Table 2. Effect of infusion of L-proline on absorption and excretion of glycine and hydroxyproline, respectively. Three normals, one homozygote, and one heterozygote were studied. The rate of hydroxyproline excretion rather than its absorption rate is given because of the difficulties in accurately measuring the filtered load of hydroxyproline. Determinations were made before infusion of L-proline and at Tm for proline.

Glycine absorption (% filtered load)		Hydroxyproline excretion* (μmole/min per 1.73 m^2)	
Before infusion	At Tm proline	Before infusion	At Tm proline
	Normal		
93–99	58–61*	0	0.5–1.5
	Homozygote		
63	60	0.3	1.5
	Heterozygote		
83	60*	0	1.2

* The filtered load of L-proline required to achieve this amount of inhibition is greater than 225 μmole/min per 1.73 m^2 in normal subjects; the heterozygote subject required only 150 μmole/min per 1.73 m^2.

and of the rat kidney cortex in vitro (*3*) indicate that L-proline has the highest affinity and glycine the least affinity for the common system.

It is this system which appears to be totally absent in the mutant homozygous phenotype and partially deleted in the heterozygote. The latter phenotype presumably exhibits hyperglycinuria alone because the imino acids have sufficient and preferential affinity for the reduced amount of the common transport system, and thus they are still completely transported by it at normal plasma concentrations.

A second type of transport mechanism can be discerned (type B) in the mutant phenotype where the A system is nonfunctional. The remaining transport activity has a small capacity by comparison with that available on the A system; the proline B system is in fact saturated at normal plasma concentrations of substrate. Glycine is transported on a B system, which is presumably also saturated at low concentrations. This system has considerable affinity and specificity for glycine uptake since it cannot be inhibited by L-proline. Hydroxyproline appears to be transported differently from glycine on a B system; its transport is more readily inhibited than that of glycine by L-proline, indicating that the order of affinity of these two compounds for uptake by B system is the reverse of that for the A system (*3*). Hydroxyproline behaves as if transported on a second B system, distinct from glycine, and which it may share with L-proline (Fig. 2).

The proposed model explains the observations on transport of imino acids and glycine. A similar type of organization may also exist in relation to other "common" transport systems. The evidence, presented by Rosenberg and Segal (*10*), for more than one type of transport for a basic amino acid supports the extension of the hypothesis. If the proposal is valid, then separate genes would appear to control A and B systems. Mutation at an A-system gene could occur without any effect on the B system. Conversely, mutation could occur in a B-system gene without effect on the related A system. Perhaps those diseases claimed to manifest selective impairment of transport of methionine (*11*) and tryptophan (*12*) will prove to be examples of the latter type of mutation (*13*). Proposals for the occurrence of more than one type of transport mechanism available to a single amino acid have also been advanced for transport of certain α-amino acids in gram-negative bacteria (*14*), and ascites tumor cells display more than one mediation for uptake of β-alanine (*15*).

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4 November 1966

Ecological Dosimetry: Radiation Levels Influenced by Plant Growth

Abstract. *The feasibility of using lithium-7-fluoride thermoluminescent dosimeters under field conditions for natural radiation at levels of 5 milliroentgens is demonstrated. Radiation dosages in tree trunks increased threefold from winter to spring and summer. This increase is attributed to the gamma radiation field resulting from relatively high levels of potassium-40 and other radionuclides present in the foliage and branches during the growing season.*

The radiation environment of a tree injected with radionuclides varies with season (*1*). In principle this seasonal variation should exist for all deciduous trees from the redistribution of radioactivity in the soil. Sources include potassium-40, members of the uranium (radium) and thorium series, and fallout. The hitherto lack of sufficiently sensitive dosimeters which could be left in place for extended periods of time has limited potential analyses of variations in the environmental radiation.

Thermoluminescent radiation dosim-

etry has relatively recently been used for a variety of personnel-monitoring applications involving low dose levels in the milliroentgen category (*2*). Accordingly, we attempted to use this dosimetric technique to study the variation in radiation environment. The following is an account of our procedure and results after monitoring the radiation levels in tree trunks for a period of 22 weeks.

Small amounts (9 mg) of annealed lithium fluoride crystals (*3*) were heat-sealed in polyethylene tubing to form 1-mm by 12-mm capsules, hereafter termed "microdosimeters." After exposure, an end was snipped open, the powder spread in a uniform layer in a small silver pan, and the thermoluminescence determined by a method similar to that of Cameron (*4*). Exact LiF weights were obtained after thermoluminescence.

Dried nitrogen was passed over the heating pan to eliminate the extraneous luminescence of LiF which occurs in the presence of water or oxygen. Thermoluminescence and background thermal radiation were carefully regulated by heater voltage control and by timing each heating cycle. The pan temperature rose to approximately 300°C in 20 seconds. The controlled temperature and the relative insensitivity of the selected photomultiplier tube (*5*) to red and infrared radiation, together with an adequate signal-to-noise ratio, made unnecessary the use of an infrared filter with its associated signal attenuation. Determination of the relative exposure dose to each microdosimeter was achieved by planimetering the appropriate area under the curve of output current as a function of time. The LiF powder was calibrated at 50 and 55 mr in a gamma field from a Ra^{226} source.

The microdosimeters were placed 5 feet (1.5 m) above the ground in trunks of 20-inch (about 50 cm) oak trees (white and burr) on the Argonne National Laboratory site. Vertical saw cuts were made through the bark to the wood. The inner portion of each cut was lined with Apiezon putty and the microdosimeters were embedded in the putty. Approximately six were removed and read, as a rule weekly, for a span of 22 weeks. During the period from early March to August the trees were dormant for 8 weeks, broke bud and developed a canopy of foliage in the next 4 weeks, and experienced summer conditions including moderate drought. An attempt was made to establish controls for the experiment by embedding dosimeters in pieces of lumber at the same location.

Dosage rates were not uniform during this period. Under winter conditions the dosimeters received about 1 mr/week. After development of foliage and concomitant movement of nutrients plus other mineral substances in the sap, weekly dosage rates increased to about 3.5 mr/week (Fig. 1). A concept from work with tagged trees (*6*) was that dosage rates at the cambium zone of the trunk would be highest during active movement of sap associated with development of the foliage canopy and active growth. Although there is a suggestion of this effect, dosage rates remained high throughout the remainder of the study. The formation of a gamma radiation field by the foliage and mineral-element-enriched shoots of the trees plus radioactive dust accumulated on the leaf surface (*7*) during the growing season probably contributed to the high dosage rates. A reasonable confirmation of this hypothesis is the fact that the controls in the dead lumber also showed a similar increase in dose rate, contrary to what one would expect if movement within the tree were the main cause. Controls in future experiments should be removed from a foliage environment.

Data from England (*8*) on oaks in full leaf showed 60 to 100 kg of potassium per hectare for the leaves and branches of the tree layer, and 41 to 118 for the trunks. A total return of the potassium to the soil from leaf fall and partial removal from branches and trunks to the roots (*1*) would account for a twofold change in the gamma field from K^{40}, the major radionuclide in sap during the growing season. Radon daughters carried upward from the soil in the transpiration stream are gamma emitters. Of the fallout radionuclides cycled by plants, Cs^{137}, which has a relatively long half-life, is the most important gamma emitter at present (*9*).

Certain problems were encountered in readout of the microdosimeters. For the very low radiation levels experienced, careful attention must be given to operational procedures. Apparent contamination of the powder was encountered, perhaps from the putty and from plant sap. Associated studies did not establish the nature of a possible contaminant whose presence could be recognized by a different shape of the glow curve. Future work with single crystals ought to eliminate the problem of contamination effects.

Previous and allied studies at Argonne (*9, 10*) with scintillation and ionization detectors have shown values of 11 to 14 μr/hr throughout the year at sites within 100 m of the trees. These are within the range of values for the present study, from 5 μr/hr in winter to 21 μr/hr in the growing season. A lesser seasonal effect seems to have been present in the previous studies and was not recognized. It

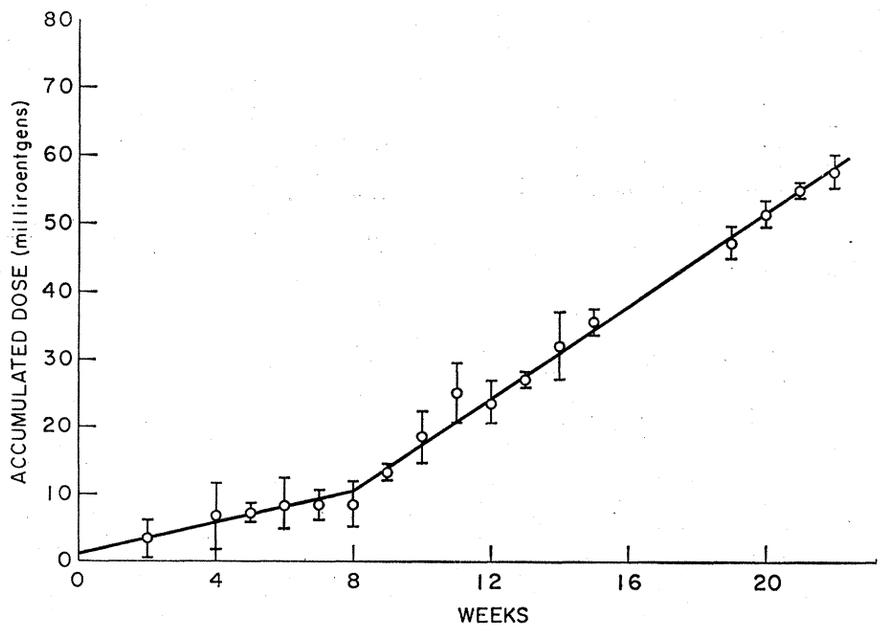

Fig. 1. The accumulated gamma exposure dose beneath the surface of oak trunks as a function of time, commencing early in March. Each bar represents the standard deviation of the mean of data for a set of dosimeters.

should be noted that the earlier measurements were made in an area away from the trees.

This investigation points up the desirable features of thermoluminescent microdosimetry for ecological radiation studies. These are: small size, low cost, ruggedness and ease of handling, reproducibility, and high sensitivity and working range, as well as long-term stability. A reasonable conclusion from this experiment is that a large increase in environmental dose rate occurs at the outset of spring growth in a forest environment with the development of foliage.

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11 January 1967

Autologous Immune-Complex Pathogenesis of Experimental Allergic Glomerulonephritis

Abstract. *A renal tubular epithelial antigen is deposited in association with gamma globulin and complement in glomeruli from rats with experimental allergic glomerulonephritis induced by immunization with renal tubular antigens. Apparently, in normal kidneys this antigen is concentrated in the distal segment of the proximal convoluted tubular epithelium, and the principal source of this antigen in the glomerular deposits is autologous. This form of glomerulonephritis provides an experimental prototype for what may be termed "autologous immune-complex" diseases.*

Immunologically induced experimental glomerulonephritides may be pathogenetically divided into two categories. Some are the result of a direct and immunologically specific interaction of antibody with glomerular antigens, whether mediated by heterologous antibody as in nephrotoxic nephritis (*1*), or by autologous antibody as observed in sheep and rabbits after immunization with glomerular basement membrane (*2*). These nephritides are characterized by linear deposits of γ-globulin and complement components along the endothelial margins of glomerular basement membranes (*3*). Others are those forms of glomerulonephritis which are the consequence of the deposition of circulating antigen-antibody complexes immunologically unrelated to the glomeruli (*4*). These are characterized ultrastructurally by electron-dense inhomogeneous deposits along the epithelial aspects of the glomerular basement membranes as well as a granular distribution of γ-globulin and complement along the basement membranes of diseased glomeruli (*5*). In the immune-complex forms of disease the antigen may be of exogenous origin (the foreign proteins in serum sickness) or autologous as proposed for the nuclear antigens in lupus erythematosus (*6*).

Among immunologically mediated experimental renal diseases, one model has a remarkable degree of similarity to certain forms of the nephrotic syndrome in man (*7*). This disease, experimental allergic glomerulonephritis induced in rats by immunization with tubular antigens (TA), is a chronic membranous glomerulonephritis manifested clinically by proteinuria, hyperlipemia, and hypoalbuminemia characteristic of the nephrotic syndrome (*8*). As in other forms of nephritis mediated by immune complexes, γ- and β_{1C}-globulins of the host are present as granules distributed along the glomerular basement membrane (*9, 10*), and inhomogeneous lumpy deposits of electron-dense material are found along the epithelial aspect of the glomerular basement membrane by electron microscopy (*11*), thus fulfilling the currently established immunofluorescent and morphologic criteria for an immune-complex pathogenesis.

A distinct relation between dose of immunizing antigen and severity of experimental allergic glomerulonephritis has been noted (*12*), and in the conventional program of induction, quite sizable amounts of antigen (2 to 5 mg) in complete adjuvant are given intraperitoneally to the rats weekly or semiweekly. This has raised the possibility that the disease might represent nothing more than a variation on chronic serum sickness in which administered foreign protein is the sole or major antigenic participant in formation of circulating antigen-antibody complexes with secondary deposition in the renal glomerulus (*10*). However, if autologous antigen participates in formation of antigen-antibody complexes, then this form of experimental allergic glomerulonephritis is an example of an "autologous immune-complex" disease.

To test this hypothesis, we used immunofluorescent methods. Antiserums to renal tubular epithelium were produced by repeatedly injecting rabbits with the ultracentrifugal sediment (78,680*g*) of a supernatant (400*g*) of sieved homogenate of rat kidney emulsified in incomplete adjuvant. This tissue fraction is referred to as fraction 1A (Fx1A) (*13, 14*). After absorption with lyophilized rat serum, liver, and supernatant (78,680*g*) of rat kidney homogenate, all of which are devoid of the specific nephritogenic antigen (*14*), the γ_2-globulin fractions of such absorbed rabbit antiserums (antibody to rat TA) were used in the indirect immunofluorescent technique (*15, 16*). In the normal rat kidney, staining was particularly strong in the inner cortical zone where the antibody to rat TA localized in the brush border and apex of the tubular epithelium (Fig. 1) which, on the basis of histologic features and location in the kidney, represents the distal portion of the proximal convoluted tubules (*17*). The antibody to rat TA reacted with neither normal glomeruli nor glomeruli in kidney sections from rats with nephrotoxic ne-