certainly not be greater than the difference between the stable isotopes of a given element. Finally, it may be pointed out that the use of radioactive isomers as tracers would be free even from the above question, since they differ neither in weight nor in charge. It is almost certain that the number of known isomers will grow, and they may find a unique application in certain tracer problems.

H. R. CRANE

University of Michigan,
Ann Arbor, Michigan,
November 27, 1939.

[1] A. Barnett, Phys. Rev. **56**, 963 (1939).
[2] L. V. Heilbrunn and Daniel Mazia, *Biological Effects of Radiation*, edited by B. J. Duggar (New York, 1936).

Vitrification of Water

The main reason for the general failure of attempts to obtain water in the vitreous (amorphous) state by a rapid cooling from the liquid state, seems to be the high rate of formation of crystallization nuclei and the high velocity of growth of the ice crystals. With the idea that a sufficiently rapid cooling would finally prevent the formation of ice, we tried various procedures which consisted essentially in immersing suddenly in liquid air preparations in which droplets of water were either sprayed with an atomizer on thin glass or mica sheets or deposited on glass plates by the condensation of steam. An examination of these droplets between crossed Nicols revealed a crystalline structure. The cooling velocity had evidently not been high enough.

We finally succeeded in obtaining amorphous solid water by flattening small quantities of liquid water between two metal plates, cooled in liquid air, one of which was thrown toward the other at a high speed. A cylindrical stream of water 1 mm in diameter was made to flow vertically from a pipette. A brass disk 12 mm in diameter and 2 mm thick, mounted on a rod perpendicular to the plane of the disk, and cooled in liquid air immediately before being used, was fastened about 2 mm behind the stream, the direction of the latter being parallel to the plane of the disk. Another brass disk of the same size, mounted on a rod 12 cm long, and cooled in liquid air, was thrown against the first disk by the propelling action of the spring of a toy pistol. The pistol had previously been fastened in a steady position and adjusted so that the disk that it was to throw was parallel to the other disk and about 13 mm away from it. The disk thrown by the pistol was, then, at a distance of 1 cm from the stream.

The water flattened between the two disks takes the shape of a film a few microns thick. Pieces of this film, which sometimes have an area of 10 mm^2, were transported on a cooled glass slide into a specially built desiccated chamber placed on the stage of a polarizing microscope. These pieces are dark between crossed Nicols and stay dark for about 30 seconds. Then, with the rise in temperature, one can observe a gradual reestablishment of light and, finally, when the temperature approaches the melting point of ice, the preparation is full of crystals large enough to be well observed under the microscope. Water has evidently undergone vitrification and devitrification.

This experiment, of course, does not allow one to conclude anything as to the possible formation of crystalline nuclei smaller than the wave-length of the light used to detect them.

B. J. LUYET

Department of Biology,
Saint Louis University,
Saint Louis, Missouri,
November 16, 1939.

Radioactive Isotopes in Biology

In a recent note[1] it has been suggested that the general body of biological work with artificially radioactive indicators, which is currently appearing in journals, is subject to the criticism that apparently no one has made any measurements of the effects of these radioactive isotopes on biological materials. As regards the general systemic effects of radioactive isotopes, Hamilton and Alles[2] have data to show that at the concentrations with which they worked, there was no effect on electrocardiographic tracings, respiratory rate, pulse, and blood pressure. Greenberg and Glazko[3] also found no difference between active and inactive salts when used on isolated hearts, *in vitro*. Work from this laboratory[4] has shown that in the case of the unicellular alga *Nitella*, high activities (1–50 millicuries/liter) of radioactive Na will produce a decrease in the rate of uptake of sodium by the cell. This rate of penetration is inversely proportional to the logarithm of the millicurie dose, and is almost certainly due to the radiation from the artificial isotope $_{11}Na^{24}$ and not due to some differential penetration of inactive Na rather than active Na. That this is so is shown by the fact that the above results could be quantitatively duplicated with x-rays as a radiant source. Radioactive $_{19}K^{42}$ could also be shown to produce the effect as stated above.

When doses of below 1 millicurie per liter of radioactive Na were used, there was no longer any change in the rate of penetration with dosage, and it was concluded that below this value there was no effect. In most of the published experiments so far done the dosage has been below this limit, although it is true that there are papers describing work in which undoubtedly the radiation was producing an effect. In the case of the experiments of Cohn and Cohn[5] who used radioactive Na, the writer is acquainted with the dosage used and it is certainly below the activity to produce any so far known biological effect. In regard to the criticism in the previous note[1] it appears there are several points on membrane structure and permeability in which more recent work has shown him to be in error. Limited space does not permit of their discussion. In concluding it seems desirable to emphasize that the radiations emitted from the various radioactive isotopes important in biology vary so markedly in their character that a different limit of biological effect will have to be made for each one.

LORIN J. MULLINS

Department of Zoology,
University of California,
Berkeley, California,
November 17, 1939.

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[3] A. J. Glazko and D. M. Greenberg, Am. J. Physiol. **125**, 2 (1939).
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[5] W. E. Cohn, and E. T. Cohn, Proc. Soc. Exp. Biol. Med. **41**, 445–49 (1939).