and at 3 weeks is already below 70 percent. At $-93° \pm 2°C$ a satisfactory recovery and survival are maintained for periods of at least 6 months, as shown in 13 transfusions.

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4. This work was carried out with funds from the Army Medical Research and Development Board and with the aid of a grant from the National Advisory Heart Council of the National Institutes of Health. We acknowledge the technical aid of Jean Bentz.

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Ionium-Thorium Chronology in Deep-Sea Sediments of the Pacific

Abstract. The ratio of ionium to thorium varies exponentially with depths in deepsea sediments of the Pacific Ocean and gives rates of accumulation of the order of millimeters per thousand of years. Surface values of the ratio were not constant over the eastern Pacific Ocean. This observation may result from differences in thorium isotope concentrations in near bottom waters which furnish these isotopes to the sediments.

The method of ionium-thorium chronology (*1*) of deep-sea sediments is based on the simultaneous removal of ionium (Th^{230}, $t_{1/2} = 80{,}000$ years, a member of the U^{238} radioactive series) and thorium (Th^{232}, $t_{1/2} = 1.4 \times 10^{10}$ years) from the water to one or more of the mineral components of the deposits. The critical assumptions for the application of the method follow. (i) The Io/Th ratio has remained constant in the waters adjacent to the sediments over the time intervals involved. (ii) The chemical species of Io and Th in the sea water are the same, and these isotopes have identical distributions among them. (iii) The analyzed materials do not contain detrital materials, of continental or volcanic origin, with significant contributions of Io or Th. This method appears preferable to the previous method of radium chronology (*2*) inasmuch as the observed diffusion of radium from the decay site of its parent ionium can invalidate any age determinations (*3*).

Table 1. Ionium-thorium ratios in three cores from the Eastern Pacific Ocean (Capricorn 50BG—latitude 14° 55'N, longitude 124° 12'W, 4270 m; Chinook 11—latitude 49° 39.5'N, longitude 177° 39'W, 4850 m; Downwind 49HG—latitude 42° 02'S, longitude 98° 01'W, 4350 m). The ratios are given in terms of disintegrations of Io per disintegration of Th per unit time.

Depth interval in core (cm)	Io/Th ratios		
	Capricorn 50BG	Chinook 11	Downwind 49HG
0–4	30	16	35
4–8	23	18	26
8–12	16	11	19
12–16	9.0	10	5
16–20	8.4	7.0	2
20–24	6.1	6.2	
24–28	5.3	4.4	

The isotopes of Th were isolated from sediment samples by previously described methods (*4*) and subsequently plated on a 1-in. platinum disc. Preferential solution of the nondetrital matter was accomplished with hot, concentrated hydrochloric acid. The principal detrital minerals, quartz and feldspars, were insoluble and were discarded following centrifugation. The recovery of the Th isotopes from the samples was determined with UX_1 (Th^{234}), and yields varied between 50 and 98 percent. The plated Io and Th were readily differentiated and quantitatively assayed with an alpha-ray spectrometer, a Frisch screen-grid ion chamber being used as a detector. The dominant alpha energies of Io and Th are 4.6–4.7 and 3.98, respectively (*5*).

Preliminary analyses (*6*) of a number of Eastern Pacific deep-sea cores have emphasized three significant results. First of all, exponential decreases in the ratio with depth have been observed in 10 of the 12 cores analyzed. Two South Pacific cores had values of the ratio that were both low and essentially invariant with depth. Whether such results indicate a lack of deposition over the last few hundred thousand years or a loss or disturbance of the upper section of the core during the handling has as yet not been determined. Table 1 gives typical analyses on three cores collected by expeditions of the Scripps Institution of Oceanography.

Secondly, determinations of the recent rates of accumulation of these Eastern Pacific clays, made on the basis of these data and of the half-life of ionium, are remarkably uniform, with values for the Capricorn, Chinook, and Downwind cores of 1, 2, and 1 mm per 1000 years, respectively, in the upper 10 cm. A dramatic drop in the Io/Th ratio, corresponding to nearly 2 half-lives of ionium over a few centimeters' distance, is observed in the Downwind core. Such a change has been observed in but one other core, also from these southerly latitudes.

Finally, *the surface ratios* fall into two distinct groups: a set in the region between the Aleutian Islands and Hawaii with values averaging about 15 and a second group, in the region between longitude 120° and 140°W and latitude 40°N and 40°S, with a ratio varying around 35. The cores given in Table 1 are representative of such groups. The isotopes of lead show a similar distribution pattern (*7*).

These results can be interpreted on the basis of the assumption that the deep-oceanic water masses, which are in contact with the sediment surfaces, furnish these isotopes to the sediments. Hence, these two regions should have circulating, overlying water masses which possess values for the Io/Th ratio which are similar to those found in the surface layers of the sediment deposits. The distinctive isotopic composition of thorium in a given water mass probably reflects the weathering processes responsible for the introduction of thorium and uranium into the water mass and the inorganic and biochemical processes in the ocean that cause their removal.

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5. A description of the plating techniques and instrumentation is in preparation.
6. This report is a contribution from the Scripps Institution of Oceanography. This study was sponsored by the Office of Naval Research under contract with the University of California.
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Radio Control of Ventricular Contraction in Experimental Heart Block

Abstract. This report describes a method for the stimulation of the ventricular myocardium by transmitting the stimulus over a radio-frequency carrier which is demodulated by a radio receiver enclosed within the animal's chest. The method can be applied in conjunction with experimental heart block.

Experimental heart block combined with electrical stimulation of the myocardium is a valuable technique in the study of the physiology and the pathology of the circulatory system.