formed per 100 ev where 52.4×10^{18} ev is equivalent to 1 Mrep) may be obtained by simple calculations from values in Figs. 1 and 2.

It was qualitatively determined that gamma irradiation at similar dosages also results in the formation of oxalates from the afore-mentioned bicarbonates and ammonium carbonate.

The yields of oxalic acid, obtained by permanganate oxidation, for varying concentration and dosage levels are presented in Figs. 1 and 2, respectively.

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Paradamite, a New Zinc Arsenate from Mexico

A suite of minerals from the Ojuela Mine, Mapimi, Durango, Mexico, was received recently for examination. The principal minerals identified were legrandite, $Zn_{14}(OH)(AsO_4)_9 \cdot 12\ H_2O$; plattnerite, PbO_2; murdochite, $Cu_6\ PbO_8$, and a new species having the composition $Zn_2(AsO_4)(OH)$, which has been named paradamite (*1*). The material was collected by George Griffith, and submitted for study by George Burnham. The type specimen is in the U.S. National Museum, catalog number 107443.

A chemical analysis of paradamite gave ZnO, 56.22; FeO, 0.45; Fe_2O_3, 0.12; As_2O_5, 40.17; H_2O (+), 3.44; H_2O (−), none; sum 100.40 percent (G. Switzer, analyst). The theoretical composition of $Zn_2(AsO_4)(OH)$ is ZnO, 56.77; As_2O_5, 40.09; H_2O, 3.14. Paradamite is triclinic and is a dimorph of adamite, which is orthorhombic. It is also the arsenic analog of tarbuttite, a triclinic form of $Zn_2(PO_4)(OH)$.

Paradamite occurs in sheaflike aggregates of triclinic crystals and in somewhat rounded and striated equant crystals up to 5 mm in size. It has a perfect {010} cleavage. It is transparent and pale yellow in color, with a white streak. The luster is vitreous and, on the cleavage, pearly. Optically it is biaxial (−) with $2V = 50°$, $\alpha = 1.726$, $\beta = 1.771$, $\gamma = 1.780$ (± 0.002). The specific gravity is 4.55 ± 0.02. Paradamite was found with mimetite and adamite on a matrix of limonite but not on the same hand specimen as legrandite, plattnerite, or murdochite.

Table 2. X-ray powder diffraction data for paradamite, tarbuttite, and adamite (copper Kα radiation, $\lambda = 1.5418$A, camera radius = 114.59 mm).

Paradamite		Tarbuttite		Adamite	
d (A)	I	*d* (A)	I	*d* (A)	I
6.33	10	6.19	10	5.99	8
5.44	6	5.44	5	5.47	1
4.77	2	4.60	5	4.96	10
3.99	3	3.88	1	4.29	8
3.71	10	3.71	8	3.79	6
3.34	5	3.28	6	3.31	1
3.16	6	3.09	4	3.06	3
3.08	7	2.99	7	3.00	10
2.99	9	2.88	8	2.71	9
2.84	9	2.78	9	2.64	6
2.76	1			2.59	5
2.73	1	2.71	2		
2.57	6	2.54	5	2.54	5
2.53	1				
2.49	8	2.48	6	2.47	10
2.45	3	2.42	7	2.43	8
2.39	3	2.36	6	2.36	7
2.32	1	2.29	1	2.09	2
2.18	2	2.22	2	2.01	2
2.13	1	2.10	3	1.97	4
2.11	7	2.06	7	1.92	3
2.08	5	2.02	3	1.89	3
1.99	1	1.95	3	1.86	2
1.95	1			1.82	1
1.91	2			1.78	1
1.88	1			1.75	2
1.84	1	1.85	4	1.72	4
1.82	2	1.82	2	1.67	5
1.79	4	1.80	2	1.64	3
1.76	2	1.74	4	1.62	7
1.72	4	1.71	4	1.60	3
1.67	3	1.60	3	1.58	5
1.58	4	1.58	1	1.52	5
1.55	2	1.54	2	1.49	5
1.54	4				
1.51	3				
1.48	4	1.48	1		

Table 1. Physical properties of paradamite, tarbuttite, and adamite.

Property	Paradamite (Mapimi Mexico)	Tarbuttite (Broken Hill, N. Rhodesia)	Adamite (Mapimi, Mexico)
Crystal system	Triclinic	Triclinic	Orthorhombic
Optical	(−) $2V = 50°$ $\alpha = 1.726$ $\beta = 1.771$ $\gamma = 1.780$	(−) $2V = 50°$ $\alpha = 1.660$ $\beta = 1.705$ $\gamma = 1.713$	(+) $2V = 88°$ $\alpha = 1.722$ $\beta = 1.742$ $\gamma = 1.763$
Cleavage	{010} perfect	{010} perfect	{010} good, {010} poor
Specific gravity	4.55	4.12	4.43
Color	Pale yellow	Colorless to pale yellow	Colorless, pale yellow, light yellowish green, bluish green

Properties of paradamite, tarbuttite, and adamite are compared in Tables 1 and 2 (*2*).

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Notes

1. Publication of this paper was authorized by the secretary of the Smithsonian Institution, Washington, D.C.
2. A detailed crystallographic description of the new mineral is in preparation.

17 November 1955

Loss of Nutrients from Plant Foliage by Leaching as Indicated by Radioisotopes

That nutrients can be absorbed by the foliage of plants from sprays has been adequately demonstrated through the use of radioisotopes (*1*). The results obtained by many workers (*2–6*) indicate that nutrients may also be lost from leaves. However, the implication is that these losses in large part occur as the plant approaches maturity. By use of isotopically labeled nutrients, it is now possible to study the magnitude of these losses, the nature of the compounds lost, and the physiological factors that may affect the rate of loss (*7*).

Young, rapidly growing plants were allowed to absorb phosphate and potassium solutions labeled with P^{32} and K^{42} through the roots, or P^{32}-labeled phosphate through the bases of cut stems. The plant material was then leached under a mist of distilled water for 4 to 48 hours, and the runoff (leachate) was collected. The leachates were then passed through anion or cation exchange resin columns (*8*), and the collected ions were eluted with 5-percent NaOH or HCl. The eluates were evaporated to dryness, made to a standard volume, and the radioactivity of aliquots was ascertained. Bean (*Phaseolus vulgaris*), sweetpotato (*Ipomoea batatas*), or poinsettia (*Euphorbia pulcherrima*) plants lost no significant quantities of root-absorbed P^{32}. However, cuttings of bean and rose (*Rosa spp.*) lost 1.5 and 12.8 percent respectively, of the labeled phosphate that had previously been absorbed through the bases of cut stems during a 4-hour period. Ten-day-old bean plants that absorbed

Table 1. Losses of Rb^{86} and K^{42} from the foliage of bean plants after 4 hours of leaching under continuous mist.

Experimental conditions	Percentage lost in leachates	
	Rb^{86}	K^{42}
Dark, high salt	14	71
Dark, low salt	7	42
Light, high salt	5	5
Light, low salt	5	12

K^{42}-labeled potassium for 12 hours from the root medium lost 2.2 percent in the leachates.

In later experiments, K^{42} and Rb^{86} were added to water cultures. Bean plants were permitted to absorb the isotopes through the roots for 48 hours and were then removed for leaching. Two salt levels in the water cultures were established by using Hoagland's nutrient solution (*9*) and diluting it with nine volumes of distilled water. In addition, during the absorption period, half the plants were kept under normal daylight, and half in the dark (under black cloth). Following root absorption of the isotope, plants were cut above the cotyledonary node, the stems were sealed off with molten paraffin, and the above-ground parts of the plants were leached for 4 hours. Analysis of leachates showed that plants that had been held in the dark lost 71 and 42 percent of the K^{42}, and 14 and 7 percent of the Rb^{86} at the high and low salt levels, respectively. Losses of root-absorbed K^{42} for plants that had been maintained in light were 5 and 12 percent at high and low salt levels, respectively, with 5 percent of the root-absorped Rb^{86} at both levels (Table 1). Standard chemical analyses of plant tissue (Table 2) were used to supplement the radioactivity assay in the K^{42} experiment (*10*). Approximately 10-percent reduction in the content of Ca, K, Mg, N, and P was found in the leached plants.

Examination of the leachates by means of chromatographic separations using Phenol and water (80:20) and *n*-butanol, acetic acid, and water (4:1:5) as solvents (*11*), indicated the presence of a ninhydrin-positive constituent with an *Rf* of 0.49 to 0.52 and 0.10 to 0.12 for the two solvents, respectively. Chromatograms of acid-hydrolyzed leachates showed four or five amino acids, suggesting a polypeptide in the original material. A positive Fehling's test indicated that large quantities of a reducing substance or substances had been leached from the leaves; this agrees with the recent report of Dalbro (*6*).

These observations and those of previous investigators (*2, 3, 5, 6*) indicate that nutrients are lost from plant foliage throughout the growing season, with the quantities increasing greatly just before maturity and death of the foliage (*2*). Light, nutrient level, and maturation of the foliage, and perhaps other variables influence the rate of loss. Such relationships should be considered in sampling and analyzing plant foliage for determining nutrient status. The implication is that nutrients may be lost from aboveground parts of plants during periods of rainfall, or in mist propagation of cuttings (*12*). These losses may be of sufficient magnitude to alter markedly the behavior of the plant.

Table 2. Chemical analysis of leached and nonleached bean plants.

Experimental conditions	Mineral content as percentage of dry wt.				
	Ca	K	Mg	N	P
Plants not leached					
Dark, high salt	0.76	1.82	0.46	4.89	0.50
Dark, low salt	0.76	1.88	0.44	4.86	0.51
Light, high salt	0.58	1.53	0.36	3.88	0.36
Light, low salt	0.55	1.66	0.36	3.82	0.32
Plants leached					
Dark, high salt	0.64	1.66	0.37	4.44	0.46
Dark, low salt	0.61	1.51	0.34	4.18	0.43
Light, high salt	0.53	1.28	0.32	3.45	0.35
Light, low salt	0.56	1.35	0.33	3.45	0.36

Note added in proof: The reducing material has been identified as a *galactan*. Similar losses have also been found with Ca^{45}.

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31 October 1955

As young investigators acquiring the principles and attitudes as well as the techniques of research, do they [graduate students] learn the rights of independent thought and action or the ways of suspicion and restraint? When they are introduced to research under conditions of secrecy and quarantine from fellow-students and unauthorized faculty members, what is their initial and perhaps lasting attitude toward freedom of choice and expression? Where is the vaunted freedom of science, heard but not practiced?—N. Paul Hudson, *Ohio State University Graduate School Record* (December 1951).