science is a most precious part of its patrimony." And again, in this book: "Humanity needs dreamers, for whom the disinterested development of an enterprise is so captivating that it becomes impossible for them to devote their care to their own material profit."

But she carried on. When Pierre died, she succeeded to his chair at the Sorbonne and continued the research work. Later on, with the establishment of the Curie Institute for Radium, she supervised the work of many—among them, the Joliots (her daughter, Irene, and her son-in-law), who were to receive the Nobel prize in their own right. She isolated radium in the pure state. For the second time she received the Nobel prize, the only instance of the kind on record. Years later, in Berlin, at the railway station, the crowd seemingly did not know whom to cheer more, Jack Dempsey or Madame Curie. But for all that, the august members of the French Academy of Sciences (with some notable exceptions) refused to elect her into their body because—she was a woman! In the spirit of science and logic with which he was so imbued, Academician Amagat closed his peroration with the declaration: "Women cannot be part of the Institute of France." The "immortals" finally gave way in 1922. They had become the butt of vaudeville performers.

Mme. Curie visited this country in 1922 to receive a gift of a gram of radium. She carried home this precious gift—a token from the women of America—together with as many honorary degrees as belong to President Butler.

She died in 1934. "Madame Curie," wrote Einstein, who knew her well, "is, of all celebrated beings, the only one whom fame has not corrupted."

To me the miracle of this volcanic period is that such women and men can be found to devote their lives to distant and often vague objectives in the midst of turmoil which distracts the minds of so many of us. These monks of 1938, devotees of the neutron, the hormone, etc., represent the immortal spirit which will not die.

BENJAMIN HARROW

THE CITY COLLEGE
COLLEGE OF THE CITY OF NEW YORK

SPECIAL ARTICLES

SELENIUM AS A STIMULATING AND POSSIBLY ESSENTIAL ELEMENT FOR CERTAIN PLANTS

SELENIUM is the only mineral element known to be absorbed from the soil by food plants in sufficient quantities to render them lethal to animals.[1] Beath[2] and his associates have found that certain native plants —including several species of *Astragalus* (legume), *Stanleya* (crucifer), *Xylorhiza* (composite) and *Oonopsis* (composite)—always contain selenium when collected on seleniferous soils. The indicator plants frequently accumulate several thousand parts per million of selenium. Furthermore, the available evidence tends to show that some species of the indicator plants occur only on soils that contain selenium. The investigations reported by Byers,[3] as well as our own observations in South Dakota, Colorado, Wyoming, Idaho, Nevada and Utah, have shown a definite correlation between the distribution of Beath's indicator plants and the presence of selenium in the soil.

These facts obviously suggest that selenium may be an essential element for the growth of the indicator plants. Since the soils supporting these plants contain only small traces of selenium, it is evident that this element, if indispensable, belongs in the group of micrometabolic or microtrophic elements, which already includes manganese, boron, zinc, copper and perhaps others.

We have grown one of the indicator plants, *Astragalus racemosus,* in artificial media. This species occurs widely distributed, from North Dakota and Wyoming southward to Texas and New Mexico. Seeds that we had collected in South Dakota were germinated in quartz sand and then transferred to solution cultures and sand cultures. One set of plants was supplied with the usual mineral nutrients, and the other sets had in addition various concentrations of selenium (as sodium selenite) ranging from 1 to 243 ppm. Though receiving a considerable quantity of selenium from the seed, the plants which were given no additional selenium made slow growth in comparison with those which obtained selenium from the culture solution. Marked stunting of the plants deprived of selenium became evident within a few weeks after their transference to the mineral solution.

These experiments show that selenium has a pronounced stimulating effect on the growth of *Astragalus racemosus,* and they suggest that selenium may be essential for the development of this and other species of selenium indicator plants. After we had completed one set of these experiments, we learned from Professor Beath that he has obtained somewhat similar results with soil tests. Germination and growth of

1 For literature review, see S. F. Trelease and A. L. Martin, *Bot. Rev.*, 2: 373–396, 1936.

2 O. A. Beath, H. F. Eppson and C. S. Gilbert, *Wyo. Agr. Exp. Sta. Bull.*, 206, 1935. *Jour. Am. Pharm. Assoc.*, 26: 394–405, 1937. O. A. Beath, *Wyo. Agr. Exp. Sta. Bull.*, 221, 1937.

3 H. G. Byers, *U. S. Dept. Agr. Tech. Bull.*, 482, 1935. J. T. Miller and H. G. Byers, *Jour. Agr. Res.*, 55: 59–68, 1937.

A. pectinatus and *A. bisulcatus* were markedly stimulated when a soil low in naturally occurring selenium was treated with a solution carrying 40 ppm of selenium (as sodium selenite). It was found to be impossible to secure a stand of either of these species of *Astragalus* on a Cecil clay loam from North Carolina.

Since plants of *Astragalus racemosus* are stimulated by selenium and sometimes accumulate as much as 15,000 ppm without visible injury,[4] it is perhaps not surprising to find that they can tolerate a relatively high concentration of selenium in the culture solution. A solution containing 27 ppm of selenium (as sodium selenite) retarded root development but stimulated the tops. With 81 ppm the *Astragalus* plants were stunted and chlorotic, exhibiting symptoms similar to those of wheat and buckwheat plants in a solution containing one tenth this concentration.[5]

Selenium, if required by certain plants, is unique among the essential elements in being needed by only a few species of the higher plants, in the Leguminosae, the Compositae and the Cruciferae. Even in the genus *Astragalus* some species appear to be definite indicators, limited to seleniferous soils, while others are indifferent in their soil requirements. These facts suggest an interesting evolutionary development of tolerance and requirement of selenium by a small number of species belonging to distantly related families.

SAM F. TRELEASE
HELEN M. TRELEASE
LABORATORY OF PLANT PHYSIOLOGY
COLUMBIA UNIVERSITY

A NEW AND RAPID DEHYDRATION PROCESS FOR VEGETABLES[1]

IN present dehydration processes the principal difficulties are: (1) the cost of fuel, (2) detrimental effects of high temperatures on the material being dried and (3) the length of time required. The process described below obviates these difficulties. It depends on the fact that certain toxic vapors, notably those of fat solvents and some toxic gases, have the property of rapidly increasing the permeability of living tissue and finally killing it. This results in a loss of turgor and a release or separation of juice from the solid material. The juice containing the water and soluble matter, such as sugars, can then be removed largely by inexpensive mechanical means at low temperatures. Subsequent drying of the solid residue is rapid because of its complete permeability and its low moisture content.

[4] Beath *et al.*, *loc. cit.*

[5] A. L. Martin, *Am. Jour. Bot.*, 23: 471–483, 1936.

[1] Contribution No. 137 from the Carbohydrate Research Division, Bureau of Chemistry and Soils, U. S. Department of Agriculture.

In connection with studies on sweet potatoes used for starch manufacture it was found, for instance, that vapors of carbon tetrachloride, toluene, chloroform and other fat solvents and sulfur dioxide and chlorine gases increased the permeability of the roots so rapidly that they were reduced to a soft, water-soaked condition in a few hours. Wetting the surface of the roots with the liquid solvent accelerated the action, which began almost immediately and reduced the time of treatment to approximately one hour. Extrusion of drops of juice on the surface of the tissue occurred during the treatment. The juice from material in this condition was readily pressed out without crushing the tissue, since the latter had become tough and pliable. The pressed residue, which then contained only about 40 per cent. of water, dried very quickly at relatively low temperatures. This is in marked contrast with thin slices of untreated material which, even after a long period of drying under the same conditions, showed fresh tissue within.

The method was tried also on other vegetables, notably, red beets, string beans, carrots and rutabagas and was found to be equally effective. Losses in weight after pressing and after drying for thirty-six hours under atmospheric conditions to an "air-dry" state are given in Table 1.

TABLE 1
DEHYDRATION OF VEGETABLES

Material	Per cent. loss in weight on pressing	Per cent. loss in weight on drying	Solids content of juice degrees Baumé
Rutabaga	50.0	65.2	4.4
Carrot	60.2	74.4	4.3
Beet	85.0	93.3	5.4
Green beans	82.0	95.5	4.0
Sweet potato	50.0	64.0	7.4

A number of interesting points were noted in connection with these experiments. Most important, however, is the possibility of applying the method for quickly dehydrating and preserving perishable material. The juice concentrated to a sirup and the residue reduced to the "air-dry" condition will keep indefinitely for future use or manufacture.

This has been done on a fairly large scale with sweet potatoes. The dehydration is carried out in this case by grinding the roots to a pulp and treating the latter with sulfur dioxide gas. The treated pulp is then spun in a centrifuge to remove the juice and the solid residue further dried to about 12 per cent. of moisture. This final drying removes the last traces of gas. Fermentation tests have shown that sugars in the juice may be converted into alcohol.

The advantages of the process, for which a public service patent is pending, are that it provides a method