COMMENTARY

by Bernard Dixon

CONTINUING WEIZMANN'S MICROBIAL LEGACY

With Chaim Weizmann as the State of Israel's first president, it is no surprise that his country has always had a more lively interest than most in biotechnology. In 1915, an acute shortage of acetone, urgently required for making cordite, led the British wartime premier, Lloyd George, to approach Weizmann about the possibility of developing an alternative source. *Clostridium acetobutylicum* obliged. There is a clear link between that organism's fermentative capacity, harnessed by Weizmann, and the creation of a new nation in 1949. In turn, the president-chemist ensured that the Hebrew University, Israel's senior institution of higher education, housed a department of industrial microbiology.

It is that selfsame university from which one of two reports has recently emerged to confirm the continuing ingenuity of Israeli microbiologists in applying their craft to the husbanding of national resources. The problem tackled by Dr. A. Singer and his colleagues, Dr. J. Navrot and Dr. R. Shapira, is that of dealing with the vast quantities of fly ash spawned by coal-burning electricity plants. In the past, Israel has derived much of its energy from oil-fired stations, but with very little oil of its own, the country is now moving towards much greater dependence on coal. That, however, brings the unwelcome burden of fly ash in the flue gases. Consisting of finely divided spheres of amorphous silica and alumina, this by-product has long been dismissed as an unwanted effluent to be removed by electrostatic precipitators and perhaps used as a filler in building materials.

Dr. Singer is investigating the practicability of exploiting fly ash as a resource by extracting the valuable minerals it contains. The starting point for his experiments was the realization that organic acids, which can be produced microbiologically from cheap agricultural leftovers, are capable of leaching metals out of rocks. Would citric acid, synthesized by *Aspergillus niger*, be similarly effective in recovering aluminum from power station ash?

Two samples of fly ash were tested, one from New South Wales in Australia and the other from Le Havre in France. Both contained around 30 percent aluminum oxide and were produced from the same type of bituminous coal that is due to be burned in Israel's new generation of power stations. The source of citric acid was a submerged culture of *A. niger*—a mold capable of growing on cotton waste, which is abundantly available in Israel. Extraction was performed simply by shaking together ash and the acid solution in a water bath.

As reported in the *European Journal of Microbiology and Biotechnology* (**16**:228), this disarmingly uncomplex stratagem liberated as much as 12 percent of the aluminum oxide. More importantly, the fungal citric acid was only slightly less efficient than an identical concentration of its commercial equivalent, which is, of course, considerably more costly. Dr. Singer and his team thus consider that their work has amply confirmed the technical feasibility of microbial aluminum recovery. They are now conducting studies to further explore the economic feasibility of the process.

Meanwhile, at Tel-Aviv University and the Weizmann Institute of Science in Rehovot, another research outfit under Dr. M. Galun has come up with a surprising and intriguing finding about the capacity of fungi to remove another element, uranium, from solution. Despite a temporary collapse in the uranium market (recently reported by Mary Ellen Curtin in BIO/TECHNOLOGY, **1**:229), it could be a discovery of far reaching significance for the future of waste water decontamination and metals recovery. The work is especially notable for being the product of a collaborative project with the Israel Atomic Energy Commission and the University of Hawaii at Manoa.

About a year ago, members of the team found that *Penicillium digitatum* could absorb uranyl chloride—one of very few cases ever reported in which a fungus, rather than a plant, lichen, or other organism, has shown this ability. Thinking of potential applications for this phenomenon, Galun and colleagues were particularly excited when they realized that they could recover the uranium quantitatively if the metal-loaded mycelium was stripped using an alkali carbonate. What makes the story doubly interesting, however, is the more recent discovery that boiling and chemical treatments, far from impairing uranium uptake, enhance it considerably—up to about 10,000 parts per million (dry weight). Absorption, it appears, is a passive property of macromolecules in the cell wall, rather than an active metabolic process.

In the first set of their latest experiments, Dr. Galun and his co-workers incubated uranyl chloride solution with fungal mycelium which was either fresh or pretreated in various ways. For the second group of tests, they added uranyl chloride to microcolumns containing mycelium or various wall-related polymers such as chitin, cellulose, cellulose phosphate, and carboxymethyl cellulose. As the researchers have reported in *Science* (**219**:285), they tried using killed mycelium "as a matter of course." But the outcome, with uranium extraction raised by over 100 percent in some cases, was "completely unexpected." The explanation seems to be that chemicals capable of boosting uptake were either solvents which remove masking groups from the fungal hyphae, or agents which cause configurational changes and thereby expose metal binding sites. The two compounds with virtually no effect were formalde-

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PULP

TITLE: A Method for the Delignification of Wood and Other Ligno-Cellulosic Products
INVENTORS: Hervé Tournier, Valleiry, FR, Ake Allan Johansson, Meyrin, SW, Jean-Pierre Sachetto, Saint-Julien en Genevois, FR, Jean-Michael Armanet, Onex, SW, Jean-Pierre Michel, Colognes sous Salève, FR, Alain Roman, Bossey, FR.
ASSIGNEE: Battelle Memorial Institute, Carouge/Geneva, SW
FILING & ISSUING DATA:
PCT Publication No.: WO 83/02125
PCT Publication Date: June 23, 1983
Priority Country: U.S.
Priority Date: December 10, 1981

The patent describes a pulping process using a mixture of phenol and dilute sulphuric acid to yield purified cellulose, lignin fraction, and pentoses. The solution contains 0.4 parts phenol by weight, with an acid concentration of 3–6% and a liquid to solid ratio of 2:1 to 4:1 at a temperature equivalent to the boiling point of the phenol solution.

MOLD

TITLE: Method for Obtaining Mold Spore Material
INVENTORS: Peter Paul Kozak, Jr., Santa Ana, and Janet M. Gallup, Garden Grove, CA, U.S.
ASSIGNEES: Peter P. Kozak, Jr., Janet M. Gallup, Leo H. Cummins, Sherwin A. Gillman, Orange, CA, U.S.
FILING & ISSUING DATA:
EPO Publication No.: 0 032 322 A2
EPO Publication Date: July 22, 1981
Priority Country: U.S.
Priority Date: January 7, 1980

The patent protects a method for obtaining mold spore material that can be used for developing allergy immunizations. The spores are neither structurally damaged nor broken open during harvesting or preparation of an extract. The method yields a higher ratio of spores to mycelia than current methods and is applicable to practically any mold with spores and mycelia, including *Alternaria, Cladosporium, Penicillium, Aspergillus, Drechslera,* and *Epiccoccum.* The method also permits use of media that are less pure and would otherwise contaminate the mold.

*Country Codes:
FR = France
SE = Sweden
SW = Switzerland
U.S. = United States

Patent information in this department was compiled from the *Official Gazette of the United States Patent and Trademark Office, the European Patent Bulletin,* and the *PCT Gazette.*

Printed copies of patents issued in the United States may be obtained for $1 from the Commissioner of Patents and Trademarks, U.S. Patent Office, Box 9, Washington, DC 20231. Patent number, title, and inventor should be specified.

Copies of patents and patent applications listed in the *PCT Gazette* and the *European Patent Bulletin* can be obtained for $.30/page from the Foreign Patents Section, U.S. Patent Office, Box 9, Washington, DC 20231.

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hyde (a blocker of binding sites) and sodium azide (which would have impaired active uptake). In the experiments with chitin, cellulose, and modified celluloses, all removed uranium from solution.

As Mary Ellen Curtin remarked in her article, metals markets are notoriously fickle. On a long-term basis, however, such instability can only enhance interest in novel developments such as these spawned in the land of Chaim Weizmann.

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has entered into a marketing arrangement with Becton Dickinson, the largest marketing force to laboratories performing infectious disease testing.

Under the scenario that I have outlined, the university retains its talent pool, the small company cultivates the resources of the university, and the larger corporation maximizes on its established position in the marketplace to manufacture and obtain regulatory approval of the product. I believe that this differentiation of skills will continue and will optimize the strengths of each of the three participants.

To summarize, all three parties should benefit from this collaboration. The university receives additional research funding, the small company speeds the commercialization of the new technology, and the large company has a new product to manufacture and market. I see this relationship continuing very effectively in today's environment.

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