somewhat similar to that elicited by tremorine (1,4-dipyrrolidino-2-butyne), but differs in several significant respects. The marked parasympathetic stimulation exhibited by tremorine is not evident; atropine and scopolamine given before or after administration of the toxin fail to prevent the tremors or convulsions. Methantheline, phenobarbital, and mephenesin also do not alter typical reactions. The unusual action of tremorine was emphasized by Everett *et al.* (*12*) who found that less than 10 of the 10,000 drugs they tested were capable of causing sustained tremors.

The tremorgenic toxin is formed during growth of *A. flavus* on oats, millet, rice, potatoes, or corn and is produced in considerable quantities when the fungus is grown on cracked, moistened corn at room temperature for 2 to 3 weeks. Very little or none of the toxin was detected on samples of timothy hay and peanut meal inoculated with this organism. The peanut meal is, however, quite suitable for the production of aflatoxin by strains of *A. flavus* which synthesize these hepatotoxins.

Strain QM 6738 of *A. flavus* characteristically forms numerous dark sclerotia which contain the toxin. Chloroform extracts of the conidia, however, do not contain detectable quantities. Production, extraction, and preliminary purification were accomplished by methods similar in some respects to those described for the hepatotoxin of *Penicillium rubrum* (*13*) and the aflatoxins of *A. flavus* (*14*), followed by chromatography on two successive columns containing layers of silica gel, florisil, and alumina. Florisil was used for selective removal of several blue and purple fluorescent materials in the crude extract. None of the substances was capable of causing tremors or convulsions in mice. Each step in the purification procedure eliminated significant quantities of nontremorgenic extract components.

On thin-layer silica gel plates developed with 3 percent methanol in chloroform, the tremorgen was associated with a nearly colorless spot which appeared as a dark area under ultraviolet light at about R_F 0.7 to 0.8. This differs from aflatoxins which fluoresce with a bluish-purple or green color when viewed on chromatograms. The toxin spot assumed a visible yellowish-brown color in 48 to 72 hours. If the material is sufficiently concentrated, a nonspecific brown color may be produced immediately after development by spraying with *m*-dinitrobenzene. A series of six or more successive thin layer chromatograms was required to eliminate all but the one spot attributed to the toxin. Some loss of toxin, attributable in part to incomplete separation of extract components on column and thin-layer chromatograms, occurred during purification.

The toxic residue, extracted with chloroform from thin-layer plate scrapings, was a yellowish-brown solid at room temperature. The addition of petroleum ether to a concentrated chloroform solution precipitated light yellow, amorphous, plate-like particles. These were readily soluble in several polar and nonpolar solvents but were only slightly soluble in petroleum ether and cyclohexane. Attempts are being made to obtain sufficient material for more extensive investigations.

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17 February 1964

Radioiodine Metabolism in Children and Adults after the Ingestion of Very Small Doses

Abstract. *One day after oral ingestion of very small doses (about 0.01 microcurie) of an I^{131}/I^{125} mixture, the radioiodine content of the thyroid gland was similar in children and adults (about 20 percent of the dose ingested) as was the biological half-life of the iodine (about 90 days). Measurements were made in 15 minutes by means of a whole-body counter with a cylindrical sodium iodide (Tl) crystal, 20 cm in diameter and 10 cm thick.*

Radioiodine released by nuclear explosions can reach the food chain, become deposited in the human thyroid gland, and increase the radiation dose this organ normally receives. To estimate this dose one requires knowledge of the retention of radioiodine by the thyroid gland as a function of time. Data on children are scarce, partly because of the reluctance of experimenters to use traditional tracer techniques on the growing and (presumably) more radiosensitive thyroid gland; for such techniques, doses of up to 25 μc of radioactive iodine must be ingested. However, we devised recently a new, highly sensitive technique which makes possible the use of very small doses of tracer (about 0.01 μc). By this method we have shown that the percentage of the dose of radioactive iodine administered which is present in the thyroid gland 1 day later is similar for children and adults. A preliminary description has been given (*1*); we describe it briefly in this report.

We use a large NaI (Tl) crystal of the type generally used for estimating radioactivity in humans (*2*). Our crystal, which measures 20 cm in diameter and is 10 cm thick, has a 0.0127-cm aluminum entry window which admits radiation of low energy. It is placed a short distance (8.2 cm) from the subject's neck to increase sensitivity. At this distance, however, uncertainty of the depth of the thyroid in the neck can produce a significant error. To determine and to correct for this, a double tracer technique was developed. A mixture of I^{131}, with a half-life of 8 days (emitting mainly 364-kev γ-rays), and I^{125}, with a half-life of 60 days (emitting mainly 27-kev x-rays) was administered orally, nominally 0.01 μc of each. Because of this

difference in energy, the radiations have markedly different attenuation in tissue (that is, half-thickness of 6.3 and 2.2 cm of water, respectively); the relative attenuation gives a measure of thyroid depth. This relationship was established quantitatively by using polystyrene neck mockups similar to the standard mockup described by Brucer (*3*). The tissue overlying the thyroid was simulated by layers of lean beefsteak pressed to uniform thickness and frozen to the contour of the neck mockup. The subject is measured twice, first with the thyroid gland unshielded and then with a thyroid-eclipsing lead shield. The first measurement includes not only thyroid radioiodine, but also non-thyroidal radioactivity. The second measurement determines background radiation from the room or the subject (that is, non-thyroid); the thyroid-eclipsing shield, as described by Brucer (*3*), is placed between the crystal and the subject, thereby shielding the thyroid area. The subject is made to recline in a tilting chair so that the head is tipped back, fully exposing the thyroid area (Fig. 1). To quiet the children during this 15-minute count, a small television set is mounted above the crystal in such a way that good viewing requires that the head be kept in the desired position.

Table 1 shows a summary of the results we obtained with children and adults; all were Los Alamos residents. The percentage of the dose present in the thyroid gland 1 day after it was administered orally was similar for both children and adults; in eight apparently normal children, ranging in age from 4 to 10 years, the average retention of radioiodine was 20 percent (the actual range was 10 to 29 percent), and in eight apparently normal adults the average retention was 23 percent (range 16 to 30 percent). Biological half-lives of the radioiodine were also similar; the average value for the eight children was 84 days (range 59 to 163 days), and the average value for the six adults (*4*) was 108 days (range 26 to 212 days). Thus, there is little if any difference between these children and adults in the two parameters of thyroid function. If a generalization can be made from these results, then equal doses of I^{131} will produce a greater amount of radiation in the thyroid gland of children only because the child's thyroid is smaller. Further, the radioactive content of the thyroid gland at 1 day is about 20 percent of the ingested dose, rather than 30 percent as indicated by the Federal Radiation Council (*5*).

The experimental data obtained with I^{125} were fitted to a simple exponential function of the form, $R_t = R_0\, e^{-0.693\, t/T_B}$, where R_t is the retention at time t, R_0 is the retention at $t = 0$, and T_B is the biological half-life; a least-squares best fit code was used (*6*). The values of the two parameters and their standard deviations are included in Table 1.

The results for the three adolescent subjects (Nos. 9, 10, and 11) are included in Table 1 because their I^{131} retention during the first week after ingestion was also measured by a different technique developed by Lushbaugh (*7*), in which a whole-body liquid scintillation counter, Humco II, was used. They received larger doses (about 0.5 μc) which are customarily used with Humco II. The results obtained with the Humco II for 1 day after ingestion were 19, 15, and 15 percent, respectively. Agreement with the values shown in Table 1 is satisfactory and perhaps surprisingly good, considering the great difference in method.

The corrections for unknown thyroid geometry derived by the double tracer dose affected the retention results substantially. In the case of the data for I^{131}, the correction ranged from 1.08 (for subject 1) to 1.40 (for subject 10). As would be expected, the correction factors for I^{125} are larger, being 1.20 and 2.65 for the same subjects.

Table 1. Retention of radioiodine in the thyroid glands of children and adults.

Subject No.	Age (yr)	Sex	Weight (kg)	I^{131} retention (%) at 1 day	Computer fit to I^{125} data	
					R_0 (%)	T_B (days)
			Children			
1	10	F	32	24	24.6 ± 0.6	80 ± 11
2	7½	M	30	24	24.3 ± 0.6	60 ± 5
3	6½	F	19	29	29.2 ± 0.7	59 ± 5
4	4	F	16	23	23.0 ± 0.5	73 ± 8
5	7½	M	29	19	19.5 ± 0.5	163 ± 38
6	5½	F	19	20	20.8 ± 0.8	84 ± 18
7	8½	M	25	10	10.4 ± 0.4	78 ± 17
8	7½	M	22	11	11.4 ± 0.2	77 ± 8
			Adolescents			
9	12	M	76	16	17.1 ± 0.7	142 ± 47
10	14	F	54	16	15.3 ± 1	90 ± 49
11	13	F	68	15	15.0 ± 0.2	73 ± 7
			Adults			
12	26	M	90	18	18.0	See ref. (*4*)
13	26	M	82	25	26.0	See ref. (*4*)
14	44	M	71	30	—	133 ± 12
15	26	M	70	23	—	212 ± 44
16	38	M	74	23	—	117 ± 72
17	46	M	86	23	—	69 ± 9
18	39	M	123	27	—	91 ± 17
19	45	M	88	16	—	26 ± 2

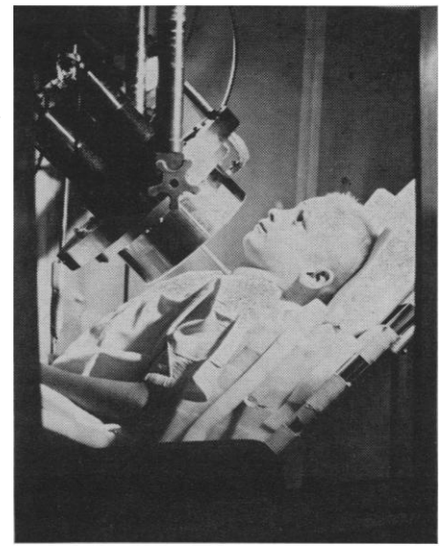

Fig. 1. Subject in tilting chair during thyroid count.

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8. This work was performed under the auspices of the U.S. Atomic Energy Commission.

2 January 1964