TABLE 1

CHANGES IN FREE AND COMBINED CARBOHYDRATE SOLUTIONS (pH 7.4) DURING EXPOSURE TO ULTRAVIOLET RADIATIONS

Change	Compounds showing change
1. Loss of reducing properties	Glucose, ribose
2. Loss of ability to give a Molisch test	" "
3. Loss of ability to give a *p*-bromoaniline acetate test	Ribose
4. Loss of furfural-yielding capacity	Ribose, adenylic acid, cytidylic acid, yeast nucleic acid
5. Loss of ability to give a Stumpf test	Sodium thymonucleate

solutions of sodium thymonucleate failed to react to the Stumpf test (*4*) for desoxypentosyl purines.

The foregoing data, summarized in Table 1, demonstrate that both free and nucleotide-bound carbohydrates are readily destroyed by ultraviolet light. These results supplement, therefore, previously known viscometric and ultraviolet spectrophotometric findings (*5–7*), indicating that the compounds undergo an extensive over-all photodecomposition.

Finally, a limited study was made of the protection of various compounds on free and on nucleotide-ribose. As gauged by furfural production (*3*), the pentose breakdown was appreciably inhibited in the presence of 1% solutions of thiourea, sodium thioglycolate, acetic acid, sodium acetate, or oxalic acid. The most effective inhibitor was composed of 1% thiourea dissolved in 1% acetic acid. Solutions of ribose, adenylic acid, or cytidylic acid in this medium showed essentially no decrease in furfural-yielding capacity, even after 4 hr exposure to ultraviolet raditions. In contrast, 1% trichloroacetic acid or perchloric acid offered essentially no protection.

No attempt was made in the present study to find optimum conditions, since results will vary quantitatively with differences in the dilutions and dosages, the composition and size and shape of containers used, the wavelength of radiation, etc.

Although there is to date no crucial proof that nucleotide destruction is involved in the damaging effects of ionizing radiations upon living protoplasm, the possibility exists that some such phenomena as described here are factors in the questions of radiation lethality and of the mechanisms of some agents in reducing radiation mortality.

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Plastics in Trace Element Research

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Water culture methods of growing plants were known as early as 1860, when J. Sachs (*1*) and W. Knop (*2*) independently grew plants in nutrient solutions containing the "essential" elements, N, S, P, K, Ca, Mg, and Fe. It was not until approximately two decades ago, however, that studies of culture solutions indicated the important role played by trace elements in the physiological functions of plants.

Trace element studies invariably pose a problem because of contamination. Purification methods have advanced to the point where contamination from the nutrient solution itself is secondary to that introduced from other sources, including the containers. In general, workers using nutrient solution methods advocate the use of Pyrex glass for containers in experiments other than with boron. However, expense and chance of breakage are limiting factors.

As plastics are relatively cheap and have several obvious advantages over glass, it was decided to test some of them for possible contamination caused by Cu, Mn, Zn, or Fe. Several small plastic refrigerator jars, $4'' \times 4'' \times 3''$, plastic cookie jars, $6'' \times 6'' \times 7''$, and a large plastic tote box reinforced with glass threads, $24'' \times 28'' \times 6''$, were cleaned thoroughly in a sulfuric-dichromate solution, after which they were rinsed first with water, then with 2% HCl, and finally with water, double-distilled through Pyrex. They were then filled with a known quantity of a slightly acid, Pyrex double-distilled water, covered, and set aside in the laboratory for 2 weeks. At the end of this period the water was transferred to clean Pyrex flasks and evaporated almost to dryness. After the samples were diluted to a known volume, an aliquot was taken and analyzed for Cu, Zn, Mn, and Fe. These analyses were run in triplicate. In no case was there any contamination from the containers. Tests were not made for boron or molybdenum, but the composition of the plastic should make the containers suitable for research on these elements also.

The small refrigerator jars were subsequently used for studies of the effect of copper on the susceptibility of the Scotia bean to tobacco mosaic virus. A small hole was made in the lid by means of a hot metal bore. The plants were germinated in Petri dishes and at an early stage were threaded through the hole in the lid so that the roots were immersed in the nutrient solution and the leaves extended above the dish. The stem was supported by cotton at the point where it passed through the lid. As the stem enlarged, the cotton was removed. The same technique was used with the cookie jars in copper-deficiency experiments. The tote box, however, does not have a lid and presents a different problem. Support of the plants was provided by stretching a plastic gauze over the top of the box. The plants were threaded through the gauze,

which is flexible enough to allow for growth of the stems. Plastic tubing may be used to set up a drainage system for the tote box. In order to simulate soil conditions and provide better support for the root system of the plant, plastic beads or debris may be used in the bottom of the box.

The expanding plastics industry has placed an infinite number of containers, dispensers, tubing, and analytical equipment on the market. These items can easily be adapted for trace element studies. Plastics, indeed, can provide an answer to the ever-present question of expense and practicality.

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Microradiography of Microfossils with X-Ray Diffraction Equipment[1]

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Several articles have appeared recently presenting different techniques of microradiography and showing their value in the study of thin sections, primarily of biological and medical material (*1, 2*). This method is valuable in the study of whole specimens as well as thin sections, as will be shown by the results with paleontological material (*3*).

Calcareous, siliceous, and pyritic microfossils of varying size and thickness were radiographed with x-ray diffraction equipment. The internal arrangement of foraminiferal chambers and of muscle-scar patterns of Ostracoda, and the presence or absence of pores in shells of both groups were detected where preservation was favorable—sometimes when no other method had been successful. Furthermore, no harm was done to the specimens.

The type of x-ray diffraction apparatus used is available in crystallographic laboratories and mineralogical departments of many institutions. This apparatus usually has 4 windows through which x-rays are transmitted into special cameras. The removal of one of these cameras makes it possible to utilize the x-rays for microradiography without any modification of the apparatus itself. The radiation is directed approximately horizontally in the equipment used (North American Philips), so that it is necessary to mount specimens and photographic plate vertically. A simple stand can be used, placing the glass photographic plate in a holder, with the specimen supported in front of it. Precautions must be taken to guard the operator from exposure to x-rays.

Diffraction apparatus has interchangeable tubes with targets of any one of several metals, permitting essentially monochromatic radiation of any one of several wavelengths between 0.6 and 2.3 A. The radiation in all cases is long wavelength, or soft, which is favorable for detecting the thin delicate structures that would not be seen if short or hard rays were used. No filter was used in this work.

[1] Publication authorized by the Director, U. S. Geological Survey.

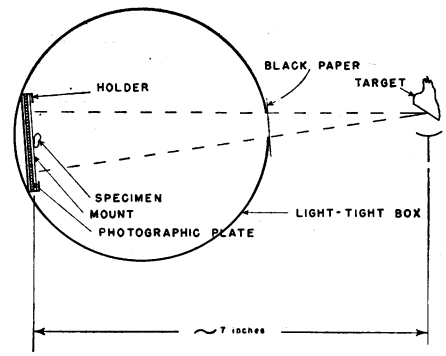

FIG. 1. Diagrammatic sketch of holder.

For microfossil specimens averaging about 0.5 mm or less in thickness, the factors, with a copper target tube, were 25–35 kv (rarely 45 kv), 15–20 ma, and 5–20 min. Time and voltage are the variables, the values depending on the size and chemical composition of the material. Distance from the target to the film is approximately 7 in., which gives a large enough beam of x-rays to cover the specimens.

To support the specimens and photographic plate, a diffraction camera was adapted by fitting a holder for the plate and specimen in the camera, opposite an opening transparent to x-rays (Fig. 1). Any light-tight box with such an opening may be used. The opening is placed directly against the x-ray window. This setup permits close contact between specimen and emulsion, thus lessening blurring (*4*). It is also easy to center the setup rapidly for each exposure.

The microfossils are mounted with gum tragacanth on cleared x-ray film, both of which are transparent to x-rays. The cleared film provides a firm support for the specimens, which can easily be placed in any position for microradiography. Eastman 548-O spectroscopic plates (an extremely fine-grained emulsion)

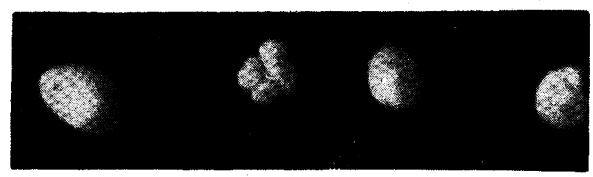

FIG. 2. Photograph of group of Foraminifera. Approx. × 36.

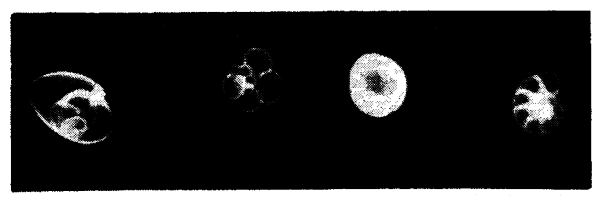

FIG. 3. Microradiograph of same Foraminifera, showing arrangement of chambers. Approx. × 36.