shifted to the violet than with the ether system (*i.e.*, iodine in methanol was orange-brown, addition of fractional amounts of hydrogen fluoride gave orange-red solutions, and this color persisted over a large range of HF–methanol mixture compositions; a violet coloration appeared at higher methanol concentrations than in the ether system).

A noticeable characteristic of the system was the difference in solubility of iodine in the oxygenated solvents and in hydrogen fluoride. Starting with even a dilute solution of iodine in methanol, addition of hydrogen fluoride to about 75% by weight precipitated iodine, and precipitation continued with further addition of hydrogen fluoride. Iodine dissolves slowly in pure hydrogen fluoride.

Some question might be raised concerning the relatively small effects of the lower concentrations of the oxygenated electron donors on the iodine spectrum. It should be pointed out that hydrogen fluoride will compete with the iodine for the electrons of the donor, so that the effective concentration of the latter is considerably diminished. From the evidence as a whole it does not seem that hydrogen fluoride interacts significantly with iodine dissolved in it.

Visual observations and solution make-up were performed with test-tubes formed of fluoride-resistant aluminum phosphate glass ("Fluorex"). The experimental procedures for following absorption spectra in liquid hydrogen fluoride will be described elsewhere.[12]

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(12) J. J. Katz and H. H. Hyman, *Rev. Sci. Instruments*, to be published.

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Significance of Fungus Growth in Analytical and Radiochemical Work with Strontium-containing Solutions[1]

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Dipping-type Geiger–Mueller tubes employed in an investigation of rates of dissolution of radioactively-labeled crystals of strontium sulfate in distilled water were observed, in runs at room temperature, to acquire an activity which increased regularly with time. The activity was in the form of an adherent deposit on the surface of the tube, for when removed from the solution and rinsed repeatedly with water, the tube gave practically the same high count as it had when immersed in the solution. The activity recorded by the tube did not decrease at all when the tube was left immersed in a large volume of a solution containing a high concentration of stable Sr^{++}, showing that the radioactive strontium deposited on the tube does not enter into exchange with strontium ions in solution. Firm wiping of the tube removed a large part of the activity, but vigorous scrubbing with a mild abrasive was necessary to remove the remainder. The same effects were observed with glass, stainless steel, and glyptal-coated dip tubes at room temperature, but they were no longer observed when the experiments were carried out at temperatures near 0°.

These observations suggested that the deposit on the G–M tube might be a fungus capable of ingesting strontium. To test this hypothesis, the solution from one of the runs (consisting of two liters of water approximately saturated with Sr^{89}SO$_4$) was made 0.5% in dextrose, and set aside for one month at room temperature. A luxuriant growth of mold mycelium was present at the end of this period; it was filtered, air-dried and measured for radioactivity. A 0.24-g. sample of the mold mycelium gave 937 ± 10 counts per minute over background; the same weight of the solution gave 5 c.p.m.

The effect of SrSO$_4$ on the rate of growth of the fungus was investigated by preparing a number of 1% dextrose solutions, half of which were saturated with strontium sulfate, and inoculating all with equal amounts of the mold mycelium obtained as described above. After one day, the solutions containing SrSO$_4$ were decidedly more turbid, due to the mold, than the other solutions; after one month, the strontium-containing solutions had large colonies of mycelium which did not adhere to the walls of the flask, whereas the solutions containing the same nutrient, but no SrSO$_4$, showed only a thin growth which adhered firmly to the glass surface.

The fungus, when cultured on bread slices, produced black colonies having the appearance characteristic of *Rhizopus nigricans*. It is concluded that this mold grows in solutions of strontium sulfate (even when the only nutrient available is what falls into the solution from the laboratory air), that its growth is actually accelerated by the presence of the Sr^{++}, and that it ingests strontium and incorporates it into its structure in a form that does not exchange with strontium ions in solution.

Analyses of solutions of SrCl$_2$ and SrSO$_4$ in water by a colorimetric procedure[2] show that the concentration of strontium ions in these solutions may decrease considerably with time; for example, a 0.06% solution of SrCl$_2$ in distilled water in a glass-stoppered flask decreased in concentration by about 60% over a three-month period.

It follows that the possibility of loss of Sr^{++} due to fungus activity must be considered in all analytical and radiochemical work with strontium-containing solutions.

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(1) This work was supported in part under Contract No. AT (30-1)-1256 between the Atomic Energy Commission and New York University.

(2) P. J. Lucchesi, S. Z. Lewin and J. E. Vance, *Anal. Chem.*, in press.

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The Preparation of Ethyl 1,1,2,2,3,4-Butene-3-hexacarboxylate

BY C. G. OVERBERGER AND PETER KABASAKALIAN

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In connection with other work, we attempted to synthesize ethyl 1,1,2,2,3,4-cyclobutanehexacarboxylate (I). Reid and Sack[1] have recently re-

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(1) E. B. Reid and M. Sack, THIS JOURNAL, 73, 1985 (1951).