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CAN WE AVERT AN ARMS RACE UNDER THE PRESENT CONDITIONS?

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by Leo Szilard

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Conflicts between the great powers can be expected to arise in the future as they have arisen in the past and there is no world authority at present in existence which can adjudicate the case and enforce the decision if they ~~can reach no agreement~~ ^{are unable to settle their differences.} In the absence of such a world authority, conflicts could perhaps still be adjusted on an equitable basis by direct negotiations if there were universally accepted principles of law and justice to which the parties could appeal. There is no such universal acceptance of ~~any~~ ^{general} principles at present. While the great powers may negotiate with each other and adjust their conflicts, their negotiations often take place in the shadow of the military might which they can muster. Under such conditions, the major powers are inevitably driven to power politics and as long as such is the state of the world, the danger of war ^{will} ~~exists~~.

Against this general background the existence of atomic bombs creates a new hazard of war. If two countries, like the United States and Russia engage in the manufacture of atomic bombs and accumulate large stockpiles of atomic bombs, war is likely to break out as a result of such an arms race, even though neither country has wanted to go to war.

How far can we go towards averting this danger of an arms race in the present conditions--~~that is~~ ^{i.e.}, without assuming such changes in the general organization of peace as for instance, the abolishment of the veto ^{right} of the great powers in the United Nations Organization? ² This ~~present~~ chapter is written in ~~the~~ attempt to give an answer to this question.

If the United States and Russia agreed to an arrangement which

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would provide that there shall be no stockpiles and no manufacture of atomic bombs on the territory of either country, it appears very likely that such an arrangement would be acceptable to all other major powers of the world and could be extended to them, or at least to all those nations whose voluntary collaboration~~x~~ is necessary. This being the case, we shall single out the United States and Russia in the treatment of our subject.

If the United States, Russia and other nations actually set up such an arrangement, an arms race could be postponed and probably averted, provided that these nations were able to rule out the possibility of secret violations by an adequate implementation of their arrangement. For the present and as long as there is no international authority which could in case of need enforce against the great powers the observance of such an arrangement, it would be just as well to let those powers retain the legal right to abrogate their arrangement at any time. This right to abrogate might in the present circumstances have even some beneficial effect on the great powers, for the fear that the others might be induced to abrogate if they suspect secret violations of the arrangement, will increase the desire of each one of them to convince the others of their good faith. ~~As long as~~ ^{that} a nation has this desire ~~it~~ will be able to convince the others that it does not secretly violate the arrangement ~~and that there are in fact no bombs manufactured on its territory. It can do so, it may be anxious to submit to inspection system and may also wish to encourage~~ ^{by using various methods up to and facing beyond} certain other related institutions which will be discussed further below.

The arrangement itself should ^{universally} provide for certain rights of inspection which might be exercised by an international agency attached to the United Nations Organization. There are a number of ways in

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which inspection could be made effective and while none of the methods may be infallible, all the methods applied together could make violations a very hazardous undertaking.

Inspection of Ores

Aerial surveys which during the war have proved to be effective, would reveal the presence of mining activities as well as other undisclosed industrial activities. Once uranium mining operations are located, it would be possible to keep track of the uranium ores which are mined and to follow the uranium from the mine to its destination. Assuming that the uranium is obtained from a low-grade ore, such mining operations could be detected by aerial photography which would reveal activity of this sort with a high probability and such activity could hardly be successfully camouflaged against infra-red photography.

The mining of high grade uranium ore, in case such deposits were discovered, might be somewhat easier to conceal, owing to the smaller quantity of ore that would need to be mined.

If mining were carried out in remote and sparsely populated areas, it could be however detected by means of aerial surveys even if the quantity of ore involved were small. The international agency, under whose auspices this survey would be carried out, would have to possess the right to issue warrants for searches so that, if necessary, inspectors, armed with such warrants, could be parachuted and could check up on the ground on any suspicious activities detected from the air.

In certain circumstances the presence of the emanation of radium, a radioactive gas, which leaks out of uranium ores, might be detected by means of sensitive instruments installed in low flying airplanes. This could afford an additional check on the location of secret uranium mines.

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Mining operations in populous areas on the other hand would hardly escape the attention of many of those who live and work in those districts and would therefore scarcely remain concealed for any length of time.

X A general geological survey of the world for uranium deposits
X which ought to be extended to deposits containing only one tenth
or one hundredth percent of uranium would enable us to ^{spell out} ~~determine~~ in detail just what measures we would have to adopt in order to have an adequate inspection on the mining of uranium.

Inspection of Industrial Installations

The detection of secret plants producing U-235 or plutonium would encounter little difficulty. Plants producing U-235 will require a supply of power, either in the form of coal, oil or electrical power which would betray their location (particularly if production is concentrated in large plants built in not highly industrialized regions). If they are decentralized and dispersed in the more densely populated regions, their existence will be known to a large number of people and will therefore not remain concealed for long.

Plants producing plutonium could be detected due to the necessity of removing the heat which is liberated in the production of plutonium. Such plants will either have to be located where water is available for cooling purposes or they will have to discard the heat in some other manner and will then become discernable due to certain peculiar structures.

The discovery of any of these plants would be particularly easy during the period of construction. Also it will be easier to discover such plants within the next few years since early developments

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of this field is characterized by more conspicuous installations than the later development which may follow it. The establishment of an inspection system at an early date would therefore be desirable.

Inspection of ~~Scientific~~ Specialized Personnel

X We have so far discussed only more or less "mechanical" methods
X of inspection. Such methods could be ^{discussed here} ~~spelled out~~ in greater detail if we wished to focus our attention merely on the prevention of the manufacture of atomic bombs. The over-all aim of preventing an arms race leading to war requires however that we check not only the manufacture of atomic bombs but also ^{"masses" mass destruction} ~~all other methods of aggressive warfare~~, ^{of human life} some of which are potentially almost as terrible as those based on the liberation of atomic energy. ^{such} ~~an~~ over-all check on the development and manufacture of ^{such} ~~aggressive~~ weapons "seems to call for novel, less mechanical methods of inspection. Knowledge of the movement and daily activity of all scientists, engineers and technically skilled personnel would permit the detection of any dangerous activity as soon as it reaches the stage of construction and before it reaches the stage of production. This would be the primary aim of the inspection of personnel.

The "inspecting" agents would of course have to have scientific knowledge but that means only that they would have to be college graduates with a fair knowledge of science or engineering and in addition to this it would be necessary to give them a short training course of perhaps four months duration in certain special fields of knowledge as well as in the inspection methods which they would have to follow. They would have to acquire during their college years

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knowledge of the language of the country to which they are going to be sent later as "inspectors".

Each of these inspectors would ^{have to} keep in constant touch with about 30 scientists and engineers who reside in the area assigned to him. If any one of his "charges" wanted to conceal some specific fact he could of course do so, but it would be very difficult for him to conceal the fact that he conceals something. A highly industrialized country with as many as 100,000 scientists and engineers who could be used for "high class war work" would under these assumptions require 3,000 resident agents of the international agency at any one time. Considering the world as a whole and assuming that the average lifetime of an engineer in his profession is about 30 years, it will take just about one year's crop of college graduates in engineering, serving for one year as inspectors, in order to have one inspector for thirty inspected persons.

The keeping of an up-to-date register for scientists and engineers would facilitate the orderly administration of an inspection service of this type.

While the inspectors represent an international agency rather than their country of origin, it would be possible to apply the principle of reciprocity in selecting the inspecting personnel. For instance, most of the inspecting agents in the United States might be Russians and similarly, most of the inspectors in Russia might come from the United States. The purpose of such reciprocity would be to give the powers who might be most afraid of each other, the greatest possible reassurance against evasions of the arrangement.

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Many college graduates might welcome the opportunity to serve upon graduation for one year as such inspectors, in some foreign country, broaden their knowledge and gather experience in a technical field of their own choosing. Clearly, the psychological conditions for the successful inspection of this type would be greatly improved if the inspectors were more than police agents, i.e., if their function were to spread as well as to receive information. Many of them could engage in a moderate amount of teaching. The American inspectors could teach English to students of science and engineering in Russian and similarly the Russian inspectors could teach Russian in the United States. In addition to that the "inspectors" could teach certain specialized subjects in which their own country is more advanced than the host country and convey some knowledge of their native country to their students, many of whom will later on have to serve there as inspectors.

~~from page 6~~
The Citizen as "Inspector".

As far as the great powers are concerned, the problem with which we are faced will be the more easily capable of a solution, the less we think of inspection in the narrow sense of the term. In other words, inspection is more likely to be successful if the necessary psychological prerequisites can be met. They will be rather difficult to meet unless we attempt to solve the problem on a sufficiently broad basis.

In dealing with the threat of the atomic bomb, we are dealing with the unprecedented. Atomic bombs are the product of human imagination applied to the behavior of inanimate matter and we may not be able to cope adequately with the problem which their existence

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created unless we are willing to apply our imagination in much the same way to human behavior, and if necessary, to experiment in the field of human relationships. It is likely that adequate solutions of our problem will strike us at first sight as odd because of necessity they will be unprecedented. [This is probably true for every aspect of the problem including such a partial solution as the setting-up of an inspection system. ~~For the present we are merely groping,~~ trying to find our way towards lifting inspection to a higher level at which we hope it might be established with greater stability than on any of the lower levels. Accordingly, the considerations presented in the following should be considered as ^(a) tentative attempts directed towards this specific aim. ~~the present we are merely groping,~~ *we must be willing to experiment in the field of human relationships.*

In experiment
In order to discuss a concrete and well-defined problem, we may again single out the United States and Russia and discuss the possibility of making the native scientists and engineers of the United States and Russia ~~who remain at home~~ rather than ~~the~~ ^{their} foreign inspectors, the chief guardians of the arrangement.

Scientists and engineers are not isolated from the community in which they live. They have the same loyalties as other members of the community and their first loyalty may very well be to their own country. Just how that loyalty is interpreted will vary however with the circumstances. Let us assume for instance that the United States and Russia had arrived at an arrangement which prohibits the manufacture of atomic bombs but which ~~gives~~ ^{leaves} these countries the right to abrogate the arrangement at any time. Let us further assume that after this arrangement was ratified and became the law of the land, the President of the United States called upon all scientists and engineers in this country asking them to pledge themselves to report to an international

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agency secret violations committed on the territory of the United States. Let us assume further, that the Espionage Act had been modified so that it no longer covered any information of a scientific or technical nature, whether or not it might relate to the national defense. In circumstances like these there is little doubt but that most scientists and engineers in the United States would respond to the request of the President and would report without hesitation to the proper international agency, any secret violations committed within the jurisdiction of the United States.

X It is true that some of them might be caught in a conflict of loyalties and others might be influenced by fear of social ostracism in their community or by fear of losing their jobs. Again some others might fear that they would be prosecuted for income tax evasions under the Mann Act or under some of the other laws which are ^{not} universally enforced. But not very many would be deterred from action by such considerations.

What would be the situation in this respect as far as Russian engineers and scientists are concerned? Assuming that the Soviet Union officially took similar action with respect to their own scientists and engineers, would we trust the Russian scientists to respond as we believe the Americans would respond?

Before attempting to answer this question, we had better define more closely the conditions under which such a system would be expected to work. Clearly, such a system would be greatly strengthened by creating international institutions which would establish close collaboration between the scientists and engineers of different countries. The field of atomic energy might be just one of those

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fields in which large scale enterprises based on collaboration could be established. Within the framework of such collaboration it might be possible to arrange for every scientist or engineer to spend in the course of his work, some time during the year, outside of his native country, accompanied if possible by his family. There could be provisions for international scholarships and fellowships to students and graduates in the field of science and engineering on a very generous scale. There could be an institution providing for paid vacations each year for all scientists and engineers to be spent abroad together with their families.

X Institutions of this sort may serve a double purpose. First, they would keep alive in the scientists and engineers the already existing loyalties, shared by all educated men, ~~and~~ which transcend the narrowly interpreted loyalties to one's own nation. Second, the frequent and regular occasions at which scientists and engineers would find themselves under such schemes outside the jurisdiction of their own nation is designed to provide each one of them with an opportunity to report secret violations of the arrangement to the appropriate international authority without endangering his life or the safety of his family. They could be effectively guaranteed immunity assuming they are willing to remain ~~in such a case~~ ^{after reporting} outside the jurisdiction of their native country. If they do so, they ought to be guaranteed the right to choose their residence abroad and an appropriate source of income would have to be provided for them.

X ~~Naturally~~ ^{Naturally} ~~Even so,~~ ^{would} no scientist or engineer ~~will~~ find it an easy decision to become an exile. But after all, under a sensible inspection system secret violations of the arrangement must be regarded as a very un-

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likely occurrence, something like a major catastrophe on the road leading to abrogation of the arrangement, to an arms race, and most probably, to a horrible war. Viewing it in this light, the scientists and engineers will be inclined to look upon the necessity of reporting a secret violation as a personal misfortune, small compared to the misfortune which the violation of the arrangement itself forebodes for the world.

X The fact that scientists and engineers would be in a position to report violations without risking their lives would help to alleviate suspicion that they know of secret violations but keep silent for fear of their lives. However exaggerated the suspicion might be, it could become dangerous inasmuch as it might lead in times of political stress, to an ^{outrage} abrogation of the arrangement by one of the major powers.

Incentives for
Danger of Abrogation

Suspicion that another power secretly violates the arrangement may certainly be an incentive for abrogation, particularly for those countries which, by virtue of the high concentration of their population, would be greatly endangered by a surprise attack with atomic bombs. About 30 million people live in the United States, in cities over 250,000, and 63 million people lived in metropolitan districts (areas having a population of over 150 per square mile comprising a central city of over 50,000) before the war, while the total urban population is even larger, i.e., about 90 million. This vulnerability of the United States endangers the stability of the arrangement in two ways:.. In the next few years it may compel the United States to strive for almost unattainable perfection in the inspection system or later on, force the United States to seek safety in abrogation and

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X acquisition of a stockpile of atomic bombs ~~rather than to be willing to take a certain amount of risk with respect to possible even though not probable violations by other nations.~~ After a number of years (particularly if atomic power plants, which can be converted into factories for atomic bombs, have in the meantime been put into operation in many parts of the world) the situation might be reversed. At that time other powers might be tempted to abrogate if by doing so they would, in view of the greater vulnerability of the United States to atomic bombs, bring about a substantial shift in the balance of power in their own favor.

in the U.S.

In the light of the foregoing, a relocation of population on a certain scale might be contemplated as a reasonable measure within the framework of an arrangement that eliminates an arms race in atomic bombs but does not rule out the possibility of abrogation. Neither the total number of people to be relocated nor the degree of their dispersal in their new locations would cause a very severe disturbance of our economic life or endanger social and political institutions if we need not assume the existence of an enormous stockpile of atomic bombs available in enemy hands at the outbreak of the war. *TP* On the other hand, if we cannot avert an arms race in which various countries rush into the manufacture of atomic bombs and if we then try to achieve comparative safety by the relocation of our population, we will have to count on the possibility that our cities might be attacked on the first day of the war by a very large number of atomic bombs. We would have then to ~~plan for the relocating of~~ *relocate* a very large fraction of our population and ~~to let them sit~~ *to arrive* at a very high degree of dispersal and even so, we cannot be sure that the arms race will not catch up with our relocation program.

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Abrogation would naturally be expected to be followed by an arms race in which two or more countries would convert their peace time installations into factories for atomic bombs. ~~Depending upon~~ ^{this time any} whether or not atomic power installations for peace time purposes ~~were~~ ^{are} in existence at the time of abrogation and ~~depending upon the~~ ^{also} restrictions which may have been imposed upon these installations, ~~it may take 6 months to 3 years until atomic bombs become available~~ ^{6 or 12} in quantity. The longer this period, the less will the desire ~~to~~ ^{for} produce bombs act as an incentive for abrogation. Renouncing for the next ten to fifteen years large scale use of atomic energy for the purposes of producing electrical power might therefore tend to remove incentives for the abrogation of the arrangement. This would be a very much smaller sacrifice for the United States than for other countries who are in greater need of electrical power and much poorer in natural resources. (Peace time applications of atomic energy for research and development work and particularly the use of artificial radioactive substances for biological and medical purposes need not be similarly renounced since such applications would not appreciably shorten the conversion period.)

Need for a Long Range ~~Plan~~ Program

We cannot expect however to hold up indefinitely the peace time uses of atomic power for the sake of security and will have to go as soon as possible beyond such temporary expedients.

An Arrangement of the type which we discussed would remove the threat of an arms race and would be of great value because under such an arrangement, war would break out only if one of the major powers actually decided to risk a war by ~~abrogating the arrangement~~ ^{abrogation}. If we eliminate not only atomic bombs but halt the development of other

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aggressive methods of warfare, and particularly eliminate stocks of long range aggressive weapons, such as long range bombers ^{and} ~~and transport~~ ~~aircraft~~ ~~planes~~, large fleets of warships, and landing craft, the risk of a war between the United States and Russia will appear to be remote and a tolerably well working peace system, under the United Nations Organization, ^{as at present constituted} might be expected to function for a while. We cannot hope however to safeguard peace forever under such an arrangement.

We may have removed for the time being the danger of one kind of war; the ~~x~~ war that arises more or less automatically out of an armed peace in which the great powers maneuver according to the laws of power politics. ~~and~~ The first world war may perhaps be cited as an example of this kind of war which could be averted under such an arrangement, ^{for instance} but the second world war in which Germany deliberately set out to conquer does not fall into this class. Under the arrangement discussed in this chapter, there will remain ^{in any one year} a finite, even ^{something chance} though ~~perhaps~~ ^{small}, ~~danger~~ of war breaking ~~out in any one year~~ and therefore in the long run, war would be certain to break out.

The ~~arrangement~~ which we discussed merely provides a breathing spell ^{which we might secure by averting an armistice} giving us the opportunity to establish a world community. Unless we made use of ^{it} ~~this breathing spell~~ for ^{any} ~~the~~ purpose, we would have done nothing but postpone the next world war, which will be all the more terrible, the later it comes. The issue ^{which} ~~with~~ which we ^{have to} ~~are~~ concerned is not whether or not we shall have a world government before this century is over. That appears to be very likely. The issue ^{which} ~~with~~ which we ^{are} ~~are~~ concerned is whether or not we can have such a world government without going through a third world war. In this respect, there are no encouraging precedents from which we might obtain guidance. With this criterion applied to it, the creation of the United States was a failure rather than a success and if the

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Civil War had been fought with atomic bombs, the North as well as the South would have been destroyed. *Insert*

Interim
It may therefore be argued that before a stable world government can come into existence there must be a considerable change in the loyalties of people which cannot be brought about in a shorter time than perhaps the time of one generation. It might further be argued that if we allowed one generation, perhaps 25 years, for such a transformation, we could bring about a shift of loyalty in the next generation by giving our children an appropriate education.

Accepting this point of view, we have to keep in mind however that education is only one of the factors that affect the loyalty of people and also that we cannot wait for two or three decades before a considerable shift of loyalty has taken place in the mass of the population. It follows that within the next 25 years there will have to be a step-by-step establishment of international institutions which will affect our lives and by affecting our lives, will modify our loyalties. But while we may have to allow 25 years for completing the necessary transformation and while the international institutions may come into existence step-by-step, the transformation cannot be achieved on the basis of agreements that may be concluded from time to time among the several nations. If this transformation is to succeed in creating a world community without going through world war, it has to follow a consistent plan and has to proceed according to a fixed schedule so that people will know at any time what to expect next. This means that within the next few years some such plan would have to be worked out and adopted by the several nations as a whole and that subsequently the transformation would have to follow the plan according to an inexorable fixed schedule, subject to such modifications *may* as might be agreed upon by all concerned.

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We might even use some of the inspection schemes which were discussed as a point of departure, and begin by a large scale interchange of students in the field of science and engineering. From this, we might proceed to the removal of immigration barriers for college graduates, permitting a stipulated, annually increasing, quota of student guests to settle permanently in the country in which they graduate or perhaps in any country of their choice. As fast as possible the base would have to be broadened from here on to bring into the orbit of new institutions a larger and larger fraction of the total population. ~~XXXXX~~

Clearly, ^{the} crucial point in this transition will be reached when a world government will in fact exist though possibly only in one narrow area--the area of security or police functions. When that point is reached the right to abrogate might cease and ~~Secession~~ may become both illegal and physically impossible. Opinions may differ just how early this point should come within ^{such a} the schedule of transformation.

~~and the discussion of these questions would certainly lead us beyond the scope of this chapter.~~

~~that this discussion of a long range program~~

~~Let us therefore end by stating in general terms that the removal of the threat of the atomic bomb with which this chapter deals, will~~

~~hardly be~~ ^{surely} successfully accomplished unless the problem of creating a breathing spell and the problem of establishing a world community, that is--the short range and the long range programs--~~will~~ will be attacked simultaneously. For we shall hardly be able to remove the threat of the atomic bomb and avert the danger of an arms race without giving up, before we have a fool-proof peace system, our own stock of atomic

bombs and ~~scrapping~~ ^{without} our own manufacturing facilities. ^{We shall have to} and we shall have to derive the courage to take risks from the faith that it is within

our power to solve the problem of permanent peace. ^{is under way,}

~~It was included because the author is concerned~~

Take notes and