

Fig. 2. (Top) Molecular models of L-tyrosine and D(+)-phenylalanine with complementary charged groups in juxtaposition. Note the close approach of the two negative carboxylate oxygens (labeled O). (Bottom) Molecular models of L-tyrosine and L-phenylalanine. Note the separation of the carboxylate oxygens made possible by a hydrogen bond.

complementary charged groups alone were responsible for the adsorption, one would anticipate no differences among the reactants, or possibly even a stoichiometric relationship. The fact that this is not observed indicates that other factors, such as steric relationship and hydrogen bonding, must be present to supplement the initial binding of the charged groups (2).

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References and Notes

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2. I am grateful to Dr. A. Douglas McLaren for reading the manuscript and making helpful suggestions. Thanks are also due Mr. Joseph Bunata for the photographs.

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Differential Staining of Connective Tissue Fibers in Areas of Stress

During the course of investigations of age changes in connective tissues, sections of formalin-fixed human jaws and teeth were oxidized in peracetic acid for 30 minutes and subsequently stained with aldehyde fuchsin. Many fibers of the periodontal membrane stained a brilliant purple; others remained unstained (Fig. 1). The fibers that remained unstained

were birefringent and therefore are believed to be collagen. The purple-stained fibers were interspersed between collagen fibers and were not birefringent. They were round, elliptical, or flattened on cross section and varied from 3 to less than 0.5 μ in diameter, the larger ones exceeding 2 mm in length.

In the mid and apical portions of the roots of teeth, these fibers were anchored either in the cementum or bone on one end, and they frequently ramified while they followed the course of the principal fibers. It was not possible to trace a single fiber that extended from the tooth to the bone. In the area of the cemento-enamel junction, the fibers were anchored in the cementum and either curved upward into the gingiva, along with the collagen fibers, or joined with the transseptal group. In addition, at all levels of the periodontal and gingival tissues in mesio-distal sections, numerous fibers were seen, cut crosswise or tangentially; this indicated their many-directional course.

These fibers were also found in tendons (Fig. 2), in ligaments, in the adventitia of blood vessels, in the connective tissue sheath surrounding hair follicles, and in the epineurium and perineurium in the human being. In sections of tendons and ligaments they were found internally as well as surrounding the collagen bundles, taking the same course as the collagen fibers.

The fibers were found in the periodontal membranes of human beings, mice, rats, and guinea pigs and in the Achilles tendons or patellar ligaments, or both, of human beings, monkeys, mice, rats, guinea pig and a turkey. In the guinea pig periodontium, some of these fibers were flattened like a ribbon and were oriented in an apical-occlusal direction, as they were in the periodontal membranes of developing human teeth.

With the usual staining procedures, connective tissue fibers of periodontal membranes, tendons, and ligaments appear to be composed almost entirely of white collagen. Fine elastic fibers have been described in tendons (1), and a few elastic fibers are found in human periodontal membranes, associated with blood vessels and nerves and not arranged to support the teeth during mastication. The fibers described in this report do not stain with any of the elastic tissue stains and were not dissolved in formalin or alcohol-fixed sections by elastase, as elastic tissues were in comparably treated skin sections. Reticular fibers of the spleen and lymph nodes were not stained by this method, and reticulum stains did not differentiate these fibers.

Undoubtedly these fibers have been called collagen heretofore and further investigation may reveal them to be a form of collagen that develops in areas of stress. Since they were not found in

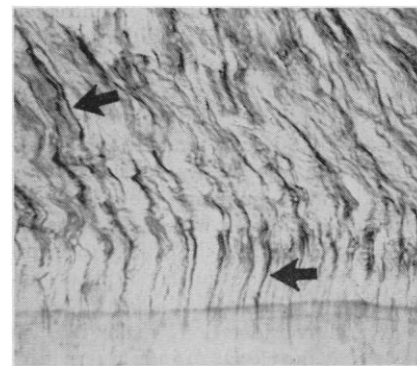


Fig. 1. Section of tooth and periodontal membrane from a white male, aged 20. Arrows point to the special fibers reacting with aldehyde fuchsin after peracetic acid oxidation. Neighboring collagen fibers are unreactive and pick up the counterstain. Horizontal band at bottom, cementum; remaining area, periodontal membrane. (about $\times 650$)



Fig. 2. Section of Achilles tendon from a white male aged 53. Arrows point to special fibers reacting with aldehyde fuchsin after peracetic acid oxidation. (about $\times 225$)

skin or in granulation tissue, it is unlikely that they are a form of procollagen or aged collagen.

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Natural and Fission-Produced Gamma-Ray Emitting Radioactivity in Soil

The gamma-ray spectrum emitted by present-day surface soil reveals the presence of several lines which do not pertain to either the thorium or uranium series or to K^{40} . These additional gamma-ray lines come from radioactive fission products in fallout, and previous investigations at Argonne National Laboratory have shown that these gamma-ray spectra may be gotten *in situ* by placing a

scintillation detector within a few centimeters of the surface of the ground (1). Due to the large amount of scattering and absorption inherent in such a massive source, little spectral detail is apparent below 0.5 Mev under the conditions of measurement specified above. However, by using a finite amount of soil and by counting under conditions of low background radiation (2), more detailed spectra may be obtained, and fairly accurate measurements of radioactivity are made possible.

In Fig. 1 the gamma-ray spectrum of topsoil collected in 1950 is compared with that of topsoil collected during Oct. 1957. Both samples were taken from the Argonne site, and the amount of soil counted was 1 kg in each case. The contemporary sample was obtained from the top 1.5 cm, whereas the older sample contained approximately the top 2 in. of soil. The spectra were taken with a 5- by 4-in. NaI crystal, canned in electrolytic copper, mounted on a DuMont 6364 photomultiplier tube enclosed in stainless steel. Each soil sample was contained in a 1-lit polyethylene bottle, 1 kg of soil constituting a right circular cylinder 14 cm high and 9 cm in diameter. A Lucite holder was mounted concentrically on top of the crystal to insure that the geometrical relationships could be reproduced. One-half inch of Lucite was placed between the flat bottom of the bottle and the crystal to absorb the 3.5 Mev beta-rays from Rh^{106} . Pulse-height analysis was carried out with an Argonne type 256 channel analyzer.

Figure 1 shows clearly three lines which are present only in the recently collected top soil. The peak at approximately 0.5 Mev is actually a combination of lines from Ba^{140} - La^{140} , Nd^{147} , Ru^{103} , and Rh^{106} . The one at 0.75 Mev is from Zr^{95} - Nb^{95} , and that at 1.6 Mev is due to La^{140} . The electronic gain is not sufficient to show the region around 0.14 Mev, but here two lines exist which are due to Ce^{141} and Ce^{144} lying in close proximity.

The pulse-height spectrum of the fallout radiation, as shown in Fig. 1, is somewhat misleading as an indicator of relative radiation dose at the earth's surface, since fallout debris is confined mostly to the surface, whereas the natural activities are rather uniformly present throughout the soil.

The dose pertaining to these various radioactive materials can be calculated by first determining the concentration available and then taking into account their distribution in depth. In order to determine the activity due to each radioisotope in soil it is necessary to break the net spectrum (fission products plus natural activity) down into its individual components. The method used is illustrated in Fig. 2 for a particular soil sam-

ple. The most energetic line is that at 2.62 Mev, due to $Th\ C''$. By using a mock soil consisting of Na_3PO_4 mixed with monazite sand of known thorium content, made up to 1 kg weight and similarly placed with respect to the crystal, the thorium spectrum may be normalized at the 2.62-Mev peak and peeled off throughout the entire spectrum. By this means the concentration of thorium in the sample was found to be 4.0×10^{-6}

g per gram of soil. The spectrum remaining, also shown in Fig. 2, has lines at 1.76 and 2.17 Mev, both of which pertain to the uranium series; by a procedure identical with that used for the thorium series, but utilizing mock soil and carnotite, the spectrum due to uranium is normalized at these energies and peeled off. The uranium concentration was found to be 5.3×10^{-6} g per gram of soil. This left the K^{40} peak at 1.46 Mev to be com-

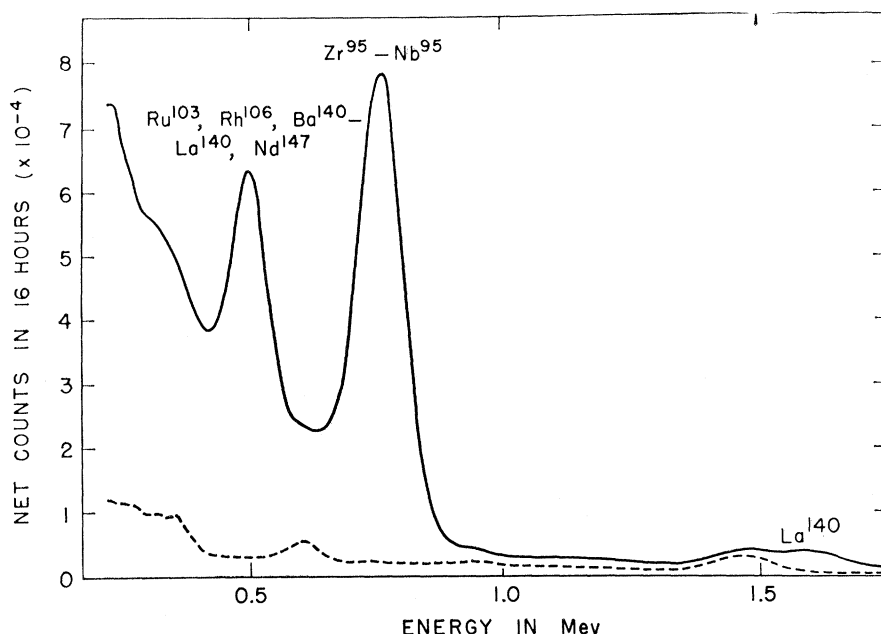


Fig. 1. Gamma-ray spectra of topsoil from Argonne National Laboratory (samples 1 kg each). (Solid line) Top 1.5 cm collected 2 Oct. 1957; counted 2 Oct. 1957. (Broken line) Top 2 in. collected 30 Aug. 1950; counted 3 Oct. 1957.

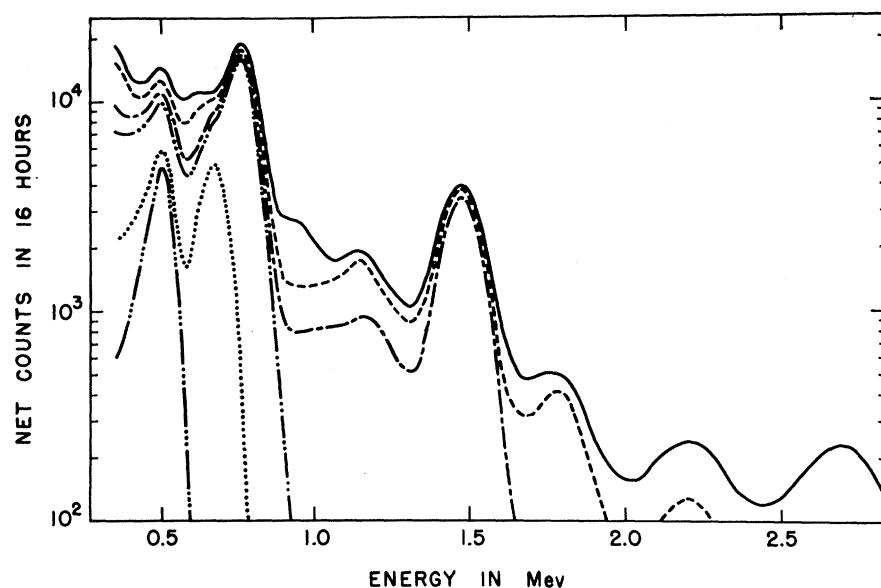


Fig. 2. Gamma-ray spectrum of top 1.5 cm of soil from Argonne National Laboratory (samples 1 kg each), collected 23 July 1957; counted 10 Oct. 1957. (—) Net spectrum (fission plus natural activities). (---) Fission products + K^{40} + U. (- · -) Fission products + K^{40} . (· · ·) Fission products only. (· · ·) Ru^{130} + Rh^{106} + Cs^{137} . (— · —) Ru^{130} + Rh^{106} .

Table 1. Gamma-ray emitting radioactivity in the ground, and the dose therefrom, at Argonne National Laboratory as of May 1957 (sample series S₁₁).

Isotope	Radioactivity		
	mc/mi ²	μr/hr	mr/yr†
U + daughters		4.02	35.21
Th + daughters		1.45	12.70
K ⁴⁰		3.32	29.08
Zr ⁹⁵ -Nb ⁹⁵	180	1.57*	3.45
Cs ¹³⁷	35	0.12	1.08
Rh ¹⁰⁶	175	0.23	1.47
Ru ¹⁰⁶	175	0.50	0.70
Ce ¹⁴⁴ -Pr ¹⁴⁴	240	0.09	0.37
Total		11.30	84.06‡

* Assuming Zr⁹⁵-Nb⁹⁵ to be in equilibrium. † May 1957 to May 1958. ‡ In this total, 77 mr are due to natural activity, the remainder arising from fission products.

pared with that obtained from 1 kg of KCl, serving as a source of K⁴⁰; normalization showed 2.27×10^{-2} g of potassium per gram of soil. The peeling off of this spectrum leaves a spectrum due to fission products alone; this, in turn, may be broken down into the components due to individual fission products, as indicated in the figure.

Soil activity profiles were taken both where grassy cover existed and where the top soil was bare. Typical findings expressed as percentages of total fission activity, indicated that 62 percent occurred in grass and other vegetation growing or lying on the surface; 27 percent in the top 1½ in. of soil; 8 percent in the layer at a depth of 1½ to 3 in.; and the remaining 3 percent at 3 to 4½ in. Similar distribution was found in soil bare of vegetation. This profile study enabled us to take samples of sufficient depth to include essentially all fallout that had accrued up to the spring of 1957.

The individual fission product activities found in a 12 by 12 in. sector of soil, 4½ in. in depth, are summarized in Table 1; these data pertain to soil collected at the Argonne site in late May 1957. The Cs¹³⁷ value is in rather good agreement with prevailing Sr⁹⁰ values for this geographic area (3) and leads one to ponder the usefulness of this technique in assaying indirectly for Sr⁹⁰ in the soil.

When the concentration of activity in the soil is known, it is then possible to calculate the dose rates. The values indicated in Table 1 pertain to a height of 3 ft above the ground. Those for uranium, thorium, and K⁴⁰ were determined by means of the method of Hultqvist (4). The dose rate of 77 mr per year, due to natural radioactivity only, agrees well with results obtained by other methods (5) and offers evidence of the essential correctness of our nondestructive tests.

In the case of the dose due to fission activities, the approach of Dunning (6) was followed—namely, the assumption was made that fallout is limited to a thin, non-self-absorbing surface layer. These are, therefore, maximum values. The dose rates in microrontgens per hour shown in the second column of Table 1, will decrease markedly with time in the case of some of the fission products. In the absence of nuclear detonations, the fallout dose accumulated from May 1957 to May 1958 will be 7 mr at 3 feet above the ground. It is of interest to note that this value agrees remarkably well with the average yearly dose estimated by Eisenbud and Harley (7) for Chicago during the period Oct. 1952 to Sept. 1955, although they used entirely different methodology. This agreement, however, does not constitute rigorous proof of the correctness of either method, for it cannot be assumed that fission debris on the ground has remained constant in that period and equal to that obtained in May 1957.

In order to rule out any question concerning radioactivity produced locally, a group of soil samples was gathered 45 miles southwest of Argonne National Laboratory in July 1957. These showed comparable fission product activities. We concluded, therefore, that the values listed in Table 1 may be considered representative for this part of the country during the spring and early summer of 1957 (8).

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8. The work described in this study was performed under the auspices of the U.S. Atomic Energy Commission.

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Visual Thresholds for Detecting an Earth Satellite

The visibility of an earth satellite of known stellar magnitude can be predicted from visual thresholds for point sources of light as measured by Blackwell (1) and by Knoll, Tousey, and Hultburt (2). The results of such calculations, together with a discussion of some problems encountered in searching for satellites, have been published by Tousey (3). This calculation was based on visual thresholds for a stationary point source of light seen against starless fields of different brightnesses. Real satellites, however, are in motion, and are often seen under full night conditions when the sky is filled with stars. For greater accuracy, it was necessary to determine visual thresholds under the latter conditions.

A satellite simulator was constructed for this purpose. Satellites of stellar magnitude 2 to 10 were produced by an illuminated pin hole and collimator. The beam from the collimator was reflected into a viewing telescope by means of a rotating plane mirror driven by a cam and variable-speed drive. In this way the satellite could be made to move horizontally at any position across the field at angular rates characteristic of earth satellites at altitudes between 200 and 1500 or more miles. Stars and a uniform sky background were introduced by reflection.

The results of the experiment are shown in Fig. 1, where the threshold magnitude of the satellite is plotted as a function of the background sky brightness. Threshold values are for a probability of detection of approximately 98 percent. The observations were made through an 8-power elbow telescope of 50 mm aperture and 53 percent transmittance. Curve A is the visual threshold relation for a stationary point source of light whose position in the field of view is known, calculated for this telescope from the data of Knoll, Tousey, and Hultburt (2). The simple theory, given by Tousey and Hultburt (4), indicates that this telescope increases the unaided eye threshold by 3.8 magnitudes, in proportion to the increased light entering the eye. The correctness of the theory and curve A were verified by using the satellite simulator to produce a stationary satellite which was viewed with and without the telescope against a field containing no stars.

Curve B is for a satellite moving in a star field. The altitude, magnitude, and angular velocity of a satellite crossing the meridian near zenith are related and are plotted on the ordinate scales of the figure for a specularly reflecting spherical satellite 20 inches in diameter. The subjects did not know where in the field of view the satellite would appear. How-