

Champaign-Urbana Committees on Public Issues

The enclosed article, which appeared in the April 1962 issue of the Scientific American, has been sent to you with the compliments of the publisher. Distribution has been undertaken by the newly formed Champaign-Urbana Committees on Public Issues (formerly Committee of Correspondence).

The Committees on Public Issues (COPI), a group composed largely of faculty members of the University of Illinois, has been organized with the idea that initiative for directing U. S. policy out of the spiral of increasing tension and increasing reliance on military might must come from a concerned and well-informed citizenry. As an example of this kind of initiative, the basis for the most recent U. S. proposal for disarmament - the plan for zonal inspection - was initially set forth by Professor Salen of Harvard in a privately organized Conference on Disarmament and Arms Control in the Boston area (Daedalus,).

"Steps Toward Disarmament" by P. M. S. Blackett evaluates the military strength and posture of both the U. S. and the U.S. S.R. and proposes some compromises in both to set the stage for fruitful negotiations. Professor Blackett is professor of physics at the Imperial College of Science and Technology of the University of London. He won the Nobel Prize in physics in 1948 and he is distinguished not only as a scientist but also as an advisor to the British government on military and scientific policy.

COPI hopes that you will read this article and that it may help you in evaluating present U. S. policy. As members of a university community, your voices can have some influence in the formulation of future American policy.

COPI invites participation in its activities and contributions to help defray the expenses of this mailing. Correspondence should be directed to Post Office Box 206, Station A, Champaign, Illinois.

STEPS TOWARD DISARMAMENT

by P. M. S. BLACKETT

REPRINTED FROM
**SCIENTIFIC
AMERICAN**
APRIL 1962

Steps toward Disarmament

A British physicist and World War II military operations analyst discusses the problems that underlie the present disarmament negotiations

by P. M. S. Blackett

The representatives of 17 nations—the two main nuclear powers, seven nations allied with one or the other of them, and eight uncommitted nations—have convened at Geneva for the third formal, full-dress attempt since the end of World War II to negotiate disarmament. It must be conceded that the circumstances are not entirely favorable to agreement. During 1961 the U.S. and the U.S.S.R. reversed the trend of nearly a decade and increased their military expenditures by something on the order of 25 per cent. The three-year moratorium on the testing of nuclear weapons was terminated by the series of Soviet tests in the fall; on the eve of the Geneva meeting the U.S. announced its intention to move its present series of underground tests into the atmosphere if the U.S.S.R. did not immediately agree to a test ban.

On the other hand, both the Soviet and the Western bloc are committed by categorical public statements to the objective of complete and general disarmament under strict inspection and control. What is more, practical military considerations, arising from the nature of nuclear weapons, commend substantial reduction in armaments to the great powers as a measure that will increase their security in the first step toward disarmament.

In considering possible first steps that would lead to increased security for both sides, partisans of each side should try to understand how the present military

situation must look to the other. A military commander, in planning a campaign or a battle, attempts to do this as a matter of course. He has first to find out all he can about the material facts of his opponent's military deployment and secondly to assess the probable intentions of his opponent for its use. This is the process that has been described as "guessing what is happening on the other side of the hill." A similar obligation rests on those who plan a disarmament negotiation. A military planner, it is true, can much more easily put himself mentally in the position of his military opponent than a statesman can think himself into the position of his opposite number, because a statesman must enter imaginatively into the political as well as the military thought processes of his opponent. This is hard to do at a time of acute ideological struggle. It is nonetheless essential that the military and political leaders of both sides do just this. No small part of the present crisis, concerning armaments in general and nuclear weapons in particular, has been due to a tendency in the West to attribute to ideological motives actions by the U.S.S.R. that seem to have been motivated mainly by military considerations. Conversely, much of the West's defense policy appears to have been influenced by political and economic factors.

It may be useful to start by describing the most important elements in the military capabilities of the Soviet bloc

and the Western alliance. In recent months there have been significant disclosures about the nuclear weapons and their means of delivery possessed by both sides. On November 12 of last year Robert S. McNamara, Secretary of Defense of the U.S., said that the U.S. nuclear-strike force consists of 1,700 intercontinental bombers, including 630 B-52's, 55 B-58's and 1,000 B-47's. He said that the U.S. possesses in addition several dozen operational intercontinental ballistic missiles (ICBM's), some 80 Polaris missiles in nuclear-powered submarines, about the same number of Thor and Jupiter intermediate-range missiles, some 300 carrier-borne aircraft armed with megaton war heads and nearly 1,000 supersonic land-based fighters with nuclear war heads. According to his deputy, Roswell L. Gilpatric, "the total number of our nuclear delivery vehicles, tactical as well as strategic, is in the tens of thousands, and of course we have more than one war head for each vehicle. . . . We have a second-strike capability that is at least as extensive as what the Soviets can deliver by striking first, therefore we can be confident that the Soviets will not provoke a major conflict." The U.S. stockpile of nuclear weapons is most often estimated as around 30,000 megatons, that is, enough for some 30,000 one-megaton bombs.

Naturally no such precise figures for Soviet strength are available. I have seen no reliable estimates of the U.S.S.R.'s nuclear stockpile, nor of its possible nu-

clear-armed submarine strength, nor of its nuclear-armed fighter-bomber strength (the last, of course, would not have sufficient range to contribute to the Soviet strike power against the U.S.). But recent semiofficial estimates from Washington give the U.S.S.R. some 50 ICBM's, some 150 intercontinental bombers and some 400 medium-range missiles (the last able to cover Europe but not the U.S.). The same sources indicate that the U.S. may have a small lead over the U.S.S.R. in the number of ICBM's. That such estimates should issue from Washington may seem surprising in view of the role that an alleged "missile gap" played in the 1960 presidential election campaign. That the estimates are realistic, however, is indicated by the statement of Senator Stuart Symington that the U.S. intelligence estimate of the missile force available to the U.S.S.R. at the middle of 1961 was only 3.5 per cent of the number predicted a few years ago. The corresponding estimate of Soviet bomber strength, he revealed, was 19 per cent of the number predicted in 1956 [see illustrations on page 10]. Mr. Symington explained that the new figures are predicated on intelligence about Soviet "intentions" as well as "capability" and expressed his own disquiet at "the tentativeness at best of our intelligence estimates." It is one of the purposes of this article to attempt to elucidate some of these Soviet intentions.

At first sight there appears to be a contradiction between Washington's claim of a marked over-all nuclear superiority and the recent statement by Marshal Rodion Y. Malinovsky, the Soviet Minister of Defense, that the U.S.S.R. has the power to destroy all the important industrial, administrative and political centers of the U.S. and "whole countries that have provided their territories for the siting of American war bases." The explanation may be as follows. To carry out such destruction would require not more than 1,000 megatons of nuclear destructive power, say five megatons for each of 100 key targets in the U.S. and another 500 megatons for Western Europe and U.S. bases overseas. At only 100,000 dead per megaton such an attack would kill 100 million people. The U.S. stockpile, estimated at 30,000 megatons, is 30 times greater than the U.S.S.R. would need to carry out the retaliatory blow described by Malinovsky.

There is, of course, the possibility that the new U.S. estimates of Soviet nuclear strength are too low. After all, firm

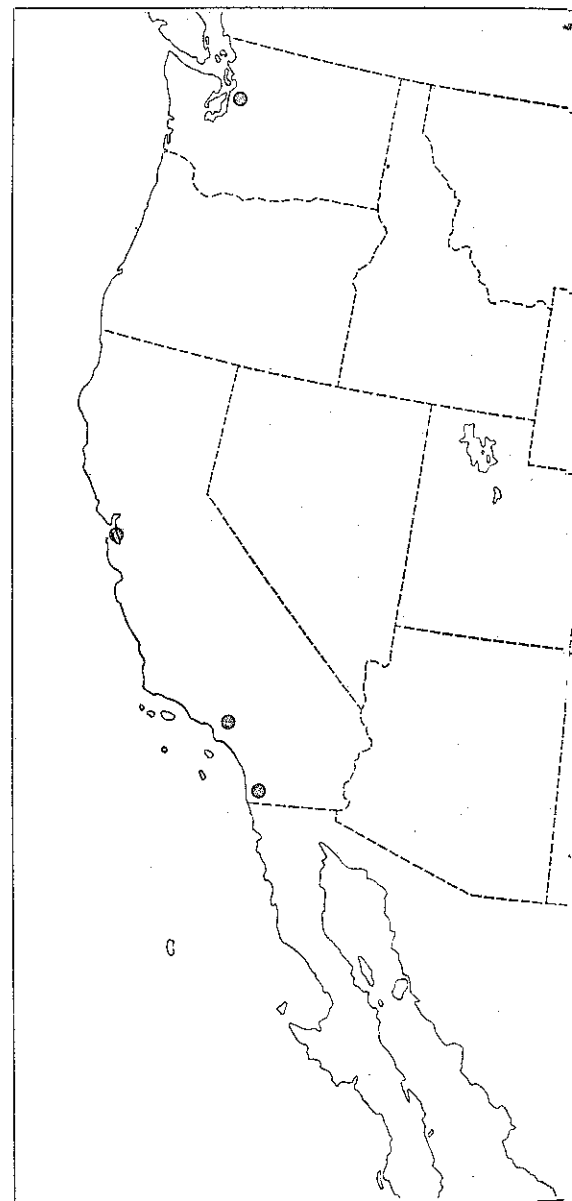
information about Soviet military preparations is notoriously hard to come by. It seems certain, however, that the U.S. Department of Defense must believe the estimates to be roughly correct. It would be politically disastrous for the Administration to be found guilty of underestimating Soviet nuclear strength. But even assuming that the estimates of the relative strength of the two sides are only approximately correct, they show that the possibility of a rationally planned surprise nuclear attack by the U.S.S.R. on the nuclear delivery system of the West must be quite negligible. The question of why the U.S.S.R. has built such a small nuclear delivery system should perhaps be replaced by the question of why the U.S. has built such an enormous striking capacity.

In order to understand the possible motives behind Soviet defense policy, it is necessary to consider the history of the growth of nuclear-weapon power. During the period of U.S. atomic monopoly or overwhelming numerical superiority, say from 1947 to 1954, the role of the U.S. Strategic Air Command was to attack and destroy Soviet cities in case of war. This countercity policy, like most traditional military doctrines, had both an offensive and a defensive aspect. From the Western viewpoint, under the doctrine of "massive retaliation," this nuclear striking power was seen to be both a deterrent to the possibility of attack by Soviet land forces and, in the extreme "roll back," or "liberation," statement of the doctrine, an offensive weapon to obtain political concessions by threat of its use. By 1954 the threat was implemented by more than 1,000 intercontinental B-47 bombers, plus larger numbers of shorter range vehicles deployed around the U.S.S.R.

From the U.S.S.R.'s point of view, its land forces were the only available counter to the Western nuclear monopoly during this period. The answer to the threat of nuclear attack was the threat of taking over Europe on the ground. In retrospect the military reaction of the U.S.S.R. seems understandable. It started a crash program to produce its own nuclear weapons. It also embarked on a huge air defense program; by 1953 it was credited with an operational fighter strength of some 10,000 aircraft. As Western nuclear strength grew, the U.S.S.R. gradually built up its land forces so as to be able to invade Europe, even after a U.S. nuclear attack. At the political level the U.S.S.R. consolidated its forward military line by the political

coups in 1948 in Czechoslovakia and integrated the other satellite countries more closely into the Soviet defense system. Since the main military threat then to the U.S.S.R. was from manned nuclear bombers, the greatest possible depth for air defense was vital. During World War II it was found that the efficacy of a fighter defense system increased steeply with the depth of the defense zone. Finally, the U.S.S.R. maintained strict geographical secrecy over its land area so as to deny target information to the U.S. Strategic Air Command.

The doctrine of massive retaliation became less and less plausible as the



MINIMUM DETERRENT strategy of a nuclear opponent of the U.S. could logically

Soviet nuclear stockpile grew. It had to be abandoned after 1954, when hydrogen bombs became available to both East and West. When the U.S.S.R. proceeded to build up a fleet of long-range bombers to deliver its hydrogen bombs, the U.S. became vulnerable to nuclear counterattack. Some form of nuclear stalemate by balance of terror seemed to have arrived.

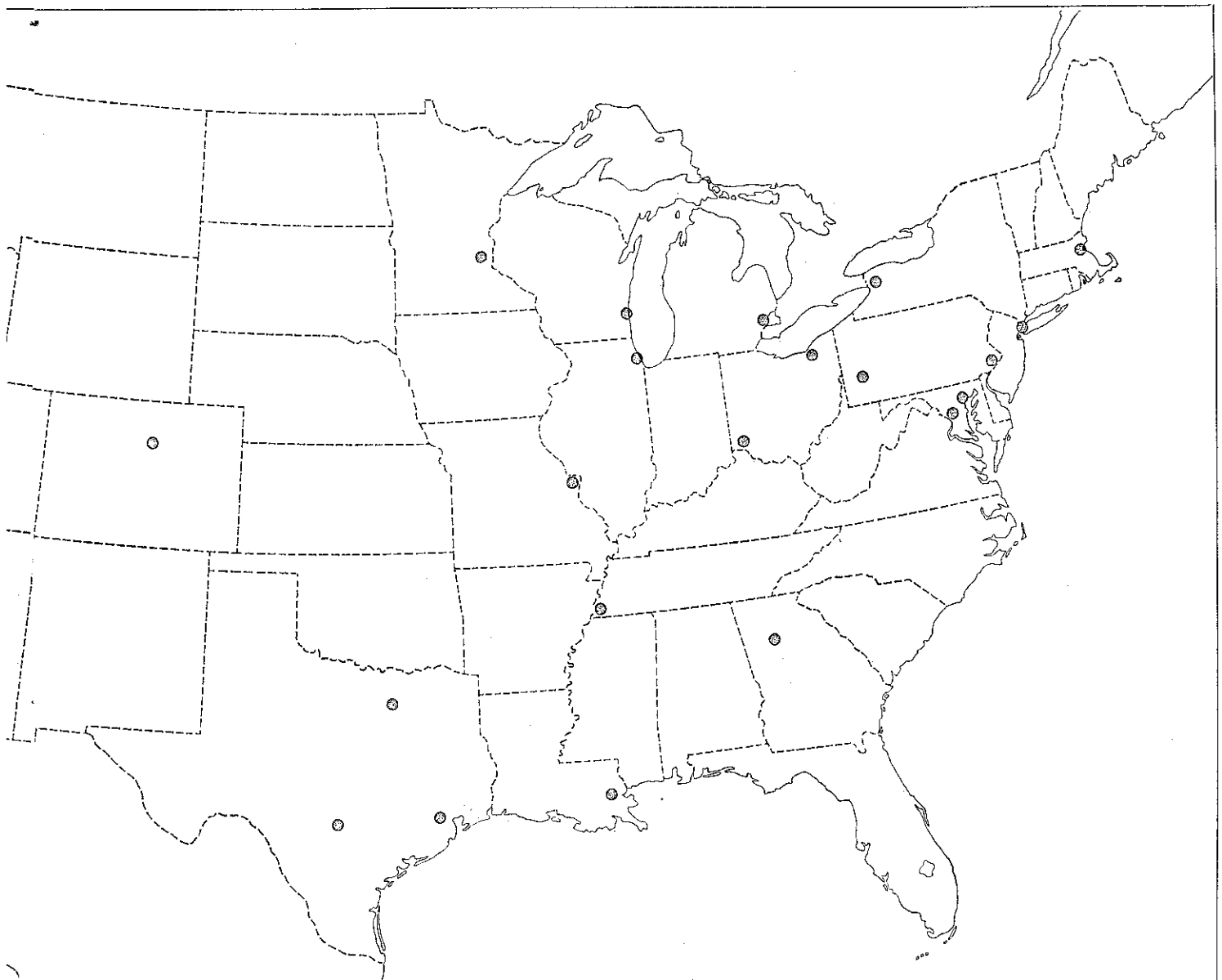
This balance seemed still further strengthened about 1957, when rapid progress in the technology of nuclear weapons and missiles made it possible to carry multimegaton hydrogen bombs in ICBM's. Because such missiles are most difficult, if not impossible, to de-

stroy in flight, a nuclear aggressor would have to leave no enemy missiles undestroyed if it wanted to keep its own major cities from being wiped out by a retaliatory attack. The advent of long-range missiles therefore made the balance of terror more stable.

Two contrasting systems of military theory evolved in response to this new situation. The first led off from the premise that a rather stable kind of military balance had been reached, in which neither side could make use of its strategic nuclear power without ensuring its own destruction. In other words, the balance of terror was likely to be rather

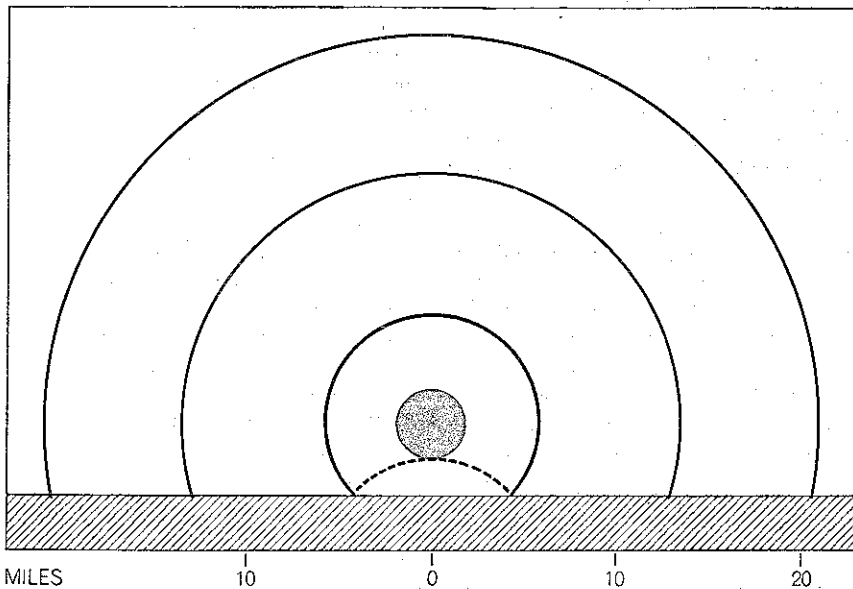
stable against rational action, even though the actual nuclear strengths of the two sides were markedly different, as indeed they were in the middle 1950's, when the U.S. was already vastly stronger in over-all deployed nuclear strength. This view rested on the assumption that neither side could hope to knock out the other's nuclear system entirely. Since some power to retaliate would survive attack, a rational government would be nearly as much, if not just as much, deterred from a first strike by the expectation that it would suffer, say, 10 million deaths as it would be if the expectation were 100 million.

This view led to the practical conclu-

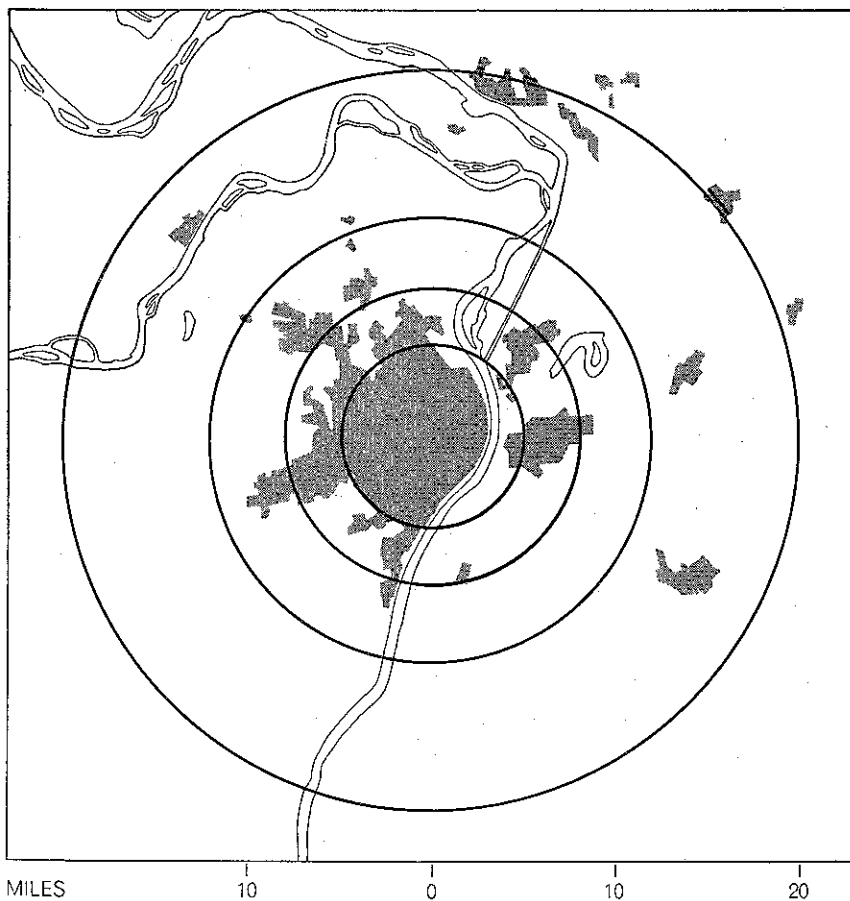


be based on an attack on the U.S. population rather than on U.S. airfields and missile bases. The colored dots on this map represent

the 25 largest U.S. cities. In the 1960 census the combined population of the metropolitan areas of these cities was 60.8 million.



AIR BURST of a nuclear bomb would maximize its effects on a city, the most widespread of which would be due to heat. This drawing outlines the effects of a 10-megaton bomb set off at 20,000 feet. At 12 miles (*inner colored circle*) from "ground zero" the fireball, 3.4 miles in diameter, would deliver 30 calories per square centimeter at a rate sufficient to ignite virtually all flammable building materials. At 20 miles (*outer colored circle*) from ground zero the heat would be 12 calories per square centimeter, enough to cause third-degree burns and start many fires. Arc extending upward from ground below the burst is a reflected shock wave that would amplify blast effects of the explosion (*see drawing below*).



RADI OF EFFECTS of a 10-megaton air burst are superimposed on a map of St. Louis and the surrounding area. The two colored circles correspond to the colored circles in the drawing at the top of the page. The black circles concern effects due to blast. At a distance of five miles (*inner black circle*) from ground zero virtually all buildings would be destroyed. At eight miles (*outer black circle*) virtually all wooden buildings would be destroyed.

sion that "enough is enough." In today's jargon this is the policy of the minimum deterrent—that is, the possession of a nuclear force adequate only for a retaliatory attack on enemy cities but incapable of successful attack on the enemy's nuclear delivery system. It is clear that only a small nuclear delivery system is necessary for a minimum deterrent. One big hydrogen bomb dropped on a big city could kill several millions. The small delivery system must, however, be highly invulnerable. Otherwise the enemy might think it possible to bring off a successful "counterforce" first strike, aimed at the destruction of the system. Little operational intelligence is needed for such a minimum deterrent policy because this involves attack on cities, whose locations are known, and does not involve surprise attack on nuclear bases, whose locations therefore do not need to be known.

On the political plane, it was thought, the resulting period of relative stability would be favorable for a serious attempt to negotiate a substantial measure of disarmament, both nuclear and conventional. Far-reaching disarmament was seen to be highly desirable, if only because such a balance of terror is stable solely against rational acts of responsible governments. It is not stable against irresponsible actions of individuals or dissident groups or technical accidents. A few suitably placed individuals—a missile crew or the crew of a nuclear bomber on a routine flight—could kill a few million enemy city dwellers on their own initiative. The best way to reduce this danger is to reduce drastically the number of nuclear weapons on both sides.

The second and quite different doctrine was that the balance of terror was not even stable against rational acts of responsible governments. This was based on the view that a determined nuclear power might be able to launch a surprise counterforce attack on the enemy's nuclear delivery system of such strength that the enemy would not be able to retaliate. The aggressor, without suffering unacceptable casualties, would then have the enemy at its mercy. The practical consequence of this doctrine is to strive for maximum superiority in number of weapons, maximum invulnerability of one's own nuclear delivery system and maximum intelligence about the enemy's nuclear system.

Plainly a successful counterforce attack would require knowledge of the location of all the enemy's nuclear missile and air bases and the power to dispatch

several weapons against each, so as to ensure that at least one reached its target. A counterforce strategy thus implies the necessity for a many-fold nuclear superiority over the enemy. Moreover, to have the slightest chance of success such an attack must come as a complete surprise to the enemy: it must be a first strike. This policy has various pseudonyms: maximum deterrent posture, first-counterforce-strike capability, or, in plain English, preparation for nuclear aggression.

Since the possession of nuclear armament raises the possibility that either side could adopt either one of these strategies, both of them must have been discussed in military circles in Moscow and Washington during the years after the explosion of the first hydrogen bombs in 1954. Let us try to find out how the discussions went by studying what shape the nuclear-defense policies of the U.S.S.R. and the U.S. took in the subsequent years.

If the Washington figures for Soviet nuclear strength are valid, it is clear that the U.S.S.R. has planned for a purely retaliatory nuclear role and has definitely not planned for a surprise attack on the U.S. delivery system. As long ago as 1956 the U.S.S.R. was believed to have the capability of making 25 long-range bombers a month. It appears today to have only some 150, compared with the 1,700 U.S. long-range bombers able to reach the U.S.S.R. Even though Soviet medium-range bombers could reach the U.S. on a one-way flight, this is much more than counterbalanced by the 1,500 or so Western fighter bombers, carrier-borne aircraft and medium-range missiles able to reach the U.S.S.R. It is also probable that the U.S.S.R. could have made many more than the 50 or so ICBM's with which it is now credited, since its space program indicates substantial industrial resources for making missiles. The evidence is that the U.S.S.R. has based its safety on the retaliatory power of a small number of missiles and aircraft operating from bases whose exact locations are kept as secret as possible. The deterrent value of its missiles is certainly enhanced by the prestige of its space program.

That the U.S.S.R. believed the danger of a major war, intentionally initiated, had been reduced by the advent of hydrogen bombs seems indicated by the fact that it reduced the total number of men in its armed forces from 5.8 million in 1955 to 3.6 million in 1959. In January, 1960, Premier Khrushchev announced the U.S.S.R.'s intention to re-

duce this to 2.4 million by the end of 1961. The U.S.S.R. needed fewer troops because it no longer had to rely on a retaliatory land blow in Europe to counter a Western nuclear attack. Its concern about the danger of accidental, irresponsible or escalated war is probably one of the reasons for its strong espousal in 1955 of a drastic measure of comprehensive and general disarmament.

Turning to the history of U.S. defense policy over this period, it is to be noted that the total service manpower fell slowly from 2.9 million in 1955 to 2.6 million in 1960. The development of improved nuclear weapons, missiles and aircraft continued, but not at a great rate, even after the Soviet launching of an artificial satellite in 1957 and much boasting by the U.S.S.R. of its missile prowess. Although subjected to considerable public pressure to engage in a crash program to close the alleged missile gap, President Eisenhower maintained that the existing program was adequate for the safety of the nation. In his last State of the Union Message in January, 1961, he declared: "The 'bomber gap' of several years ago was always a fiction and the 'missile gap' shows every sign of being the same."

As 1954 was the year of the hydrogen bomb, so 1961 was for both sides in the cold war the year of the Great Rearmament. In the U.S.S.R. the decrease of total armed forces to 2.4 million projected for 1961 was deferred and the arms budget was markedly increased. In July the Soviet Government went on the diplomatic offensive to bring about changes in the status of Berlin and to get the division of Germany recognized. In August it began testing nuclear weapons again, in spite of a promise in January, 1960, by Premier Khrushchev that the U.S.S.R. would not be the first to do so. No doubt there were some political motives behind these drastic moves. Possibly heavy pressure was put on Khrushchev from China and from the opposition elements in the U.S.S.R. to admit that his policy of coexistence had not produced political gains commensurate with its possible military risks. But such drastic changes, with the inevitable adverse reaction of much of world opinion, would hardly have been made unless there were strong military reasons for them. To get at these reasons it is necessary to recall in more detail the circumstances in which the changes took place.

In the first place the flights of the U.S. reconnaissance U-2 aircraft must have had decisive importance in shaping the

attitudes of Soviet military leaders. Although the over-all nuclear strength of the U.S. is now, and was then, much greater than that of the U.S.S.R., Soviet leaders could reckon that one vital factor would make a U.S. nuclear attack on the U.S.S.R. exceedingly risky: the secrecy as to the location of the Soviet nuclear bases. Obviously one of the main objectives of the U-2 flights was to locate those nuclear bases. The Soviet command knew that the U-2 flights had been going on for some years before the first aircraft was shot down in the spring of 1960; presumably they reacted by greater dispersal and camouflage. What must have disturbed the Soviet military staff was President Eisenhower's justification of the flights as essential for U.S. security. This implied that U.S. security could only be maintained if the U.S. had sufficient information as to the location of Soviet nuclear sites to make possible a successful surprise attack on the Soviet retaliatory force.

If these were the Soviet fears, the rejection by the U.S.S.R. early in 1961 of the British-American draft of a treaty to ban the testing of nuclear weapons finds explanation in the same jealous military concern to protect the country's geographical security. A detailed study of this document makes it clear that the elaborate international inspection system proposed for the prevention of underground tests could conceivably have served to reveal the location of at least some of the Soviet missile sites. It would be hard to convince a military staff officer of any nationality that this possibility was negligible. If the West had been content to monitor only the atmosphere against test violations, a much less comprehensive inspection system would have sufficed and a test-ban treaty might well have been signed. The Soviet fear of inspection may have been the more acute because there was so little in the U.S.S.R. to inspect.

The resumption of testing by the U.S.S.R. in September, 1961, would seem to fall into the same pattern of motivation. Although its timing may have been influenced by the Berlin crisis, which Khrushchev himself brought to a head, the testing of war heads with an explosive force of up to 60 megatons and the simultaneous well-publicized success of putting seven ICBM's on their target in the Pacific at a range of some 7,000 miles was an effective way of re-establishing the U.S.S.R.'s confidence in the few deployed ICBM's that formed its main retaliatory force. Soviet spokesmen

were at pains to promote the credibility of the U.S.S.R.'s deterrent by emphasizing to the U.S. the accuracy of its missiles and the possible power of the war heads demonstrated in these tests.

In the redirection of Soviet military policy considerable weight must also have been carried by the fear that if the NATO rearmament continued, the time could not be far distant when West Germany would get *de facto* control of its own nuclear weapons. In Soviet eyes the refusal of the West to take disarmament seriously at the "Committee of Ten" conference in 1960 was evidently decisive. As early as November, 1960, the Russians stated that if the West continued to temporize on disarmament, the U.S.S.R. would be forced into massive rearmament.

Sometime in the latter half of 1960 or early in 1961 it seems probable that the Soviet military staff began to have doubts as to the adequacy of the minimum deterrent posture in relation to the near-maximum deterrent posture of the U.S. It must have been later than January of 1960, for in that month Khrushchev announced a drastic cutback of both long-range bombers and conventional forces. Since the effectiveness of the Soviet minimum deterrent rested so heavily on geographical secrecy, the U.S.S.R. command may have feared that the U.S., by further air or satellite reconnaissance, or by espionage or defections, would ultimately acquire the intelligence necessary to make a successful nuclear attack on Soviet nuclear bases. Probably the main fear of the Soviet Government was that circumstances might arise in which the U.S. Government would be pushed by irresponsible or fanatical groups into reckless action. The Russians certainly noted the doctrine of some civilian analysts that it would be quite rational to make a "pre-emptive first strike" even at the cost of 10 million deaths to the attacking side, and the doctrine of others that the U.S. should prepare itself mentally and materially to suffer such casualties.

In the U.S. the program for the Great Rearmament was projected as early as 1959 by the Democratic National Committee. In preparation for the impending presidential election the party leadership published a detailed study of defense problems and recommended a \$7 billion increase (16 per cent) in the \$43 billion defense budget proposed by President Eisenhower. The funds were to go partly for increased conventional forces and partly to increase the strength

and reduce the vulnerability of the U.S. nuclear striking power. In January, 1961, almost immediately after taking office, the Administration authorized an increase of \$3 billion and later in the year another \$4 billion, thus carrying out the program in full. The present plans include the provision of up to 800 ICBM's of the solid-fuel Minuteman type in underground "hardened" bases by 1965.

The Democratic Party's campaign for increased nuclear armaments was closely linked with the theoretical doctrine of the instability of the balance of terror, derived from the alleged overwhelming advantage accruing to the nuclear aggressor. This was ably argued by civilian analysts closely associated with the U.S. Air Force. The U.S.S.R. was said to have both the capability and the intention to launch a surprise nuclear attack on the U.S. In retrospect, it would seem that these "looking-glass strategists" endowed the U.S.S.R. with a capability that it did not have and that the U.S. had once had and had now lost.

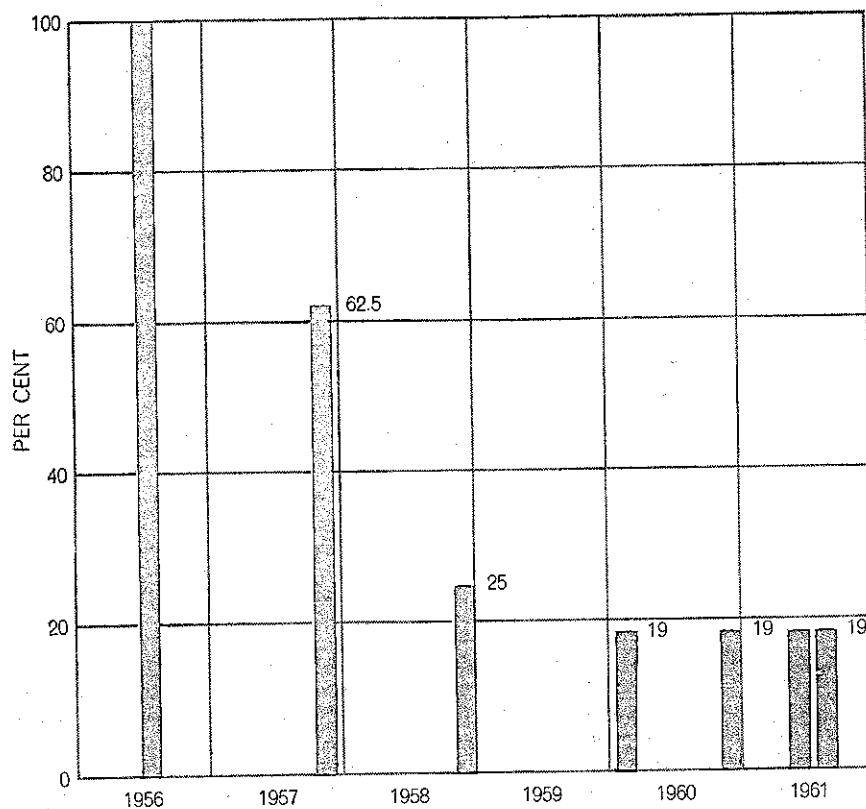
That the Soviet military staff had reason to take this element in U.S. opinion seriously may be judged by the fact that President Kennedy himself found it necessary to launch in the fall of 1961 a vigorous campaign against all those in the U.S. who urge "total war and total victory over communism... who seek to find an American solution for all problems"—against those who were living in the long-past era of the U.S. nuclear monopoly. In this campaign President Kennedy has been vigorously supported by ex-President Eisenhower. Very possibly the U.S.S.R. may have overestimated the potential influence of the proponents of aggressive nuclear strategy and the ultra-right-wing groups that yearn "to get it over with." Nonetheless, the fact that both Kennedy and Eisenhower have felt it necessary to combat them must also imply that the Soviet military planners could not afford to ignore their existence.

The Kennedy Administration's recent vigorous emphasis on the overwhelming nuclear superiority of the U.S. over the U.S.S.R., and the assertion that the U.S. possesses a second strike that is as strong as the Soviet first strike might perhaps be held in the U.S.S.R. to suggest a move by the U.S. Administration toward a preventive war posture. Undoubtedly the exact reverse is the case. The Administration's statements are designed to bury officially the fear of a Soviet first strike, sedulously propagated by those who believe that the U.S.S.R. has

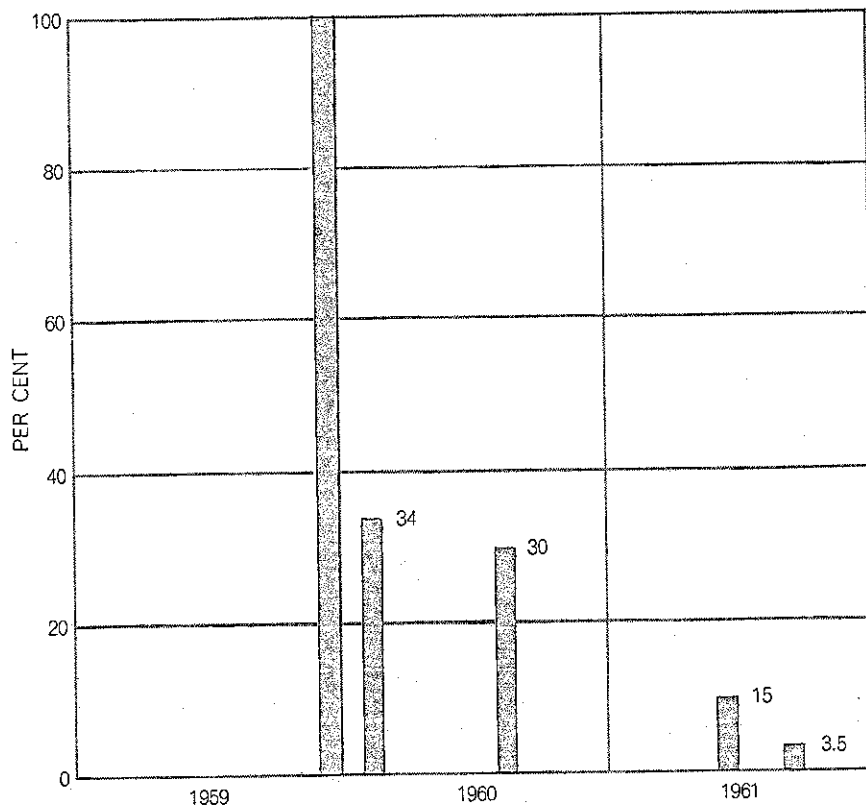
planned for, and in fact now has, a first-counterforce capability, and so at a time of crisis might use it. If this were in truth the situation, the argument that the U.S. must forestall the Soviet blow might seem strong. The Kennedy Administration evidently foresaw this danger arising and effectively removed it by denying that the U.S.S.R. has ever had an effective first-strike capacity; thus there would be no reason for a forestalling blow in a crisis. The President, by emphasizing U.S. nuclear superiority over the U.S.S.R., has forestalled the potential forestallers, or, in the current jargon, has pre-empted the potential pre-empters. At the same time he has refuted many of the arguments on which the Democratic Party based much of its election campaign, and indeed many of the arguments for his own present rearmament program.

It is, for instance, hard to see the military justification for the program of up to 800 Minuteman ICBM's in the next few years. If these are, as claimed, reasonably invulnerable, this number is at least 10 times larger than is necessary for an effective retaliatory force to attack Soviet cities.

The only military circumstance that could justify such a continuous build-up of nuclear striking force would be that the other party could adequately protect its cities or succeed in perfecting an anti-missile defense system. Recently Soviet generals have boasted that "the complex and important problems of destroying enemy rockets in flight have been solved." This must refer to the scientific and technical problems; these have also been solved in the U.S. A complete anti-missile defense system that is of any operational significance certainly does not exist today and, in my view, will not exist in the foreseeable future. Suppose, however, that I am wrong and that a system can eventually be constructed capable of destroying, say, 50 per cent of a retaliatory missile attack by 50 ICBM's, so reducing the number reaching the target to 25. Even this reduced blow would kill tens of millions of people. Moreover, it would only be necessary to increase the strength of the retaliatory force from 50 to 100 missiles to cancel out the antimissile missile. This illustrates the general conclusion that since a purely retaliatory nuclear force can be quite small, any possible defense system, either active or passive, can be canceled out by a small number of additional missiles. The fact that a purely retaliatory posture is little affected by technological innovation, whereas a



U.S. ESTIMATE OF SOVIET HEAVY-BOMBER STRENGTH by the middle of 1961, according to an article by Senator Stuart Symington in *The Reporter*, decreased by 81 per cent between August, 1956 (bar at left), and August, 1961 (right). Senator Symington's figures were given in percentages, rather than absolute numbers, for security reasons.



U.S. ESTIMATE OF SOVIET OPERATIONAL ICBM STRENGTH similarly decreased, according to Senator Symington, by 96.5 per cent between December, 1959, and September, 1961.

first stage to low levels such as those suggested by the Anglo-French memorandum of 1954: one million or at most 1.5 million men each for the U.S., the U.S.S.R. and China. When the correspondingly limited contributions to the land forces of NATO from Great Britain, France and West Germany are taken into account, the armies of the Soviet bloc would not have the capability of overrunning Europe in a surprise land attack.

The number of nuclear weapons in existence on both sides, their explosive power and the diversity of the delivery systems are so overwhelming that no small step in nuclear disarmament can have much significance. In a situation in which the U.S. has 10,000 delivery vehicles and a stockpile of 30,000 megatons of explosive (which is said to be increasing at the fastest rate in its history), a first disarmament step involving only a small percentage reduction is not worth negotiating. To justify the labor of negotiating any agreed reduction, and to offset the undoubted strains and disputes that will inevitably arise from the operation of any inspection and control system, the negotiated reduction must be a major one; in fact, of such magnitude as to change qualitatively the nature of the relative nuclear postures of the two giant powers.

The simplest big first step, and the one most consistent with realistic military considerations, is that both giant powers should reduce their nuclear forces to a very low and purely retaliatory role. That is, each should retain only enough invulnerable long-range vehicles to attack the other's cities if it is itself attacked, say less than 100 ICBM's with one-megaton war heads. This is still an enormous force, capable of killing tens of millions of people. A reduction to a level of 20 ICBM's or less would be much preferable. Such a reduction would at once prevent nuclear weapons from being used by sane governments as weapons of aggression or coercion. It would not, of course, prevent them from being used by irresponsible groups who do not calculate the cost. It is only at a later stage in disarmament, when nuclear weapons are completely destroyed, that this danger will be excluded. It has always been clear that the ever present danger of accidental or irresponsible war is a cogent reason for big and rapid steps in the disarmament process.

Detailed studies are needed of possible ways in which both the U.S.S.R. and the U.S. could take such an impor-

tant first step without upsetting the present strategic balance. A major problem is how to phase the building up of a system of general inspection while at the same time making a drastic reduction in nuclear delivery systems by their actual destruction under international verification. Taking military considerations only into account, I believe that a procedure acceptable to both blocs could be devised.

The difference hitherto between the proposed Western and Soviet first steps in relation to nuclear weapons has been often simplified to the statement that the U.S.S.R. wants disarmament without control and the West wants control without disarmament. It would be more accurate to say that the clash is on the phasing of the stages of disarmament and the stages of control.

In its 1960 proposals the U.S.S.R. suggested that, in the first step, international teams should be dispatched to inspect the destruction of all rocket weapons, military aircraft and other carriers of nuclear weapons. It did not propose the inspection or control of those that remain waiting to be destroyed. Full inspection of a country was to be undertaken only when all weapons had been destroyed. It is clear that the U.S.S.R.'s first steps of disarmament are consistent with its presumed military policy of relying for its safety from nuclear attack on a relatively small force of purely retaliatory nuclear weapons in secret sites.

On the other hand, the U.S. proposals in 1960 envisaged widespread inspection in the first stages and no actual disarmament until the second stage. This proposal might make military sense if put by a weak nuclear power to a much stronger one. But when put by a strong power to a weaker one, rejection must have been expected. If the U.S.S.R. had accepted the proposal, the geographical secrecy of its nuclear sites would have been lost and it would have been vulnerable to nuclear attack from the much stronger West.

Any realistic first stage must start from the fact that the present nuclear balance, such as it is, has a highly asymmetric character: the West's much greater nuclear power is balanced by Soviet geographical secrecy. Since the military balance is asymmetric, so must be any mutually acceptable first step. Concessions must be made by both sides and these must be based on the realities of the military postures of the two blocs.

The U.S.S.R. should accept general inspection not, as in their proposals

hitherto, when disarmament is complete but at some intermediate stage on the road to disarmament. Reciprocally, the West should not demand widespread inspection before any disarmament has taken place, as it has done hitherto, but only after substantial destruction of nuclear armaments has taken place under international verification.

In the first stage, therefore, all parties might supply to one another a list of nuclear weapons and their delivery systems, together with research and production facilities. The exact location of sites would not be included at this stage. An agreed number of weapons would then be destroyed and their destruction would be verified by on-site inspection by the international control organization. When this destruction has been verified, a general inspection, using some sampling technique, would begin. The object would then be to verify the correctness of the original declared inventories by checking the numbers remaining after the agreed reductions had been verified, and to proceed to the elimination of the armament remaining.

A word must be said about the place of a test-ban agreement in the stages of a disarmament plan. If this agreement did not involve a type of inspection that might reveal the Soviet nuclear sites, it would be advantageous for it to be included in the first stage, or preferably agreed to at once. If, however, it involved widespread inspection that might reveal these sites, Soviet military planners would certainly advise its rejection. It would then have to wait for the second stage of disarmament, when general inspection starts after the destruction of agreed numbers of nuclear weapons in the first stage.

Some such compromise between Western and Soviet proposals would seem to meet many of the reciprocal criticisms made by the two parties of their respective 1960 proposals without compromising the military security of either. The problem becomes more difficult, however, when nonmilitary considerations are taken into account. Since nonmilitary considerations have played a major role in shaping the defense policies of the great powers, they must inevitably also affect their disarmament policies. For example, if it is difficult to find legitimate military reasons for the vast number of U.S. nuclear weapons and delivery vehicles, it is clear that military arguments alone are not likely to be dominant in U.S. discussion of a possible drastic first step toward nuclear disarmament. This is widely admitted in

the U.S., where the impediments to disarmament are being seen more and more as economic, political and emotional in origin rather than as based on operational military considerations. A vital aspect of the problem for the U.S. is the effect that drastic disarmament steps would have not only on the economy as a whole but also on those special sections of high-grade, science-based and highly localized industries that are now so overwhelmingly involved in defense work. A valuable step would be for both the U.S. and Soviet governments to produce and publish detailed and politically realistic economic plans for the transition to a purely retaliatory capacity.

It is fair to conclude that a realistic military basis for an agreed drastic first step in disarmament may not be impossible to find. The urgency of the situation was declared with eloquence by President Kennedy in his speech to the United Nations in September:

"Today, every inhabitant of this planet must contemplate the day when this planet may no longer be habitable. Every man, woman and child lives under a nuclear sword of Damocles, hanging by the slenderest of threads, capable of being cut at any moment by accident or miscalculation or by madness.... The risks inherent in disarmament pale in comparison to the risks inherent in an unlimited arms race."

This great goal of disarmament will be achieved only if the real nature of the arguments against disarmament are clearly identified and frankly faced. The problems of disarmament must not be obscured, as they sometimes have been in the past, by ingenious but fallacious military doctrine applied to false intelligence estimates.

The growing power of China, and the evidence of an ideological rift between it and Russia, provide an added reason for urgency in the drive for disarmament. The U.S.S.R. and the U.S. will be wise to limit drastically their nuclear arms before China becomes a major nuclear power. It is to be observed that whatever influence China may now be exerting on the U.S.S.R. to adopt a harder policy with the West certainly arises in part from the failure of Premier Khrushchev's campaign for disarmament. This failure greatly weakens Khrushchev's argument for the feasibility of peaceful coexistence of the Soviet and the Western worlds. It would seem urgently necessary to attempt to bring China into the disarmament negotiations as soon as possible.

The Author

P. M. S. BLACKETT, professor of physics at the Imperial College of Science and Technology of the University of London since 1953, is distinguished both as a physicist and as an adviser to the British Government on military and scientific policy. A graduate of the University of Cambridge and a Fellow of the Royal Society, he won the Nobel prize in physics in 1948. He went into physics from the Royal Navy, a graduate of the Royal Naval College at Dartmouth and a veteran of the Battle of Jutland. From 1934 to the beginning of World War II Blackett served on the Aeronautical Research Committee headed by Sir Henry Tizard, which developed Britain's radar defense system;

his work during the war was instrumental in defeating the German submarine campaign. Since the war he has played a leading role in public discussion of military questions; his writings include *Atomic Weapons and East-West Relations*, published by Cambridge University Press in 1956. Portions of the present article appeared in the *New Statesman* for March 2, 1962.

Bibliography

CRITIQUE OF SOME CONTEMPORARY DEFENSE THINKING. P. M. S. Blackett in *Encounter*, Vol. 16, No. 4, pages 9-17; April, 1961.

THE LIMITS OF DEFENSE. Arthur I. Waskow. Doubleday & Company, Inc., 1962.