praeger, 1965; and Albert Wohlstetter, "Nuclear Sharing: NATO and the N+1 Country," *Foreign Affairs*, April 1961. In the latter

paper I tried to examine more inclusively the disincentives and incentives for acquiring a nuclear strike force, and in particular the high costs of small nuclear forces that seriously aim at surviving a major power attack. More recent cost study emphasizes the results presented there.

9. For more detail on these studies, see Albert Wohlstetter and Richard Rainey, "Distant Wars and Far Out Estimates," monograph presented at the APSA meeting, New York City, September 1966. *Cf.* also Albert Wohlstetter, "Theory and Opposed Systems Design," to be published in *New Approaches to International Relations*, Morton Kaplan, ed. In this connection we are indebted to the work of Mary Anderson, Wallace Higgins, L. P. Holliday, Norman Jones and John Summerfield.

10. I am indebted here to the work of Leland Johnson. See "Some Implications of New Communications Technologies for National Security in the 1970's."

11. This formulation was suggested to me by H.S. Rowen.

12. *Essay on the Production of Wealth*, London, 1821.

13. Frequently revived and modified by Werner Sombart at the turn of the century, by Keynes and D. H. Robertson in the 1930's, and more recently by Karl Deutsch and Alexander Eckstein.

14. For the years up to 1959 see Alfred Maizels, *Industrial Growth and World Trade*, Cambridge, UK: Cambridge University Press, 1963, pp. 79 ff. For an extension of these data through 1966, see "Monthly Economic Letter" of the First National City Bank, New York City, September 1967.

15. See Robert Lipsey, *Price and Quantity Trends in the Foreign Trade of the United States*, Princeton, NJ: Princeton University Press, 1963.

16. Richard Cooper, "Growth and Trade: Some Hypotheses About Long-Term Trends," *Journal of Economic History*, December 1964.

17. See Wohlstetter and Rainey, "Distant Wars and Far-Out Estimates," *op. cit.,* for the complex effects of distance on nuclear capabilities as well as classical strength. And for a very detailed empirical study of the effects of various critical distances on nuclear capabilities in the 1950's, see A. J. Wohlstetter, H. S. Rowen, F. S. Hoffman and R. J. Lutz, *The Selection and Use of Strategic Air Base Systems*, R-266, Santa Monica, CA: The RAND Corporation, 1954.