Conklin told a group of British scientists that civilization faced a crisis brought on by the rapid advancement of science and the stagnation of society. He warned that society would react to this situation by the violence of revolution if scientists and the world's leaders did not act to bring about social advancement by the calm, reasonable means of evolution.

When the war he prophesied appeared, Dr. Conklin turned his scientific knowledge to blasting the racist theories of Hitler. Intolerance, bigotry and prejudice are man-made, he said, appealing for the use of reason and the scientific spirit.

Concerning the world of tomorrow, Dr. Conklin wrote in his book, "Man, Real and Ideal," published during the war, that men should fight together for society in peacetime as they fight together to preserve their society in war.

"Why should not the service of society be the supreme duty in time of peace?" Dr. Conklin asked.

Theory is no good unless backed by fact, Dr. Conklin had learned from his work as a scientist. And so he warned the planners of the future:

"To be of any real effect, ideals must lead to action. Faith that will move mountains must be put to work with steam shovels."

Science News Letter, December 6, 1952

ENGINEERING

No Quick Solution Seen To Air Pollution Problem

➤ NO QUICK solution to annoying air-pollution problems was foreseen by Allen D. Brandt of the Bethlehem Steel Co. at a meeting of the American Society of Mechanical Engineers in New York.

"A certain amount of air pollution is the price that must be paid for those many conveniences which are the product of an industrial giant (the United States), and this condition requires a long time to correct," he said.

About $100,000,000 already is being poured annually into corrective measures to make the air less contaminated. Effects of the control measures are beginning to show. Despite increased employment and production, air pollution due to dust and sulfur dioxide is on the downgrade.

Industries are cutting air pollution by substituting machines that release few objectionable contaminants into the air for machines that expel many air-pollutants.

Other industries are converting their wastes into by-products. Horrible-smelling hydrogen sulfide can be converted into sulfur dioxide, and that can be made into sulfuric acid. Poisonous carbon monoxide can be burned into harmless carbon dioxide.

Still other industries are filtering the solid polluting products out of waste gases by machinery, or are building tall smokestacks that will disperse waste gases high into the atmosphere where they will not be objectionable.

Science News Letter, December 6, 1952

PHYSICS

Eventful Atomic Decade

Dec. 2, 1942, the date of first self-sustaining nuclear chain reaction, marked beginning of new era in history. In closing weeks of first decade, H-bomb presumably was exploded.

➤ TEN YEARS ago the first atomic "fire" was "kindled" in an old squash court at Stagg Field, University of Chicago. Dec. 2, 1942, was the date of the first self-sustaining nuclear chain reaction in the history of the world, an event ranking with man's first prehistoric lighting of a fire.

In this event-packed decade, the atomic bomb was developed in the most intensive and expensive research project of history.

Nearly 40 atomic bombs have been exploded, two of them to cause Japan's precipitate surrender.

Perhaps 30 nuclear reactors (atomic piles or "furnaces") of various varieties are operating, most of them in the United States, but some also in Canada, Britain, France, Norway and, presumably, Russia.

A stockpile of perhaps 500, perhaps 1,000, atomic bombs has been built up in the United States, with their plutonium more precious and more closely guarded than the gold of Fort Knox.

Soviet Russia is known to have exploded three atomic bombs. The balance of world power may rest with the size of the Soviet A-bomb stockpile.

The first "hydrogen" bomb presumably was exploded in the closing months of atomic energy's first decade. This "thermonuclear" H-bomb weapon is potentially perhaps a thousand times as powerful as the city-devastating A-bomb.

Two atomic engines for submarines, one for an aircraft carrier and two for airplanes are under development.

Study Photosynthesis Secret

Many new artificially radioactive elements have been created in nuclear reactors. Over a score of radioisotopes are in production and use in medicine and research. Cobalt 60 alone produces many times more gamma radiation for cancer treatment and other use than all the world's radium. If the secret of photosynthesis is discovered through use of radioisotopes, it will be worth more than the whole atomic energy development.

Industrial and commercial use of atomic power has been postponed by emphasis in the U. S. Atomic Energy Commission program upon weapon and military application. But there is the eventual possibility that out of a slowed down H-bomb reaction there will come power cheaper than from oil and coal, without use of scarce and expensive uranium.

So far for atomic energy the United States has spent $12,046,000,000 and the rate is now about $3,000,000,000 a year.

What happens in a nuclear reactor or an atomic bomb is that matter is converted into energy.

Einstein's special theory of relativity in 1905 showed the equivalence of mass (matter) and energy, the famous formula being E equals m (mass) times the square of c, which is the velocity of light. Long before that first reactor in 1942, scientists had thus figured out that the obtaining of energy from matter should be possible. They had proved it in various experiments.

The war-inspired supersecret atomic energy program got under way in great earnest in 1940. Its first great step was the successful operation of the historic first self-sustaining chain-reacting pile. Although the date was Dec. 2, 1942, the date line of the news about this event was Aug. 10, 1945, when the famous Smyth report (written by the same Dr. H. D. Smyth now an AEC commissioner) was released. Just a few days earlier the world had learned of the use of the first two atomic bombs in war.

First Pile Built Slowly

It was a dramatic time when that first reactor "went critical," that is, achieved a chain reaction that kept producing energy without outside aid. About six tons of uranium and uranium oxide were used, all that could be scraped together. There was purified graphite to moderate, or slow down, the reaction. The pile was built as a lattice, with the lumps of metal or oxide regularly spaced through the graphite. Movable strips of absorbing materials served as controls. Slowly the pile was built, with many instruments monitoring what happened. Earlier than anticipated, the reaction started. Controlled atom-fissioning or splitting was a reality.

Leaders of this 1942 experiment, Dr. Enrico Fermi, scientific refugee from Mussolini's Italy in charge of the experiment, Dr. A. H. Compton, now chancellor of Washington University, Dr. E. P. Wigner of Princeton University, and Dr. W. H. Zinn of Argonne National Laboratory, are all still associated in some way with the atomic energy program. They had a reunion meeting at the St. Louis meeting of the American Physical Society on Friday, Nov. 28.

The story of the release of atomic energy really begins with many discoveries, experiments and theories in nuclear physics in the 1930's. But the immediate start of the researches which resulted so spectacularly was in December, 1938, when two Germans, O. Hahn (awarded the Nobel

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prize in 1945) and F. Strassmann, proved that an isotope of barium was produced by neutron bombardment of uranium. The neutron is a fundamental particle of matter without electrical charge and with a mass about equal to that of the proton or nucleus of the hydrogen atom.

Two refugees from Germany, O. R. Frisch and Lise Meitner, suggested that the absorption of a neutron by a uranium nucleus sometimes caused that nucleus to split into approximately equal parts, with the conversion of some of the mass, by Einstein's 1905 formulation, into enormous quantities of energy, a process called fission.

Experimental confirmation of uranium fission in several laboratories followed. The suggested likelihood of emission of neutrons in the process was demonstrated. This indicated the possibility of a chain reaction releasing energy explosively, the neutrons produced splitting asunder other uranium atoms and producing more neutrons as well as energy.

The world's common sources of power, other than sunlight and water power, are chemical reactions, such as the combustion of oil and coal. They release energy as the result of rearrangements in the outer electronic structures of the atoms. This is the same kind of process that supplies energy to the living body.

Combustion is self-propagating. A match releases enough heat to ignite the neighboring fuel, which in turn releases more heat which ignites more fuel. Similarly, nuclear reactions may emit particles of the same sort that initiate them, and they may be sufficient in number to propagate the reaction in neighboring nuclei. This is called a chain reaction, and it is this sort of reaction accompanied by release of energy that occurs in the atomic bomb.

By June, 1940, it was known that slow neutrons caused fission in one isotope, uranium 235, but not in the other, uranium 238. It was known that the average number of neutrons emitted per fission was between one and three. A chain reaction had not been achieved but its possibility was clear.

It was found necessary to separate uranium 235 (less than ½% in any uranium sample) from the more abundant isotope 238 (more than 99%). An enormous isotope separation plant, using gaseous diffusion methods, was erected at Oak Ridge, Tenn.

Two new elements, heavier than uranium 92, both of which were "made to order," played an important part in the atomic bomb researches and manufacture. These were elements 93 and 94.

Element 94 is formed from uranium 238 by neutron capture. This element undergoes slow neutron fission like uranium 235.

Plutonium was obtained from uranium 238 by way of the intermediate shortlived element 93, named neptunium.

Manufacture of plutonium from uranium 238 allowed utilization of the inert uranium isotope for atomic power purposes. It allowed the advantage of sharp chemical separation of different elements instead of the tedious diffusion methods of isotope separation. Plutonium is probably the A-bomb material of today.

Thus transmutation, for centuries the alchemists' goal, became the method of choice of the group of scientists who worked out the chemistry of the atomic bomb.

The great nuclear reactors at Hanford, Wash., manufacture plutonium from uranium by this process.

Fusion for H-Bomb Reaction

The reaction of the hydrogen bomb is different from that of the fission bomb. The thermonuclear reaction involves the conversion of hydrogen into helium with a release of energy due to loss of mass. This is called fusion. This may be the kind of reaction that keeps the sun stoked.

The most likely kind of hydrogen for use in the H-bomb is the triple weight variety or isotope, tritium. It can be produced in a nuclear reactor such as those at Hanford by neutron bombardment of lithium metal. Deuterium, or double-weight or heavy hydrogen, possibly may fuse also.

The starting trigger of the H-bomb would be a plutonium bomb, the A-bomb, whose sun-like high heat brings about the fusion.

Nuclear reactors are thus prime instruments of the atomic age. The original one, called CP-1, has long since been removed from its athletic field cradle. The AEC admits it has 23 reactors, aside from the power ones being built for military purposes and the unrevealed ones at Hanford, where the official count is four, and at the new Savannah River H-bomb plant now building.

Out of the reactors come the stuff of bombs, exploding atoms that cure, and new knowledge about the way the universe is put together. If men can refrain from destroying the world with the atoms they have harnessed, Dec. 2, 1942, will be a great day in history.

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