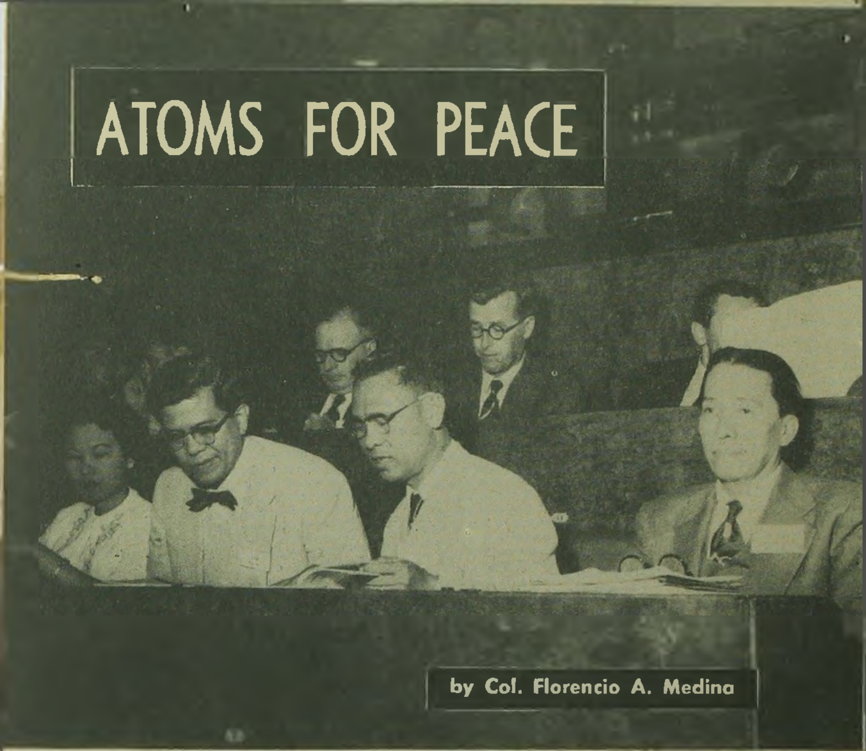
ATOMS FOR PEACE



by Col. Florencio A. Medina

THE first A Bomb that was dropped at 0815 hrs, August 6, 1945, in Hiroshima, Japan, exploded the atom and released an energy equivalent to that of 20,000 tons of TNT. It destroyed a whole city and its 70,000 people. But it cast light that made people everywhere see the potentialities of the mighty tiny atom for better living, better health, better comfort. A greater but more humane bomb was dropped by U.S. President Dwight D. Eisensower on December 8, 1953, on the U.N. when he announced his plan for sharing the peaceful uses of the atom. And on August 8, 1955, delegates from about 85 countries convened in Geneva, Switzerland, and shared in a free interchange of information concerning the peaceful, beneficial and humanitarian uses of the atom.

Who may be interested in knowing the atom? The industrialist, the metallurgist and the engineer may be interested to know that a small amount of radiocobalt, Co ^{60}, hardly the size of a grain of corn, can be put to work in the inspection of solid metallic materials for defects and that radioisotope thickness gauges can do the best job of keeping tab of the thickness of thin sheets of metallic or plastic materials continuously produced. The physicians and others interested in human health may be interested to know that radioisotopes are used in diagnosis, in therapy and in the treatment of certain diseases. The agriculturist, the biologist and even the farmer may as well know that radioactive atoms are used as tracers for more efficient utilization of fertilizers by plants and as irradiation sources for plant mutation. The housewife may want to know that radiation from a reactor or radioisotope can sterilize foods that she can keep for long periods without refrigeration. In fact, everyone should be interested in knowing the mighty atom.

This world in which we want to live in peace, as a matter of fact, the whole universe, is made up of basic fundamental particles called atoms. Substances that are made up of atoms of the same kind are called elements, such as oxygen, iron, carbon and others. There are now 101 known elements. When 2 or more elements combined together according to some chemical laws, they form compounds, like water, carbon dioxide, sugar, etc.

In order to understand how nu-

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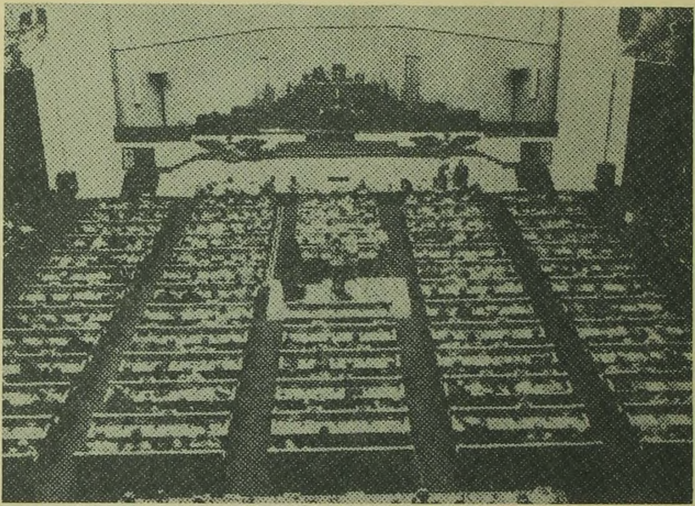
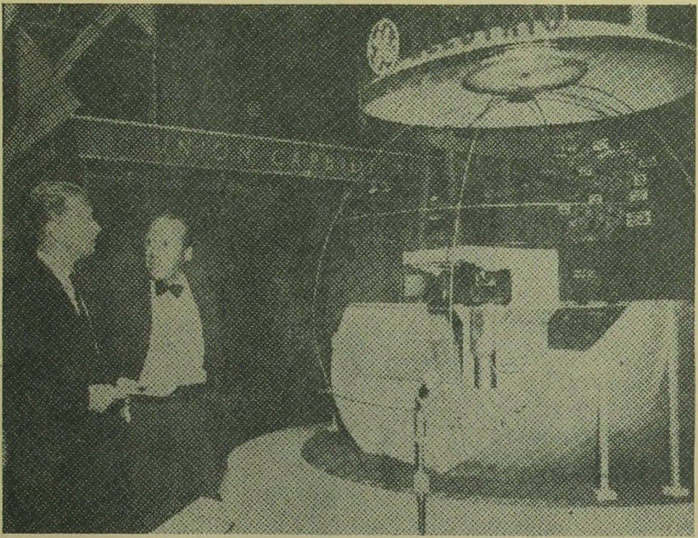


The International Conference on the Peaceful Uses of Atomic Energy held in the Palais des Nations in Geneva, Switzerland, on August 8, 1955, was attended by 1,200 atomic specialists, one of whom was Col. Florencio A. Medina, of the AFP.

clear energy is released we shall first talk about the structure of the atom. An atom consists of a dense, central part called the nucleus, surrounding which is a cloud of electrons. In the nucleus are protons, which are positively charged particles and neutrons which have no charge. The weight of the atom is concentrated in the nucleus. In the electron cloud surrounding this nucleus, there are as many negatively charged electrons as there are protons in the nucleus to make a neutral atom. An atom of any element may be designated by the symbol $_zX^A$, where X is the symbol of the element, z is the number of protons in the nucleus and A is the atomic mass. The lightest and simples element, Hydrogen, for example, is designated as $_1H^1$ because it has only 1 proton in the nucleus and its atomic mass is 1. Helium is designated $_2He^4$. It has 2 protons and 2 neutrons in the nucleus making an atomic mass of 4, and 2 electrons in the electron cloud which neutralize the 2 positive charges of the protons in the nucleus., Uranium 235, which is a dense, complicated atom, has 92 protons in the nucleus, 143 neutrons making an atomic mass of 235 and 92 electrons in the electron cloud. Hence, it is designated as $_{92}U^{235}$. Naturally occuring uranium consists



General Electric Company's dual cycle, boiling water reactor Model on display at Geneva's International Conference on the Peaceful Uses of Atomic Energy.

of 3 kinds of isotopes, namely, traces of U-234, 0.7% U-235, and about 99.3% U-238. These isotopes of uranium have the same chemical properties, that is, they behave chemically in the same way but they have different physical properties. Because they are all radioactive, that is, they are capable of undergoing radioactive decay, forming other elements and emitting smaller particles or protons of radiation called radioisotopes. Of these three (3) uranium isotopes, only $_{92}U^{235}$ in fissionable, meaning it can be split into 2 more or less equal parts with emission of tremendous energy. $_{92}U^{238}$ is not fissionable but it is a fertile material which can be converted into a fissionable element, Plutonium-239.

In a nuclear reactor, when a neutron hits a U-235 nucleus, it splits this nucleus into molybdenum and lanthanum, throws out 2 or 3 neutrons, and generates tremendous amount of heat. The heat is utilized to generate steam which may be made to turn turbines for the production of electricity. At the same time, another neutron may hit a U-238 nucleus, may be absorbed in this nucleus, and after emitting beta particles, it is finally converted into Plutonium-239. This new material, just like U-235, is fissionable. Another radioactive fertile material is thorium, which on neutron bombardment can be converted to a fissionable uranium isotope, U-233.

Now, let us see how this tremendous amount of heat is generated in the reactor. When a U-235 atom is split by a neutron, the total weight of U-235 plus the neutron is only 236.13297 amu, compared to the total weight of the products, molybdenum and lanthanum and 2 neutrons, which is 235.91794 amu. There is a mass defect of 0.215 amu. This, according to the Einstein mass-energy equation $E = mc^2$, is converted to 200.165 million electron volts (mev). Considering that this energy is released from only 1 tiny atom of uranium and knowing that there are 6.02×10^{23} such atoms in 1 gram mol. of uranium, you can see the tremendous energy that can be released from this nuclear reaction. This is the same energy that is released in the atomic bomb. In a nuclear reactor, however, this reaction is controlled so as to prevent explosion and by means of a coolant the heat generated is utilized for peaceful purposes.

What is a nuclear reactor? It is an apparatus in which nuclear fission may be sustained in a self-supporting chain re-action. It usually consists of (1) fissionable material (fuel) such as uranium or plutonium, (2) moderating material such as water or graphite, (3) a reflector to conserve escaping neutrons, (4) coolant for heat removal, and (5) measuring and control elements. A nuclear power reactor produces heat energy thru fission, which generates the steam for conventional steam turbine. A research reactor is designed for research purposes and for the production of radioisotopes. The Philippines will in the near future receive from the U.S. a research reactor. This will mean an acquisition of a new research tool for the physicist, who studies crystal-latices and difraction phenomena, for the engineer who is

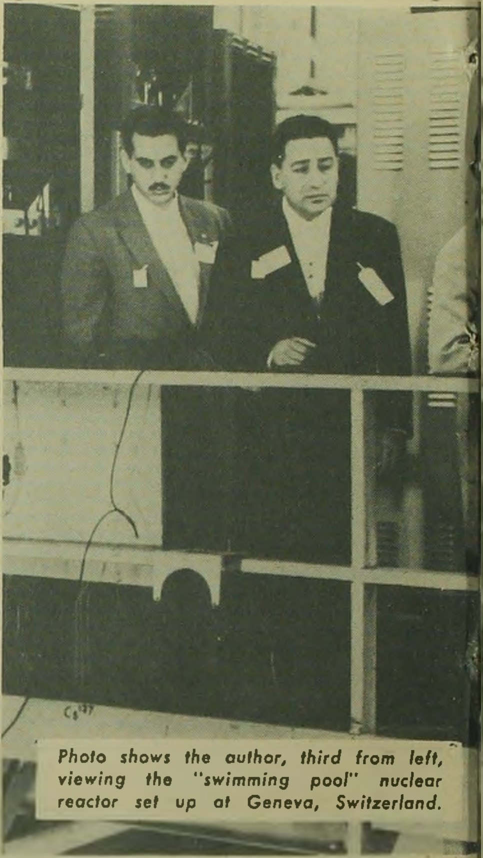
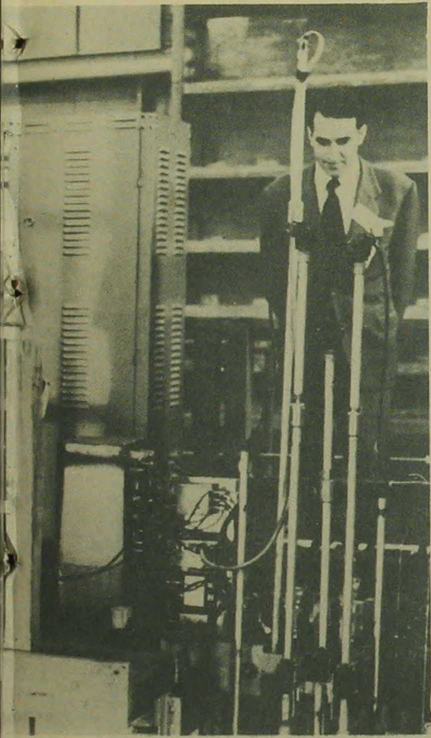


Photo shows the author, third from left, viewing the "swimming pool" nuclear reactor set up at Geneva, Switzerland.



interested in radiation damage to construction materials, for the chemist who works on effects of radiation to chemicals and their reactions, for the biologist who is interested in plant mutation. This research reactor may also produce radioisotopes for the agriculturist who may use them as tracers and for the physician who will utilize then for therapy and the treatment of diseases. The research reactor is particularly important in the production of radioisotopes with short lives. Importing short-lived radioisotopes from the U.S. can only mean paying for radioactivity that is lost during the time of shipment from the U.S. to the Philippines. Thus, when one buys 10 millicuries of a radioisotopes of 2 days half-life from the U.S. and considering that it takes 4 days before this radioisotopes is received in the Philippines, it will only be 2-1/2 millicuries upon arrival but the importer has to pay for 10 millicuries just the same.

Now, how about the nuclear power reactor? Reports from different countries that participated in the conference in Geneva show that at present the production cost of electricity from nuclear power plants is about 11 mils ($0.011) per kilowatt hour. This cost may be driven down to 7 mils by about 1965 and to about 4 mils in 1975. It is interesting to know that Canada produces electricity at present from hydro-electric power plants at 4.06 mils per kilowatt hour. According to a report of Mr. Filemon Rodriguez, former chairman, National Power Corporation and National Economic Council, our hydro-electric power plant in Caliraya, Laguna, produces electricity at 1 mil (₱0.00107) per kilowatt hour and those in Maria Cristina are estimated to be producing at 3 mils (₱0.003) per kilowatt hour. In the power development programs of England, Canada, France, India and others, hydro-electric power plants will be constructed until 1975, at which

Delegates, including Col. Florencio Medina of the Philippines, second from left, take a look at exhibits. The Philippines expects to receive a nuclear reactor soon.

time it is expected that only about 5%, in the case of England, will be supplied from nuclear power reactors.

So, while the production of electricity from nuclear power reactors is still costly and considering that there are plenty of water power sources in the Philippines, any attempt to put up nuclear power reactors must be supported by a thorough, complete and detailed economic study to justify such attempt. We must however have a research reactor and step up the training of personnel to meet this relatively new tool of science and industry.