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ATOMIC ENERGY AND THE AMERICAN FARMER

An address by David E. Lilienthal, Chairman,
United States Atomic Energy Commission,
before the Annual Meeting of the American
Farm Bureau Federation, Chicago, Illinois,
Tuesday, December 16, 1947, 2:30 p.m.

The theme of what I have to say to this gathering of farmers from all over the country I can summarize in this way:

First: No one in this country has a greater stake in the vigorous development of atomic energy, and the consequent increase in knowledge of the fundamental laws of Nature, than you who day after day work most closely with Nature -- the farmers of America.

Second: Since so much is at stake -- for you and your children and for your farm -- I am here to urge you to keep yourselves informed of what atomic energy discoveries and their peaceful uses can hold for you as farm operators and as responsible citizens, and to use your farm organizations, your land grant colleges and extension services, your federal and state agricultural agencies and your schools to this end.

At the outset let me warn you against the Myth of the Atom Bomb. That Myth (and it is widely believed) is this:

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That atomic energy is useful only in a bomb, a weapon -- and nothing else; that it is only in a military weapon that atomic energy has any real importance; that talk about peaceful uses is nonsense.

Nothing could be farther from the truth.

Atomic science -- or more exactly nuclear science, that is, the science of the nucleus or heart of the atom -- atomic science is not confined to weapons, but opens a new world of knowledge. This new realm of knowledge deals with the forces contained within every particle on the earth and in the sea and in the very air we breathe. These atomic forces are within our bodies, within every living thing on your farm, within every object you touch or eat or wear. Atomic forces are fundamental, as are electrical forces, and the forces of gravity and of magnetism. We are not dealing here merely with a new explosive, with "just another bomb", however powerful. You and I are witnesses, here in our time, of the unfolding of new knowledge that goes to the very heart of all things physical.

The first large-scale demonstration of this energy was the detonation of a bomb, a weapon that in a single blast destroyed an entire Japanese city. The dramatic way in which word of the release of atomic energy first reached us, with this news of the first atom bomb, naturally enough created the impression that this was only a military weapon. Quite overshadowed

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was its importance as the opening of a door to a whole new world, the land of the nucleus. But let me warn you that if this Myth that atomic energy is simply a military weapon becomes a fixed thing in people's minds, if we accept the error that it can never be anything else, then certain most unhappy consequences will follow. For we will become wholly preoccupied with only its destructive uses, we will wear blinders that shut out its full importance. And we will therefore never make it anything but a weapon.

An even more baleful consequence will ensue if we persist in this Myth. We will drift into the belief -- some people already have such a belief -- that we Americans are safe in the world, safe and secure, because we have this devastating weapon -- this and nothing more. We will then tend to relax, when we need to be eternally vigilant, constantly alert. We will come to believe that for our nation to be secure in a troubled world all we need is this powerful weapon.

The Myth will cause us to fall into an even deeper pit of error. We will grow forgetful of the true sources of America's strength. We will be misled into believing that America is strong because of military force alone, when in truth the foundation of our strength and amazing vitality is not in material things but rather in the spirit of this nation, in the faiths we cherish.

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We are a people with a faith in each other -- and when we lose that faith we are weak, however heavily armed. We are a people with a faith in reason, and the unending pursuit of new knowledge; and when we lose that faith we are insecure, however heavily armed. We are a people with a faith in God, with a deep sense of stewardship to our Creator, the Father of us all; and when that is no longer strong within us we are weak and we are lost, however heavily armed with weapons -- even with atomic weapons -- we may be.

Atomic energy is far more than weapons. But let no man underestimate its destructive power. However fantastic atomic weapons may seem, they are real, as those of us who live with them well know, they are very real indeed.

Atomic energy is a military force of vast power. Its further development is, by express provision of law, a paramount obligation of your United States Atomic Energy Commission. In the laboratories and plants of the Commission this is a high duty that we seek to discharge with vigor and determination. One evidence of the importance we give to weapons is supplied by the Commission's recent announcement that we have presently under construction proving grounds in the Marshall Islands of the Pacific (7000 miles from our place of meeting today) for "routine experiments and tests of atomic weapons." The design, development and production of atomic weapons at the Commission's laboratory at Los Alamos on top of a mesa in the mountains of

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New Mexico, constitutes a scientific and engineering undertaking calling for the highest order of skills. No effort is being spared to keep this part of our responsibility to you and to all Americans on a high level of superior competence and vigilance. In this we have the cooperation of universities, industries and the National Military Establishment.

This country for two years -- since November 15, 1945 -- has made and continues to make efforts to place the destructive aspects of atomic energy under effective fool-proof workable international controls. For we are and always have been a peace-loving nation. But until such controls are effective throughout the world we must act on a realization that here are weapons that have shaken previous military and international concepts as has no event in centuries, if ever. This fact is just as important to you and your neighbors on your farm in Iowa or Alabama or up-state New York as it is to those who sit at the council tables of Washington or London or Paris or Moscow.

My purpose in seeking to dispel the notion that atomic science and atomic weapons are synonymous is not to deprecate the position of this force as a weapon. It is rather to warn that this mischievous Myth --(that the two are one and the same) is a major fallacy, a fallacy that will make it more difficult to eliminate atomic energy as a weapon of war, a fallacy that may keep us from an understanding of this great force and deprive you and yours of the peaceful fruits of this discovery.

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I have asserted that the farmer and the farm family have a very special stake in the wise and vigorous development of the science of the nucleus of the atom, for peaceful purposes.

Let us consider this proposition, to see why it is true.

We depend -- all of us -- upon you, the farmer, for our human energy. We depend upon you for the energies that produce great poems, that build churches and homes, the energies from which spring such noble ideas as our Constitution and Bill of Rights. That energy has been stored up in the plants of the field, and in the tissues of the animals that feed on your pastures; thence it comes to men.

Where does that energy come from; where do the plants get it? As we all know it comes from the sun. This is familiar to every school child. But what is not well known is that the sun is an atomic energy factory. In the sun forces within the atom's nucleus are released, and then transmitted to earth and caught and stored up in plants. I repeat, the sun is an atomic energy factory.

The farmer then, since time immemorial, has had much to do with atomic forces, for he is at the center of the majestic energy-transmitting function, the function of those who till the soil and raise the food of the world.

The farmer may be called the trustee and steward of that never-ending miracle by which the atomic energy of the sun becomes chemical energy and then human energy. Who then has a greater stake in seeing to it that more and more is known about this fundamental force of nature, and that its fruits are applied, than he who season following upon season, watches over this life-giving process?

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You and I have been vouchsafed the great privilege of living in that moment of time when we can dimly see ahead a whole new world of knowledge about Nature. But the door to this new understanding is but barely opened, just far enough for us to realize that beyond its portals lie vast new continents to explore and develop. Even the most talented men of science insist that they are profoundly ignorant about the nucleus, the dense core of the atom, and about the forces that hold that nucleus together with energies that are almost unbelievable.

Let me illustrate rather simply. Suppose this small black cylinder I hold in my hand were a lump of coal. If you were to burn this amount of coal the coal's energy thereby released in the form of heat would be negligible in amount (originally of course that energy came from the sun, was stored in plants, and the plants became coal). But this black cylinder is not coal. It is uranium, uranium of very great purity. This cylinder is made up of three million billion billion atoms of uranium, and each of these atoms has a nucleus. If the energy within the atoms of this cylinder were released not by burning, but by the splitting of the nucleus, by what is called "fission," the energy from the heat that would be created would be equivalent to that produced by the burning of 2500 tons of coal. That is about the amount of coal required to supply electricity for the city of Washington for a day. Atom for atom, the energy released by the burning of this amount of coal compared with that released by the splitting of the fissionable atoms in this cylinder of uranium bears the ratio of <u>one</u> for coal to <u>sixty million</u> for atom splitting.

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These forces within the nucleus are so fundamental that it is of the utmost importance, that they should be understood -- in their essentials -- by all of us. Here are two facts of the greatest importance to every living being the world over.

First: Mankind has probably learned more in the past 30 years about atomic forces than in all the preceding centuries.

Second: Within the next few years -- a decade perhaps -- IF THE PEOPLE OF THIS COUNTRY MAKE IT PLAIN THAT THEY ARE DETERMINED THAT THIS NATION SHALL LEAD THE WORLD IN PRESSING FORWARD IN THIS FIELD -- we should be in a position to unlock new knowledge about life and matter and growth and disease and suffering so that wholly new concepts of human life will follow in the wake of this new knowledge.

Much of the difference between a modern American farm and a backward poverty-stricken farm can be expressed in one word: Knowledge. There is nothing more inspiring than the way in which farmers, not themselves scientists, have recognized the importance of science and new knowledge. I don't mean applied science alone. I mean the support farmers give to fundamental research, the application or the practical use of which is usually neither known nor deemed relevant. In this country the farmer has seen that the scientist is his partner, his companion and friend.

Perhaps the greatest single opportunity for new fundamental knowledge about the nature of the physical world lies in atomic energy development. For within the nucleus are those deep forces, so terribly destructive if used for warfare, so beneficient if used to search out the cause and cure of disease, so almost magical in their ability to pierce

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the veil of life's secrets. If the decision whether these forces within the atom shall be put to destructive or to peaceful and life-giving purposes were left to the farmer, custodian of the sun's energy and the forces of growth, no one need puzzle a moment as to what his choice would be.

Let me cite one demonstration of the ways in which atomic forces can increase knowledge in fields close to the farmer and his high function of transmitting the blessings of the sun to man. It involves what is known as radio-activity, and a device known as a nuclear reactor, or pile, or what can simply be called an atomic furnace.

Down in the Tennessee Valley, at Oak Ridge, the Atomic Energy Commission owns a huge establishment as trustee for the American people, and included in these facilities is an atomic furnace, one of the first in the world. It looks like a windowless warehouse built of solid concrete, with a profusion of small black holes in one face. Inside these concrete walls, which are several feet thick, there are blocks of graphite -- like the "lead" in a pencil -- piled up in a particular way. Interlaced with the graphite blocks are pieces of uranium, quite a good deal of it. When this pile, or reactor, or atomic furnace is set off, substantially what happens is that infinitesimally small particles called neutrons, bombard the nucleus of an atom of the uranium in the pile. The

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neutron bullet splits that nucleus. The split nucleus thereupon releases other neutron bullets, and these repeat the process, hitting still other nuclei, and this spreads with more and more neutrons hitting more and more nuclei. This is called a chain reaction, one reaction creating others. Tremendous heat or energy results, and also an intense body of different kinds of rays, that is, radiation. I'm sure you have in a general way, a sense of how intense and powerful is the radiation from a mere speck of radium. Well, the radiation within this atomic furnace is the equivalent of tons of radium within those walls. (There are only about 25 ounces of usable radium in the whole country.)

Now within this nuclear furnace at Oak Ridge all kinds of interesting things happen to materials that are inserted into the pile through the holes in the concrete shield. This capsule for example that I have in my hand, can be filled with a bit of phosphorus, such as you put on your land, or lime, or potash. The filled capsules are thrust into the pile, in the middle of the violent radiation of the chain reaction. When that phosphorus (or it could be calcium or potassium or carbon) comes out of that bombardment of rays, the phosphorus is itself radio-active, that is, it emits powerful rays. They are invisible but they are potent, and will readily pass through solid matter. To transport a bit of phosphorus -- about 1/4 of an ounce -- that has been made radioactive, in this way it must

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be put into this large container -- it weighs 200 pounds -- made largely of lead, which can keep these radiations from coming through and causing injury.

Phosphorus that has been through this process -- or any other of scores of other substances -- are called "radioactive isotopes," or simply radio-phosphorus, or radio-carbon or radio-calcium and so forth. All this amounts to is that a radioactive isotope of phosphorus, say, is a species of phosphorus that is like any other phosphorus, in a chemical sense, but this bombardment has given it a different character in an atomic sense. The term "radioactive isotope" is one you should add to your vocabulary, just as you have added such terms as vitamin or hybrid or contouring, or the technical names of the soil types on your farm.

This atomic pile at Oak Ridge can make these radioactive substances in substantial quantities at low cost. And they have become of the greatest value in adding to knowledge about fundamental processes that go on before your eyes every day on your farm. You know that phosphorus in the soil, say, or calcium, or nitrogen is taken up by plants. No one knows completely what happens to that phosphorus or lime within the plant. But feeding a plant this radiophosphorus helps the researcher tremendously in discovering what goes on within the plant. As this radiophosphorus makes its way through the plant it sends out those rays, -- in effect sends out radio messages. The research worker, in following the course of these isotopes, uses a device that is sensitive to these radiations, a radio

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receiver for such rays. Such a receiving set is called a counter, or Geiger counter; and this is another phrase you might well add to your working vocabulary for you will hear about Geiger counters and see them many times in the years to come.

By special techniques the plant scientist can by means of these tagged atoms trace the course of the elements in soil solutions through plant tissues, and in a way never before possible chart the changes that occur in matter in the process of plant life and growth. In your behalf, the researcher can gain new and important knowledge of how plants convert the sun's energy into life energy on this planet. Who can say where this will lead in results beneficial to mankind?

The same process of tagged or "radio broadcasting" atoms works in animals, and in man. Radio-iodine, from Oak Ridge, for example has often been administered by trained physicians to patients with enlarged thyroid, familiarly known as goiter. That iodine can be clocked by a Geiger counter. The counter tells the doctor that the iodine makes its way almost at once to the thyroid or goiter. It happens that these radiations have been successful in certain cases in actually controlling goiter without surgery. But that is another story -- the use of radioactive isotopes for medical treatment, human therapy, and a wonderful story it promises to be, too.

It is not necessary for farmers to be nuclear scientists to understand the elementary principles of this new and challenging field. But it is important that you understand that you have a big stake in its rapid development. Oak Ridge, and Hanford in Washington

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State, the Argonne Laboratory near Chicago, Brookhaven Laboratory near New York City and other of the Commission's installations are uncovering new knowledge for mankind, as are independent laboratories using radioactive materials supplied by the Commission. And new knowledge is the very staff of life to the farmer.

Let no one try to tell the American farmer that the unfolding of new fundamental knowledge is of no importance to him. No one can tell you that Gregor Mendel methodically charting down the generations of sweet peas in his monastery garden 75 years ago was merely puttering. You know that what he learned made possible, for example, the hybrid corn which has been an untold blessing to man in these postwar years of world food shortage.

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No one can tell you that Armsby and Kerbes, patiently measuring the body heat of cattle at Penn State in their calorimeter 40 years ago, were just fooling around. You know that what they learned speeded up the modern science of animal nutrition which balances animal rations and gives more meat and milk and eggs per 100 pounds of feed than your grandfathers dreamed was possible.

No one can tell you that it was all foolishness when Dr. Theobald Smith, and my beloved co-worker in TVA Dr. Harcourt Morgan patiently worked out the role of the cattle tick in transmitting Texas fever. You know that what they and other scientists found about insect vectors made it possible to eliminate from the United States Texas fever of cattle--and also to set up the control over yellow fever in humans which made the construction of the Panama Canal possible.

All over the country agricultural research is being stimulated by the availability of these isotopes as great tools for the discovery of new knowledge. Studies aimed at control of the insects so costly to you will be aided by the radioisotope techniques. Plant disease can be observed in a wholly new way. The whole range of sciences affecting farm activities is the field now open.

I will not include it in this speech, but for your proceedings, I have attached to my remarks a summary of the many subjects of agricultural research stimulated by atomic isotopes as tools of great value; and the places in the country where it is going on. And day after tomorrow at Alabama Polytech, at Auburn, a conference of agricultural scientists and workers of many states will be held. Their three day session will be devoted to the use of radioactive isotopes in agricultural research. I predict that this will make history and be the pioneer and forerunner of many such meetings.

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Just one final word, now on the applications of atomic energy in the agricultural field. It will come in the main through research using the by-products -- the radioisotopes -- from the reactors operated for the people of the United States by the Commission. Do not, I urge you, take any stock at this stage in the vivid claims of great stimulation of growth and production by use of radioactive materials directly on the farm as fertilizers or in feeds. These are not tested and proved. Look to the men at your federal and state agricultural experiment stations for the facts on these matters. You can trust them. They are hard at work on these problems. As practical farming applications are formed they will let you know.

Here then, is one of the glorious promises of atomic science. It well may help to solve one of the most vexing problems of humanity -- how to keep food production in pace with the growth of the world's population. Today, according to the Food and Agriculture Organization of the United Nations, there are some 200 million more people on this planet than in 1938. Increase is continuing at the rate of 1 per cent, over 20 million a year.

This is one of the basic difficulties of the world in our time. To maintain around the globe diets adequate for health and working energy requires more food production each year. More food production can come only from adding to the area under cultivation or grazing use, or from increasing the output per acre, or from a combination of the two. The frontiers of farm science and land development must be pushed forward faster than ever before.

For greater production per unit of plow or pasture land we look to the plant scientists and they are moving rapidly aided by the use of radioisotopes, and by other means, to unlock new knowledge of plant growth which

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may magnify each year's production from the land of the earth and the toil of the farmers.

Trained as are no other group of men in the discipline of understanding and working with and through natural forces, endowed by the very nature of your calling with both persistence and patience, you American farmers are uniquely qualified to play a leading part in realizing the beneficial possibilities of this new force. Atomic energy is not something of interest only to scientists and military men. Atomic energy is your business, an important part of your business as citizens and as farmers.

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Dr. Allen Maggs - Rehfeldt Filter (Kredel & Stein)
Chas Wilson - G.E.
Pl. Hettlemans - U of Chicago
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