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NOV 2 2 1957

TO: Otha Lloyd

FROM: Jean Roek

.....For your information

.....Note and return to me

..XX...Per your request

.....For your action

Comments:.....

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43

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43

Missile Defense of Cities Is Out, Magazine Says

WASHINGTON, Oct. 15.—(AP)—Aviation Week magazine says the United States may have decided not to defend cities against the intercontinental ballistic missile (ICBM).

The magazine said administration and Air Force planners reportedly have accepted a study recommending that missile defenses be concentrated around bases of the Strategic Air Command (SAC) rather than metropolitan areas.

It said this would be done to protect SAC as a deterrent to aggression, and because defense budget restrictions would limit other defenses.

It added that the study was prepared by Rand Corp., Santa Monica, Calif., a nonprofit organization.

The Defense Department information desk said there would be no comment on the article.

[May 1958]

Democratic Programs for Action

Foreign and Military Policy for Peace and Security

A Series of Ten Pamphlets

NUMBER ONE

Where We Are: The World of Today and How It Got That Way

"If we could first know *where* we are, and *whither* we are tending, we could then better judge *what* to do, and *how* to do it."

—Abraham Lincoln

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These pamphlets are recommendations for policy, prepared under the authority and supervision of the Advisory Council. They are in furtherance of the most ancient and the most vigorous tradition of the Democratic Party—to bring about the widest discussion and understanding of public questions, and participation in forming Party policy.

Where We Are: The World of Today and How It Got That Way

The Seemingly Safe and Solid World of the Nineteenth Century Has Been Destroyed by Two World Wars

Young voters who will go to the polls for the first time this year were born before the Second World War. Most of their parents were born before the First World War, and some of them fought in it. For two generations we have lived through wars and the constant threat of them. Now another generation is growing up to face equal, perhaps greater, dangers. It used to be fashionable for young people to say that their elders had made a mess of things and demand bold solutions. But there is more to the problem than that. Understanding the problem comes before finding answers.

The world as it was before the First World War seems a distant and mythical place. It was a world largely without automobiles and airplanes. It was also without world wars. For a hundred years people everywhere had suffered less from international war than they had for centuries. Also, in those hundred years, the world had experienced greater economic development than in all prior history. Our own country, helped by capital from Europe, had grown from a fringe of settlements along our eastern and southern coast to an industrial half-continent. Then, too, none of the great powers tried to keep international relations perpetually tense. Cold wars were unknown.

The key factor in all of this was that the great empires of Europe maintained a balance of power before 1900 which prevented any one of them from attempting to establish supremacy over the others. In the comparative peace which they kept, an international economic system developed and common ideas of international behavior grew up—and were sometimes enforced. But by 1914 the balance of power was upset by the greater industrial progress and strength of Germany. Two fatal attempts by Germany to become supreme destroyed, or greatly weakened, all but one—Russia—

of the great empires which had maintained the old world order.

The Emergence After the Wars of Two Powerful Groupings of States

After the wars two strong powers, the United States and Russia, and the beginnings of two world systems emerged. The future of western civilization, indeed the very existence of mankind, depends on the relations between them.

The Soviet System and Russian Power

Russia has been an important power for at least two centuries. In the past thirty years the Soviet regime has made it even greater by vastly increasing heavy industrial production.

From the start, the regime has maintained an enormous military establishment, subsidized subversion in every country, and now exports arms, capital, technicians, and propaganda. It believes in the inevitable collapse of capitalistic governments and economic systems and the triumph of Soviet communism in world domination.

Moreover, the regime rejects every basic idea of the established order in other countries. This has added a new and vexing complication to the conduct of international relations, the cold war.

Industrial production in Russia has been growing at an amazing rate.

When Germany attacked Russia in 1941, few people believed that Russian industry, military organization, and methods of supply were adequate to withstand the onslaught of the highly industrialized militaristic Nazi state. And, in fact, we have continued to look upon Russia as an under-industrialized, inefficient, and semi-literate country—one which could not possibly compete with our mass production and highly skilled economy. This illusion of ours is proving costly today.

A congressional report tells us that Russian steel production in 1955 was 43 per cent of ours, and in

1960 will be 51 per cent. These percentages appear less deceptively comforting when we realize that Soviet steel production increased twelvefold within sixteen working years through 1955, while that of the United States merely doubled. And the report warns that these figures underestimate the relative power of the Soviet Union, where "only an insignificant proportion of that steel goes into satisfying consumer needs for automobiles, washing machines, refrigerators, etc. The bulk of it—perhaps as much steel as in the United States—is available for production of military goods or for items conducive to further economic growth."

With the present reduction in our steel production due to the recession, our actual production is probably running not much, if any, above the Russian.

REASONS FOR RUSSIAN INDUSTRIAL GROWTH

There are three main reasons for Soviet industrial growth and for its continuance. The Russian people work longer hours and consume less of what they produce than we do. The Soviet communist command requires them to do this. Sternly restricted consumption in the Soviet Union (hence the poor housing, poor food, few automobiles, refrigerators, the high price of clothing, etc.) permits the investment of 40 per cent of production in capital equipment and arms. In the United States the amount available varies from 25 to 30 per cent.

Personal consumption in the Soviet Union is only about 56 per cent of production, while it is 67 per cent in the United States, 69 per cent in Canada, 70 per cent in Italy, and 72 per cent in France. The lowest figure in the West, 61 per cent in West Germany, in part explains that country's spectacular recovery.

In the second place, Russian industrial plant, largely post-war, is modern and efficient, while that of the western nations is generally older.

Finally, Russian technical and inventive brains are first class and are rapidly increasing in numbers. In 1928 in Russia, the congressional report tells us, "the state of technology was generally backward, and labor skilled in modern technology was scarce." Now the

Soviet Union graduates double the bachelors of science graduated in the United States and over two and a half times as many engineers.

The Chairman of the President's Scientific Advisory Council has just predicted "tremendous and explosive development in Russian physics during the next ten years" and that "without a conscious effort on our part, their numbers of trained scientists will soon dwarf ours." *The Bulletin of Atomic Scientists* for December, 1957 (p. 348) states: "The fact is that America always has been behind Russia—Czarist or Communist—in many areas of applied mechanics. . . . Russia has had an unbroken scholarly tradition in hydrodynamics, aerodynamics and ballistics."

In short, Soviet Russia is a powerful state, able to concentrate human and material resources for national purposes in a quantity and quality which this country is not doing—and, perhaps, has never done. This has given a new dimension to the problem before us. The terrible fact is that we are running out of time.

THE LESSON OF THE SPUTNIKS

The reason is simple. With showmanship that must make our advertising experts green with envy, the Soviet Union has demonstrated its ability to shoot heavy satellites into outer space. In doing so, it has made unpleasantly clear that it possesses rockets that are usable for intercontinental ballistic missiles—and, of course, intermediate range ballistic missiles—rockets that are more powerful than any that this country has, or has in sight. This produces an immediate result, and holds an ominous prophecy.

The immediate result is that those nations which have relied upon our strength for protection, now doubt it. In this world a nation must not only be strong but must have other nations believe in that strength, or else it may be put to disastrous tests of its strength.

The evil omen for the future is that if, as the facts indicate, the Soviet Union is already producing IRBMs in quantity, and should produce ICBMs in quantity substantially before the United States can do so, our decline in military power and capacity to retaliate against attack

may be serious indeed. In this situation, it is well to look at the other side of the power ledger.

The Free World

WHAT WE MEAN BY THE TERM

By the Free World we mean all those countries which want to live and develop in their own way, and do not want to be run by a communist clique under the domination of Soviet Russia. These countries differ from one another in many ways, including their attitude toward us, but are alike in one vital respect—their desire to go their own way to their own goals, unbossed by any other power.

The central purpose of United States policy, essential to our well-being, is to do all in our power to enable this Free World to be militarily secure, economically vigorous, and united by some basic ideas about international conduct.

THE CENTER OF FREE WORLD POWER

At present the strength which brings military security and helps economic development among the free nations lies in North America and Western Europe.

We can get a good idea of relative potential strength if we look again at steel production. United States production (1956 figures) was more than twice that of the Soviet Union. It was 140 per cent of that of Western Europe. So United States and European production together is something over four times Russian production. But, if Russian and Western European production were to be combined against us, ours would be only 87 per cent of the combination; and, at present rates of growth, it would be only 81 per cent in 1960.

So far as population goes, similar results follow the same combinations. The population of the United States is 172 million; that of the Soviet Union 202 million, and that of the European NATO countries 261 million. Make the additions yourself.

Close alliance and common effort are essential for both Western Europe and the United States. Without our

support, the European countries cannot survive as independent states, against Russian pressure.

On our side, we have had to intervene in two world wars to prevent the unification of Europe by a power hostile to us. That combination would be just as hazardous to us now as it was in 1917 and 1941; indeed, more so, because of the great increase of Russian power.

For this reason the keystone of United States policy since 1945 has, first, been to restore Western Europe by the Marshall Plan, and then to join forces through NATO to protect our common interests. Unless the strength to preserve us all is created and bound together, neither national independence nor the ability of a people to pursue its own goals in its own way will long survive in any part of the world.

Why Russian Power Must Be Balanced

None of us begrudge the Russians their economic growth. We wish that the Russian people enjoyed more of it. But it is precisely because they do not that it concerns us. When the share which goes to the Russian people is harshly restricted in order to build up the world's greatest military forces—both nuclear armaments and forces of the older types—we ask why.

The power of Russia's traditional enemies, Germany and Japan, was destroyed in the Second World War. The present and potential power of China has been added to the communist system.

After the war, the only other great military power, the United States, demobilized and substantially denuded itself of regular forces. To remove the fear and danger of nuclear weapons, of which it then had a monopoly, the United States offered to put the whole business of nuclear power and weapons under international control. But the Soviet government refused all offers and redoubled efforts in both nuclear and regular armaments.

During the war the Kremlin used its military power to absorb Lithuania, Esthonia, Latvia and Outer Mongolia. At the war's end it used its military power to make satellites of Poland, Hungary, Rumania, Bulgaria, East Germany, North Korea, and to try to make satel-

lites of Iran, Greece and Yugoslavia. In other words, communist governments took over wherever the Kremlin had the physical power in position.

Where troops could not or dared not go, subversion or threat was used—successfully in Czechoslovakia, unsuccessfully in Greece, Turkey, Italy, France, West Germany, and the Low Countries.

And the Kremlin has recently added the export of capital and arms as a means for dominating Asia and Africa.

Four years of high level talks (1946-1949) failed to make any progress toward unifying Germany and getting a German peace treaty. Instead, the Soviet Union first declared the cold war by compelling its satellites to reject the Marshall Plan; and, then, again showed its willingness to use force, directly and indirectly, in the blockade of Berlin and in Korea. Again, in 1955, at the summit conference in Geneva and afterwards, attempts to reach agreement on Germany failed.

Almost steady discussion of armaments from 1946 to 1958 has run into the blank wall of Soviet refusal to permit any safe and reliable inspection and control.

We return to our question, why has this happened? Why does the Soviet Union maintain the greatest armaments in the world and persist in maximizing international tensions?

The answer lies not in wickedness among the Russian people; but, partly, in the nature of dictatorships, and, more, in the nature of the Soviet communist dictatorship. The suspicion, fear, and ruthlessness of absolute power—which corrupts absolutely—have combined with Marxist-Leninist ideology to compel the Soviet leaders to a warped and distorted view of the non-communist world. They see their relations with it as an unremitting struggle in which capitalism will inevitably collapse, and communism —and with it Soviet power—will triumph. "One cannot stop the course of history," says Khrushchev. And again, "We will bury you."

So they think that time is on their side and that international tension is more likely to divide the West than

to hurt the communists. Somewhere along this inescapable road they believe that force will be used by the decaying West in a last desperate effort to destroy the Soviet Union.

It also seems plain that, if they can do so without substantial risk, the men in the Kremlin are likely to imagine the impending attack, and anticipate it. So completely have they eliminated from their minds the difference between what is true and what they want to believe to be true that they will have no trouble in finding justification for any action they desire to take.

Our first task, therefore, is to strengthen our military establishment to the point where the Soviets will be convinced that they will risk much and gain little from either the use or the threat of force. To let the Kremlin get to a position of military supremacy, with the record it has, is a sure road to disaster. At the same time, military strength can only postpone an inevitable decline in the relative power of the Free World unless we also provide large amounts of capital to the undeveloped areas that so urgently require it, and adopt a trade policy which will permit them to repay us.

What It Takes

To balance Russian military power and economic maneuvers will be tough and costly. It will take more than moralizing, exhortation, or, even, money. It will require a government with the will to lead through difficulties, dangers, and hardships. A government of this kind can inspire us to do what has to be done.

First of all, we must increase our basic industrial production. This means expansion of plant and shift of production from less essential to more essential articles. It means, too, all the economic, financial, and fiscal measures to keep the country sound and the burden fairly distributed. We must have economic policies which maintain a high level of production with an expanding economy. We cannot afford the present waste of idle plants and idle men.

The calls upon our industry will be large. Production for consumption, for essential national needs (such as the best obtainable educational system), for both nuclear

and conventional forces and weapons systems, for even a minimum shelter system against fall-out, for capital goods for export to countries now ready and pressing for them—all these demands upon industry will call for national production greater than we now have.

The urgent need of our day is to use the limited period in which the West will have a sizable lead in industrial production over the communist system, to make the non-communist states militarily strong and economically workable.

Not only must we produce more, but we must find scientific and inventive brains of better quality and greater quantity than we now have. The brains developed by our mass-production industries are not sufficient to keep abreast of the swift movement in the weapons field. Just as we needed the help of foreign scientists to make atomic weapons, so we need it now. Even though the training of our own scientists has become a must of the highest priority, youth takes time to grow, to learn, and to gain experience.

To get the help we need now we must amend our immigration and atomic energy laws to permit a greater and freer exchange of scientists and scientific information. We have been the greatest sufferers from our own obsession with security.

Talks With the Russians

To do all that we can to make our military power a deterrent to the use of force by the Russians and to counteract their economic programs does not mean that we should not meet and talk with them. This includes talks alone with them, provided we consult our allies first, keep them fully informed, and have a Secretary of State whom they trust.

When the Kremlin wants to solve a problem, it can do so in the simplest and most secret way, as it ended the blockade of Berlin in 1949. When it is not ready to solve one—as it was not ready to advance German unification in 1955—not all the glare of summit meeting publicity is of any use. Although for the present, at least, it does not appear that any large matters can be

worked out in talks with the Russians, possibly some small ones can be.

Unfortunately, the present Administration has become obsessed by a self-induced terror of meeting with the Russians. Wild talk in the campaigns of 1952 and 1954 —"twenty years of treason," and the like—plus the bitter fruit of the ill-timed summit conference at Geneva seem to have convinced the Eisenhower-Nixon Administration that to meet with Russians is a breach of security.

Then, too, they keep asking the Russians to give evidence of sincerity. Sincerity in what? The communist leaders are sincerely what they are. They are not going to change, no matter who asks them. Talks from time to time can be useful. No one need be afraid of them if they are conducted sensibly and quietly. They should neither be approached like a dose of castor oil, nor heralded like a new model car. But they are no substitute for strength. In fact, without strength on our part, meetings with the Russians are not likely to lead anywhere we want to go.

The physical job before us is large, but possible; to obtain and produce the necessary inventive and scientific brains is harder, but still possible, if we go at it. But both are impossible, as is the delicate task of keeping open the door to negotiations with the Russians, unless we have a government with the will to lead, with the confidence of the country, with the trust of our allies, and, with the respect, at least, of those who wish us ill. We do not have this today.

The Republican Party Cannot Lead Today

The present decline of American power and prestige is the consequence of the failure of the Republican Administration to provide the Free World with leadership. The Administration has failed, not because it lacks patriotism, but because it lacks the will, the vigor, and the perceptive intelligence the world situation we have described so urgently requires.

What the Free World needs at this moment of mounting danger and shrinking time is imagination,

courage, and an unshakable confidence in its own institutions. The Administration possesses none of these attributes; nor can its party provide them. The Sputnik episode demonstrated the poverty of imagination of both the Administration and the world of big corporations and advertising agencies from which Republican administrations are recruited. Washington generally, and, in particular, the President of the United States and the former President of General Motors, who was then serving as Secretary of Defense, were wholly unprepared for the world reaction to the launching of the Russian satellites and remained, for some time, incapable of comprehending it. The Eisenhower Administration deferred its own satellite program because it was incapable of imagining the possibility or the consequences of a Russian success in this field.

In the same way, and for similar reasons, the Administration allowed itself to be outdistanced by the Russians in the races to perfect both an intermediate and an intercontinental missile. Success in those races involved the expenditure of large sums of money, and the Administration was the prisoner, as any Republican administration must be, of the big business belief that nothing can be done which interferes with the balancing of the budget at a low level. The world of big business has no faith in the power of democratic institutions to inspire and direct the growth of national productivity, as they have done again and again in our history.

We do not say that the Republican leaders are not well-meaning, and, doubtless, as sincere as the rest of us. This may even go for Mr. Nixon, too, though we had best, in this case, keep in mind the old adage, "don't go to sleep with your thumb in his mouth." The trouble is that, being the prisoners of those who provide the funds for their party, they are incapable of leading where the necessities of the times demand.

But even more important than this, they do not understand the quality that is essential to democratic government. They do not see that the task of government is not merely to make and carry out policies. Government is, also, an educator and leader. The governed cannot

freely consent unless a government presents to them all the relevant facts and its proposals for meeting them. Then, and then only, is there a basis for choice. There is no possibility of choice when, as for the past five years, all the methods of Madison Avenue are used to drug the minds of the people into happy acceptance of what they are told. Undoubtedly, these methods produced, for a time, a contented people and a popular administration. Undoubtedly, also, they have brought the country to the brink of disaster.

For months, stretching into years, we have heard that all was well. We have been bewitched into believing that an obviously aging and incapacitated man was fit to carry on the most mercilessly exacting office in the world. We were given dietary and physiological details; we watched the doctors perform on super-quiz programs. All the time a misled and uninformed President has, quite honestly, misled us further. All the while, so Mr. Allen Dulles, Director of the Central Intelligence Agency, assured a Senate investigating subcommittee, the Administration had been kept fully informed of the decline of our power, and the rise of Russia's in missile development. When he was asked why the Eisenhower Administration had neither acted nor informed the people, he could only shrug his shoulders.

It would be unfair and wrong to suggest that the state of the world which we have described, and which has been in the making for half a century or more, is solely the fault of the present Republican Administration. We do not do so. What we do charge is that during the past five years the Eisenhower-Nixon Administration has squandered advantages, relaxed efforts, alienated friends, and deceived its own people, with the result that a dangerous situation has become a highly critical one. We say, further, that this Administration is incapable of doing what must be done. What this is, other pamphlets, listed in the back of this one, will describe in detail.

But the first of all requirements is that we shall have a government which tells us the truth. For a long time the Administration has known of the decline of our power compared with that of the Soviet Union. To this

day we have not yet been told the facts. The government dares not tell us. Because it is incapable of action, it is incapable of truth. We, the American people, are at the beginning of a long line of disillusion, frustration, deep humiliation, and alarm. To get through it will take all our courage;—but more than this, all our ingenuity. For the Constitution, with its elections by the calendar, provides no easy way to deal with a situation where without a government, except in name, we find ourselves drifting and in danger.

Surely in this great and resourceful people there is the inventive genius, not only to deal with rocketry and outer space, but to restore to government a sense of mission which can galvanize this nation's energies, and to give it a future worthy of its past.

We do not have such a government today. We can have one in 1961, though the race with disaster may be a close one. For the years until then are the critical years. What we do or fail to do in these years may be decisive. Vacillation or feebleness in action now may leave us with no second chance.

What the Country Demands the Democratic Party Can Give

What the country demands, what the Free World so critically needs, is leadership in the government of the United States.

Leadership must inspire confidence. To do so, it must earn confidence. The first of all requirements in earning confidence is that it tell us and the Free World the truth. Moreover, to earn confidence, leadership must represent and respect the interests of *all* our citizens, not be confined to any small section or group. It must act—and must be free to act—in the national interest, it cannot be tied to any timid fiscal or economic dogmas, or to special interests which support a political party with lavish contributions. Lastly, if leadership is to earn and deserve confidence it must call on all the brains throughout our population, not merely on the leading figures in business and advertising.

This leadership the Democratic Party can provide. By great good fortune the Majority Leader of the Senate,

Senator Lyndon Johnson, Speaker Sam Rayburn and Majority Leader John McCormack of the House of Representatives are men of outstanding courage and vision. They are supported by many other able leaders, all trusted and followed by their fellow Democrats.

Executive leadership cannot, of course, be furnished by the Congress. Unhappily the White House is paralyzed by absentee landlordism. But the Congress can do, and is doing, much with funds and orders, to prod forward lethargic administrators, though no one can force an executive to use authority wisely and well, or even at all, against his will.

What Is Needed in 1958 and 1960

At present, the Democratic majorities in both Senate and House are too narrow for effective handling of our Party policies and program in Congress. They are too narrow for a full demonstration of the leadership that can be given to the country by our Party in Congress. What we need in 1958 is a large increase in our Senate and House majorities, as well as in our State governorships. We can and will get these increases—provided all of us make it our job to see to it. This job of 1958 is all the more important because it is prelude to 1960. Large increases in 1958 will provide a basis and a springboard for the national campaign in 1960, and for a national victory that will return government to all the people, and that will restore to the nation and the Free World the leadership we so desperately need.

The timid policies that the Eisenhower-Nixon Administration follows and the inadequate measures that it timidly asks make impossible provision of the strength and security which the country and the free world demand. From 1958 through 1960 our leaders in Congress need and deserve vigorous support from all Democrats in policies which will go beyond those of this Administration. They particularly need our vigorous support because these greater policies will call on all of us to forgo things we would like to have and on some of us to forgo special privileges.

The country is about to call on the Democratic Party for the greatest service in its long and honorable history.

In preparation for this, it is the duty of all Democrats to think long and hard about the world and the times in which we live, and to do so not in the search for pat answers which seem to offer easy escapes from responsibility. The search is for policies which will best serve both the country which we love and that greater, world-wide community of men and women who long to live in peace and freedom.

PAMPHLETS ON FOREIGN AND MILITARY POLICY FOR PEACE AND SECURITY

No. 1 Where We Are: The World of Today and How It Got That Way. (May 1958)

No. 2 Why We Need Allies and They Need Us To Preserve the Free World.

No. 3 The Military Forces We Need and How to Get Them.

No. 4 The Economic Side of Foreign Policy. The Export of Capital to Undeveloped Countries. A Sensible Trade Policy.

No. 5 A Policy to Guide Our Relations with Europe.

No. 6 A Policy to Guide Our Relations Within the Western Hemisphere.

No. 7 A Policy to Guide Our Relations with the States of Asia and Africa.

No. 8 An Immigration Policy Worthy of America.

No. 9 How to Lose Friends and Influence: Mr. Dulles in a China Shop.

No. 10 The Goal We Seek. When and How to Negotiate with the Russians and About What.

Copies of these pamphlets, as they are published, may be obtained from The Advisory Council of the Democratic National Committee, 1028 Connecticut Avenue, Washington, D. C. Prices: For less than 100, 10 cents each; 100, $7.50; 1000, $65.00.

Price

NOV 4 1958

ADLAI E. STEVENSON
DEMOCRATIC RALLY
MINNEAPOLIS, MINNESOTA
Saturday, November 1, 1958

FOR RELEASE SUNDAY A.M. NEWSPAPERS
November 2, 1958

I last came to Minneapolis on a political errand exactly two years ago -- on the eve of my defeat. And it is good to come back to this exhilarating state of Minnesota on the eve of a victory -- even if it isn't mine!

Tonight marks the end of one of the most confused and unrewarding national political campaigns in recent memory. For the anxious world it has been a disheartening spectacle; for us it has had amusing aspects

Things were remarkably quiet until the Republican leaders met in the White House and Nixon sallied forth to stir things up -- both Nixons, Old and New. Then Mr. Alcorn, the Republican National Chairman, also sallied forth with a Republican manifesto denouncing the New Deal and all its works, which the Old Eisenhower promptly repudiated. But Mr. Alcorn repudiated the President's repudiation.

Meanwhile Mr. Dulles rebuked the New Nixon for discussing foreign policy, and the Old Eisenhower agreed; but then the Old Nixon disagreed; and then the New Eisenhower agreed with the Old Nixon's disagreement. After this the New Eisenhower also sallied forth to stir things up on his own -- and today you can't tell the New Eisenhower from the Old Nixon.

Their contribution to the political dialogue is that Democrats are "extremists," "socialists," "radicals," "hare brains," and "boondogglers." The New Republicans sound like the Old Guard in their last titanic struggle to ward off the 20th Century.

Well, to ignore the issues and denounce the Democrats is not unfamiliar Republican strategy. And it is nice, in a way, to have the Old Nixon back -- the statesman's toga always did hang a bit loosley from those padded shoulders. And I suspect Mr. Nixon also is not unmindful of Old Guard delegates in the 1960 convention.

But the tragedy of this campaign is that the President has taken up where the Vice President left off -- with the help of a new speechwriter. For the past six years the President has sent the Vice President to run his political errands and do the dirty work. But this year we have the spectacle of the Vice President's sending the President out to run <u>his</u> errands.

And have you noticed that this year the Republican candidates don't seem to want to be reminded that they are Republicans. In New York Mr. Rockefeller declines to identify himself with the Republican administration at all, disowns President Eisenhower's views of labor unions, and prefers to meet Mr. Nixon in private at breakfast when no one is looking. In California the Republican candidate for governor, Mr. Knowland, is still fighting hard -- but mostly against the Republican candidate for Senator, Mr. Knight. And here in Minnesota, I understand, your Republican candidate for Senator is doing his best to run away from his Secretary of Agriculture, while the billboards of Mr. Judd are innocent of any taint of Republicanism.

All around the country the Republican candidates who were coat-tail riding a few years ago are now involved in an operation of massive disengagement. And no wonder -- if you were a candidate, how would you like those fellows Quemoy, Chiang, Dulles, inflation, Adams, Goldfine, Benson and Sputnik all creeping around -- at Halloween time!

Instead of discussing the great issues, the Republican leaders say that the overwhelming challenge of our time is saving the United States from radical Democrats in Congress, which certainly must be news to Lyndon Johnson, the Democratic majority leader in the Senate, and Sam Rayburn, the Democratic Speaker of the House, who have never been distinguished for their radicalism.

And they are saying, too, that the recent improvement in the economic situation is their handiwork, when in fact we are principally indebted for the maintenance of personal income and consumer demand for goods and services to the stabilizers built into our economy long ago. Such Democratic innovations as unemployment compensation and social security have checked the effect of unemployment and lost wages, and arrested the downward spiral of economic activity -- programs, I remind you, the Republicans fought most bitterly.

But the prize gimmick is the Republican attack on labor. I saw a leaflet in California entitled "Know Your Opponents," which listed ten offices before the voters -- and opposite all ten offices was the picture of -- Walter Reuther! And he isn't running for anything!

And don't think this is a coincidence. Let me read you from a news story which appeared the other day in the New York Times:

"The concentration on Mr. Reuther is the product of a top-level policy decision...The Republicans were in urgent need of an issue that would take people's minds off the recession, high prices, high taxes, war fears, Sherman Adams and President Eisenhower's golf game."

They certainly were -- and they still are! And they don't approve trade union misconduct either. But when the President talked about "fumigating" unions he forgot to mention that it was the Republicans in Congress who killed the bill to give honest workingmen a chance to clean up their unions. And he forgot to say that the leading betrayers were not Walter Reuther, whose record is clean, but the President's own supporters -- Hutcheson, Hoffa and Beck.

I said this campaign is disheartening -- because millions look to our leaders for sober discussion of our problems. Momentous and fateful issues confront us -- disarmament, our alliances, the state of affairs in the Far East, the Middle East, and all the under-developed world; the reconciliation of the races within our own land; the urgent need to adapt our institutions to cope with the onward rush of our population and wealth.

Confronted with the sobering realities, it is comforting to come to Minnesota, and to sit on this platform with such Democrats -- such American leaders -- as Hubert Humphrey, Orville Freeman and Eugene McCarthy.

I don't need to say anything to you Minnesotans about the vigorous and constructive leadership, the compassion and the energy, of your great governor -- Orville Freeman. You know well what he has done to strengthen your schools, your economy, your programs for the aged and the handicapped and the mentally ill -- to make Minnesota a model for the nation.

But I am glad to have the opportunity to tell you how strongly I feel about your candidate for United States Senator.

No member of the House of Representatives has more completely won the respect of his colleagues for his intelligence, his conscience and his strength. His sensitivity of feeling, his breadth of vision, his scholarship and intellect, his unfaltering liberalism and humanity -- all guarantee that Minnesota and the nation will

have another great representative -- when Eugene McCarthy goes to the Senate.

I can't pay him a higher compliment than to say that he will make a fitting partner for the most eloquent voice and tireless champion of a better America -- Hubert Humphrey.

But I did not come here tonight to talk to you just about this campaign. For grave problems confront the nation, and it is to the future that we must look -- beyond next Tuesday, yes, and beyond our own borders.

Of course the Republicans don't want us Democrats to discuss foreign policy. And no wonder! But in peacetime foreign policy must always be the subject of discussion in a democracy -- and I hope not just during political campaigns. What we need is not less but more public ventialtion and honest discussion of our situation. Too often we are so involved in domestic concerns that we neglect the intricacies of foreign affairs until a crises arises. Quemoy is a case in point, where the crisis of four years ago was forgotten until we were on the "brink" again. But this time public opinion and the mounting protest against our military involvement in the defense of Quemoy has forced a more realistic policy on the administration. But let's not forget again if this crisis subsides as we pray it will.

This summer I travelled from Siberia to the Sahara. The thing borne in upon me most forcibly was the magnitude of the Russian challenge.

The industrial growth of the Soviet Union is a phenomenon of this age. And I'm told it is the same in Red China, or more so. Russia's resources are unmeasured, her energies immense, and it is wishful thinking at its worst and most dangerous to pretend that the Soviet system is about to collapse. It isn't. Russia is here to stay, and so is China -- and we may as well face it, Secretary Dulles and President Eisenhower to the contrary notwithstanding.

We see the communist challenge too in Asia, the Middle East and Africa, in all the underdeveloped countries, where the former colonial peoples are rising from a long sleep. They want many things, including a better life, and while Russia beguiles them with friendship and aid without strings, we have too often turned to them a stern military face.

But what distressed me most behind the Iron Curtain was the ignorance of the ordinary Russian people about the United States. They were friendly beyond anything I had imagined, but they are permitted to know little about us, or even themselves -- as the ferocity of the attack on Boris Pasternak these past few days so tragically reveals.

Since the peoples of the world now must either live together or die together, it is imperative that all the world be opened up and that travel, trade, and cultural exchange be encouraged wherever possible. I think we should be ready to talk with the Russians at every level. We must not hope for too much. The road will be long and rough. Our differences are deep. Mutual trust and confidence are a long way off.

But we must try to keep communication open, to exchange views, to break down if we can, little by little, the barriers of ignorance that divide us. For in the hydrogen age we cannot afford to neglect any chance to pierce the barrier.

Yesterday a new chance opened up -- at Geneva, where our representatives met to discuss means of stopping nuclear tests with safeguards by inspection. I take no personal pride in having urged our country to take the first step in this direction almost three years ago. What matters now is that we break the disarmament deadlock and get on with the business of nuclear controls -- for, as I said here in Minneapolis just two years ago, "the conquest of this scourge is a more imperative goal of mankind than the conquest of the black plague in the Middle Ages."

Forgive me if I dwell a moment longer on our foreign affairs. For, despite all our efforts to build a peaceful world -- and I give the administration full credit for trying -- I fear we are losing ground. The world is more dangerous, not less, than it was six years ago when the Republicans took office. The free world is less united, less confident, less sure of what it is trying to do.

As I see it, the United States has a two-fold task in the world. The first task is defensive: we must hold the line against the Soviet drive for a communist world order. The second task is offensive: we must strive to build a peaceful world

So the United States and its allies must develop military defenses strong enough to discourage the use of force as an instrument for expansion.

But the defensive task is becoming less a military problem than a political and economic offensive. One of our serious national problems is that we have not fully understood the use of non-military weapons of defense. We will spend forty billions or more this year for military defense, but we hesitate to spend a billion for political and economic programs that might be much more effective.

But defensive measures, no matter how skillfully we use them, will never be enough by themselves. If the rest of the world believes that America's aim is only to defend the status quo, we will lose out in the struggle. For the status quo is not an inspiring goal. To most of the people in the world status quo means poverty, frustration, and indignity.

And the status quo certainly isn't good enough for us. We do not want a world in which we must go on, year after year, spending forty or fifty billions a year for defense.

If we cannot accomplish our positive goals by military means alone, the United States must propose other means for settling disputes. And if they are not to be settled by force, they must be settled in some other way -- by the decisions of the United Nations or by the judicial decisions of the World Court. The United States should take more positive leadership in proposing ways to settle disputes by the processes of law. For, after all, our ultimate goal must be a world order under law.

The second aspect of our peace offensive is economic. There are tremendous differences in standards of living in the world, and the gap between the rich and the poor is widening, not closing. The rich countries have a tiny minority of the world's population, and we will not be able to hold onto our fortunate position indefinitely -- unless the vast majority of the world believe that they have a better chance for progress by cooperating with us than by trying to dispossess us.

So we must lift the standards of life in the poor countries. Our own interest in our own survival demands that we take leadership in this task -- not a grudging, halting, hesitant leadership, but a

strong, clear, purposeful leadership for economic justice.

Last year about this time I was trying to help out in Washington with preparations for the big post-Sputnik Paris conference of NATO. There I urged a broad economic offensive in concert with all our friends. I am happy to say that there are some signs of progress. But the larger perspective is still lacking, and I think we still need a meeting to devise a long term economic strategy for a world in violent transition. I think the administration could count on loyal Democratic support for anything that looked like a positive Western policy. As it is, unhappily, the Western powers are agreed on precious little -- and least of all on China.

As I have said, the petty superficiality of the Republican campaign seems to me inexcusable. Here we are in the midst of the most shattering series of revolutions ever to involve humanity, and all they have to say is "You never had it so good."

Here we are with the population of the world about to increase by the turn of the next century by three times as much as all the millennia have produced so far.

Here we are with two-thirds of the human race entering the millrace of industrialization for the first time.

Here we are with the idea spreading everywhere that something can be done about poverty, just when the collapse of the old political order, the surging birthrate and the shortage of capital are going to make millions poorer than ever.

Here we are with Western science about to obliterate much of ancient culture and religion and sweep away the old familiar mental landscapes.

Here we are holding in our hands the means of total self-incineration, when we haven't yet learned how to keep peace in the family of nations.

And, as if that were not enough, we have conquered inner space and are now pressing out into infinity.

All these revolutions are occurring at once. The world we think we know is dissolving and changing shape all the time. Since the whole substance of world politics and economics has suddenly become plastic, the dominant forces are those with strong creative

ideas about the patterns this malleable world must take.

Communist ideas are wrong, but they are strong, for they are directed to the kind of world that really exists -- a revolutionary world of rising expectations.

Western policy has not always been effective because -- like the old Manchus of China -- we act as if there isn't a world revolution, or if there is that we are not involved in it.

The intolerable political sin is to encourage the voters to see the world in terms simply of fear or satisfaction. To give the people no vision, no courage, no aspiration -- is to give them disaster and ultimately defeat.

I know -- I have learned long since -- that truth is not always the stuff of campaigns -- especially Republican campaigns -- but I pray that our leaders will always try to keep a hand on the hem of her garment.

It will not be easy. The bitterness stirred up by intemperate campaigning will not make bipartisan government any easier -- in spite of the President's post-election smiles and explanations.

Yet in these next two critical years the Democrats in Congress must rise to the responsibility of a still larger role in guiding American policy. For with the lack of leadership in the White House we must look to the Congress for the new ideas, for the leadership and the great debates, as we hammer out new policies for the future.

And far from cowering in our bomb shelters while eyeing the Sputnik-spanned skies, let us glory in the knowledge that this is a great, an exciting time to be alive. History will determine whether this year represents the conquest of man's last frontier or the first step toward his annihilation. Few generations of men have had so awesome a choice within their power.

Twenty-two years ago Franklin Roosevelt said: "This generation of Americans has a rendezvous with destiny."

And in that spirit of bold adventure, with that courage to face the future, and with reverence for the truth, we shall go forward now to fulfill our destiny as a free nation and a free people.

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THE GENEVA SERIES ON
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Chapter 2

THE ATOM AND THE WORLD FOOD PROBLEM *

The present world population of about 2.5 billion is growing at the rate of nearly 1½% each year. Every day nearly 100,000 additional hungry mouths appear at the breakfast table, and twenty-five years hence it is expected that we shall be 3.5 to 4 billion in number. Evidently one of the many major problems facing us, probably basically the most important for the future welfare of mankind, is how we shall be able to provide food, clothing and shelter for the world's peoples at the ever higher standards that they so rightly expect.

The Neo-Malthusians believe that we are engaged in a losing battle and that it will not be possible for world resources to meet requirements. The Food and Agriculture Organization of the United Nations believes that technically it is possible to achieve the necessary increases in production of foodstuffs and basic raw materials to meet world needs for the foreseeable future, and has recommended to governments that they aim at increases in production 1% to 2% greater than their anticipated growth in population. For many countries this will mean production increases of 3% to 4% a year. This admittedly will do little more than maintain the *status quo;* but even so, the social, political, and administrative problems involved will be of immense magnitude. Their solution alone, quite apart from the further urgent need to make a real improvement in the inadequate subsistence levels which at present characterize so many parts of the world, will require determination and fortitude on the part of governments. Although freedom from want must depend essentially upon the efforts made by each country on its own behalf, success in achieving this is of such general concern to all peoples that these national efforts should be supplemented by pooling the knowledge and experience of all countries on an international basis for the common good. In doing so, it is imperative that all possible advantage be taken of the contributions to increased production

* This chapter is taken from Geneva Conference Paper 780, "The Uses of Atomic Energy in Food and Agriculture" by R. A. Silow of The Food and Agriculture Organization of the United Nations, and M. E. Jefferson of the United States Department of Agriculture.

that might come from scientific and technical advances in other fields. Among those advances the development of atomic energy is of great significance for agriculture and the related industries of forestry and fisheries.

From the technical standpoint the solution of the problems of providing more of the primary necessities of life can come in three main ways. The easiest method of increasing supplies is by taking adequate measures to reduce the heavy losses which at present occur in all segments and stages of production, storage, and distribution. Secondly, the productivity of land now under cultivation could be much increased and the current utilization of our fisheries and forestry resources intensified through development of improved technical methods. Finally, supplies could be increased by developing new areas and resources; but this is the most difficult course since the areas and resources most easily developed are already being utilized.

The ways in which atomic energy can help in feeding, clothing, and housing the world's growing population will be considered in relation to these three main ways of improving production and making better use of our natural resources.

The Significance of Atomic Energy for Food and Agriculture

When relatively inexpensive power from nuclear reactors becomes generally available it will undoubtedly make a substantial impact on agriculture, if only by cheapening costs of production and distribution, improving conditions of work, and making modern conveniences and comforts more widely available in rural communities. This is particularly true in areas where other sources of power are deficient. These and other at present more speculative developments must, however, await the widespread application of nuclear power in industry, and its possible contributions will be discussed a little more fully later. At present and for the immediate future the radioactive isotopes and radiation that have become available as by-products of nuclear reaction are of greater importance to agriculture.

It was at one time thought that radiation and radioactive isotopes might prove of direct value in the stimulation of plant growth. To date the only stimulatory effects in the irradiated generation which have been observed in extensive investigations conducted in the United States of America, the United Kingdom, and Canada, have been those associated with damage to the plant, much as growth is stimulated, in a sense, by the use of the pruning knife, and there has been complete failure to substantiate the earlier hope for useful stimulation of growth.

Neither radiation nor radioisotopes therefore can make any direct contribution to increased production in the sense that an application of fertilizer leads to increased crop yields. Their contribution to food and agriculture is indirect, but nevertheless of immense potential. The value of radiations lies partly in

their ability to induce inherited changes in the germ plasm and partly in their sterilizing effects on biological tissues. The ability to induce mutations is being used in plant breeding programs and in other ways, while the sterilizing effects have promising applications in food preservation and pest control. The value of radioisotopes in agriculture arises from the ease and accuracy with which they can be identified and measured in extremely minute amounts, which makes it possible to use them as highly refined research tools in so-called tracer studies in a wide range of nutritional, metabolic, developmental, and pathological investigations in plants, animals, and man. In this way they are giving information which at the present time could be obtained in no other way or only at much greater expense in terms of time and money. Thus, by giving a clearer insight into basic biological processes that have hitherto been obscure, the use of radioisotopes in tracer studies is already leading to greater efficiency and economy in the production and utilization of agricultural products. Bearing in mind that it was only unfettered scientific investigation of the nature of the atom—the pursuit of knowledge for its own sake—that made nuclear energy available to mankind, the potential value of the contributions which radioactive tracer studies can make to food and agriculture may similarly be almost unlimited.

Applications of Radioisotopes in Agriculture and Forestry

Food preservation and storage. Potential food supplies and other agricultural products are subject to heavy losses in all phases of production, distribution, and storage through fungal and bacterial infection and the ravages of insect pests, and it is by combatting these that the most immediate and spectacular improvements in supplies can be achieved. No valid estimate of total world losses is possible, but they are undoubtedly of immense magnitude. A very conservative estimate that has been brought forward for losses in stored grain, largely from the depredations of weevils and other insect pests, is 10%, but the losses are undoubtedly much greater in the hot and humid areas of the world, where the figure of 25% to 50% loss of harvested cereals and pulses which has been estimated for Central America is probably generally applicable in most of the less advanced countries. In addition, perishable foodstuffs such as fruits, vegetables, meat, and fish are particularly subject to spoilage in distribution and storage. Similarly the deterioration resulting from fungal infection and the attacks of various insect pests is of major concern in timber utilization.

Evidently there is great scope for the adoption of control measures, and these can be applied relatively easily at a cost which is usually but a small fraction of the value of the returns. Already radiations and radioactive isotopes show promise of making important contributions to the development of improved control measures which would markedly improve the supply situa-

tion. Thus the destructive power of radiation has been used to eliminate insect infestations in grain and cereal products at costs which compare favorably with those of the more conventional procedures such as fumigation. The sprouting of potatoes has been successfully inhibited as a result of the effects of radiation on the enzyme system, thus permitting transportation under less stringent conditions than are usually required and extending storage life by many months. Much attention is also being given to the possibility of food preservation through cold sterilization by irradiation at normal temperatures. While full success has not yet been attained, significant improvements in the keeping quality of meat and meat products have been achieved without off flavors or color changes arising from detrimental side reactions. In some countries trichinosis is an important health problem and it has been shown that the irradiation of pork can kill or sterilize the trichinae, thus rendering infected meat safe for human consumption.

Evidently radiation may have a very useful field of application in food processing and preservation, although much more exploratory work must be done to evaluate its full potentialities. One of the most attractive features of this application is the wide scope it offers for the useful employment of the radioactive residues arising as a by-product of the operation of nuclear reactors.

Reducing losses in growing crops. Every year a large part of the potential harvest is destroyed by diseases and pests which attack the growing crop. It has been said that even in such relatively developed countries as the United Kingdom the work of over 51,000 skilled farm workers is lost each year, and that in the United States of America losses caused by insects, weeds and plant diseases account for losses in farm output equivalent to $13 billion per year. Most of these losses could be avoided by the timely application of control measures, and radioisotopes are proving to be exceptional tools in studies which are leading to the development of improved materials and methods for safeguarding our harvests. Adequate control of a destructive insect, for instance, generally requires a thorough knowledge of its life cycle and habits, and tagging insects with radioisotopes provides a much more efficient means of determining their flight range, migrating routes, and overwintering habits than methods such as painting which were previously used. In Canada $cobalt^{60}$ has been used to label wireworms, making it possible to follow their underground meanderings, while in both the United States of America and Canada the flight and overwintering habits of a number of forest insects are under investigation, using similar techniques. These studies will undoubtedly be important factors in better control.

Extremely effective insecticides have become available in recent years but one of the problems associated with their continued use is that insects frequently build up resistance to these poisons. Studies with insecticides labeled with a radioisotope permit comparison of uptake and metabolism by normal

insects and by those that have developed resistance. This work may be a step in determining the nature of resistance to the poisons, concerning which so far little is known except that resistant insects take up the poisons just as susceptible ones do, but do not react to it in the same way.

Similarly radioactive tags are playing an important part in the development of fungicides, insecticides, and weed killers, for use either as direct applications or as systemic poisons. These latter are substances which are applied, usually through the soil, and taken up by the plant without harm to it but are toxic to pests feeding on the plant. It is important to know that such substances are not altered in use to products harmful to man or animals. For instance the weed killer 2-4-D when used to kill weeds in the bean field is readily absorbed by the bean plant also and has been found by the use of labeled material to be distributed throughout the plant together with at least two additional products derived from 2-4-D. It is obviously important in the case of edible plants to be able to trace such compounds and their metabolic products because of their possible effects on the consumer, animal or man, and the use of radioactive labels is playing an important part in the development of safe materials and methods.

Breeding improved crop varieties. Although control of crop pests and diseases by chemicals can be extremely effective, their use involves additional expenditure and usually requires considerable care. Undoubtedly the most satisfactory safeguard, and one that is particularly applicable in the underdeveloped areas, is the growing of crop varieties resistant to the prevalent pests and diseases. The plant breeder has long been engaged in developing such varieties, by well-known conventional methods involving selection and hybridization, and has achieved marked success; but this is a never-ending task, for existing varieties do not satisfy all needs and new pests and diseases or new forms of old ones are constantly appearing. In his task of developing disease- and pest-resistant varieties as well as other improved types with better agronomic characteristics and higher productivity, the plant breeder is already being greatly assisted by the new potent sources of radiation which have recently become available, and their use in this connection may well ultimately prove to be one of the most significant contributions of atomic energy to agriculture. It has long been known that radiations cause heritable mutations in plants and animals. With the advent of atomic energy further kinds of radiations and more potent sources have become freely available for experimental use, and in many countries extensive programs have recently been initiated for crop improvement through irradiation, with a view to accelerating the normal rate of mutation and so increasing the variability available to the plant breeder for selection.

Radiations are applied either in the early flowering stages in order to affect the developing gametes or to seeds in which somatic mutations are first induced, and such affected cells may subsequently give rise to germinal tissue,

in which case the mutations are transmitted to later generations. Although as in the case of spontaneously appearing mutations the vast majority are deleterious, desirable types occur in low proportion and have been selected in a wide variety of crops. Improved types that have been obtained include higher-yielding or disease-resistant strains of cereals and other crops such as peanuts, stiff-strawed types of cereals resistant to lodging, types better adapted to mechanical harvesting on account of particular size or shape characteristics, types with extended or reduced maturity period, and types with changed ecological requirements, for instance in relation to higher or lower rainfall or soil fertility. An example of a particularly significant outcome of work of this type may be cited from Canada, where among some twenty barley mutants produced by irradiation and now under field trial are some maturing sufficiently early to extend the area in which barley might be grown in that country.

Plants such as some orchard crops which are normally propagated vegetatively are also receiving radiation treatment for the induction of bud mutations. Mutants have similarly been induced in algae, and in this way types have been obtained which are adapted to high temperatures and thus more suitable for growth in mass culture. Such types may one day become an important source of food and industrial raw materials. In forestry increasing emphasis is being given to the breeding of fast-growing types and varieties resistant to pests and diseases, and radiation may play an important role in the production of such improved strains of trees.

In the case of disease control the ability of radiations to induce mutations in the disease-producing organism itself may also prove to be a tool of exceptional value. Such pathogens as the rusts that affect wheat and oats or the smut attacking maize undergo spontaneous mutations in nature at a rate rapid enough to cause constant trouble for the crop breeder. If he develops, for example, a wheat resistant to black stem rust, he may find that within a comparatively short time a new mutated form of the rust organism appears to which his variety is no longer resistant as it was to the original form. Current work has shown that radiation will produce new races of such disease organisms with increased virulence. By developing these new races artificially and under controlled conditions, the breeder may be able to anticipate the resistance requirements of his crop and to breed adequate resistance prior to the appearance of new strains of the pathogens in the field.

Increasing productivity through improved practices. In addition to the adoption of adequate measures for the control of plant and animal diseases and pests and the use of higher-yielding crop varieties developed by the plant breeder, the productivity of land now under cultivation can be increased by the adoption of a wide range of improved methods of crop and animal husbandry. Here again through tracer studies using radioisotopes, atomic energy is making notable contributions to the development of improved techniques through the advancement of fundamental knowledge in animal and plant nu-

trition and physiology and a better understanding of the complex relationships between animal, plant, soil, water and sunlight on which man is dependent for his existence. The study of such a dynamic biological system is normally particularly difficult and the tracer technique has immeasurably facilitated such investigations. In many cases it provides the only practical approach to the solution of a problem and without it further progress in certain directions would at this time have been impossible.

Soil fertility. The major limiting factors in the productivity of land now in cultivation are the inherent yielding potential of the crops and livestock on them and the amount of nutrients available to enable those plants and animals to produce to their capacity. Contrary to general belief, some of the most productive soils in the world were originally of rather poor fertility and have been brought to their present capabilities by man's careful tending of the soil and the development of various principles of good husbandry, which through the ages have built up the fertility of the soil. The potentialities for increasing production through adoption of those principles on a wider scale are very great. As just one example, the yield of rice in Japan is about four times that of India's one ton per hectare. Much, though admittedly not all, of this increased productivity is due to the much greater use of inorganic fertilizers in Japan, and evidence from experiments indicates that through the use of only a moderate dressing of 30 kg of nitrogen per hectare, with other plant nutrients where necessary, India's annual rice production of about 35 million tons could be raised by more than 10 million tons—which would mean much for the welfare of the population and for the economy of the country. However, the present limited use of fertilizers in such countries is almost entirely a question of economics, so that it is essential that the best use be made of the natural fertility of the soil, and that added fertilizers be employed in such a way as to ensure the fullest possible return from them. Here tracer studies with isotopes in many countries are providing a wealth of fundamental information and practical hints. Radioisotopes of most of the important plant nutrients are now available and they have opened up new avenues of attack on important problems of soil fertility.

The fact that phosphorus is to so large a degree retained by soils in forms that are not readily available for use by plants is one of the major concerns of soil science. Advances in the study of this problem are being made through such work as that in the United States of America with radioactive phosphorus and calcium on the factors influencing the fixation of phosphorus in calcareous soils. Canadian workers, who were among the first to point out the advantages of the tracer technique in soil fertility and plant nutrition problems, have shown that the usual procedure for evaluating the contribution of a phosphorus fertilizer by comparing the total phosphorus absorbed by the plant from fertilized and unfertilized plots could be misleading. Before the use of tagged material it was thought that the increased uptake from the fertilized plot all

came from the fertilizer. Through the use of radioactive phosphorus it has been found that when the fertilizer is applied, the plant takes up additional phosphorus from the soil itself as well as from the added nutrient.

Rice, the basic food of nearly one-half of the world's population, is typically grown under irrigation, in submerged soil. In Japan the radioisotopes of phosphorus, sulfur and iron are being employed in preliminary investigations of the chemistry of such submerged soils, which is quite different from that of ordinary soils, and valuable information is to be expected on the factors affecting the uptake and translocation of these nutrients by rice. Similar work on the determination of the phosphorus fertility status of tropical and submerged soils is under way in India. Other investigations are giving information on the most economic source of specific nutrients and the best placement and time of application of added fertilizers, particularly in relation to the growth period when the plant can best use them and their placing in relation to the main feeding zones of the roots. In this connection a good deal of attention is being given to investigation of the characteristic rooting habits of different plants through use of labeled nutrients, and this ability to define the zones from which particular crops obtain the major portion of their nutrients and moisture requirements should make a valuable contribution to better agricultural practices.

Soil moisture, drainage, and irrigation problems. Many other soil problems are amenable to attack by this new tool. It makes possible, for instance, rapid determination of the moisture content and the density of soils, a matter of interest alike to the agronomist, the soil conservationist, and the engineer. Moisture content of the soil may be estimated by a method dependent on the degree of neutron scattering by hydrogen atoms contained in the soil water. A similar method involving gamma rays instead of neutrons is used in measuring the density or degree of compaction of the soil. One application of these methods in the United States of America is the study of the effects of tillage and harvesting machinery in compacting the soil.

A different application to soil problems is the addition of phosphorus-32 or rubidium-86 to surface waters such as streams or ponds to determine the rate and direction of drainage into the soil, and to irrigation waters to find out whether they reach the farthest points of the field as well as the nearest points —that is, to evaluate the efficiency of distribution of the water in the soil. Radioisotopes are also being used, for instance in Japan, to detect leakage in irrigation dams and to survey supplies of underground water, and tritium may have a particularly valuable application in large-scale research in hydrology, for example over entire watersheds.

Plant nutrition and metabolism. In plant nutrition the basic mechanisms involved are the uptake of nutrient elements, their transport through cell membranes, and their subsequent translocation or movement throughout the plant. Such mechanisms are of course basic also in the case of animals.

Investigation of these fundamental mechanisms through the use of a considerable variety of radioactive elements is under way in many countries. Fuller knowledge of the phenomena involved is essential to the understanding of plant nutrition and growth, and discoveries that were hitherto impossible in this field are now being made. Amongst other practical aspects the mechanism of transport plays an important part in the utilization of growth-affecting or growth-regulating factors—the so-called plant hormones which are used to regulate development in crops, particularly in horticulture—and in the utilization of such compounds as the previously mentioned 2-4-D which are used as weedkillers, and the systemic insecticides which are administered to the pest by way of the host plant. An interesting example of the place of such translocation studies in relation to practical problems is the work on mistletoe in Australia, where this parasite is a serious menace of eucalyptus. In work directed towards its control, the isotopes of cobalt, iron and zinc are being used to obtain information on the efficiency of movement of toxic compounds from the host tree to the parasite.

Many of the plant hormones and weedkillers are used as leaf applications, and essential nutrients may also be applied to aerial parts of the plant as well as by way of the soil. Thus under certain conditions, especially with trees, temporary deficiencies of such vital elements as iron and zinc may occur, and these can often most readily be corrected by spray applications either in the dormant stage or when in leaf. Radioisotopes have been particularly helpful in demonstrating that some plants can absorb such nutrients efficiently through the foliage and that nutrients so absorbed are rapidly translocated throughout the plant. This principle is already being applied rather widely in practice, urea for instance being used fairly extensively as a leaf spray by fruit and vegetable growers in the United States of America. Additional information on the absorption and translocation of such substances is needed and through the use of urea labeled with carbon-14 it has already been found that crops differ markedly in their ability to utilize this compound as a source of nitrogen, cucumbers using it more than four times as fast, for instance, as do cherries and potatoes. In the case of strawberries, calcium is readily absorbed, but it has been found that it is not translocated into daughter plants and hence foliar feeding as a major source of calcium is not adequate in this plant.

In Puerto Rico studies of the formation of *Hevea* rubber are being made in tissue cultures, using possible chemical precursors of rubber tagged with carbon-14. Such investigations should lead to increased knowledge of the basic reactions and mechanisms involved in the secretion of gums and resins and will contribute in the long run to more efficient production of these economically important materials.

Radioisotopes offer a means of determining the rate of movement of water in plants and rather direct evidence of the structural pathways involved. Canadian forests are suffering from a die-back in birch, and radioactive phos-

phorus and rubidium have been used in the current investigation of the disease. These isotopes have shown that the normal narrow-band upward-spiral path of solution movement is broken in the affected tree and replaced near the dying region by a confused irregular pattern. Although no answer to the die-back problem is as yet forthcoming, it may be anticipated that the new techniques will play their part in the ultimate solution.

Well in the forefront amongst the contributions of radioisotopes to the advancement of fundamental knowledge of plant nutrition and metabolism has been the remarkable progress made through their use in the elucidation of the highly complex mechanism of photosynthesis, the process by which green plants use the sun's energy in the formation, from air and water, of compounds essential to life. Using radioactive carbon, the early principal pathways of this element have been established, and subsidiary pathways and the specific biochemical reactions involved in the synthesis of carbohydrates are being investigated.

The efficiency of energy conversion by photosynthesis is low, probably not more than 1% of the total available energy in the sunlight falling on a green leaf is effectively used. This low value arises at least in part from the fact that the process is limited somehow by the plant itself. Investigations are now under way with the aim of identifying the compound or compounds that limit the photochemical reaction. Inefficient though this process is, so far in the earth's history it has been the primary source of all food used by men and animals to sustain life, and the source of all our fuels including wood and the fossil fuels, coal and oil—those to which we now refer as conventional fuels in contradistinction to the nuclear fuels of the atomic age.

The remarkable advances that are being made in the understanding of photosynthesis may well lead to important methods of increasing the efficiency of this conversion of energy from the sun into chemical compounds. How much this might contribute to the enlarging of the world's food supply is at this stage a matter of speculation, but the work so far seems to hold much promise.

Another field of investigation of major importance concerns the part played by enzymes in life processes. More detailed knowledge about them is necessary if we are to have a true understanding of the metabolism and the synthesis of organic products. In this field earlier British work on cell metabolism is being paralleled by Canadian studies on the role of enzymes in the synthesis of sugars and amino acids in the living organism, while in the United States of America fundamental investigations are under way in the basic mechanisms and the factors influencing reaction rates and the dynamic equilibria characteristic of living cells.

Animal husbandry. Tracer studies are also giving much impetus to investigations on basic problems involved in animal production. As in the case of plants, understanding of enzyme action and other metabolic processes is of prime importance in animal nutrition. Some of the more fundamental investi-

gations concern the amino acids, which are combined in complex ways to make the proteins of the body. Among the amino acids essential in the animal diet are two that contain sulfur—methionine and cystine. It is known that cystine can partly replace methionine in animal metabolism. Cows, sheep, goats and other ruminants have the power of synthesizing these amino acids from inorganic sulfur through the action of microorganisms in the rumen, or first stomach. It had been thought that non-ruminants, which do not have multiple stomachs, could not carry out this process within their own bodies. But recent work with inorganic radioactive sulfate in the diet of poultry has shown, through the recovery of radioactive cystine, that non-ruminants can also synthesize at least part of the cystine they require, which in turn can partly replace methionine; and hence that inorganic sulfate should be considered an important mineral nutrient for poultry and for swine as well as for cattle and sheep.

Studies on the biochemistry of lactation provide another example of the effective use of tracer techniques in metabolic studies. In such work in the United Kingdom radioactive carbon and tritium, an isotope of hydrogen, have been used to label dietary components. Isolation of the milk constituents and determination of radioactivity indicates directly which milk components are derived from the labeled source and permits some well-founded speculation as to the metabolic route involved. In a typical experiment, sodium acetate labeled with radiocarbon was administered intravenously to a lactating goat. Analysis of the fatty acids in the milk clearly indicated that the synthesis of acids from the acetate took place in the udder itself, not earlier. Such studies, evaluating dietary components and elucidating the steps by which they pass into the sugars, fats (lipids), proteins, and other milk constituents, should lead to more efficient feeding and management for production.

Radioisotopes are especially effective in studying the efficiency of food utilization because it is possible with this technique to arrive at more accurate values than are obtainable by the usual methods employed in food balance studies, which permit only the determination of the total intake and loss of nutrients from the body. In materials found in the waste it has not hitherto been possible to differentiate those that passed through the intestinal tract without being absorbed from those absorbed and subsequently excreted. The use of tagged nutrients permits ready identification of the source of the excreted materials and in such investigations in animals it has been possible, for instance, to distinguish endogenous (body) and exogenous (feed) calcium and phosphorus.

As an example, the value of alfalfa as a source of phosphorus for lambs had long been considered, on the basis of the usual evaluation procedures, to be of the order of 20%; that is, only a fifth of the phosphorus in the alfalfa was utilized by the body. The tracer technique has shown that the phosphorus from alfalfa is actually far more effectively absorbed, about 90% being utilized.

The low value previously estimated was due to the fact that phosphorus was being rapidly involved in the body chemistry, and the large amount excreted was not phosphorus from the feed but phosphorus that had been absorbed earlier, used, and returned to the intestinal tract. Studies of this nature on food utilization have been extended to the egg, the fetus, and the milk, permitting evaluation of the relative contribution of the diet to each.

All of this newer knowledge contributed by radioisotopes work on the metabolism and nutrition of animals is of major concern for the world food problem, since with rising standards of living there is a demand for a higher proportion of animal proteins in the diet.

Just as in the case of crop production, advances in the control of animal pests and diseases and the development of improved breeds also constitute important methods of increasing animal production. In the case of animals, however, experimentation is usually more costly and time-consuming than with plants, with the result that (with some important exceptions) the utilization of radioisotopes and radiation has not progressed so rapidly. Thus while irradiation for inducing mutations in plants is being quite widely used for crop improvement, this technique has not as yet been employed to the same extent with livestock nor has it yielded comparable results. Irradiation has also been shown to induce mutations in fungi causing crop diseases, and these mutants are being used in experiments to develop greater resistance to those diseases. It may be expected that this kind of work with animal disease-causing organisms will have comparable important practical applications. Thus variants of reduced virulence developed by radiation may prove to be of value for use as vaccines in the production of immunity to commonly occurring more virulent forms of the pathogen, and irradiation may also be of help in developing polyvalent vaccines. These are possibilities which, though so far untested, may have great significance, since vaccines constitute the most effective way of combatting the many widespread animal diseases which cause losses of millions of animals throughout the world.

A somewhat different use of radiation has been made within a limited area in the case of at least one insect pest of livestock, the screwworm fly (*Callitroga americana* C. and P.), which is responsible for damage to the cattle industry in the United States of America to the extent of some twenty million dollars annually in killed or crippled animals and damaged hides. An ingenious method of control has been successfully demonstrated by the United States Department of Agriculture in cooperation with the Dutch authorities on the island of Curaçao in the West Indies. Large numbers of male flies were bred in the laboratory, sterilized by radiation from radioactive cobalt, and released in numbers far in excess of the normal population of males in the area so that females were much more likely to encounter a sterilized male than a fertile one. The female fly mates only once in her lifetime and hence there was no possibility that she would subsequently produce fertile eggs. This unique

undertaking was carried out after a close study of the life cycle of the insect, the determination of the susceptible developmental stage and dosage requirements, and careful estimation of the screwworm population of the area. The possibility of eradicating other insects by radiation undoubtedly merits further attention following such fruitful results with the screwworm fly.

Applications of Radioisotopes in Fisheries

The world's fisheries at present contribute over 26 million tons of high-quality food. Although this represents but a small proportion of the animal protein consumed by man, fish is an important element of the diet of many peoples, especially in certain countries in the tropics where proteins of animal origin may otherwise be almost absent from the diet. Up to the present, however, the potentialities of the ocean and inland waters as sources of food have been utilized to only a relatively limited extent; but with the application of modern scientific and technological advances revolutionary developments in man's exploitation of the world's aquatic resources may be anticipated.

As in agriculture and forestry, radioactive isotopes have many uses in fisheries research and their employment will accelerate the conclusion of certain investigations which are essential for the evaluation of fishery resources and the understanding of those resources that will permit efficient exploitation. Probably the most important application has been the use of carbon-14 in estimating the productivity of ocean waters. Carbon-labeled sodium acetate has been added to water samples taken at various depths and the samples incubated under controlled conditions. The growth of the phytoplankton or plant life under these measured conditions gives an estimate of the basic productivity of the water from which the samples were taken. The use of this method is rapidly being extended and will contribute significantly to the achievement of a realistic estimate of the basic productivity throughout the seas. The importance of this contribution will be clear since the production from the plant life in the oceans determines the quantity of organic material in subsequent links of the food chains and more particularly in those links that furnish material of economic value to man.

Applications similar to this have been made in fresh-water studies. Radioactive phosphorus has been used in several investigations in fresh-water lakes to study the efficacy of mixing, or the distribution of the phosphorus throughout the water and to the flora and fauna. Recent experiments in Canada have indicated that the turnover of phosphorus in lake waters is much more rapid than had previously been estimated, and further that the rapid turnover under natural conditions appears to be caused primarily by bacteria. This clearly indicates the need for further work, since it had not hitherto been thought that planktonic bacteria play an active part in the phosphorus cycle. On the contrary, the primary organisms involved were considered to be algae,

which are highly important in the food cycle of fishes. What contribution, if any, the bacteria make to productivity in these waters is therefore unknown, and it is possible that their high consumption of phosphorus may adversely affect the growth of algae. The importance of radioisotopes in this connection is that they will accelerate the analysis of the ecological systems in inland waters and add precision to the available methods. It may be emphasized that this is especially important in inland waters, where the opportunities for human intervention to modify ecological systems are much greater than in marine systems.

Radioactive tags have also been used in fisheries work for tracing and measuring more massive movements of material. For example, they have been employed in studies of the movement and population density of fish, where they have some advantages over the usual marking methods. There is also the possibility that radioactive tags might be used for following the movements of oceanic currents and for measuring water transport in marine systems. Evidently radioisotopes can play at least as great a part in increasing the productivity of our fisheries resources as they can in agriculture and forestry.

Applications of Radioisotopes in Human Nutrition

Reference has already been made to the particular value of radioisotopes in analyzing the movements of specific nutrients in a dynamic biological system and the important part that such tracer studies can play in elucidating problems of animal nutrition and metabolism. Much of the knowledge concerning human nutrition and metabolism is gained from animal studies and therefore much of what has been discussed earlier with reference to animal nutrition applies equally in the field of human nutrition. Thus work in progress on the metabolism of amino acids and proteins in mammals is especially significant in connection with certain deficiency diseases such as kwashiorkor in man. Current studies also include work on the absorption and excretion of fat and cholesterol, which are considered important factors in atherosclerosis, a type of hardening of the arteries.

Use of the tracer technique with human beings is rather limited because of understandable reluctance to submit them to chronic internal exposure to radiation; but such studies are being made in the United Kingdom, the United States of America, and France on fat and cholesterol metabolism under normal and abnormal conditions. A limited amount of work has also been done with human beings in the field of amino acid and protein metabolism, using carbon-14 and radioisotopes of sulfur and iodine. In connection with mineral nutrition, work has been carried out in the United States of America on the metabolism of calcium in young male children.

An excellent example of international cooperation in the study of an important health problem was one involving the use of the tracer technique in an

investigation of iodine metabolism in areas of endemic goiter in Argentina, where with the help of radioactive iodine Argentinian and American doctors made a complete study of uptake and metabolism under conditions of minimum iodine supply. Although the work did not result in any startling new discoveries, it was possible to observe the patterns of iodine metabolism, the changes imposed by deficiency, and the adaptation of the body to deficiency. In addition this investigation contributed new knowledge of the dynamics of iodine transfer within the body.

It is evident that tracer studies can make valuable contributions to a better understanding of the physiology of human nutrition. This in turn will affect the pattern of utilization of available food supplies and help in the development of adequate balanced diets which are so important for the maintenance of health and efficiency.

Future Outlook

Research. It is obvious from the foregoing discussion of past and present work that radiations and radioisotopes will play an increasingly important part in research and development in agriculture and related fields. In fact, the vast field of potentialities of the peaceful uses of atomic energy has hardly been touched, and it may be said that the applications of radioisotopes and radiation to problems of concern to agriculture are limited only by the imagination and ingenuity of the investigators.

The adaptability of radioisotopes to such a wide range of research arises from the fact that they may be quantitatively determined in such minute amounts. As we have noted, this makes it possible to introduce an identifiable component into a complex system such as the soil, a plant, or an animal, and follow its path to determine its fate in the dynamic system. The techniques involved, however, require carefully trained personnel and a considerable investment in laboratory facilities and instrumentation. Because of these limitations it would be well, for the immediate future at least, to confine the use of this tool in general to those problems in which it is the only applicable method, or to cases in which the desired information may be obtained by the use of isotope techniques with a marked saving in time and effort.

The supply of the more important radioisotopes is now generally adequate for present needs and the rate of progress in research in the immediate future will be determined largely by the number of investigators with the necessary training and experimental facilities. Hence, it will be necessary to make arrangements as rapidly as possible for the training of investigators in the handling of radioactive materials and the research techniques involved. The governments of those countries with experience in atomic energy are already generously making their training facilities available to the nationals of other countries; and the Food and Agriculture Organization of the United Nations, like other international agencies, is prepared to assist in facilitating arrange-

ments on request and hopes from time to time to be able to award fellowships for training and research in the applications of radioisotopes to problems in agriculture and related fields. To make the best use of the available knowledge, skill, and facilities, it may be desirable to develop cooperative programs of research on the more important problems of general interest. Many of the fundamental investigations using radioactive isotopes can be pursued at any centers with adequate facilities irrespective of location, but studies of the applicability of the results in specific regions must often be undertaken locally, and here again it is likely that progress will be accelerated through cooperation between neighboring countries.

The encouragement of promising long-term investigations might well be a suitable function of the projected atomic energy agency in consultation with the appropriate Specialized Agencies of the United Nations, which have much experience in stimulating international cooperative investigations where such procedures can lead to more effective use of relatively restricted resources in trained manpower and facilities.

Power aspects. Little reference has so far been made to the potential benefits to agriculture and related industries that may be expected from the more abundant supplies of cheaper electric power that will eventually become available from atomic energy developments, other than to indicate in a broad way the general lowering of costs of production and distribution, and the improvement in the conditions of work and in domestic amenities for rural populations that would result. With the reservation that such benefits must undoubtedly await the widespread application of nuclear power in industry, mention may appropriately be made of some of the further though admittedly still speculative developments that might be possible in agriculture, forestry, and fisheries. Although at this stage any discussion of these possibilities may seem to be purely visionary, some reasonable speculation appears to be fully justifiable in view of the spectacular technological advances in the past few decades that have revolutionized the human way of life in less than the span of a generation. Already an atomic-powered submarine is in existence and in some quarters atomic-powered locomotives and aircraft are said to be only a few years away. Much, therefore, of what appears to be fantastic today may be a commonplace of tomorrow.

It has already been pointed out that while the reduction of losses due to diseases, pests, and spoilage, and the adoption of various improved techniques which lead to more efficient exploitation of areas already cultivated are the most immediately promising ways of increasing production, attention should also be given to the benefits that might arise through bringing new areas into cultivation, although this is a more difficult and expensive undertaking. Probably the greatest contribution in this direction would be through the provision of irrigation facilities, particularly in the desert and semi-arid areas of the world. Many areas suitable for such development exist in North and South

America, Africa, Central Asia, and North China, to name but a few. There are also areas where drainage and reclamation of marshlands and deltas, especially in the tropics, could render land fit for cultivation, though there are fewer opportunities for this type of action than in the case of irrigation. The availability of more abundant and cheaper power from atomic reactors might well make possible the development of such irrigation and drainage projects. In addition work is now under way on the partial desalting of water, and abundant and cheaper power would make it possible to do this on a scale adequate for irrigation. Such applications would be of particular significance to the underdeveloped countries, especially where conventional power sources are deficient.

As in the case of agriculture, in forestry more abundant and cheaper power would have far-reaching implications. It would affect not only the primary, often small, rural forest industries as well as the larger ones such as the manufacture of pulp and paper, but also forest policy and management in general. For instance at the present time about one half of the world's harvest of wood is used for fuel, which forms a particularly important source of energy in rural areas. Past experience has shown that where a more convenient, and sometimes more efficient, source of power is available, the use of wood as fuel drops very rapidly. This may be of advantage or disadvantage to good forest management, according to the circumstances. In areas where wood is scarce and the forests badly abused by destructive harvesting to meet the needs of the population, as in some Mediterranean and Asian countries, the replacement of wood by an alternative source of power would greatly facilitate the much-needed reconstruction of an adequate forest cover. On the other hand in some regions the use of wood as fuel is often an important factor in good silviculture, offering the sole or one of the few markets for small and rough assortments that would otherwise be unmarketable. This shows the complexity of the problems involved and, particularly in view of the length of time needed to plan and execute changes in forest management practices and policies, explains the unusually keen interest of forestry in the long-time changes in power sources and costs that may be affected by atomic energy developments.

The availability of cheaper power would also make possible the more efficient exploitation of large forest areas and would have a particularly marked effect on the practicability of establishing economically sound and integrated wood industries in the remote and less developed parts of the world. Looking even further afield, it might play a most important part in opening up some of the world's last untapped forestry resources in the tropical areas, particularly in South America and Africa.

Similarly atomic power could be of considerable significance to the fishing industry, where the development of nuclear power units of a size suitable for installation in ships would be of particular interest for possible use in mother

and factory vessels of fishing and whaling fleets operating over long periods at great distances from their bases, especially in the antarctic, since they might in various ways lead to substantial reductions in operating costs.

This discussion of the possible implications of cheaper and more abundant power for agriculture, forestry and fisheries is by no means intended to be exhaustive but rather to give in broad outline an indication of what atomic energy developments could mean to these industries.

Agriculture is perhaps the most conservative of our arts; but when modern methods of farming and the multitude of highly technical services provided by an up-to-date department of agriculture are compared with primitive nomadic and pastoral systems of food production, it is obvious that the farmer is ever ready to adopt improved methods which increase the efficiency of his usage of land, water, capital and labor. It is therefore reassuring to know that this newest of our scientific advances, atomic energy, can contribute in so many ways to man's oldest industry and thus open up the way to improved methods of feeding, clothing, and housing the world's ever-growing population.