Radiocarbon From Cosmic Radiation[1]

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It has recently been suggested (*2*) that neutrons produced by cosmic radiation should form radiocarbon by the reaction $N^{14}(n,p)C^{14}$ in such amounts that all carbon in living matter (and in other chemical forms in exchange equilibrium with atmospheric CO_2 on a 5,000-year time scale) should be radioactive to the extent of 1–10 disintegrations/minute/gram. In view of the 5,000-year half-life of radiocarbon (*3*, *4*), it was further expected that it should be absent from such geologically "old" carbon sources as petroleum, coal, or limestone. The existence of such "cosmic radioelements" was anticipated by one of us (*1*) shortly after the discovery of artificial radioactivity.

These predictions were investigated by examining the radioactivity of two series of isotopically enriched samples of methane. The first series was derived from petroleum methane (referred to as petromethane) and the other from methane from the Patapsco Sewage Plant of the city of Baltimore (referred to as biomethane).

Measurements on the enriched biomethane samples established the activity of "living" carbon to be 10.5 disintegrations/minute/gram, in good agreement with the predicted value. On the other hand, enrichment of the petromethane by a factor of 25 failed to show activity beyond the limits of experimental error, in line with the theory that cosmic rays produce our activity.

The two methane thermal diffusion plants located at the Houdry Laboratories were used. Six hundred l. of biomethane were necessary to obtain about 20 l. of 12 per cent $C^{13}H_4$; these were purified in a high-vacuum system and reconcentrated to 65–70 per cent $C^{13}H_4$. Experimental values of $C^{13}H_4$ separation were used to determine the operating constants of the thermal diffusion columns. Upon extension of the separation theory to $C^{14}H_4$ concentration, the C^{14} enrichment was calculated, jointly with D. Tanguy, of Houdry's Special Projects Division, using these constants. The over-all error in the computed factor was probably about 20 per cent.

Possibilities of contamination were essentially excluded by running the plants and purification apparatus alternatively with bio- and petromethane, as indicated by the take-off dates of Table 1.

The samples were measured in a brass-cylinder Geiger counter, with glass heads, of 1,900-cc. volume, surrounded by 1.5-inch-thick lead shield to reduce the background. Alternate readings were taken at 6.5 cm. Hg pressure with the two series of samples. A standard external sample of U_3O_8 was used to check that the counter sensitivity was the same for all fillings.

TABLE 1

Source	Sample No.	Calculated C^{14} enrichment	C^{13} concentration from mass spectrometer (%)	% CH_4 in gas before final purification	Date taken	Total count rate, including background (disintegrations/minute)
Petromethane	I	1	1.04	99.6	10/16/46	340.6 ±1.0
	II	1	1.04	99.6	"	342.6 ±1.0
	III	25	6.55	97.2	1/ 6/47	345.8 ±1.3
Biomethane	III	1	1.04	99.4	12/ 5/46	342.9 ±2.0
	I	10	7.36	93.6	10/17/46	348.7 ±1.3
	VII	32	11.02	99.9	12/ 2/46	364.0 ±1.5
	VIII	260	63.5	97.2	2/10/47	562.0 ±2.9

Our data are given in Table 1. There is no significant activity in the petromethane, whereas the biomethane has a definite, easily measurable activity increasing linearly with the calculated C^{14} enrichment.

To eliminate the possibility that the activity was due to tritium, the most concentrated methane, sample Bio VIII was burned and converted to $CaCO_3$. The activity of the $CaCO_3$, as measured in a screen wall counter, established the radioactivity as carbon rather than hydrogen. Further identification of this radioactivity was obtained by a measurement of its absorption in aluminum, which agreed with that of synthetic C^{14}. The data thus establish the activity as being carried in carbon in a molecule of mass 18, present in the original biomethane in very low concentration. The agreement of the absorption data with those for C^{14} further confirms the identification of the activity with C^{14}.

The possibility that the C^{14} found in Baltimore sewage is due to contamination is not entirely excluded, although it is remote. Our sample was taken on September 2, 1946, at which time, according to P. C. Aebersold, no C^{14} from the Atomic Energy Commission had been received by anyone in Baltimore. The possibility of its origin from the atomic piles or bombs is excluded when one realizes that our activity corresponds to the existence in nature of some 10^8 curies, or 20 metric tons—an amount far larger than any synthetic source could have produced to date.

The discovery of cosmic-ray carbon has a number of interesting implications in the biological, geological, and meteorological fields; a number of these are being explored, particularly

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the determination of ages of various carbonaceous materials in the range of 1,000–30,000 years.

This investigation is continuing with other sources of carbon and is being extended to other possible cosmic radioelements. A more detailed report will be published elsewhere.

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Fowl Spirochetosis Transmitted by *Argas persicus* (Oken), 1818 From Texas[1]

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Hoffman, Jackson, and Rucker (*4*) have given a preliminary report of spirochetosis in turkeys in California in which no vector was found, although a careful search was made in all poultry houses. This spirochetosis manifested itself in a mild nature compared with that reported by various investigators in other parts of the world. The symptoms were: standing or sitting with the eyes shut, anorexia, loss of weight, and diarrhea. More severe cases walked with difficulty. In a later paper, Hoffman and Jackson (*3*) reported the pathological effects of the spirochete in fowl. The epizootiology of the disease in the flock remained unknown.

Steinhaus (*7*) reported the isolation of an unidentified spirochete from hen's eggs after inoculation with liver tissue from hens raised in Montana. This spirochete was not pathogenic for chickens—a fact which may indicate a difference from the known infectious agent of fowl spirochetosis.

Marchoux and Salimbeni (*6*) showed that the common fowl tick, *Argas persicus*, is a vector of *Borrelia anserina* (Sakharoff) (= *Spirochaeta gallinarum* Blanchard), the agent of fowl spirochetosis. This was verified by the work of Balfour (*1*) and others. The spirochete is transmitted to the progeny of an infected tick through the egg. Incubation in the fowl, when tick transmitted, takes 4–9 days before spirochetes are demonstrable in the peripheral blood. Recovery from the disease is followed by lasting immunity, but in some outbreaks in the Old World the case fatality has been from 60–90 per cent.

Cooley and Kohls (*2*) report *Argas persicus* of almost world-wide distribution in warm climates and a vector of avian spirochetosis in many Old World regions and in Brazil, Panama, and Cuba in the New World. Hungerford and Hart (*5*) showed that the common red mite of chickens (*Dermanyssus gallinae*) can serve as a vector of the fowl spirochetosis.

In the present studies a white Leghorn rooster, on which a large number of ticks obtained from a poultry raiser in El Paso, Texas, were being maintained, became very ill. Blood smears were not made at first, and later they were negative for parasites. Several hundred progeny from these ticks and a few unfed nymphs and adults were next fed on a white Leghorn pullet. A blood smear from the normal hen was negative with Giemsa stain. In 6 days the pullet was obviously ill, and blood smears were positive for spirochetes. On the 7th day many spirochetes were present in blood smears, and a few were still present in the peripheral circulation on the 8th day. After the 8th day no spirochetes were found in blood smears.

Symptoms of the spirochetosis were: jaundice, anorexia, and diarrhea, with loss of weight. The rooster exhibited symptoms of partial paralysis. Both birds tended to sit and droop the head with the eyes shut. Recovery was uneventful in each case. It is believed that this is the first finding of tick-borne avian spirochetosis in the United States.

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A Growth Inhibitor and a Growth Promotor in Sugar Cane[1]

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In connection with a study of structural development in sugar cane, a series of investigations was begun on the growth-regulating substances produced by that plant. In order to find a method by means of which the substances from all tissues of the plant, chlorophyllous as well as nonchlorophyllous, would be extracted, several methods of extraction and analysis described in the literature were tried. The results were unsatisfactory, however. When the direct ether extraction method of Boysen-Jensen was used, the chlorophylls, easily extracted from the green tissues of sugar cane, caused undesirable coagula which interfered with the accurate assay of growth substance in the *Avena* test. Van Overbeek, *et al.* (*10, 11*) applied this method to node and internode tissue of sugar cane stem, where apparently little or no chlorophyll was extracted. Furthermore, in all instances in which tissue was extracted with ether or with water, the sets of coleoptiles showed mixtures of curvatures, some positive toward the agar block and some negative. Since it was thought that such curvatures could not be averaged to give results of any significance, a series of experiments was begun to determine the source of the positive curvatures.

The presence in plants of substances which prevent the

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