Since October
no public

Will it be made
How will it be used 2
The most important aspect

Hydrogen bomb
not the least dangerous but
most repugnant

Tellers article: 3 years ago no less dangerous but more repugn
Freedom more secure than life in suicide
danger unplanned

Pres has no power of forbidding abolition

Responsibility of Individuals.

no censure:

Separation
Separation of bombs:

Education of the moral issues involved

Education of the political issues involved

Mrs Mann

Since the President announced that we are going to develop hydrogen bombs, it may be generally assumed that we have a better than even chance for succeeding and actually producing such bombs in quantity sometime in the course of the next ten years. The obvious raw material of hydrogen bombs is heavy hudrogen, since this is the only naturally occurring light element that it might be possible to detonate. If it is in fact possible to detonate heavy hu rogen than the quantity that may be burned in any one bomb is limited only by the size of the container which is used. If such bombs are made very large, it may no longer be possible to carry them by air to specific enemy targets and the temptation will be great to use them for purposes of radio active warfare in which there is a kind of war fare which makes it unnecessary to deliver the bombs in enemy territory.

Since the detonation of the bomb will be very expensive while heavy hydrogen itself is not expensive, radio active warfare will probably be based on a comparatively small number of exceedingly large bombs which, however, could be carried by boat or truck.

Since the President announced that we are going to develope hydrogen bombs, it will be generally assumed that we may have a better than even chance actually to produce such bombs. If it is in fact possible to detonate in principle unlimited quantities of heavy hydrogen, then it is also possible to produce very large quantities of radio active elements. When a hydrogen bomb is detonated, neutrons are liberated. If these neutrons are permitted to be absorbed in air, radio active carbon is formed. It would take an unlikely large number of unlikely large bombs before radio active carbons thus formed would consittute a major menace to the population of large areas. It is, however, possible to rig hydrogen bombs so that the produce other much more dangerous radio active elements in great quantities. Many natural elements become radio active if they absorb neutrons and all one has to do, therefore, is to incorporate a suitable select natural element in a hydrogen bomb in order to produce, when the hudrogen bomb is dtonated, radio active substances which will be carried and dispursed by the winds and which can effect the population of large areas if a sufficiently large number of sufficiently large hudrogen bombs are detonated. One possible use which might be made of this if it becomes possible to detonate in principle unlimited quantities of heavy hudrogen in any one single bomb would consist in building up a large number of large hydrogen bombs and to rig them for the production of a comparatively long lived radio active element having a half lifetime of say a few years. Even though it would require industrial effort of some magnitude, this would present only an initial investment and subsequently without any further cost to the United States, the United States would be invincible, for if we ever got entangled into a war and if there was any danger that enemy tropps would occupy this country or that an enemy would threaten our cities with destruction by bombing them from the air, we could tell them to stop and to desist lest we detonate our bombs and in time kill them all along with ourselves. In a similar sense, Russia might become invincible. All that is necessary is to build up a sufficient quantity

Insert page 2

Teller discussed the possibility of so rigging the bombs that they produced a comparatively short lived radio active element. He discussed how a string of hydrogen bombs detonated off the Pacific Coast might produce radio active elements which would be carried by westerly winds and might destroy life in the United States. If the Russians used this kind of warfare against us, they would have to use short radio active elements, otherwise the activity would in time be carried to their own territory before they have decayed. What the Russians could to to us, we could also do to them.

of such bombs and to convince the enemy that we mean it that we would rather kill them, even though it involves suidide, than be conquered. This is but one of the aspects of radio active warfare, and it is perhaps the least repugnant aspect of it even though an aspect which is not without danger. The danger to the world araises from the fact that the final decision to blow up the suicide bombs cannot be left to a democratis process. In order to convince the enemy that we mean it, it will be necessary to establish a chain of command and it is a decision of a small clique of men or a single man to destroy the world, th fate of the world hangs on a thin thread. The Commander-in-Chief, the Secretary of Defense, or the Chief of Staff are not immune to insanity, and there are forms of insanity which befall not a single man but a whole governing group. And even more repugnant and perhaps no less dangerous type of radio active warfare, has been described three years ago by Dr. Edward Teller in an article in the Bulletin of the Atomic Scientists and I should add that this article was cleared by the Atomic Energy Commission for publication. Teller discussed the possibility of using comparatively short lived radio active elements produced by hydrogen bombs in the moment of their detonation and of permitting westerly winds to carry the radio active substances to the territory of the enemy. The radio elements must be suf iciently short lived to have decayed by the time the westerly winds reach your own territory. Writing three years ago, Teller stated th t it is by no means an established fact that this could be done, but that it is much more than merely a fantastic possibility. There are a number of difficulties involved in this type of radio active warfare but if they can besolved, the total quantity of heavy hydrogen that would have to be detonated would be considerable smaller than the amount needed to kill the population of the whole earth. While this kind of warfare does not end with suicide, it is more repugnant than the one discussed before and in the end it too might lead to suicide, for what we might do to the Russians, if we adopt this method of warfare, they might be able to do to us too, and the hope that we might succeed while they might

fail might result in an unwanted suicide. No one can know today in what manner hydrogen bombs will in fact be used if they can be made, but the temptation to use radio active warfare will be all the greater the more difficult it will be to deliver hydrogen bombs by airplanes to enemy targets.

H Lamb Physics of the air
III ed Edinburgh 1940 W. J. Humphreys
Also from Hull

p. 599 6° to 7° degree of
fall for $\frac{1}{174^{th}}$ of a (Km)^3 of dust

(or perhaps only $\frac{1}{350^{th}}$)

20% fall of sun's intensity
at ↘ double of shortest
path through
dust.

Explosion of Katmai
1912

1 to 3 years for
dust to settle.—

In May, 1784, Benjamin Franklin wrote as follows:

During several of the summer months of the year 1783, when the effects of the sun's rays to heat the earth in these northern regions should have been the greatest, there existed a constant fog over all Europe, and great part of North America. This fog was of a permanent nature; it was dry, and the rays of the sun seemed to have little effect toward dissipating it, as they easily do a moist fog arising from the water. They were, indeed, rendered so faint in passing through it that, when collected in the focus of a burning glass, they would scarce kindle brown paper. Of course, their summer effect in heating the earth was exceedingly diminished.

Hence, the surface was early frozen.

Hence, the first snows remained on it unmelted, and received continual additions.

Hence, perhaps the winter of 1783-1784 was more severe than any that happened for many years.

The cause of this universal fog is not yet ascertained. Whether it was adventitious to this earth, and merely a smoke proceeding from the consumption, by fire, of some of those great burning balls, or globes, which we happen to meet with in our course round the sun, and which are sometimes seen to kindle and be destroyed in passing our atmosphere, and whose smoke might be attracted and retained by our earth; or whether it was the vast quantity of smoke, long continuing to issue during the summer from Hecla, in Iceland, and that other volcano which arose out of the sea near the island, which smoke might be spread by various winds over the northern part of the world, is yet uncertain.

It seems, however, worthy the inquiry, whether other hard winters, recorded in history, were preceded by similar permanent and widely-extended summer fogs. Because, if found to be so, men might, from such fogs, conjecture the probability of a succeeding hard winter, and of the damage to be expected by the breaking up of frozen rivers in the spring; and take such measures as are possible, and practicable, to secure themselves and effects from the mischiefs that attend the last.

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* * *

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...etzel.
...ef and cabbage," said
... or without orange

...y's Chuckle

...SSER: "If you can
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... you how to earn
... money you are now

...: "I do that now."
CALL WORKMAN

... David Cogan, Harvard U...
...versity opthalmologist.

"So far there has been no detectable increase in the incidence of deformities among the progeny of persons known to have suffered irradiation at Nagasaki and Hiroshima," Warren said.

He added, however, that it is "possible" there may be "genetic changes" in the second and third generations.

* * *

WARREN SAID that the commission has developed a number of "useful" m e d i c a l measures against atomic attack.

He said they include:

1. Use before an attack of female sex hormones, which temporarily suppress the blood cell building activities of the bone marrow, and some types of amino acids. Used prior to irradiation, he said, they have all increased the survival rate of experimental animals.

2. Shielding the body or parts of the body (particularly the spleen) and somehow reducing the amount of oxygen being breathed at the time of an attack. He said "a few feet of earth or concrete" may be "satisfactory" for shielding purposes and that research on reducing the oxygen supply for individuals at the time of an attack is now going on.

3. After a "mid-lethal dose of irradiation," he said, practical measures include: complete rest for several weeks; use of antibiotics; transfusions of whole blood and plasma, and the use of anti-heparin substances to combat hemorrhage.

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* * *

SGT. ARTHUR Schaller...
Homewood county highw...
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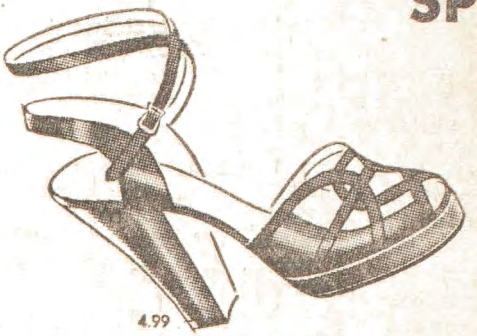
SPR



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Foreign Policy Report

The H-Bomb

To the date of this writing, the only official information the public has received about the H-bomb is the President's statement which read, "I have directed the Atomic Energy Commission to continue its work on all forms of atomic weapons including the so-called hydrogen or super-bomb." Most of the information available to the public to this date, consists of newspaper columns based on leaks or mere guesses, sometimes surprisingly correct, quite often incorrect.

CORNELL UNIVERSITY
Ithaca, New York

March 20, 1950

Dear Sir:

Enclosed I am sending you the final version of the two pages of my article on the Hydrogen Bomb. Page 6 will replace the old pages 6 and 7.

I have been asked by the Atomic Energy Commission to request you to return to me the obsolete pages 6 and 7 and 9, of the old version. You should not quote any statements from these obsolete pages.

As originally stated, you may freely quote from the new version on or after April 1 if you give due credit to the "Scientific American" in which this article is to appear.

Yours sincerely,

H A Bethe

Hans A. Bethe

4.

If thermonuclear reactions are to be initiated on earth, one must take into consideration that it will not be possible to keep the temperature high for a long time. Therefore, if the reaction is to proceed at all, it must proceed very quickly. Reaction times of billions of years, like those in the sun, would never lead to an appreciable energy release; we must rather think in millionths of a second. On the other hand, on earth we have a choice of materials: While the stellar reactions can only use the elements which happen to be abundant in stars, notably ordinary hydrogen, we can choose any elements we like for our thermonuclear reactions. We shall obviously choose those with the highest reaction rates.

The reaction rate depends first of all, and extremely sensitively, on the product of the charges of the reacting nuclei. The highest rates will therefore be obtainable from a reaction between two hydrogen nuclei because hydrogen has the smallest possible charge, one unit. (The principal reactions in stars are between carbon, of charge six, and hydrogen). Next we can choose any of the three hydrogen isotopes, of atomic weight 1 (proton), 2 (deuteron) or 3 (triton). A further variable governing the rate of the reaction is the density. The more atoms there are per unit volume, the greater the chance for a nuclear collision.

(There is no page 7.)

all nuclear radiation casualties in Hiroshima and Nagasaki were due to this instantaneous nuclear radiation. However, the range over which the neutrons (and gamma rays) have a lethal effect will not be much greater than for the A-bomb, in spite of their much greater number. It is therefore likely that most of the people who would get a lethal dose of radiation would be killed in any case by flash burn or by collapsing or burning buildings.

The persistent radioactivity formed is of two kinds, the fission products formed in the bomb itself, and the radioactive nuclei formed by the neutrons which are emitted by the bomb. Since the H-bomb must be initiated by an A-bomb it will produce at least as many fission products as the latter. Just as the A-bomb, the H-bomb can be exploded high up, in which case there will be little radioactive contamination of the bombed area, or it may be detonated on the ground in which case there will be much.

The main increase in radioactive effect is due to the neutrons which are emitted by the H-bomb. Some of them will be absorbed by the bomb case, by rocks and other matter on the ground in the bombed area, or by the air. In any case, radioactive nuclei will be formed. Those formed on the ground will contaminate the center of the bombed area for some time, but probably not very long because the constituents of soil and buildings do not form many long-lived radioactive nuclei by neutron capture. On the other hand, the bomb case could be so designed that it would become highly radioactive in the explosion in which it would at the same time disintegrate; the radioactive atoms would then be carried by the wind over a large area of the bombed country and might be very dangerous, especially if a very large bomb or several bombs

CORNELL UNIVERSITY
Ithaca, New York

March 14, 1950

Dear Sir:

It has been pointed out to me that my calculations underlying the statements on page 10 of my manuscript on the hydrogen bomb were incorrect. I have verified this and I am therefore changing page 10. A revised version of page 10 is enclosed. You will see from this that the radioactivity of carbon 14 is not a danger. Only the insertion of special materials in the bomb which become highly radioactive under neutron bombardment is dangerous.

Yours sincerely,

H. A. Bethe

Hans A. Bethe

are exploded. This danger has been described by Dr. Teller in an article in the Bulletin of the Atomic Scientists.

If the neutrons go into the air, they are finally captured by nitrogen nuclei which are thereby transformed into the radioactive isotope carbon 14. This isotope has a very long half-life, namely 5000 years. However, just because of the long life, the radioactivity is weak, and even if many bombs are exploded, the carbon 14 is not likely to become dangerous.

The decision to proceed with the development of hydrogen bombs has been made. I believe that this decision settles only one question and raises a hundred in its place. What will the bomb do to our strategic position? Will it give us back the superiority in armament which we possessed before the Russians obtained the A-bomb? Will it improve our chances of winning the next war if it comes? Will it diminish the likelihood of seeing our cities destroyed that war? Will it serve to avert or postpone war itself? How will the world look after a war fought with hydrogen bombs?

I believe the most important question is the moral one: Can we, who have always insisted on morality and human decency between nations as well as inside our own country, introduce this weapon of total annihilation into the world? The usual argument, heard in the frantic week before the President's decision and frequently since, is that we are fighting against a country which denies all the human values

Not for Release

Changed ... ! L.h.

THE HYDROGEN BOMB

By H. A. Bethe

1.

Last month, Professor Ridenour published an article on this same subject in this magazine. The repetition indicates the tremendous importance of the issue. Professor Ridenour has already described the essential parts of the theory of the nuclear reactions in this bomb: It is based on the nuclear reaction between heavy isotopes of hydrogen, namely deuterium of mass 2 and possibly tritium of mass 3. He has also discussed the likely effects of this bomb on our military security. I agree profoundly with his view that the creation of the H-bomb makes our country more vulnerable rather than more secure.

It remains for me to discuss two things: On the technical side, I shall try to clarify the many misconceptions which have crept into the discussions in the daily press. On the political side, I wish to take up the moral issue and the meaning of the H-bomb in the general framework of our foreign relations.

2.

Everybody who talks about atomic energy knows Einstein's equation $E = Mc^2$: the energy release in a nuclear reaction can be calculated from the decrease in mass. In the fission of the uranium nucleus, one-tenth of a percent of the mass is converted into energy; in the fusion of four hydrogen nuclei to form helium, seven-tenths of a percent. When these statements are made in newspaper reports, it is usually implied that there ought to be some way in which <u>all</u> the mass of a nucleus could be converted into energy, and that we are merely waiting for technical developments to make this practical. Needless to say, this is wrong. Physics is sufficiently far developed to state that there will never be a way in which a proton or a neutron or any other nucleus simply disappear, their mass being converted into energy.

It may be objected that physics does know of processes in which particles simply disappear and their total mass is converted into energy. The oldest and most important example is the positive electron, discovered by Anderson in 1932 and now familiar in every physics laboratory: When this particle meets a negative electron (the particle found in every atom), it can happen that the two annihilate each other. The energy liberated is $2\ mc^2$, with m the mass of the electron (positive and negative electron have the same mass), and this energy appears in the form of gamma radiation. This, however, is not a method to release mass energy because the positive electron must first be created: This creation is the inverse of the annihilation process; a gamma ray of high energy E creates a pair of electrons, one positive and one negative; the energy $2\ mc^2$ is consumed in the creation of their mass, while the rest of the energy of the gamma ray is given to the electrons as kinetic energy.

Similar processes are the creation and annihilation of mesons, particles not normally found in nature. All these phenomena in which the entire mass of particles is transformed into other forms of energy, have one thing in common: they involve at least one particle which does not normally occur in nature and which must first be created, and this creation process consumes as much energy as is afterwards liberated. The very fact that energy is liberated when they disappear makes these particles, positron, meson etc., unstable, so that they do not "live long" and thus have to be created each time before they can be observed. Physicists believe that there is also an "anti-proton" of negative electric charge which can annihilate with the ordinary proton, just as the positive and negative electron annihilate. This particle has not yet been observed, but it can be predicted that it again has a short life, and that in its creation as much energy must be spent as will be liberated in its annihilation. The complete destruction of a particle is therefore not a possible way to release energy, not even theoretically.

All the nuclear processes from which energy can be liberated, involve the rearrangement of protons and neutrons in nuclei, the protons and neutrons themselves remaining intact. Hundreds of experimental investigations have taught us, through the last 30 years, how much energy can be liberated in each transformation. The chart "fission and fusion" in Dr. Ridenour's article shows the result: Fission of heavy nuclei (splitting into two smaller ones) and fusion of light ones (combination of two or more nuclei to form a larger one) can potentially release energy. Only the fusion of the very lightest nuclei, however, releases very large amounts of energy: In the fusion of 4 hydrogen nuclei to form helium, 0.7 percent of the mass is transformed into energy, but when 4 helium nuclei are in turn fused into oxygen the mass would decrease by only 0.1 percent, and the fusion of two silicon atoms, if it ever could occur, would release less than 0.02 percent of the mass. There is thus no prospect to use elements of medium atomic weight for the release of nuclear energy, even on purely energetic grounds.

3.

The main problem in the release of nuclear energy, however, is not the amount of energy released - this is always large enough - but whether there is a mechanism by which the release can take place at a sufficient rate. This consideration is almost invariably ignored by science reporters in the press who seem to be incurably fascinated by $E = Mc^2$. The rate of reaction is governed by entirely different factors in fission and fusion: Fission takes place when a nucleus of uranium or plutonium captures a neutron. The fission reaction will proceed as long as there are neutrons present, and it will proceed at an accelerated rate if the neutrons multiply, as they do in a lump of uranium which has more than the critical mass. The temperature has no important influence on the fission reaction; no matter how slow a neutron, it can enter a uranium nucleus and cause fissions. This is because the neutron has no electric charge and is thus not repelled by the nucleus.

In fusion reactions, on the other hand, two nuclei must come in contact, both of which have positive electric charge. For instance, in the "carbon cycle" which is mainly responsible for the energy of the stars, (see Dr. Marshak's article, in the January 1950 issue of this magazine) a proton must collide and react with a nucleus of carbon or nitrogen. Since both nuclei are positively charged, there are strong forces of electric repulsion between them. To overcome these, the nuclei must move at each other with great speed. Dr. Ridenour has explained how in the laboratory this is achieved by giving very high velocities to a very few nuclei, and that this method is very inefficient because it is very unlikely that one of the fast "projectiles" hits a target nucleus before it is slowed down by the many collisions it makes with the electrons which also are present in the atoms in the target. Therefore, in this laboratory method, the energy released by nuclear reactions is always much less than the energy invested initially in accelerating the particles, which makes it impractical for the obtaining of nuclear power.

The only known way how energy can actually be extracted from light nuclei by fusion is by thermonuclear reactions, i.e. nuclear reactions proceeding at exceedingly high temperature. The prime example for thermonuclear reactions is the interior of stars where temperatures are of the order of 20 million degrees Centigrade. At this temperature, the average energy of an atom is still only 1700 electron volts, much less than the energies given to nuclear particles in "atom smashers". But all atoms, nuclei and electrons, have high kinetic energy, so that they are not slowed down by colliding with each other, in contrast to the projectiles in the atom-smashers". They will keep their high speeds "for ever". In spite of the high temperature, the nuclear reactions in stars proceed at an extremely slow rate; only 1 percent of the hydrogen in the sun is transformed into helium in a billion years. Indeed it would be catastrophic for the star if the reaction went much faster.

The temperature at the center of a star is kept high and very nearly constant by an interplay of a number of physical forces. The main point is that the radiation which is produced in the nuclear reactions can escape from the star only with great

difficulty. A quantum of radiation which is emitted by some atom near the center of the sun will be absorbed by another atom before it has gone one tenth of an inch, in other words, stellar matter is very "opaque". The absorption of the quantum heats the second atom which after a while emits a new quantum which will travel in a random direction unrelated to that of the old quantum. Thus light does not proceed from the interior of the sun to the surface in a straight line (which would take about 3 seconds) but in an extremely complicated zigzag path, by "diffusion". It can be calculated that in the sun the escape of radiation from the center takes about 10,000 years. A corrolary of this slow diffusion of radiation is that the temperature at the surface of the star is much lower than in the interior; for the sun, the temperatures are 6000 and 17,500,000 degrees, respectively. This keeps the emission of radiation from the surface moderate and prevents the cooling of the interior. Actually, conditions in the star adjust in such a way that the energy production in the center exactly corresponds to the loss of radiation from the surface: Any deviation which might occur is quickly eliminated; the star is an excellent thermostat.

Only the very large size of stars makes it possible to maintain permanently in their interior temperatures which make significant energy production by nuclear reactions possible. A star weighing one-tenth as much as the sun would produce so little energy that it would not be visible (some such stars have been detected by the infrared radiation they emit). The largest planet, Jupiter, is already so small that it could not possibly maintain nuclear reactions, and the earth, of course, is smaller still. This rules out the possibility that the earth's atmosphere, or the ocean, or the earth's crust, be set "on fire" by a hydrogen super bomb, and the earth converted into a star. Because of the small mass, radiation would carry away the nuclear energy much faster than it is developed, and the temperature would drop rapidly so that the nuclear reaction would soon stop.

5.

What would be the effects of a hydrogen bomb? Dr. Ridenour has already pointed out that its power would be essentially unlimited and would increase as the amount of heavy hydrogen that can be carried in the bomb. For instance, if the bomb is carried by a submarine it might be much larger and therefore more powerful than if carried by a plane. For the sake of argument, however, we shall assume an energy release a thousand times greater than the Hiroshima bomb. The radius of severe destruction by blast at Hiroshima was a mile and this radius will increase as the cube root of the power; an H-bomb will therefore cause almost complete destruction of buildings up to a radius of ten miles. A single bomb can obliterate almost all of greater New York or Moscow or London, or any of the largest cities of the world. (Figure 5).

About 30 percent of the casualties in Hiroshima were caused by flash burn. the intense burst of heat radiation from the bomb, fatal burns being frequent up to distances of 4000 or 5000 feet. The radius of heat radiation would increase even more than that of blast, namely by the square root of the power, or by a factor of thirty. This would make flash burn from an H-bomb lethal up to 20 miles or more. Numbers are too easily written down and read; one must visualize what it would mean if Chicago, for instance, with all its suburbs and most of their inhabitants were wiped out in a single flash.

In addition to blast and heat radiation there are nuclear radiations. Some of these are instantaneous; they are emitted by the exploding bomb itself and may be absorbed by the bodies of persons in the bombed area. Others are delayed; these come from the radioactive nuclei formed as a consequence of the nuclear explosion, and they may be confined to the explosion area or widely distributed.

The bombs, both A and H, emit gamma rays and neutrons while they explode. Either of these radiations can enter the body and cause death or radiation sickness;

are exploded. This danger has been described by Dr. Teller in an article in the Bulletin of the Atomic Scientists.

The most persistent danger, however, is the radioactivity formed in air. When neutrons go into air, they are finally captured by nitrogen nuclei which are thereby transformed into the radioactive isotope carbon 14. This well known isotope which has been used for many highly interesting experimental investigations, has a half-life of 5000 years. The carbon 14 nuclei in the air will in time combine with oxygen to form carbon dioxide, which is then assimilated by plants and thus gets into the bodies of all forms of life, vegetable, animal and human. The radioactivity thus produced can become dangerous to health and life if a number of H-bombs is exploded which, though large, is not impossible in an all-out war. This does not even take into account the unknown genetic influence; the fact that mutations may be produced which may prove lethal in future generations. With the extremely long life of carbon 14, there is danger of cumulative effects which can hardly be estimated.

6.

The decision to proceed with the development of hydrogen bombs has been made. I believe that this decision settles only one question and raises a hundred in its place. What will the bomb do to our strategic position? Will it give us back the superiority in armament which we possessed before the Russians obtained the A bomb? Will it improve our chances of winning the next war if it comes? Will it diminish the likelihood of seeing our cities destroyed in that war? Will it serve to avert or postpone war itself? How will the world look after a war fought with hydrogen bombs?

I believe the most important question is the moral one: Can we, who have always insisted on morality and human decency between nations as well as inside our own country, introduce this weapon of total annihilation into the world? The usual argument, heard in the frantic week before the President's decision and frequently since, is that we are fighting against a country which denies all the human values

we cherish, and that any weapon, however terrible, must be used to prevent that country and its creed from dominating the world. It is argued that it would be better for us to lose our lives than our liberty, and this I am willing to subscribe to for my person, although I would consider it too much of a responsibility to decide this question for 150 millions of Americans. But I believe that this is not the question, I believe that we would lose far more than our lives in a war fought with hydrogen bombs, that we would in fact lose all our liberties and human values at the same time.

Whoever wishes to use the hydrogen bomb in our conflict with Russia, either as a threat or in actual warfare, is adhering to the old fallacy that the ends justify the means. Hardly ever has this been more of a fallacy. For it is the means that Russia is using, both in dealing with her own citizens and with other nations, that we abhor; with their professed aim of providing a decent standard of living for all, we have little quarrel. Therefore I believe we would invalidate our cause if we were to use in our fight, means that can only be termed mass slaughter.

What do we stand for in our conflict with Russia? We believe in personal liberty and human dignity, the value and importance of the individual sincerity and openness in the dealings between men and between nations, prosperity for all, and peace based on mutual trust. Many of these values are denied and suppressed by the dictatorship of the Kremlin, and others, as far as we can see, are given only lip service.

However, the defenders of Russia will protest that all this is done to bring the Golden Age of Socialism to the world, to give every worker, and indeed every citizen, his fair share in the national product. This is an aim which seems worthy enough. We would probably argue that Marx's thesis that capitalism did not give a fair share to the workers may have been right a hundred years ago but has ceased to be so, that in fact Capitalist America comes very close to the ideal of the fair

share to everyone, much closer probably than Communist Russia. We might also argue that private enterprise will ensure a larger share to everyone than government enterprise, and we do argue this point in all friendship with Socialist Britain.

But all this is not the main point of our conflict with Russia: What we deeply disagree with are the methods which the Russian Government uses in pursuing its aims and which it believes to be necessary in the "beginning phase" of Communism which by now has lasted 33 years. The regimentation of the private lives of all citizens, the systematic education toward spying upon one's friends, the ruthless shifting of populations, regardless of their personal ties and preferences, the labor camps with their inhuman treatment, the suppression of free speech, the falsification of history in dealing both with their own citizens and with other nations, the violation of promises and treaties and the distorted interpretations of these violations which are offered in excuse - these are some of the methods of Russia which are hateful to the people of the Western World. But they are methods, not aims, and if we wish to fight against them, our methods must be clean.

We believe in peace based on mutual trust. Shall we achieve it by using hydrogen bombs? Shall we convince the Russians of the value of the individual by killing millions of them? If we fight a war and win it with H-bombs, what history will remember is not the ideals we were fighting for but the method we used to accomplish them. These methods will be compared to the warfare of Genghis Khan who ruthlessly killed every last inhabitant of Persia.

Originally, the American method of waging war was aimed at saving lives as much as possible. The First World War, especially in its first years, had been a frightening example of the needless sacrifice of hundreds of thousands of soldiers in fruitless frontal attack. All the warring nations in the Second World War were determined not to repeat this slaughter, and the American High Command particularly so. So we substituted the war by machines for the war by soldiers wherever possible, and the war against production for the war at the battle front. But with the advent

of the atomic bomb, and especially the hydrogen bomb, mechanical warfare has defeated itself. Instead of saving lives, it takes more lives, instead of one soldier, it kills a hundred civilians. It is time to reconsider our real intentions.

7.

What would an all-out war fought with hydrogen bombs mean? It would mean the obliteration of all large cities, and probably of many smaller ones. It would mean the killing of most of the inhabitants of the cities by direct action of the bombs, and possibly of many more people by radioactivity. Many of the survivors would perish for lack of shelter, others from hunger. The devastation that we have seen in Germany, and which overwhelmed many American visitors when they first saw it, would be nothing compared with the effects of hydrogen war.

After such a war, nothing would remain that resembles present civilization. The fight for mere survival would dominate everything. The destruction of the cities might set technology back a hundred years or more, and in the struggle for the bare necessities of life it would be difficult to rebuild any considerable number of factories. In a generation, even the knowledge of technology and science might disappear because there would be no opportunity to practice them. Indeed it is likely that technology and science would be suspected as works of the devil, having brought such utter misery upon man, and that a new Dark Age would begin on earth.

Technology, factories, worldly goods are nothing to the moralist, even less than his life. But we know what physical destruction means to the moral values of a people. We have seen how the Germans, already demoralized by the Nazis, lost all sense of morality when during and after the war the bare necessities of life, food, clothing and shelter were lacking. The black market flourished, crime of every kind abounded, from the theft of the last belongings of bombed-out families to murder. Democracy, human decency were empty words: There was no reserve of strength left for such luxuries. If we have learned any lesson from the aftermath of World War II, it is that physical destruction brings moral destruction.

We have learned that prosperity is the best shield against communism and dictatorship, and in this knowledge we have poured billions into Western Europe to restore her economy. This generosity has won us more friends than anything else we did. But after the next war, if it were fought with atomic and hydrogen bombs, our own country would be as grievously destroyed as Europe and Russia, and we could no longer afford this generosity. It would be every one for himself, and every one against the other. If we had any intention to prevent renewed attacks upon ourselves, we could do so only by brute force, the very thing we are fighting against.

In all this, I have assumed that we would win this next war. What if we don't? If the world were dominated by Russian Communism, our only hope would be to have enough moral strength left to resist the occupation spiritually. How can we have this moral strength if already now we regard moral considerations as secondary.

Why make all these arguments against H-bombs, and not against atomic bombs in general? Is there so much difference? Is an atomic bomb moral and a hydrogen bomb immoral, and if so, where is the limit? I believe there was a deep feeling in this country that the use of atomic bombs in Japan had been a mistake, and that these bombs should be eliminated from national armaments. This feeling, indeed, was one of the prime causes of President Truman's offer of international control in 1945. We know that the negotiations for control have not led to success as yet. But our inability to eliminate atomic bombs is no reason to introduce a bomb which is a thousand times worse.

When atomic bombs were first introduced, there was a general feeling that they represented something new, that the thousand-fold increase of destructive power from block buster to atom bomb required and made possible a new approach. The step from atomic to hydrogen bombs is just as great again, so we have again an equally strong reason to seek a new approach. We have to think how we can save humanity from this last disaster. And we have to break the habit which seems to have taken hold of this nation, of considering every weapon as just another piece of machinery, and as fair means to win our struggle against Russia.

8.

We have talked about the moral issues which should prevent us from using hydrogen bombs if we were sure that we alone would have them, and sure that they would contribute to our victory. As Dr. Ridenour has explained last month, the situation is rather the opposite. We can hardly expect to have a monopoly on hydrogen bombs. If we ever had any illusions on this, the events of the last months should have destroyed them. Russia has the atomic bomb; she has proved herself capable of the scientific and industrial effort required for this achievement, just as scientists have kept predicting through the past years. She has undoubtedly been helped in her efforts by the secret information she received from Dr. Fuchs which presumably included many of the vital "secrets" of our project. Knowing how another group of scientists has put together the bomb does not by itself make a bomb: The rpims requirements for this still are a group of highly capable scientists, a country determined to make this weapon, and a great industrial effort. We know now, if we ever doubted it, that Russia has all of these. If Fuchs had given his information to Spain, for instance it would hardly have been understood, it would presumably not have been used and, even if used it would almost certainly not have led to success. For the Russian scientists, on the other hand, the information must have resolved many doubts as to which steps to take next in their technical development, and it must have saved them a lot of costly and futile parallel developments.

Their obvious competence will presumably again bring success to the Russians when they are trying to develop the H-bomb. However, it would be wrong for us to believe, as we often seem to, that their decisions and their success are independent of our own. Our decision to make the H-bomb may well have caused them to make the same decision, since they obviously desire to keep abreast of us, and since our decision indicated that we consider this project as feasible. This is the reason why I think our decision should have been made in secret if at all; but this was

impossible because the advocates of the H-bomb used public statements as a means of exerting pressure on the President. If the Russians were already working on the H-bomb before our decision to proceed with it, they will now have increased their effort.

Nobody can predict who will have the hydrogen bomb first. We may assume that we shall be the one. If so, I still refuse to believe that the United States, through possession of this weapon, would start a preventive war. This would violate all the fundamental beliefs of this nation. That these beliefs are still strong is shown by the history of the past four years, in which we did not start a preventive war although we had the monopoly of the atomic bomb. So the time will come when both Russia and this country will have H-bombs. Then, in the event of war, this country will be very much more vulnerable than Russia: As Dr. Ridenour has explained, we have many more large cities which would be inviting targets, and many of these lie near the sea so that they need not be bombed by plane but could be reached by submarine and perhaps a relatively short-range rocket. I think it is correct to say that the existence of the hydrogen bomb will give us military weakness rather than strength.

But what if the Russians obtain the H-bomb first? Would this not create a peril to our nation against which we must guard by speedy development? This, indeed, was the chief and last argument of the advocates of our development of the bomb. If the Russians have the bomb, Dr. Urey argued in a speech just before the President's decision, they may confront us with an ultimatum to surrender. I don't believe we would accept such an ultimatum even if we did not have the H-bomb, not that we would need to. I do not think that the hydrogen bomb is going to win a war in one stroke. True, our cities may be devastated in the first days of the war, and this would cripple our ability to conduct a long war with all modern weapons. But it would not seriously affect our power for immediate retaliation. Our atomic bombs, whether "old style" or hydrogen, and our planes will presumably be so distributed that they can not all be wiped out at the same time, and would hence still be ready to take off

and reduce the country of the aggressor to the same state as our own. This shows the futility of the large bomb: It will bring untold destruction but no military decision.

I believe that "old fashioned" A bombs would be sufficient to "even the score" in case of an initial Russian attack with H bombs on this country. In fact, because of the greater number available, A bombs may well be more effective in destroying legitimate military targets including production centers, and thus to equalize once more the military potential of the two countries. H-bombs, after all, are only "useful" against the largest targets of which there are very few in Russia. But suppose you do want to be in a position to retaliate with H-bombs as well, in case of a Russian attack. Then the reason why the United States is building them would be to prevent the Russians from using them against us, for fear of our retaliation. And this reason, it seems to me, is the only one which has any validity at all.

But if this is our only reason for developing the bomb, then we lose nothing and may gain much by taking a step which twelve physicist including myself proposed on February 4, namely "that the United States, through its elected government, make a solemn declaration that they will never use this bomb first".

9.

What would be the consequences of such a step? It would obviously improve our moral position, it would reduce the likelihood that hydrogen bombs will be used in the next war, and it might prevent the H-bomb from starting the next war and therefore be a step away from war. The pledge may not be relied on by our adversaries, but at least it would throw a certain amount of doubt into their minds and they might decide to wait and see. Perhaps they would not wish to provoke the certain use of the bombs by throwing the first one.

If we do not make the pledge we have proposed, the hydrogen bomb would almost surely be used. Indeed, once war breaks out, our military leaders would be blamed if they did not start it with a full scale hydrogen bomb attack. If the pledge is made, they would be blamed if they did. After war breaks out, actions are largely automatic, the time for sober and constructive thought, even about war plans, is in peace.

If we were to use hydrogen bombs first, we would have to expect immediate retaliation, and the destruction of our great cities would be a certainty. If we do not use them, we can of course not be sure that we will save our cities. But the Russians will, to a certain extent, believe our pledge, especially if they see that we live up to it by not starting the war with an H-bomb attack. While they would know that they could probably hurt us more by H-bombs than we could hurt them, they may still consider it worth while to save their own country from the effects of H-bombs by refraining from their use. Moreover, if they started a war, they would probably hope to capture our country intact, as far as possible, and to exploit its wealth rather than to conquer a heap of rubble.

What I propose is the outlawing of the hydrogen bomb by unilateral action. Am I not contradicting what all atomic scientists have said from the beginning, namely that outlawing of the atomic bomb would be meaningless and would bring no security? However, the hydrogen bomb, just because of its size, seems to be in a different category because it is not a widely applicable weapon. Its military value is probably far less than its indiscriminate destructiveness. It is, on a larger scale, somewhat similar to poison gas which was successfully outlawed, being a weapon of doubtful military value.

We have purposely envisaged unilateral action in proposing this pledge. Negotiations with Russia, we know are long and frustrating. The pledge would be a step which this country could take by itself and could therefore take quickly. Further, it would be almost as effective if taken unilaterally as if it were embodied in a treaty. If Russia wishes to make the same pledge, so much the better; and if she declares that she cannot believe us without guarantees, this would be exactly what we have always wanted: her realization that atomic energy must be controlled effectively if atomic bombs are to be eliminated.

Obviously, the pledge can only be a first step. It must not obscure the fact that what we really want is a workable agreement on atomic energy, as part of our efforts towards a lasting peace. But the pledge would at least be a step toward peace.

It might bring to a temporary halt the continuous and accelerated trend toward war which we have permitted to take place since the end of World War II. It would show that we were able to think of something else in our policy than purely military superiority over Russia. And by showing that we could still think of the long range consequences we would create an international climate more conducive to agreement.

Much has been said these last weeks about renewed negotiations with the Russians. We have proposals like that of Senator McMahon to spend 50 billion dollars for rehabilitation of war devastated countries including Russia in exchange for an atomic settlement; they show the deep desire of this country for an agreement and the sincere search for a way out of the present tension. From Moscow, there come persistent newspaper reports that the Russians are willing to negotiate. What exactly they have in mind, we of course do not know, but too much is at stake to miss any such opportunity.

On the other hand, President Truman has voiced the fears of many of us when he stated recently that there is no security in agreements with the Russians because they break them at will. He referred to the agreements of Yalta and Potsdam in 1945. Since then, we have learned much about Russian methods, and the Russians have found that we do not retreat as easily as they apparently imagined in 1945. This more realistic mutual appraisal makes it much more likely that we could now come to arrangements which neither side would regret afterwards. Obviously, in any negotiation, both sides must be willing to make concessions, and both must consider primarily the mutual advantage, rather than their superiority over the other.

Since 1945, we have had no real negotiations. In the United Nations Atomic Energy Commission, we proposed a plan which was then generous, which is still a good plan but which can hardly be called generous any more, now that the Russians also have the A bomb. They refused our plan and countered with one of their own. Never was any serious effort made to settle the differences by give - and - take.

If we can seriously negotiate with the Russians, the scope should probably be as broad as possible. But the situation would already be eased if we could agree to eliminate the greatest menace to civilization, the hydrogen bomb.

PRESS RELEASE
From the office of
Richard Bolling, M.C. (Dem.,Mo.)

FOR RELEASE P.M.
Monday, February 7, 1.

MORE PEACE FOR A PRICE?

Declaring that peace is our business, Representative Richard Bolling (Dem., Mo.) today re-introduced his bill, known in the 83rd Congress as H. Con. Res. 229. The bill calls for a special study of the necessity for effective, non-military defense against H-bomb attack.

"Peace is possible," Bolling said. "It is our duty to achieve a peaceful way of life. The price is high, but I believe the people of the U.S.A. are ready to learn the facts and pay the costs of peace.

"To insure peace," Bolling said, "we must create a working defense system for our homes and industries and a forewarned, informed citizenry.

"Selective industrial and urban dispersal may be the difference between atomic war and peace," Bolling continued. "So I propose that a House-Senate Committee on the Economics of Atomic Defense be established. The Committee would be composed of ten members, five from the Joint Committee on Atomic Energy, five from the Joint Committee on the Economic Report.

"The great difficulty," Bolling stated, "is to create an awareness of the immediate need for action at a time when the people are being assured by the 'economy firsters' that present programs are adequate.

"Public relations firms, so prominent today in public affairs, could make a contribution to the country's welfare if they made it their business to dramatize the need for protective measures in this age of totally destructive weapons. We had better forget 'more bang for a buck' and choose more peace for a price," Bolling declared.

When the Bolling bill was introduced for the first time last May, support came from many civil defense officials and top-flight scientists. For example, Edward Teller, called by some "the Father of the Hydrogen Bomb", supported Bolling's resolution, saying, "I feel that dispersal is one form of defense which this country can undertake, while Russia, due to its clumsy transportation system, will be slow to adopt it. Thus I hope that if your proposal is adopted, we shall have made a long step toward genuine security. I shall be happy if I can be of any help to you in this matter." The Federation of American Scientists has endorsed the proposal, and the American Municipal Association wrote, "Please count on our support for testimony favoring your suggestion."

"Faced with the terrifying prospects of thermonuclear warfare and the little understood effects of radioactive 'fallout', many have closed their minds to the awful threat. However," Bolling said, "we still can face the facts. No matter how you approach it, space is still the best defense against H-bomb attack.

"We must reduce potential casualties and ensure ourselves of being able to fight if attacked. If instead of having 90% of our key manpower and vital industrial, governmental and other facilities concentrated in about 100 targets, we could have our vital resources scattered in 500 dispersed locations, how much greater would be our chance of survival and ultimate victory!"

Bolling urged, "If we can absorb an all-out enemy surprise attack, we will be able to retaliate effectively against an aggressor. A potential enemy's awareness of the impossibility of destroying us without suffering devastating retaliation might well prevent the initial blow from being struck. Thus, effective dispersion could prevent World War III or, if it came, enable us to win it!"

-oOo-

THE H-BOMB:

'Rules' for Nuclear War

Room 812 in New York City's Memorial Hospital is attractively and comfortably furnished, and its big windows overlook the ever-fascinating mid-Manhattan skyline. The room's present occupant is Dr. Leo Szilard, now a University of Chicago biophysicist, and one of the talented few responsible for the atomic bomb. He welcomed a NEWSWEEK reporter to his hospital quarters one day last week with reassuring words. "I am not going to die in a few weeks," the 62-year-old Hungarian-born scientist said, putting to rest a published report on the seriousness of his bladder cancer.

Then the graying, heavy-set Szilard pulled his blue and white hospital robe around him and launched into a discussion of the nuclear-arms race, a topic which has deeply concerned him ever since he drafted a petition to President Truman in 1945 asking that the new and terrifying A-bomb not be used on Japanese cities.

Szilard first cited his extensive article, "How to Live With the Bomb—and Survive," in the current Bulletin of the Atomic Scientists. In this most unusual piece he envisaged Russia and the U.S. using threats of force as their main instrument of policy for many years to come. The two, he wrote, will not become friends and disarm, for "there is no such thing as friendship between governments." What we must do, Szilard added, is to "learn to live with the bomb."

Reality: And the first way to do that is to face what Szilard considers reality. His radical suggestion is that both Russia and the U.S. should respond to any future threat of limited war by threatening to demolish a specified number of the enemy's cities, first giving them adequate warning to evacuate.

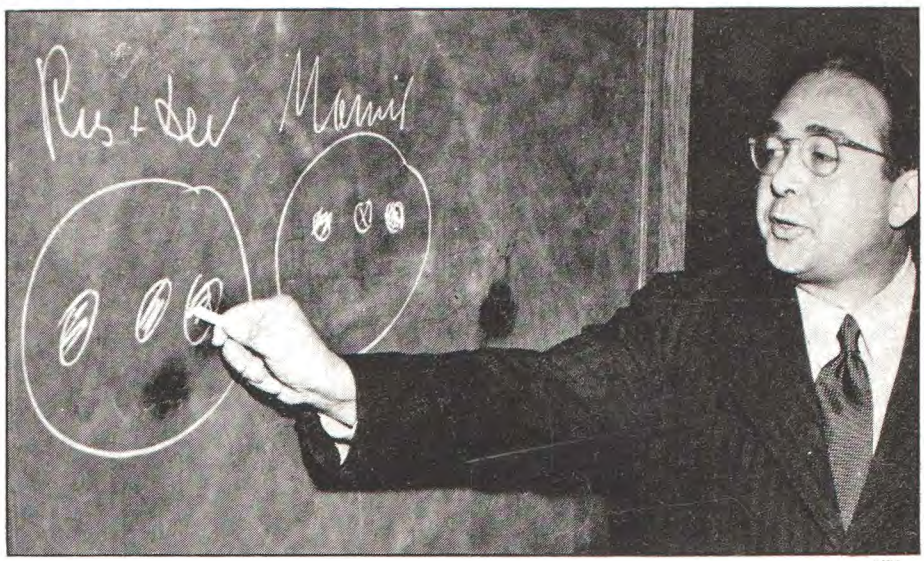
If such a limited-war threat, and such a limited-destruction counterthreat were carried out, the quid pro quo might be this: Russia would have to face the sacrifice of Leningrad and Omsk, say, in exchange for Detroit and Philadelphia.

Are such dangerous international ground rules conceivable? Could the U.S.S.R. and the United States go through with such a bizarre plan of mutual devastation? The inhabitants of the cities directly concerned would not be happy, Szilard admitted, but once a limited war was actually under way the eye-for-an-eye agreement would be irrevocably sealed. Despite the drastic nature of his idea, Szilard then explained why he considers it the only alternative to continued instability.

"When America and Russia build enough long-range rockets to annihilate each other, the assumption is that the mutual threat of mass murder will produce a stalemate, and thus security," he said, pointing a finger from his hospital bed for emphasis. "But this vague threat of murder and suicide is not a believable one, especially as an answer to a minor disturbance. Sooner or later, one nation is going to call the other's bluff, with disastrous consequences. What is needed is a threat that is really believable"—one that is limited enough, in other words, to be easily accepted.

Presented with such a daring and destructive use of atomic weapons, neither country would decide to start a brush-fire war, Szilard believes. "The public pressures in both countries would most likely prevent it from happening," the physicist pointed out.

But even if this dreadful decision were made and cities in each country were marked for extinction, evacuated and destroyed, Szilard added in his article, "the price lists would be invoked only once." To the vision of whole cities being wiped out by mutual agreement, Szilard answered: "Have we any right to expect that the world may be able to get by with less trouble than this?"



UPI

Dr. Szilard: A room with a startling view

Periscoping S & A

If that "mystery satellite" is really part of Discoverer V (as the Air Force suspects), don't be surprised if it eventually settles softly to earth by parachute. The Air Force thinks the workings froze up after its launch last August, but might thaw as its orbit lowers, sending the 'chute into action. Big worry: It could land in Russia, with its highly secret reconnaissance equipment . . . Test pilots will soon be selected and trained to fly Dyna-Soar, the Air Force's rocket-launched orbiting glider. Unlike the seven Mercury astronauts, however, they won't be segregated, nor will they be highly publicized.

MISSILES:

Rapid Fire

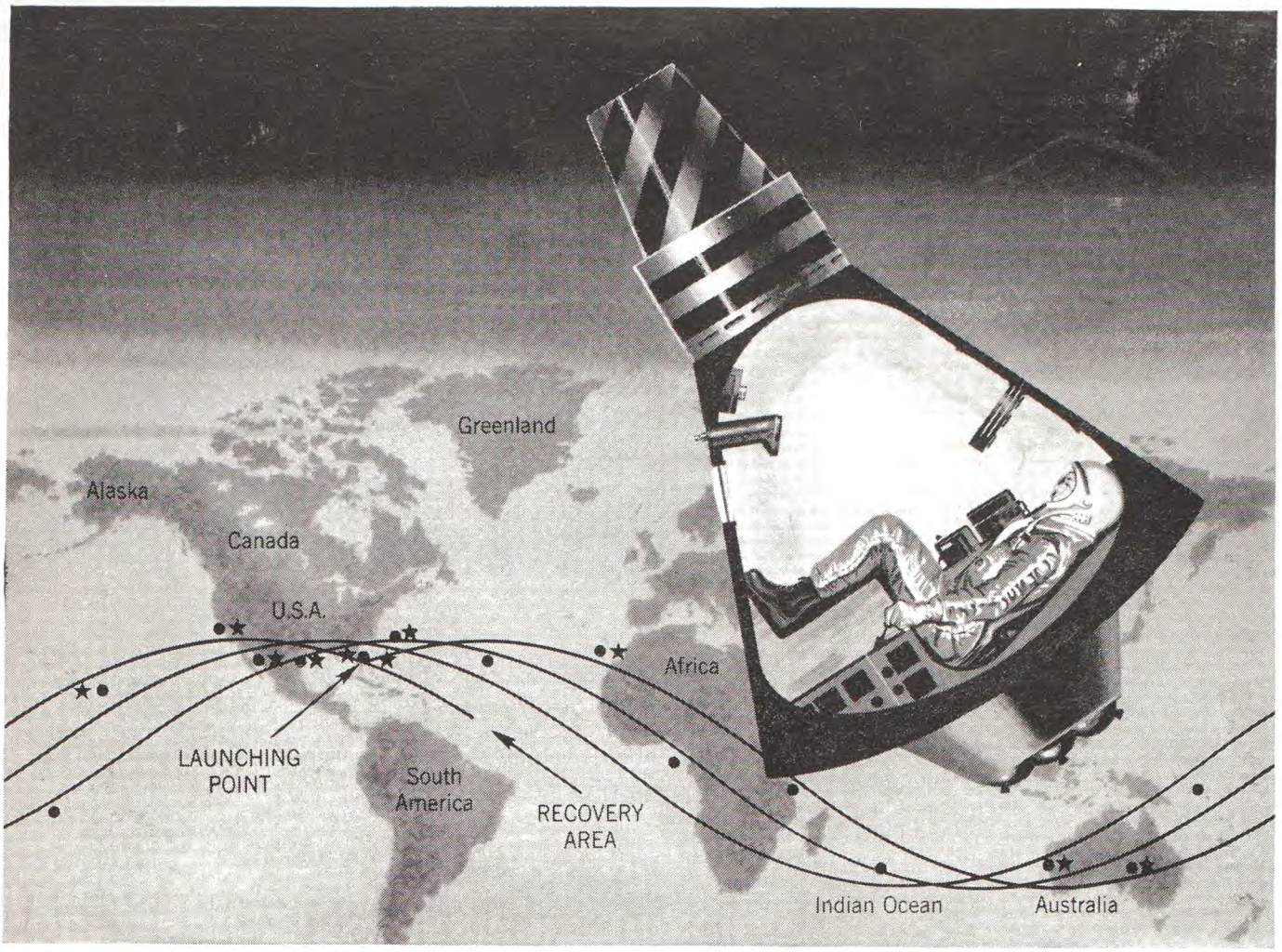
As a prelude to March, which has already been dubbed "missile month" by observers at Cape Canaveral, the Air Force, Army, and Navy filled the waning days of February with the roar and flame of shoots last week. Their luck was no more than half good.

►A muscular attempt to put a weighty Midas satellite into orbit fizzled when the second stage of the Atlas-Agena booster failed to separate. The heat-sensing spy satellite, designed to detect enemy missiles, might have been the largest yet put aloft, reportedly outweighing Sputnik III by a few pounds.

►For the first time in its troubled existence, a second-generation Titan ICBM flew the full 5,000 miles down the Air Force "shooting gallery" from Canaveral to Ascension Island. The 300,000-pound thrust, 92-foot missile, which destroyed two expensive launching pads last year, will be able to fly 9,000 miles.

►The Army's "shoot and scoot" Pershing tactical missile performed perfectly in its first test, darting off from a wheeled vehicle similar to a combat trailer. The solid-propellant Pershing, capable of traveling 400 miles, will replace the larger, clumsier Redstone, whose liquid fuel makes it tougher to handle.

►After six straight bull's-eyes, the intermediate-range Polaris picked an embarrassing occasion to go wrong. As Navy Secretary William B. Franke watched, the missile veered off course and was destroyed by the range safety officer.



Bendix tracking and ground instrumentation sites for NASA's Project Mercury gird the globe as indicated above by stars and dots. They are located to provide optimum coverage of the manned capsule.

PARTNERS IN MAN'S MOST DARING ADVENTURE

Seven hand-picked astronauts, selected from the military services by the National Aeronautics and Space Agency, are in rigorous training for their historic role in the greatest adventure ever undertaken by man. It is known as Project Mercury.

Sometime in 1961 one of the astronauts will be blasted into the emptiness of space, propelled by rockets at satellite speed. He will orbit the globe in a special capsule designed to protect him from the tremendous forces of acceleration, deceleration and the fiery heat of re-entry. Finally, he will be picked up from a selected area in the vastness of the Atlantic Ocean.

Great as they were, the epochal adventures of Columbus and the Wright brothers pale by comparison. Nothing man has ever done can approach this fearsome journey into space and back.

To help him, he will be surrounded with every useful instrument and device which science and industry can provide. Because of the difficult and complex problems involved, the resources and skills of some of the nation's greatest companies have been chosen after competition.

We are proud to announce that Bendix® has been named as one of four members of a team associated with Western Electric Company, Inc., to develop the $30,000,000 global tracking, communications and computing system for the project. It will be Bendix' responsibility to provide the ground-to-air communications which will keep the astronaut in constant touch with earth; to install the radar which will precisely track the capsule as it orbits the earth and to pinpoint its position in the Atlantic at the recovery point.

We will also provide telemetering systems which automatically send hundreds of messages per minute to earth stations about the physiological reactions of the astronaut and the performance of the capsule and its re-entry command equipment. And finally, we will provide "site display equipment," which enables the earth team to quickly read and constantly chart essential information from man and capsule.

To have been chosen as a member of the industrial team in this highly competitive and awesome undertaking is a valued privilege. As security permits, we hope to report further progress on the important work entrusted to us in connection with "man's most daring adventure."

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A thousand diversified products

February 7, 1950
Richard M. Fagley

MEMORANDUM ON THE FUSION BOMB
II.

Further background information made available the past few days, and additional considerations not dealt with in the memorandum of February 3, are here summarized.

Technical Data

Mr. Laurence of the N.Y. Times, in a supplementary article on February 5, states that either of two isotopes of hydrogen, or a combination of the two, theoretically could be used in a fusion bomb. These are deuterium (hydrogen 2) and tritium (hydrogen 3). According to the figures given, the deuterium would yield about as much explosive power per pound as uranium or plutonium, and the tritium 7 or 8 times as much. This is less significant, of course, than the fact that, unlike the fission bomb, the fusion bomb is theoretically capable of indefinite expansion in size. Said Professor S. K. Allison, who helped coordinate research at Los Alamos, "We can no more talk about the hydrogen bomb as an improved atomic bomb than we could talk of the atom bomb as an improved blockbuster."

The supplementary article also stresses the vast amount of poisonous radioactivity which would result from the explosion of a fusion bomb. Such enormous masses of radiation would be released, writes Mr. Laurence, as "to make the affected area forbidden to the habitation of human beings for possibly centuries to come." At least one-fourth of the mass of a deuterium bomb would be released in the form of penetrating neutrons, which would convert the air, soil, and other substances in the area of the explosion into "deadly radioactive entities." This release is said to constitute an infinitely greater amount of radiation than occurs when a fission bomb is exploded.

Another and potentially important fact is the statement by Dr. Hans Bethe, who developed the generally accepted theory to explain the heat of the sun and who headed the theoretical physics division at Los Alamos, that the hydrogen bomb process "would lend itself to international control." Whether such control would depend upon control of the uranium components of the bomb, or would include new means of control, is not stated.

The Problem of International Control

Renewed emphasis on fresh negotiations regarding international control of atomic energy has followed the President's announced decision. Several Senators have spoken in favor of a direct approach to the Soviet Union, and a dispatch in the N.Y. Times of February 5, states that "some Moscow diplomatic quarters" believe that Soviet leaders are prepared to discuss with the U.S. "major problems confronting both countries, including the question of atomic controls." The dispatch makes clear, however, that the men of the Kremlin, believing that their science is adequate, that the march of history favors their cause, and that the West will inevitably be involved in depression, are in a confident mood. Mr. Vishinsky's vitriolic speech at the U.N. General Assembly, in which he retracted Soviet acceptance of the important principle of national quotas for the production of fissionable material, reinforces this impression. The Administration's position

appears to be that negotiations on this question must be carried on through the U.N. Yet, in view of the breakdown of multilaterial negotiations the U.N. and Atlantic Pact countries might well agree to sanction two-power negotiations to end the stalemate.

The prospect of the H-bomb (or hell-bomb, as Walter Lippmann calls it) has strengthened the arguments that the majority plan of control requires reexamination and overhauling. Mr. Lippmann criticizes Senator McMahon's proposal (see Memorandum I) on the ground that the Baruch plan assumed an extended period of U.S. monopoly, and is obsolete in a world of two atomic powers. He calls for a reconvening of the Acheson-Lilienthal board, or something like it, to think out fres proposals. The Federation of American Scientists, while less critical of the majority plan, likewise urge a non-partisan commission of men experienced in science, political science, foreign trade, military problems and U.N. affairs, dedicated to making a fresh start. Said the Federation:

> "The United States has sought atomic agreement separate from related issues. It seems necessary now to seek a solution within a much broader framework. Our objective must continue to be effective atomic control, including thoroughgoing inspection. But we must consider alternative proposals; perhaps proposals without the far-reaching international ownership concept, perhaps proposals making greater concessions to national interests, certainly proposals in which procedural issues are subordinate to the simple question of adequacy in giving nations warning of possible violation."

The Problem of Military Policy

The Federation of American Scientists also pointed to a serious issue in American policy, which deserves more attention than it has received. The United States, say the scientists, has "sought to achieve international control of atomic energy, on the one hand, while on the other basing our military planning on atomic armaments." Statements by military men indicate strategic reliance on atomic weapons as a relatively "cheap" means of overcoming Soviet advantages in geographical position and military manpower, in a possible war with the Soviet Union. This apparent reliance on weapons of mass destruction inevitably complicates the task of negotiating agreements to outlaw such weapons. If by some miracle, the Soviet Union should tomorrow agree to speedy implementation of an adequate control plan, what would be the position of the U.S. military establishment, lacking visible alternative plans of national defense?

More serious is the moral issue posed by this apparent strategic reliance on atomic bombs. The moral justification of the Manhattan District, in the minds of many leading scientists who helped to organize it, was the need to have means of retaliation if the Nazis succeeded in fashioning atomic weapons. The moral justification, if any, of seeking to construct a fusion bomb, lies in having a means to discourage the use of H-bombs by the Soviet Union. Is there any justification for the use of H-bombs, or A-bombs for that matter, except under this condition?

This question has been raised pointedly by 12 leading nuclear physicists, headed by Dr. Hans Bethe. Their statement in full is appended. Reinhold Niebuhr raises the same question in the current issue of Christianity and Crisis:

> "Perhaps we ought to work for a solemn national covenant that we will, in no case, be the first to use such a bomb. The difficulty with such an assurance is that the Russians will probably not trust us, no matter what kind of commitment we make. But such a commitment would be a valuable check upon military strategists, who are tempted to disregard moral factors in their strategic calculations. It would also have some moral meaning to the world at large. We cannot afford, morally or strategically, to confront the world with such a weapon as the primary source of our defence."

The Problem for Christian Conscience

The prospective development of the fusion bomb constitutes a giant stride in the direction of total war. The question raised by Section IV at Amsterdam - "Can war now be an act of justice ... when force is used on a scale which tends to destroy the basis on which law exists"? - is presented in more acute form. This is an issue which our churches must consider anew.

APPENDIX

New York Times
2/5/50

STATEMENT BY 12 LEADING NUCLEAR PHYSICISTS

"A few days ago President Truman decided that this country should go ahead with the construction of a hydrogen bomb.

"This decision was one of the utmost gravity. Few of the men who publicly urged the President to make this decision can have realized its full import. Among the reports in the press was a great deal of misinformation. However, it was stated correctly that a hydrogen bomb, if it can be made, would be capable of developing a power 1,000 times greater than the present atomic bomb. New York, or any other of the greatest cities of the world, could be destroyed by a single hydrogen bomb.

"We believe that no nation has the right to use such a bomb, no matter how righteous its cause. This bomb is no longer a weapon of war, but a means of extermination of whole populations. Its use would be a betrayal of all standards of morality and of Christian civilization itself.

"Senator (Brien) McMahon, in a speech on Thursday, has pointed out to the American people that the possession of the hydrogen bomb will not give positive security to this country. We shall not have a monopoly of this bomb, but it is certain that the Russians will be able to make one too. In the case of the fission bomb the Russians required four years to parallel our development. In the case of the hydrogen bomb they will probably need a shorter time.

"We must remember that we do not possess the bomb but are only developing it, and Russia has received, through indiscretion, the most valuable hint that our experts believe the development possible. Perhaps the development of the hydrogen bomb has already been under way in Russia for some time. But if it was not, our decision to develop it must have started the Russians on the same program. If they had already a going program, they will redouble their efforts.

"Statements in the press have given the power of the H-bomb as between two and 1,000 times that of the present fission bomb. Acutally the thermonuclear reaction on which the H-bomb is based, is limited in its power only by the amount of hydrogen which can be carried in the bomb. Even if the power were limited to 1,000 times that of a present atomic bomb, the step from an A-bomb to an H-bomb would be as great as that from an ordinary TNT bomb to the atom bomb.

"To create such an ever-present peril for all the nations in the world is against the vital interests of both Russia and the United States. Three prominent Senators have called for renewed efforts to eliminate this weapon, and other weapons of mass destruction from the arsenals of all nations. Such efforts should be made, and made in all sincerity from both sides.

"In the meantime, we urge that the United States, through its elected government, make a solemn declaration that we shall never use this bomb first. The only circumstance which might force us to use it would be if we or our allies were attacked by this bomb. There can be only one justification for our development of the hydrogen bomb, and that is to prevent its use."

S.K. Allison, University of Chicago
K.T. Bainbridge, Harvard
H.A. Bethe, Cornell
R.B. Brode, University of California
C.C. Lauritsen, California Tech
F.W. Loomis, University of Illinois
G.B. Pegram, Columbia
B. Rossi, M.I.T.
F. Seitz, University of Illinois
M.A. Tuve, Carnegie Institution
V.F. Weisskopf, M.I.T.
M.G. White, Princeton

February 3, 1950
Richard M. Fagley

MEMORANDUM ON

THE FUSION BOMB

President Truman's announcement on January 31 that he has directed the Atomic Energy Commission to "continue its work on all forms of atomic weapons, including the so-called hydrogen or super-bomb", introduces officially a new phase of this insecure and perilous atomic age. It poses more sharply than ever the issues of Christian conscience and modern war, as well as the problems of effective outlawry of weapons of mass destruction. This memorandum is an attempt to summarize some of the factors which need to be taken into account in formulating a judgment consonant with Christian principles.

One difficulty in arriving at any sound conclusion appears to be that the scientists who know most about the possibilities and perils of the "super-bomb" are related in one way or another to the Atomic Energy Commission and thus unable to say very much about the proposed weapon. It is unsatisfactory to base policy recommendations upon newspaper reports which may be ill-informed as to the facts. When a man as informed as Mr. Lilienthal expresses uncertainty whether the public ever can know and debate the "real issue" of the proposed weapon, involving "military matters, matters of state, other considerations which cannot be stated by those of us in a position of having classified information", it increases our hesitation to speak without any sure command of the facts. Some of the important premises for judging the issues are at best uncertain.

The Fission Bomb

The atomic bombs developed thus far derive their explosive power from the fission of unstable isotopes of uranium and plutonium. Atoms of these very heavy elements are split into lighter atoms nearer the middle of the atomic table. In the process, enough neutrons are released to split additional atoms in a chain reaction, and 1/10th of 1 per cent of the mass is converted into energy. It is this conversion of a tiny fraction of the mass through fission which accounts wholly for the explosive force equivalent to 20,000 tons of TNT, and the destructive power equivalent to 167 ten-ton blockbusters which characterized the bombs used against Hiroshima and Nagasaki.

Since the war the fission bombs have been made more powerful, six times as powerful as the early bombs according to Senator Johnson (The increase in destructive power, of course, would be much less). This does not mean that a greater fraction of the mass of the uranium or plutonium atom is converted into energy. It means rather that a larger amount of fissionable material is split, either through increasing the size of the bomb, improving the firing mechanism so that more of the material is utilized, or both. It is essentially a mechanical "improvement."

The possibilities of increasing the explosive power of the fission bomb appear to be limited. This is because the essential factor in the chain reaction is the concentration of enough fissionable material in one mass to give the neutrons a more than even chance of hitting other fissionable atoms. The explosion takes place as soon as this critical mass has been reached. Thus the explosive power of the fission bomb could be increased only by increasing the number of sub-critical masses which would have to be joined at the same precise moment, or by further elaborating the bomb mechanism to hold the fissionable material together for a greater fraction of a second to prolong the chain reaction and thus explode more of the material.

The Fusion Bomb

The theoretical possibility of releasing atomic energy by a reverse process, namely through fusing atoms of one of the lightest elements into heavier atoms, was mentioned by scientists in conversation four years ago. Evidently experimentation with these lighter elements since then has convinced scientists of the A.E.C. that a fusion bomb is feasible. The Seventh Annual Report of the A.E.C., submitted January 31, states that "important information has been gained" from research with the elements at the beginning of the atomic table, and mentions specifically the release of energy by a transmutation of a triton. This is an atom of a heavy isotope of hydrogen, known to scientists as tritium, with an atomic mass of three. It can be found in water in very minute amounts, but can be produced synthetically.

This tritium, according to W. E. Laurence, the distinguished science editor of the N.Y.Times, is the key to the proposed fusion or thermo-nuclear bomb. This "triton bomb", he states, would release seven times the energy per given weight released by fission bombs, one kilogram releasing "a total explosive force equal to that of 140,000 tons of TNT." Thus, some 315 lbs. of tritium, through fusion, could generate the explosive energy of 1,000 fission bombs as used against Japan (20,000,000 tons of TNT). Such a bomb, he points out, would devastate 300 to 400 square miles, as compared with 10 square miles for the first atomic bombs. Theoretically, the triton bomb would not be limited in size by the problem of critical mass.

Since the atomic fusion which takes place in the sun requires enormous heat and pressure, the presumption is that the fusion bomb would be combined with a fission bomb to generate the necessary heat and pressure. As Richard K. Winslow points out in the Herald Tribune, the unanswered question is whether this "priming charge" can be "contained for a long enough time to produce the necessary temperature and pressure to set off the hydrogen charge."

If tritium can be produced synthetically in quantity, it may, according to Mr. Laurence, "turn out to be cheaper than either XU235 or plutonium," in terms of explosive power. Senator McMahon confirms this conclusion. He also suggests that it is possible that quantity production could be achieved in some of the present A.E.C. plants. Various sources have suggested that the cost of producing the new bomb would be a fraction of the cost of the Manhattan District; $200,000,00 is a figure commonly cited. If hydrogen is the raw material, there would presumably be, in contrast to the limited supply of uranium, a supply without limit. These factors, taken together with the indefinite possibilities as to size of bomb, remind one of the statement in the Smyth Report: "Should a scheme be devised for converting to energy even as much as a few per cent of the matter of some common material, civilization would have the means to commit suicide at will."

Mr. Laurence, however, cautions against exaggerated estimates of the bomb now deemed feasible by scientists. Scientists agree, he states, that "the limit of feasibility now is regarded as being no greater than 10 times the power of the present bomb, with a future possible limit set at a factor of 100 times that of the atomic bomb". Such bombs would mean a vast increase in fire damage, which is roughly proportionate to the power of the bomb, and a much smaller increase in blast damage. Even this fairly conservative estimate indicates an enormous increase in mass destructiveness. If the present bomb is six times as powerful as the bomb used on Hiroshima, then the short range prospect is a bomb 60 times as powerful, and several times as destructive, and the longer-range prospect is a bomb 600 times as powerful.

Beyond the question of the "local" effects of such bombs, two questions about their possible wider consequences have been raised, but not answered. One question reflects the fear that a super-bomb might ignite the hydrogen in the atmosphere, turning this planet into a comet, as one man expressed it. One must assume that the scientists who advise the President canvassed such possibilities and came to a negative conclusion about them.

The other question is whether a large number of fusion bombs might not give off such vast quantities of air-borne radioactive poisons that life generally would gradually be extinguished. The same question has been raised in regard to fission bombs. The potential danger would seem now to be greater, in that atomic armaments may now be capable of indefinite expansion.

The International Competition

A frequent argument used in justification of the decision to proceed with the attempted construction of fusion bombs, is the need to "stay ahead" in the atomic armaments race with the Soviet Union. Indeed, it may be that the U.S.S.R., and not the U.S.A., has done more preliminary work on fusion bombs. Dr. Peter Kapitza, leading Russian physicist, is a recognized top expert on materials at very high and very low temperatures. At the least, there seems little reason to believe that the competition for fusion bombs will not be conducted on much more even terms than has been the case with regard to fission bombs. The possible Soviet inferiority in available supplies of uranium loses in significance. Contrary to the expectations of many that the new bomb will restore American predominance in weapons of mass destruction, the reverse may be true. The fusion bomb may hasten the loss of this predominance.

The consequences of the race for atomic weapons, upon freedom and peace, were well portrayed by Senator McMahon in his speech yesterday. After pointing to the lessons of history that armament races lead to war, he spoke of the effect on freedom:

> How is it possible for free institutions to flourish or even to maintain themselves in a situation where defenses, civil and military, must be ceaselessly poised to meet an attack that might incinerate fifty million Americans - not in the space of an evening, but in the space of minutes? Consider what sustained fear does to the individual - especially to the individual enterpriser. It constricts his imagination, paralyzes his initiative, and even affects his personal morality. It constitutes the most subtle and potent of poisons. Consider the crushing burdens already imposed upon our private enterprise economy. Consider, too, the restrictions on freedom already brought about by the atomic bomb and by its pressures upon us to accept loyalty checks, espionage counter-measures, and widening areas of official secrecy. For a preview of the future if the armaments race continues, multiply the effect of these factors by something like 1,000 times - to allow for the 1,000-times greater energy release of the hydrogen bomb - and if you are candid and realistic, I believe you will find it is difficult indeed to see a dominant role for freedom in such a picture. To stay alive we will find ourselves more and more compelled to imitate the totalitarian rival.

The Problem of Democratic Decision

The "widening areas of official secrecy" of which Senator McMahon speaks, indicates the growing difficulty which confronts the citizens of this democracy, as far as any personal participation in some of the gravest decisions of policy are

concerned. The policy decision is made, without public knowledge of the facts or opportunity to discuss the issues. Indeed, if it had not been for a remark by a member of the Joint Congressional Committee on Atomic Energy (who, ironically, was concerned lest the government tell allied governments about the super-bomb), it is open to question whether the public would possess as many facts as have been made available. One possible demand on the part of our churches might be to insist that such non-technical facts as would enable the people to understand the issues now confronting this nation be made available, so that our citizens might help to shape policy in accordance with our traditions. Such a demand has not been outmoded by the President's announcement, in my judgment, since this initial decision is obviously but the first of a series.

Certainly, our churches can never accept the abominable proposition, that because of the deadly international competition, moral considerations no longer apply. The N.Y. Times, for example, stated on February 1, that the President, by acting as Commander-in-Chief, "removed the question of producing the super-weapon as an issue that might be argued on moral grounds." The same day, the Herald Tribune in its lead editorial, stated that the decision to make the bomb "is not a 'moral' issue and cannot be so regarded," because American action cannot determine Soviet action. Surely the churches must insist that military considerations are only one factor in a momentous moral decision.

The Problem of International Agreement

There is little reason to suppose that the Soviet leaders, who rejected international control when they had no atomic weapons, will be likely to accept it now that they may envisage greater equality in such weapons. They have disrupted the six-power discussions, so that at present not even the motions of negotiation are taking place. In this impasse it is important that the presuppositions of the majority plan be examined anew, and that every promising avenue of approach to genuine agreement be explored.

There are various proposals which might be considered :

1. We might reiterate our plea for discussions at the highest levels on a basis for agreement.

2. We might urge a declaration that the U.S. will not be the first to use the new weapon - difficult to say convincingly, in that the U.S. was the first to use fission bombs.

3. We might urge exploration of modest proposals designed to establish an initial bridge of agreement, such as the idea of outlawing the use of atomic weapons against open cities, as defined and declared by international agreement, and checked by U.N. inspectors.

The one bold and imaginative new proposal is that of Senator McMahon's. It seems to me to merit careful consideration. I quote at length from his address:

"There remains the question of what fresh atomic offer we should advance as means of igniting a moral crusade for peace. Recently some observers, quite properly conscious of the desisive position occupied by atomic energy, have argued that a board should be appointed (analagous to the one which prepared the famous American report in 1946) and that such a board should take a "new look" at the entire control problem - especially with a view toward re-evaluating the need for certain technical phases of what is now the United Nations plan.

"Yet the scientific facts surrounding the hydrogen bomb more than ever render necessary the general kind of technical program which the United Nations, after exhaustive study, has approved. More than ever it is true that an ineffective agreement would be worse than no agreement at all. More than ever there is no escape from strict control of raw materials, strict control of plants, and continuous inspection. We can enter into no scheme of a type which would only serve to mislead us and induce a false sense of security.

"The new approach that I have in mind is somewhat different. Although it flows from many weeks--and indeed months--of continuous reflection, I offer it only as an example of the bold steps which the Soviet atomic explosion, the shadow of the hydrogen bomb, and the pyramiding arms race should persuade us to consider.

"We now spend about $15,000,000,000 annually for armaments. Why not offer to take two-thirds of this sum, or $10,000,000,000, and, instead of amassing sterile weapons, use it to foster peace throughout the world for a five-year period? Why not offer to spread the annual $10,000,000,000 over three programs: President Truman's Point Four proposal, development of atomic energy everywhere for peace, and general economic aid and help to all countries, including Russia?

"Such a global Marshall Plan might combine with the marvelous power of peacetime atomic energy to generate universal material progress and a universal cooperative spirit.

"In exchange for our own contribution of $10,000,000,000 annually, we would ask (1) general acceptance of an effective program for international control of atomic energy, and (2) an agreement by all countries, enforced through inspection, that two-thirds of their present spending upon armaments be devoted toward constructive ends. Administration of the annual $10,000,000,000 which we offered to make available would be carried out through the United Nations.

"Such a proposal, if advanced by our Government, might vividly bring home to all the world's population--in a manner far more successful than we have so far used--the profundity of our desire for peace. It would accomplish this result even if it accomplished nothing else.

"If the proposal were actually accepted, we would have concluded the cheapest monetary bargain in our history; we would have probably saved mankind from destruction by fire; and we would have paved the way toward a new era of unimagined abundance for all men, based upon atomic energy constructively harnessed.

"At present only one-third of the world's two billion two hundred million people receive enough food to sustain life on a decent basis. The other two-thirds live continuously at the margins of starvation. Mr. President, it is atomic energy that opens up the vision of expanding material decencies until there is enough to go around for all--until every last hungry mouth is filled.

"Perhaps through the expenditure of a few extra tens of millions we can conquer the riddle of photosynthesis and extract from the processes of plant growth a means of multiplying many times the world's food supply. Perhaps through atomic power for industry and agriculture we can transform the deserts of Africa, Asia and the Americas into blooming crop-producing acres and the arid hills of the world into gardens.

"It is almost impossible to over-estimate what all-out concentration upon atomic energy for peace might accomplish in terms of remaking and improving the physical environment of mankind.

"I might point out that we have already poured billions into foreign economic aid, asking nothing in return, and still Communist propaganda has blackened our motives in the eyes of millions. Here, in accordance with my suggestion, we would ask effective control of the atom and substantial disarmament - which every man and woman in the world has a right to expect without any further inducement on our part.

"Yet we would in fact provide further inducement, in the form of $10,000,000,000 annually for five years, as proof of our overwhelming will to peace. At the same time it goes without saying that we would provide no such funds unless they were associated with the measures needed to rescue humanity from hell on earth, control of the atom and disarmament.

"I suppose that my suggestions will be termed impractical or theoretical in some quarters. Before they are condemned, however, I would ask that whoever condemns them produce a better proposal. ' ' '

"This is a time for soul-searching, for nationwide and world-wide debate, and for the launching and maintaining of that moral crusade for peace which alone can save us and lead mankind along the righteous paths of security, abundance and liberty."

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ANC

The President Takes the Lead

FILE

The Reporter

January 5, 1954 25c

No words needed...

Before ever he speaks a word, he asks your love.
In it begins the security he will need forever.

The whimper when he's hungry, the sigh of peace when he's fed and warm, the cuddle of his sleepy body—all these tell a need that never ends.
The need that none of us outgrows: to be safe and secure in body and heart as long as we live.

The security of our homes is a universal dream. That each of us is free to make secure the lives of those we love, is our peculiar privilege.

As we take care of our own, we also take care of America. Out of the security of each home rises the security of our country.

Your security and your country's begin in *your* home.

Saving for security is easy! Read every word—now! If you've tried to save and failed, chances are it was because you didn't have a *plan.* Well, here's a savings system that really works—the Payroll Savings Plan for investing in United States Savings Bonds.

This is all you do. Go to your company's pay office, choose the amount you want to save—a couple of dollars a payday, or as much as you wish. That money will be set aside for you before you even draw your pay. And automatically invested in Series E Savings Bonds which are turned over to you.

If you can save only $3.75 a week on the Plan, in 9 years and 8 months you will have $2,137.30. If you can save as much as $18.75 a week, 9 years and 8 months will bring you $10,700!

For your sake, and your family's, too, how about signing up today?

A Tale of the Steps To Hiroshima—and Beyond

MICHAEL AMRINE

PRESIDENT EISENHOWER'S United Nations speech on December 8 opened up new alternatives for the future. As the world again discusses the Kremlin and the atom, a look at the original formation of U.S. atomic policy is in order. This segment of our recent history has been particularly mysterious, but the accounts of various participants enable us to piece together the story of the beginning of an age.

In his speech, President Eisenhower picked up threads of thought that Henry L. Stimson was pursuing in the days when the first atomic bomb was exploded in New Mexico and the Big Three were meeting in Potsdam. Even the title of the President's U.N. speech, "Perils Which Confront the World in This Atomic Age," is reminiscent of a memorandum which Stimson prepared for Truman at Potsdam: "Reflections on the Basic Problems Which Confront Us." Perhaps some of the White House advisers have been rereading Stimson's conclusions of those days. If so, they may agree that Stimson prophetically confronted the problems President Eisenhower now asks the world to confront and surmount.

ON APRIL 12, 1945, the day Franklin Roosevelt died, most men in the West were following maps carrying the names of Luzon, Warsaw, Frankfurt, Okinawa, the Elbe, Iwo Jima, Berlin. . . .

Meanwhile a few hurried and harassed men endeavored to "place" on *their* maps the names of Oak Ridge, Los Alamos, and Hanford.

To such men as Dr. Klaus Fuchs, these names had been familiar for over a year.

In *Mr. President,* Harry Truman has described his feelings on the day of Roosevelt's death: "I knew the President had a great many meetings with Churchill and Stalin. I was not familiar with any of these things, and it was really something to think about but I decided the best thing to do was to go home and get as much rest as possible and face the music."

April 25. The representatives of the United Nations met in San Francisco to draw up the U.N. Charter.

On the same day, Secretary of War

Henry L. Stimson, in company with the head of the atomic project, Brigadier General Leslie R. Groves, briefed President Truman on the history and nature of atomic development.

Earlier in April Truman had gotten a briefing on the Manhattan Project from Fred Vinson and James F. Byrnes. This occasion, for which no date is given in his memoirs, was Truman's first news of the atomic bomb. While he had been head of the Senate War Contracts Investigating Committee, Truman had gotten wind of a vast plant at Oak Ridge. He had intended to look further into it, but the personal intervention of Stimson at that time had stopped him.

When Stimson and Groves called, the Secretary left with the President a memorandum that began: "Within four months we shall in all probability have completed the most terrible weapon ever known in human history, one bomb of which could destroy a whole city."

It is obvious that Stimson saw with clarity what many did not see for years after the bomb was known: that the creation of the bomb and the fact that other countries could create their own, in spite of anything we could do, meant that nuclear energy would radically change the balance of power in the world and the nature of war. Stimson's memorandum of April 25 reiterated that easier and cheaper methods of bomb production would be found, and that other large or smaller countries would have bombs.

It said: "The world in its present state of moral advancement compared with its technical development would be eventually at the mercy of such a weapon. In other words, modern civilization might be completely destroyed. . . . To approach any world peace organization of any pattern now likely to be considered, without an appreciation by the leaders of our country of the power of this new weapon, would seem to be unrealistic. . . . the control of this weapon will undoubtedly be a mat-

ter of the greatest difficulty and would involve such thoroughgoing rights of inspection and internal controls as we have never heretofore contemplated. . . . Furthermore, in the light of our present position with reference to this weapon, the question of sharing it with other nations and, if so shared, upon what terms, becomes a primary question of our foreign relations. . . . our leadership . . . has placed a certain moral responsibility upon us which we cannot shirk without very serious responsibility for any disaster to civilization which it would further."

'Deteriorating Relations'

May 1. Hitler's death announced.
May 2. Berlin fell.
May 6. The first ground echelon of the 509th Composite Group, which was to drop the atomic bombs, sailed from Seattle for Tinian. The recently published fifth volume of the official history *The Army Air Forces in World War II* states that "[Colonel] Tibbets [of the 509th] alone knew the real mission of the team; the others apparently knew no more than they were to drop a special sort of bomb which they came to call 'the gimmick.' "
May 8. Germany surrendered.
May 18. The advance air echelon of the 509th arrived at Tinian.
May 22. President Truman noted in a memorandum:

"Had a long talk with Joe Davies [former Ambassador to the Soviet Union] last night on the Russian situation. . . .

"He had come over to tell me how blue he was over our deteriorating relations with Russia.

"I informed him that . . . I had sent Harry Hopkins to see Stalin with instructions to tell Stalin my views and that I would be pleased to meet him face to face.

". . . Churchill wanted me to meet with him first—which I do not want to do. Stalin already has an erroneous opinion we are ganging up on him.

"To have a reasonably lasting peace, the three great powers must be able to trust each other, and they must themselves honestly want it. They must also have the confidence of the *smaller* nations . . .

". . . Davies said he would go to London."

May 29. The ground echelon of the 509th arrived at Tinian by ship from Seattle.
June 2. Harry Gold, a Philadelphia chemist, arrived in Santa Fe, New Mexico. He went for a short drive

in the country with Dr. Klaus Fuchs, a theoretical physicist associated with the atomic project. Fuchs described in detail the approaching bomb test and incidentally predicted there would not be a successful explosion before 1946. Harry Gold then took a bus to Albuquerque, New Mexico.
June 3. Gold walked up a flight of stairs at 209 North High Street, knocked on a door, and said, "I came from Julius." The occupant of the High Street apartment, David Greenglass, like Fuchs an employee of the bomb project at nearby Los Alamos, gave Gold sketches showing the basic mechanism of the atomic bomb.
June 4. James Byrnes gave Fleet Admiral William D. Leahy, personal Chief of Staff to the President, a special briefing on the atomic project. Despite this and other briefings, Leahy did not believe the bomb would do what was claimed for it, and in his memoirs frankly admits he "misjudged its efficiency." Even after the test in New Mexico, just before it was used in Japan, Leahy still called it "a professor's dream."

Planes and Plans

"Early in June." Colonel Paul Tibbets, commanding officer of the 509th Group, was told by his headquarters that he would definitely have an atomic bomb for use by August 6.
June 5. In Admiral Leahy's memoirs, *I Was There,* there is a description of a White House dinner on this evening, at which the May 26 meeting at Chequers between Churchill and Davies was described.

"When they got around to discussing the Soviet Union, Davies said the British leader became vehement and violent in his criticisms. He revealed to Davies that the imposition of secret police and Gestapo methods by the Soviet in the reoccupied areas was to him 'more horrible' than Communism itself. . . .

"He seemed surprised and hurt that Truman would want to 'exclude' him from the first meeting with Stalin after victory. . . . In his calmer moments, Davies said, the Prime Minister recognized the gravity of the immediate situation and said 'perhaps it would fall to a very few men to decide in the next few weeks the kind of life that would confront several generations to come.' "

During the very hours of the Leahy-Davies-Truman dinner, Harry Gold was hurrying through Brooklyn to a 10 P. M. appointment where Metropolitan Avenue goes into Queens. Gold's man approached leisurely. They exchanged newspapers – and walked on after a few words. "John" Yakovlev, a Soviet agent, gave Gold an empty newspaper. In the newspaper Gold gave to Yakovlev were two manila folders, one marked DOCTOR and a second one marked OTHER. They contained papers from Fuchs and Greenglass.

The Conscience of Science

June 11. A "Committee on Social and Political Implications" appointed by the director of the government's atomic laboratory in Chicago addressed a report to the Secretary of War. This was to become known as the Franck Report, after its chairman, Dr. James Franck, Nobel Prize-winning chemist.

The report, based on unanimous agreement among seven scientists, reached the main conclusion that "the use of the bomb should be considered as a fateful political decision, and not merely as a matter of military tactics."

Its text said: "All of us . . . live with the vision before our eyes of sudden destruction visited on our own country, of a Pearl Harbor disaster repeated in thousand-fold magnification in every one of our major cities. . . .

". . . The experience of Russian scientists in nuclear research is entirely sufficient to enable them to retrace our steps within a few years, even if we should make every attempt to conceal them. Even if we can retain our leadership in basic knowledge . . . for a certain time by maintaining secrecy . . . it would be foolish to hope that this can protect us for more than a few years. . . .

"If no efficient international agreement is achieved, the race for nuclear armaments will be on in earnest not later than the morning after our first demonstration of the existence of nuclear weapons. After this, it might take other nations three or four years to overcome our present head start, and eight or ten years to draw even with us . . .

". . . There is no doubt that Russia, too, will shudder at the possibility of a sudden disintegration of Moscow and Leningrad . . . Therefore, only lack of mutual *trust*, and not lack of *desire* for agreement, can stand in the path of an efficient agreement for the prevention of nuclear warfare. . . .

". . . *a demonstration of the new weapon might best be made, before the eyes of representatives of all the United Nations, on the desert or a barren island* . . .

"We believe that these considerations make the use of nuclear bombs for an early unannounced attack against Japan inadvisable. If the U.S. were to be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race for armaments, and prejudice the possibility of reaching an international agreement . . ."

The Wheels Turn

June 11. Combat air crews of the 509th Group began arriving at Tinian, flying their own B-29s.

June 18. President Truman held a White House conference with the Joint Chiefs of Staff to discuss plans for the invasion of Japan. Secretary Stimson took special note of the unusual fact that civilian advisers were present, "a return to the procedure which Franklin Roosevelt had abandoned in 1942." The meeting was not attended by the Secretary of State, but was attended by John J. McCloy, then Assistant Secretary of War, who has since written an account from which the following quotations are taken:

"We had an impregnable moral position before Japan and the world. We had advanced across the Pacific to the main islands after an act of outrageous aggression on the part of Japan. On top of it all, we possessed the secret of the atom bomb. All present in the room knew that the scientists and engineers working on that project had given definite assurances that within a very short period of time an atomic explosion . . . would occur.

"After the President's decision had been made and the conference was breaking up, an official, not theretofore participating, suggested that serious attention be given to a political attempt to end the war. The meeting fell into a tailspin, but after control was recovered, the idea appealed to several present. It appealed particularly to the President . . .

"It was also at this meeting that the suggestion was first broached that warning be given the Japanese of our possession of the bomb before we dropped it. Although all present were 'cleared', the uninhibited mention of the 'best-kept secret of the war' caused a sense of shock, even among that select group.

"Now this incident indicates that, at that time, everyone was so intent on winning the war by military means that the introduction of political considerations was almost accidental . . . Not one of the Chiefs nor the Secretary thought well of a bomb warning, an effective argument

being that no one could be certain, in spite of the assurances of the scientists, that the 'thing would go off.'

"As a result of the meeting, a rather hastily composed paper was drawn up. It embodied the idea which later formed the basis of the appeal to the Japanese to surrender. That proposal . . . was refused brusquely by the Japanese Government. Yet, as we now know, it did provoke considerable discussion . . . It is interesting to speculate whether, better prepared, this proposal might not have included statements of the policy which we put into effect in Japan almost immediately after the war ended. Such a proposal might well have induced surrender without the use of the bomb. . . .

"Though we have a tendency to blame the decisions that were taken at Yalta and Potsdam for many of the postwar difficulties with the Soviet Union, events were forming a pattern for our postwar fate before those conferences ever took place. We concentrated so heavily on the actual conduct of the war that we overlooked the need for political thinking."

On or about June 19. At a bar in Flushing, New York, in a two-and-a-half-hour meeting with Yakovlev, Harry Gold heard that the DOCTOR and OTHER envelopes had gone immediately to Moscow and "were . . . very valuable."

June 20. As the United States Strategic Bombing Survey later reported, the Japanese Emperor on this day "on his own initiative called the six members of the Supreme War Direction Council . . . and said it was necessary to have a plan to close the war at once, as well as a plan to defend the home islands."

July 2. The "hastily composed paper" to which McCloy referred in his account of the June 18 invasion meeting was signed by Secretary Stimson and given by him to President Truman at the White House. In it he sketched the gloomy prospects of an invasion of the two main islands of Japan, Honshu and Kyushu. Stimson said he thought it worthwhile to give them "a warning of what is to come and definite opportunity to capitulate . . . I believe Japan *is* susceptible to reason . . . to a much greater extent than is indicated by our current press . . ."

Stimson urged us to disavow "any attempt to extirpate the Japanese as a race or to destroy them as a nation . . ." and to "indicate our willingness . . . to give Japan trade access to external raw materials . . . to enter into mutually advantageous trade relations . . ." and to accomplish the "withdrawal from their country as soon as the . . . objectives of the Allies

are accomplished, and . . . a peacefully inclined government [is established]."

A large issue, in view of such wartime statements as Admiral Halsey's that he intended to ride Hirohito's white horse in Tokyo, was whether we could leave the Japanese their Emperor. In his memorandum Stimson said that he "personally" thought "it would substantially add to the chances of acceptance . . . if . . . we should add that we do not exclude a constitutional monarchy under her present dynasty. . . ."

A Light for Poets

July 6. President Truman departed for Potsdam, accompanied by Stimson, Byrnes, Leahy, Marshall, Arnold, Eisenhower, and King.

July 10. After much delay, the Franck Report, prepared by the seven scientists, arrived at Secretary Stimson's Washington office. He had, of course, already gone to Potsdam.

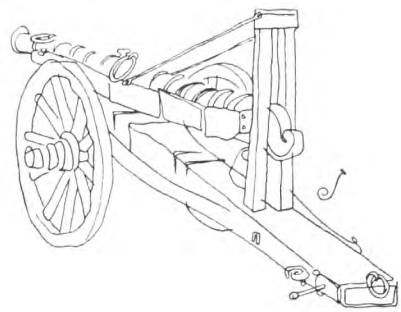
July 16. Truman, Byrnes, and Leahy toured the ruins of Berlin after a meeting with Churchill, and Truman opened the Potsdam Conference. Stalin arrived the next day.

A few hours later, at 5:30 A.M. U.S. time, on a barren mesa near Alamogordo, New Mexico, the first atomic bomb was exploded. General Groves's deputy described it thus in the Smyth Report:

"The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light with an intensity many times that of the midday sun. It was golden, purple, violet, gray and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described. . . . It was that beauty the great poets dream about but describe most poorly and inadequately. Thirty seconds after the explosion came . . . the air blast, pressing hard against the people and things, to be followed almost immediately by the strong sustained awesome roar which warned of doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to the Almighty."

July 17. The Potsdam Conference began.

The agenda included military plans for the Far Eastern war, and a dozen knotty diplomatic issues concerning Poland, the Balkans, Trieste, Vienna, Berlin itself, Britain's debt, occupation of defeated coun-



tries, withdrawal of troops, demobilization.

Churchill wrote: "In the afternoon Stimson called at my abode and laid before me a sheet of paper on which was written, 'Babies satisfactorily born. . . .' 'It means,' he said, 'that the experiment . . . has come off.' "

Truman wrote in *Mr. President:* "I went into immediate consultation with Byrnes, Stimson, Admiral Leahy, General Marshall, General Arnold, General Eisenhower and Admiral King. I asked for their opinions whether the bomb should be used. The consensus of opinion was that the bomb should be used. We were planning an invasion of Japan with the use of 2,000,000 men and the military had estimated the invasion might result in very heavy casualties. . . .

"General Marshall said in Potsdam that if the bomb worked we would save a quarter of a million American lives and probably save millions of Japanese. I gave careful thought to what my advisers had counseled. I wanted to weigh all the possibilities and implications. Here was the most powerful weapon of destruction ever devised and perhaps it was more than that."

July 20. In the Pacific "the 509th Group began a series of combat strikes . . . to accustom the Japanese to the sight of very small formations of high-flying B-29's."

July 23. Churchill has written of the Potsdam dinner that night: "I had another very friendly talk with Stalin, who was in the best of tempers. He spoke with enthusiasm about the Russian intervention against Japan, and seemed to expect a good many months of war, which Russia would wage on an ever-increasing scale . . ."

Stimson and the Police State

Stimson had been urging a direct and conciliatory approach to the Soviets, and a month later he was again to do so, but in his memoirs it is noted that he "personally was deeply disturbed, at Potsdam, by his first direct observation of the Russian police state in action. The courtesy and hospitality of the Russians was unfailing, but there was evident nonetheless, palpable and omnipresent, the atmosphere of dictatorial repression. Nothing in his previous life matched this experience . . ."

At Potsdam Stimson wrote a paper for the President, "Reflections on the Basic Problems Which Confront Us." The subject was primarily the Russian police state, secondarily the atomic bomb.

Among other things, the paper said, "It . . . becomes clear that no permanently safe international relations can be established between two such fundamentally different systems. With the best of efforts we cannot understand each other. . . . I therefore believe that before we share our new discovery with Russia we should consider carefully whether we can do so safely . . . until Russia puts into effective action the proposed constitution . . . [a reference to the Soviet Constitution of 1936].

". . . We must go slowly in any disclosures or agreeing to any Russian participation whatsoever and constantly explore how our headstart in X and the Russian desire to participate can be used to bring us nearer to the removal of the basic difficulties which I have emphasized."

Years later in Stimson's memoirs it was shown that immediately after Potsdam he became "worried," and asked himself such questions as these: "Granting all that could be said about the wickedness of Russia, was it not perhaps true that the atom itself, not the Russians, was the central problem? And was it practical to hope that the atomic 'secret' —so fragile and short-lived—could be used to win concessions from the Russian leaders as to their cherished, if frightful, police state?"

But his recommendations of the

moment at Potsdam were secretive and cautious in their approach to the Soviets.

'Great New Fact'

July 24. At the end of a formal session, while the main Potsdam participants were waiting for their automobiles to arrive, President Truman took Premier Stalin aside and told him that we had a new and special kind of bomb to use in the Far East.

In 1953 Mr. Truman still said of Stalin's reaction, ". . . I'm sure he did not understand its significance."

Churchill has written of this:

"A more intricate question was what to tell Stalin. The President and I no longer felt that we needed his aid to conquer Japan . . . Stalin's bargaining power, which he had used with such effect upon the Americans at Yalta, was therefore gone. Still, he had been a magnificent ally in the war against Hitler, and we both felt that he must be informed of the great New Fact which now dominated the scene, but not of any particulars.

". . . [On] July 24, after our plenary meeting had ended and we all got up from the round table and stood about in twos and threes before dispersing, I saw the President go up to Stalin, and the two conversed alone with their interpreters. I was perhaps five yards away, and I watched with the closest attention the momentous talk. . . . I can see it all as if it were yesterday.

"[Stalin] seemed delighted. A new bomb! Of extraordinary power! Probably decisive on the whole Japanese war! What a bit of luck! This was my impression at the moment, and I was sure that he had no idea of the significance of what he was . . . told. . . . As we were waiting for our cars I found myself near Truman. 'How did it go?' I asked. 'He never asked a question,' he replied."

Byrnes wrote in his memoirs, "I was surprised at Stalin's lack of interest. . . . I thought that the following day he would ask for more information about it. He did not. Later I concluded that, because the Russians kept secret their developments in military weapons, they thought it improper to ask us about ours."

No published account indicates that the President used the word "atomic."

July 25. A military directive signed by General Thomas T. Handy, Acting Chief of Staff in the absence of Marshall at Potsdam, went to General Carl Spaatz for the 509th "to deliver its first special bomb as soon as weather will permit visual bombing after about 3 August, 1945, on one of the targets: Hiroshima, Kokura, Niigata and Nagasaki."

Truman's account in *Mr. President* would seem to indicate the decision was not made until the news from Los Alamos arrived at Potsdam, and another Truman account says the final order was not given by him until the Presidential party was aboard the cruiser *Augusta* returning home from Potsdam.

THE SAME day this directive was issued Churchill flew home, to be there when the results of the British election of July 5 were made public.

July 26. On this day the Potsdam Declaration calling for Japan's surrender was released over the signatures of Truman, Churchill, and Chiang Kai-shek. (Russia was not yet at war with Japan.) The statement made no reference to the status of the Emperor or to new weapons, but warned that if there were no surrender "the only alternative for Japan is prompt and utter destruction."

On this same day it was announced that Clement Attlee was Great Britain's new Prime Minister. Churchill drove to the Palace and tendered his resignation to the King. In his departing message he hinted that the end of the war "may come much

quicker than we have hitherto been entitled to expect."

July 26. The cruiser *Indianapolis* arrived at Tinian with part of the fissionable material for the first combat atomic bomb.

July 28. From Byrnes's account: "... the Japanese Premier issued a statement saying the [Potsdam] declaration was unworthy of notice. That was disheartening. There was nothing left to do but use the bomb."

August 2. From Byrnes's account: ". . . I continued to hope the Japanese government would change its mind. I was greatly disappointed when the day of our departure from Potsdam arrived and no further word had been received. I recognized then that our hope of avoiding use of the bomb was virtually gone."

The Presidential party went to England and boarded the U.S.S. *Augusta* in Plymouth Harbor for the trip home. Leahy and Byrnes accompanied the President to a ceremonial luncheon with King George aboard H.M.S. *Renown.*

Leahy wrote ". . . I knew of no explosive that would develop the power claimed for the new bomb. . . . To my surprise, I found King George well informed about the project and the possible postwar uses of atomic energy. Jestingly he said to me, 'Admiral, would you like to lay a little bet on that?' "

Years later, Leahy had this verdict on the bomb, ". . . in being the first to use it, we had adopted an ethical standard common to the barbarians of the Dark Ages. . . . That is why, as a professional military man . . . I come to the end of my story with an apprehension about the future. . . . These new concepts of 'total war' are basically distasteful to the soldier and sailor of my generation. Employment of the atomic bomb in war will take us back in cruelty toward noncombatants to the days of Genghis Khan."

Some time between August 2 and August 6, by his own account, Truman made the decision to drop the bomb. Did a specific order other than the directive of July 25 go from the *Augusta* or from Washington? Records so far available do not mention any further order. The "wheels" were "in motion," in the President's phrase.

The Air Force history says the directive "had set 3 August as the earliest day for the attack, and thereafter, as so often in the past, it was a question of waiting for a break in the weather . . . On the 5th the weather forecasts looked good; at midnight the crews were given last-

minute details on weather and on air-sea rescue . . ."

In *Mr. President* Harry S. Truman wrote: "I . . . agreed to the use of the atomic bomb if Japan did not yield.

"I had reached a decision after long and careful thought. It was not an easy decision to make. I did not like the weapon. But I had no qualms if in the long run millions of lives could be saved.

"The rest is history."

August 6. The Air Force history states:

"At 0245 on 6 August Tibbets lifted the *Enola Gay* off the runway and was followed at two-minute intervals by the two observation planes. The trip out was uneventful, with a rendezvous at Iwo Jima where the slow climb to bombing altitude began. Tibbets was to select the target on the basis of reports from the weather planes, but was to bring back the bomb if all [the] cities were hidden by cloud. At 0815 he received the report from Hiroshima: '2/10 lower and middle, and 2/10 at 15,000 feet.' This sealed the city's doom. . . . The initial point was reached at 0911, and as the *Enola Gay* swung into her short run-in, the bombardier . . . navigator . . . and radar operator . . . took over. At 0915 (0815 Hiroshima time) Ferebee toggled the bomb out; the altitude was then 31,600 feet, the ground speed 328 m.p.h. Ferebee gave the controls back to Tibbets who executed a violent turn of 150 degrees and nosed down to gain speed."

August 8. Russia declared war on Japan.

August 9. A plutonium bomb was dropped on Nagasaki.

August 14. Japan surrendered.

September 21. On this day the President's Cabinet first wrestled with the problems of atomic policy, secrecy, and an approach to the Russians. For Secretary Stimson, white-haired and frail, it was also his seventy-eighth birthday and his very last day in office.

After a birthday luncheon he went to the Cabinet meeting, where his thoughts on the bomb, which he had already presented to the President in a memorandum, precipitated a stormy discussion, and the longest meeting Truman's Cabinet had had up to that time.

Stimson's memorandum read in part:

". . . I consider the problem of our satisfactory relations with Russia as not merely connected with but as virtually dominated by the problem of the atomic bomb. Except for [that] problem . . . those relations, while vitally important, might not be immediately pressing.

". . . Those relations may be perhaps irretrievably embittered by the way in which we approach the solution of the bomb with Russia. For if we fail to approach them now and merely continue to negotiate with them, having this weapon rather ostentatiously on our hip, their suspicions and their distrust of our purposes and motives will increase . . .

". . . I think the bomb . . . constitutes . . . a first step in a new control by man over the forces of nature too revolutionary and dangerous to fit into the old concepts. I think it really caps the climax of the race between man's growing technical powers for destructiveness and his psychological power of self-control and group control—his moral power. If so, our method of approach to the Russians is a question of the most vital importance in the evolution of human progress."

Stimson advocated a direct approach to Russia, and he alone in that day put emphasis upon the possibility of mutual development of atomic power as an avenue to mutual trust:

". . . My idea of an approach to the Soviets would be a direct proposal after discussion with the British that we would be prepared . . . with the Russians . . . to control and limit the use of the atomic bomb . . . and so far as possible to direct and encourage . . . peaceful and humanitarian purposes. . . . We might also consider including in the arrangement a covenant with the U.K. and the Soviets providing for the exchange of benefits of future developments whereby atomic energy may be applied on a mutually satisfactory basis for commercial or humanitarian purposes. . . . I emphasize perhaps beyond all other considerations the importance of taking this action with Russia as a proposal of the United States—backed by Great Britain but peculiarly the proposal of the United States."

Later Stimson was to ask himself the question, "What if the man whose trust you sought was a cynical 'realist' who did not choose to be your friend?"

But in that Cabinet meeting, "It was Stimson's primary object to turn the thoughts of his colleagues back to the great principle of direct negotiation on basic issues which had been so long pursued by Franklin Roosevelt, and upon which Stimson's whole experience in forty years of public service had led him to rely."

Stimson's views were seconded by Henry Wallace and were opposed by Vinson and Forrestal. The latter advocated that we should keep "the secret" as a trust, as countries sometimes kept trusteeship of islands in the Pacific. The following month in a press conference, Mr. Truman confirmed the growing American conception of the atomic secret as a virtually unbreakable monopoly. On October 27, 1945, Truman spoke of atomic energy as a "sacred trust."

The heated discussion at the Cabinet meeting made Stimson an hour late for his scheduled departure from Washington Airport, where ". . . to my surprise was a huge meeting of apparently all the general officers in Washington . . . together with my . . . personal civilian staff. . . . These men had been standing there for an hour because . . . the Cabinet meeting had lasted so long. . . ." After a nineteen-gun salute Stimson shook hands with General Marshall and his civilian secretaries, and boarded his plane.

None of those bidding him goodby knew that on his last day in public life Henry Stimson had made the heads of the U.S. government face for the first time the need for formulating an atomic policy.

HYDROGEN BOMB, POSSIBLE IN FUTURE, WOULD NEED HEAT FROM ATOMIC BOMB

3/27/47

By SCIENCE SERVICE

BERKELEY, Calif., March -- New speculation has been started about an atomic bomb using the lightest known atoms, those of hydrogen.

Dr. Philip Morrison, Cornell University atomic scientist, told the recent Northern California Association of Scientists Conference here that such a bomb, turning hydrogen into helium with the release of atomic energy, may be possible in the future, though scientists do not know how to do it yet.

The method of producing this new bomb, hinted at by scientists at the meeting, is to utilize the unprecedentedly high temperatures generated by the explosions of today's atomic bombs.

Dr. L. Szilard, of the Institute for Nuclear Physics at the University of Chicago, told the group that with effective control of uranium and thorium, there would be no danger of atomic energy from other elements, while Dr. Selig Hecht, biophysicist at Columbia University, explained that uranium or thorium would be necessary to produce the heat required for the hydrogen-type bomb.

These statements indicate what has been suspected by some observers, that the fabulous heat of an atomic bomb explosion may make possible other revolutionary new sources of atomic energy.

The temperatures produced by the explosion of atomic bombs is classified information which has not been revealed, but it has been suggested that the temperatures may be on the order of those found on the sun. If the temperature produced by exploding a plutonium atomic bomb is comparable to the heat of the sun, then the hydrogen bomb may be possible.

With such a bomb, energy would be released on earth in the way the sun's heat is created.

The generally accepted theory of the heat of the sun is that it is produced by a cycle of nuclear changes involving carbon, hydrogen, nitrogen and oxygen, leading eventually to the formation of helium. This sun energy theory was advanced by an atomic scientist, Dr. Hans Bethe, now professor at Cornell.

The best guesses have been that the carbon-stove reaction, as the Bethe suggestion is also called, won't work except at the immense temperatures of the sun. Unless such temperatures are

created in the conventional atomic bomb itself, sun temperatures do not exist on earth.

This is the way the Bethe cycle is believed to work:

An ordinary carbon atom atomic weight 12 picks up a hydrogen atom of mass one and becomes nitrogen 13, which shoots off a positive electron or positron to become carbon 13, which in turn takes up a hydrogen atom, becoming nitrogen 14. This atom adds a hydrogen atom to become an unusual oxygen 15, which expels a positron, which changes it into nitrogen 15. This heavy-weight nitrogen joins with another hydrogen atom to make the same kind of carbon atom that began the cycle, plus a helium atom of an ordinary sort.

The total effect is the use of four hydrogen atoms to make a helium atom, two positrons and a release of about 30,000,000 electron volts of energy. Chemists have long known that four hydrogen atoms have a slight excess of mass compared with the helium atom of atomic mass 4, and it is this excess of mass that is turned into energy according to the famous Einstein mass-energy equation.

A suggestion that scientists might be trying to harness this process of the sun was made earlier this year in a magazine article. At that time, John J. McCloy, former assistant secretary of war, hinted that scientists are working on a new kind of atomic bomb.

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