COBALT-60 GAMMA-RAY IRRADIATOR

opens new doors to biological research at Davis

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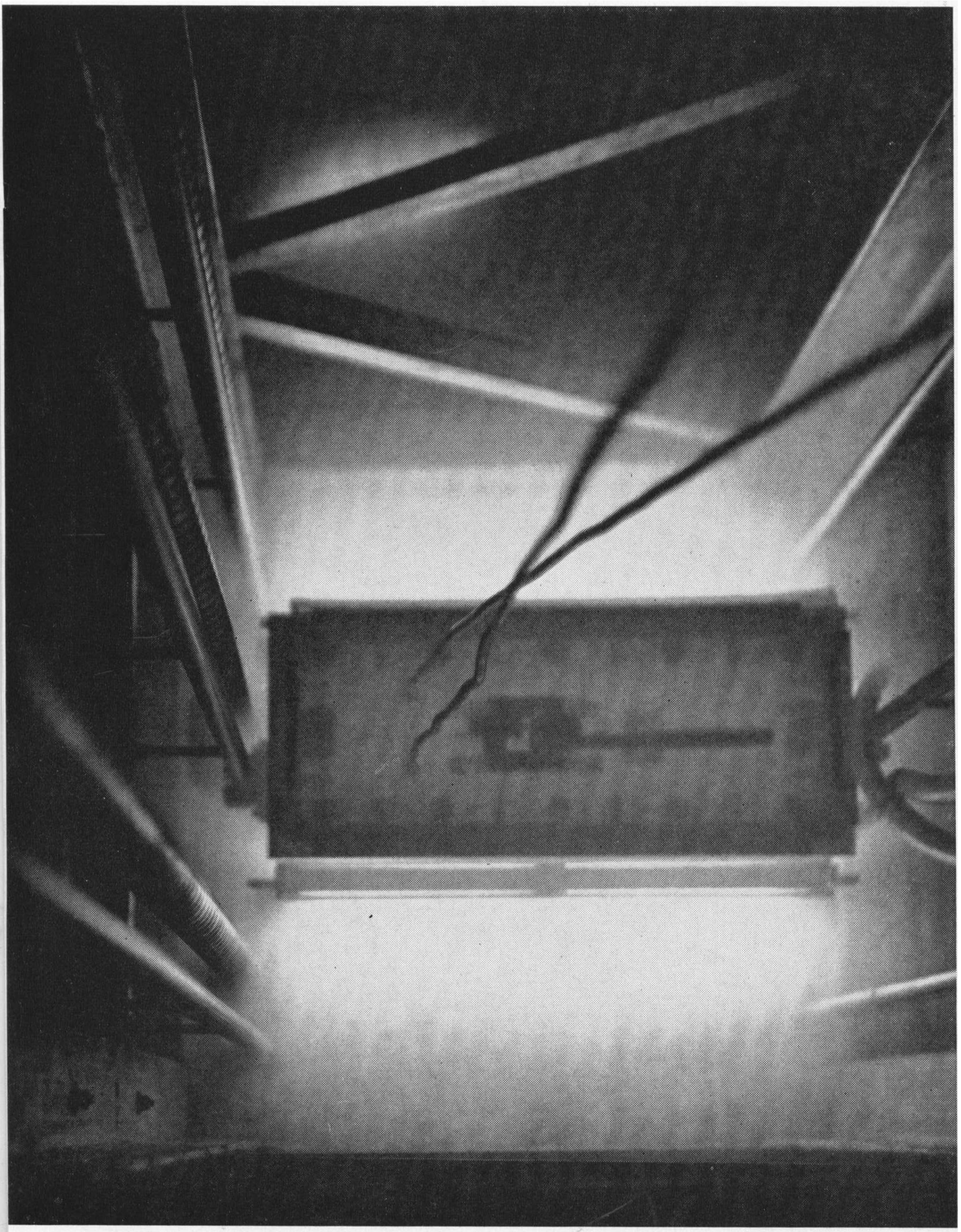
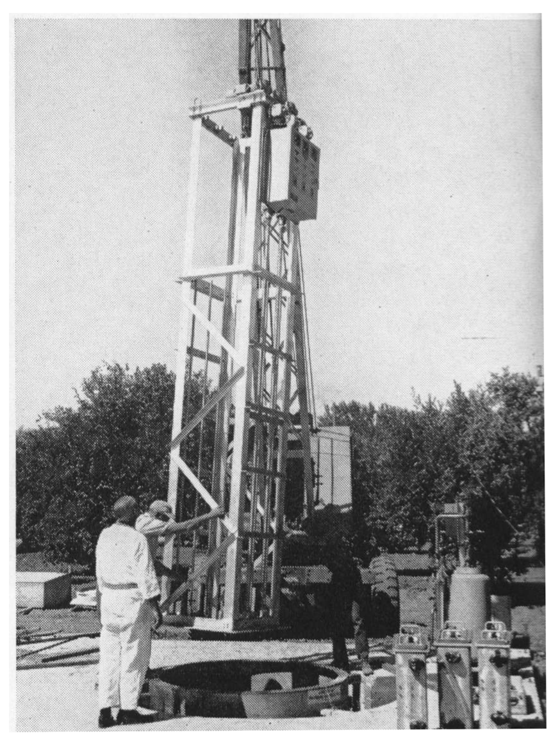


The center irradiation chamber is approaching the radiation field and is seen in the eerie blue light emitted by the radioactive Cobalt-60. Air lines can be seen emerging from the top of the chamber and refrigerant lines on the side.

The new Cobalt-60 gamma-ray irradiator, recently installed at the Davis campus, is designed specifically for biological research. The first application of the new facility involves a study of possibilities for extending the storage life of fruits by irradiation. The irradiator has also been used in studies of genetic mutations and breeding programs for agricultural products. Desirable features for research include a large, uniform radiation field, temperature control, atmospheric modification, and safety of operation. Ten feet of de-ionized water in this pool-type unit maintains a constant radiation barrier against the 32,500 curies of Cobalt-60. The unit is one of the largest of its type in existence.

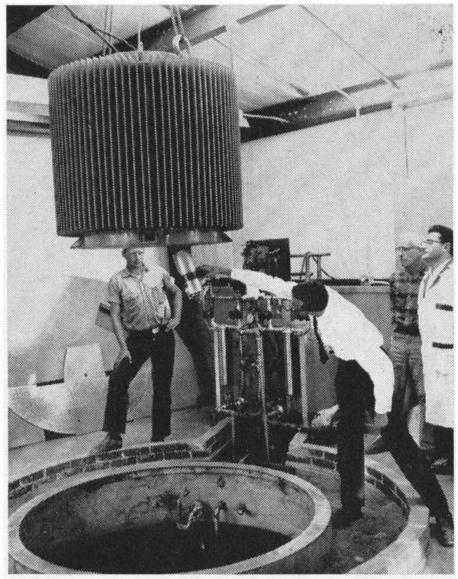
Below—installation of the elevator and guide system into the tank. Visible are the guides, worm screws, control panel and motors of the elevator system. The ion-exchange system and irradiation chambers are on the cement slab at the right.



As part of the nation's effort to promote the peaceful uses of atomic energy, a Cobalt-60 gamma irradiator has been installed on the Davis campus. The gamma source was designed at the Atomic Energy Commission's Brookhaven National Laboratory, New York, N. Y. Several unique features will make it particularly useful to many scientists and students interested in the biological effects of ionizing irradiation. Initially, the facility will form an integral part of a current AEC-sponsored research program to study the irradiation of fruits. However, future research plans will extend to other biological materials and to chemical and physical studies.

Maximum safety and simplicity of operation are inherent in the design of the unit. The irradiation housing consists of an underground stainless steel tank 6 feet in diameter and 11 feet deep. An 18-foot elevator and guide system, three watertight irradiation chambers and 32,500 curies of gamma-ray-emitting Cobalt-60 are mounted within the tank.

The radioactive cobalt is enclosed in 140 tubes, each consisting of an inner and outer envelope that is individually sealed and tested. The tubes are arranged in two $19 \times 23\frac{1}{2}$-inch plaques permanently positioned opposite each other in vertical, parallel planes at the bottom of the tank. In the irradiation position, the center chamber, containing the material to be treated, is lowered between the two plaques. The outer chambers may also be lowered on either side of each plaque for simultaneous irradiation.



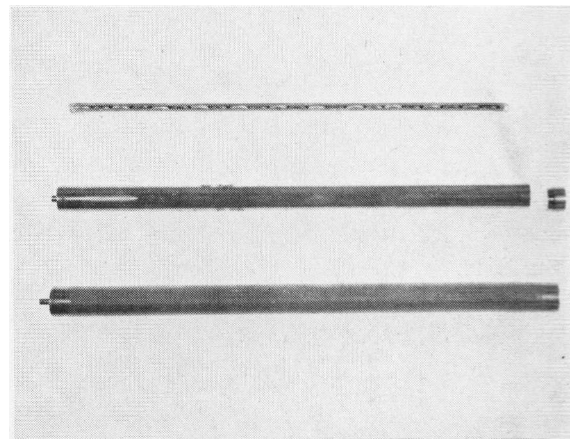
A seven-ton lead "pig" containing the Cobalt-60 is being lowered through the roof into the pool. Exposure readings are taken by the Radiation Safety Officer.

Lowering the chambers within the guiding mechanism is accomplished by three 18-foot stainless steel worm screws. These are electrically driven and may be actuated manually or set to automatically lower and then raise the chambers after a prescribed irradiation time. The tank is filled with de-ionized water, which provides adequate radiation shielding for the protection of personnel at all times.

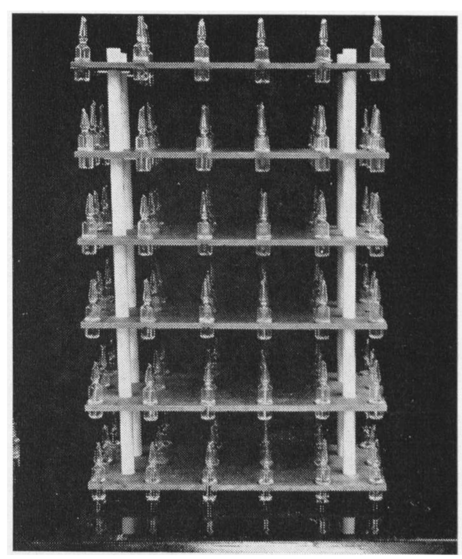
Safety features

As an added precaution, the steel tank is enclosed in a larger concrete well and the intervening space filled with sand. Among the safety and warning devices are two radiation monitors and a water level probe. These monitors actuate both audible and visual alarms should malfunctions arise. If the water level falls below a set level, a solenoid valve will open allowing the necessary water to flow into the tank until the proper level is reached.

One of the important design features for biological experimentation is the relatively large and uniform dose field facilitated by the penetrating nature of the gamma ray. The three irradiation chambers seen in the photographs measure $6 \times 14 \times 20$ inches each. The center chamber receives a uniform irradiation

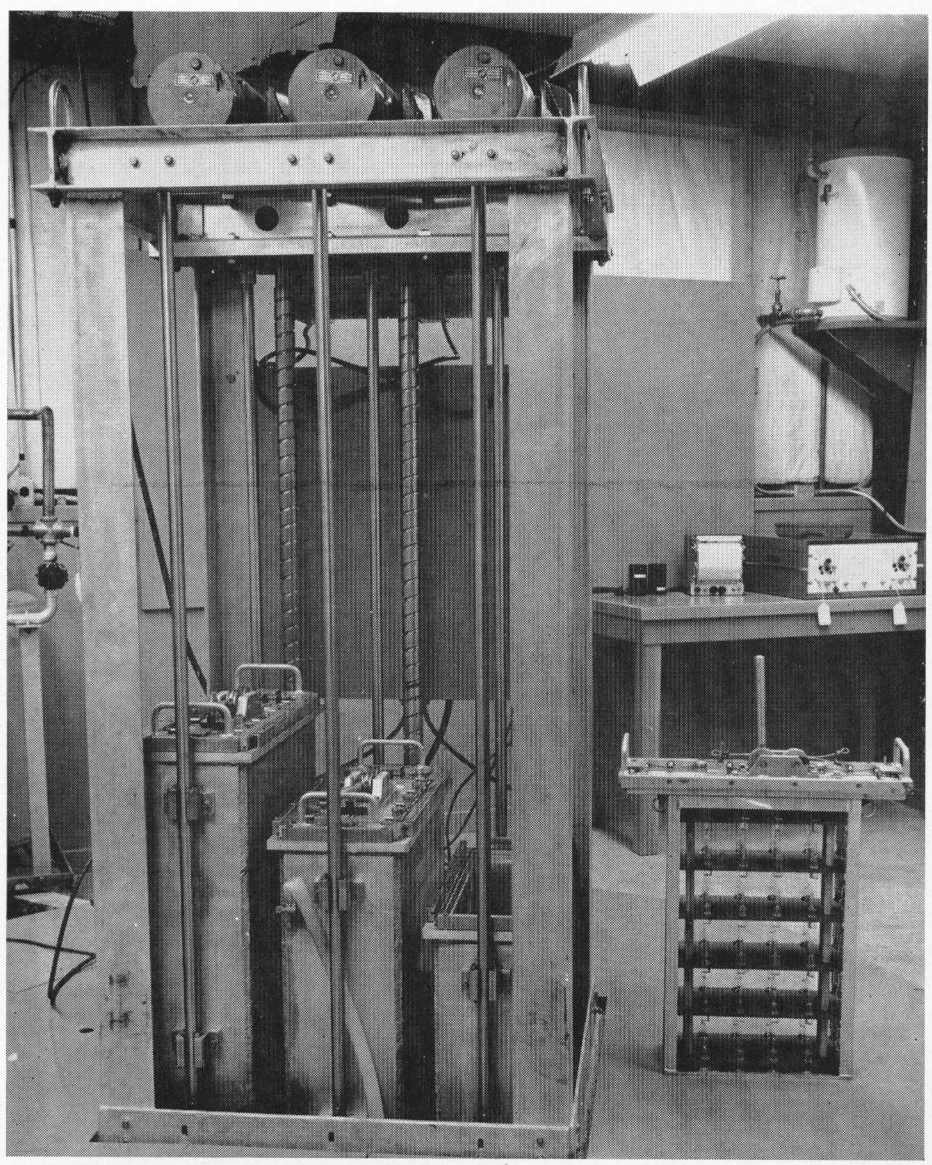


Two stainless steel tubes encase the wafers of Cobalt-60 which are represented by the model at top in photograph above.



Above—in order to determine the strength and uniformity of the irradiation field, vials containing a chemical dosimeter are arranged as shown above, and lowered in the irradiation chamber.

Left—the center chamber being lowered with air, refrigerant and thermocouple lines attached.



A view of the Mark II gamma irradiator showing all three irradiation chambers prior to being lowered into the radiation well. The top lid of the right chamber has been removed and is seen with the internal rack and dosimeter vials.

throughout most of its volume and the outer chambers can be assured of uniform dose distribution by raising them at half irradiation time and turning the contents 180 degrees. Such a large and uniform irradiation volume has been incorporated for the first time in this unit and two similar facilities at the Massachusetts Institute of Technology and at the University of Washington.

Another very important feature is the ability to introduce air or any other atmospheric mixture into the chambers during the irradiation period. This is accomplished by attaching lines of polyethylene tubing to the inlet and outlet ports on the lid of each chamber and pumping through the desired air mixture. In addition a coil of tubing around the inner perimeter of the center chamber acts as a heat exchanger. By circulating the appropriate cooling or heating liquids it is possible to irradiate at any temperature in a range from below freezing to about 150° F.

Planned experiments for the fruit research program include a survey of many varieties of fruit, which could benefit from an extended storage life. It is assumed that irradiation will not replace any of the normal refrigeration and storage needs in the marketing and distribution of fruit. However, it has been known for some time that irradiation may extend the storage life of several types of fruit, when it is used in conjunction with refrigeration and other post-harvest and storage manipulations.

Experiments in the past have often been limited and sometimes contradictory because of the difficulty in controlling temperature, total dose, dose distribution, atmospheric composition, and other conditions during irradiation. The new facility permits the control of all these variables and should prove invaluable to research in this field.

Along with its application for post-harvest treatment of fruits, the gamma facility has already been used in studies of genetic mutations and in breeding programs associated with agricultural products. This new tool is expected to lead to many new areas of radiation research for the benefit of California agriculture and science in general.

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WATERGRASS CONTROL IN RICE

Two YEARS of field experiments have shown that 3,4-dichloro propionanilide (DPA) can selectively control watergrass, *Echinochloa crusgalli* (L.) Beauv. in rice when used as a foliage spray. In 1960 yields of rice were increased by as much as 4,700 pounds per acre as a result of weed control from DPA applied at rates of 2, 4, and 8 pounds per acre. The only injuries observed were necrotic areas at the tips of rice leaves. In no case was subsequent growth of rice adversely affected by treatments.

Control of watergrass was poor when treatments were made one week after the initial irrigation of the field. Control improved for treatments made each succeeding week until the fourth week after initial irrigation. Treatments at five weeks were slightly less effective than at four weeks.

Watergrass is most susceptible to DPA in the two-to-four-leaf stages but it can be controlled later by using higher rates of herbicide. The over-all effectiveness is dependent on the size of the plants and the extent to which new plants emerge after treatment.—*Kenneth L. Viste, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Department of Agronomy, University of California, Davis.*