earth's upper atmosphere in a compact, gravitationally stable mass, which was broken up by differential drag during the last few orbits before the tektites fell. The fall would thus closely resemble the phenomena of the meteor procession of 9 February 1913, for which Chant (*6*) and others postulated a nearly circular satellite orbit around the earth. Breakup of the larger bodies of this shower was directly observed.

A nearly circular satellite orbit will have one or two sections, which might be called "active regions," from which meteorite falls are likely to occur. If the orbital eccentricity is greater than the earth's ellipticity (about 0.003), the body will approach the earth most closely at perigee. If the orbit is very nearly circular, the closest approach will be at the nodes, because of the equatorial bulge.

At any instant, the falls from the active region will occur along an arc of a great circle, where the orbit reaches its lowest point in the atmosphere. In the case of the 1913 shower, this seems to have been the region from about Port Huron, Mich., to Wilkes-Barre, Pa., according to the work of Chant (*6*) and Mebane (*7*); detonations were heard in this region.

Within a few minutes, however, the earth will turn perceptibly under the active region; and thus the strewn field will be widened in longitude. Mebane records one direct observation of this phenomenon by the weather bureau at Alpena, Mich.

It is interesting to notice that this hypothesis furnishes a natural explanation of the fact noted by Beyer (*8*) that in the Indo-Malaysian fall, the tektites of Cambodia are much larger than those of the Philippines. The larger tektites should have a smaller ratio of drag to mass, and thus would be found west of the smaller tektites because they stayed up longer.

The explanation in terms of sedimentary rocks proposed by Barnes and Urey is difficult to reconcile with the almost total absence of water.

The explanation in terms of interstellar swarms postulated by Kohman (*9*) encounters the difficulty that once the particles had reached a state of rest, in contact with one another, the mass would be dense enough to be gravitationally stable, and would thus arrive undispersed at the earth's upper atmosphere. The limit of stability in the neighborhood of the earth is about 10^{-6} gm/cm^3. Kohman remarks that the presence of aluminum-26 and beryllium-10, in concentrations comparable with those found in stony meteorites, excludes the possibility of origin from the moon. The half-lives of these nuclides are, however, 10^6 and 2.6×10^6 years, respectively. It follows that if the tektites spiraled down to the earth in a compact swarm over a period of 10^7 years, as I have postulated, there would have been sufficient time to build up a near-equilibrium concentration such as that found by Kohman.

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Induced Growth of Diapausing Silkworm Embryos in vitro

Abstract. Fully diapausing silkworm embryos (*Bombyx mori* L.) ordinarily never reach the stage of appendage formation when they are cultured singly in hanging drops. However, when they are cultured side-by-side with nondiapausing embryos, they survive longer and some even achieve appendage formation.

Embryos from fully diapausing eggs of the silkworm *Bombyx mori* do not grow in vitro even when they are cultured in an extract of nondiapausing eggs in which nondiapausing embryos grow well (*1*). This is interesting in view of the fact that spermatogonia and spermatocytes from diapausing pupae of the Cecropia silkworm can be induced to grow and differentiate by in vitro culture in the blood of nondiapausing individuals (*2*). This difference in response may reflect some basic natural difference between pupal and embryonic diapause —that is, diapause in the pupal and in the egg state.

I have had a special interest in the mechanism of termination of diapause in insects, not only from a theoretical standpoint but also from that of practical needs in sericulture, and I have recently observed during in vitro culture experiments that fully diapausing silkworm embryos grow when they are cultured side by side with nondiapausing embryos in a hanging drop.

The results of side-by-side culture experiments carried out in 1958 are summarized in Table 1. Hanging-drop cultures were made in accordance with methods described previously (*1*), except for side-by-side explanation of embryos. The egg extract used for a culture medium was prepared from diapausing eggs stored at 5°C 2 days after deposition. In this medium nondiapausing embryos showed good growth when cultured singly, and all but two of 50 embryos reached the stage of appendage formation within 7 days, while 72 of 83 diapausing embryos cultured alone died within 5 days without attaining appendage formation. These are results one would expect from the data published previously. A noticeable finding evident in this table is the appreciable growth, or at least increased survival, of diapausing embryos cultured side-by-side with nondiapausing embryos. In 53 of 65 such side-by-side cultures, diapausing embryos survived for more than 5 days, and in nine they reached the stage of appendage formation. This improvement in growth, or increase in survival, cannot be attributed solely to coexistence of two or more embryos in one culture, because culture of two diapausing embryos in a drop had no effect on growth or survival; in all of seven such cultures the embryos died within 5 days. In the side-by-side cultures it was not necessary for diapausing embryos to come into contact with nondiapausing embryos for

Table 1. Induced growth of diapausing embryos through side-by-side culture.

Item	No. of embryos per culture				
	1 Non-diap.	1 Diap.	2 Diap.	1 Diap. with 1 nondiap.	1 Diap. between 2 nondiap.
No. of cultures	50	83	7	60	5
				65	
Death within 5 days	1	72	7	12	0
				12	
Survival more than 5 days	49	11	0	48	5
				53	
Appendage formation	48	0	0	9	0
				9	

growth to occur, though it seemed necessary for the two embryos to be close to each other. In cultures in which the medium either had been "conditioned" by having nondiapausing embryos cultured in it for 2 days or had been prepared from nondiapausing eggs at the stage of appendage formation, there was no sign of increase in survival or growth of diapausing embryos (*3*).

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Partitioning of Body Water in Sea Lamprey

Abstract. Measurements were made of the partitioning of total body water in the sea lamprey, *Petromyzon marinus,* between intracellular and extracellular compartments and the division of the latter into interstitial fluid and plasma. The apportionment of body water in agnathans is very similar to that in elasmobranchs, and both of these primitive groups differ from what is known of the more advanced teleosts.

Until a recent study of the fluid compartments of Chondrichthyes (*1*), only the body water partitioning of mammals, among the vertebrates, had received more than passing attention. Existing studies of body fluid measurements on nonmammalian vertebrates have been reviewed by Martin (*2*), Prosser and Weinstein (*3*), and Sturkie (*4*). For the class Agnatha, apparently the only fluid compartment measurement on record is that made by Welcker (*5*), who measured the blood volume of a single sea lamprey, *Petromyzon marinus.* The smaller variety of this species found in the Great Lakes has been used in this study for measurement of the fluid compartments of a representative agnathan (*6*).

Details of the methods employed have been described elsewhere (*1*). Briefly, known quantities of Evans blue (T-1824) and sucrose were injected simultaneously by cardiac puncture into the bloodstream of lampreys anesthetized with tricaine methanesulfonate, also known as M.S. 222-Sandoz (*7*). Over a period of 25 to 30 minutes, which allowed for complete circulation of the dye, samples of blood were drawn to make colorimetric comparison of the diluted dye with standard solutions for calculation of plasma volume. After a longer period (40 to 235 minutes), to allow filtration and complete equilibration of the sucrose in the plasma and interstitial (tissue) fluid, blood samples were drawn for similar calculation of the space occupied by the sucrose, which should approximate the extracellular fluid volume. The employment of more than one sample in each case allowed extrapolation of optical density readings to zero time, thus revealing the hypothetical volume before inevitable losses of dye or sucrose had taken place. The animals were dried completely in an oven at a temperature of 105°C for determination of total body water.

Twelve complete sets of results are summarized in Table 1. The animals were all of fairly large size for the freshwater variety in the Great Lakes. Four were male and eight female, but consistent differences were not detected, so sex has been disregarded. All volume values are expressed as percentages of body weight, although the original measurements were in milliliters. Specific gravity of plasma was used in converting volume to percentage of body weight for plasma and extracellular fluid, and specific gravity of blood was used for the same purpose in blood volumes. The hematocrit reading was used to calculate whole blood volume from plasma volume.

The only comparison that can be made with previous work on agnathans is with the single blood volume determination made by Welcker (*5*) on the marine variety of the sea lamprey. His value, 4.16 percent of the body weight, was about one-half of the present mean for 12 animals (8.5 percent, with a range of 6.5 to 10.9). Although this low figure may stem from an extreme individual variation, or from differences in technique, it more likely reflects the inverse relationship between relative blood volume and body size demonstrated in elasmobranchs by Martin (*2*). No effect of size is evident within the range employed in this study. No check over a large size range was possible, for the largest lamprey available weighed less than one-fourth as much as Welcker's specimen (261 g versus 1094 g). The possibility remains that there may actually be a difference in the body fluid partitioning between the marine and fresh-water varieties, possibly associated with the salinity of the habitat.

When the fluid measurements of the lamprey are compared with those of *Squalus acanthias* (*1*), a remarkable similarity becomes evident. The 75.6 percent body water of the lamprey and 71.7 percent of the dogfish are apportioned among the fluid compartments, respectively, as follows: intracellular water, 51.7 and 50.5; extracellular water, 23.9 and 21.2; interstitial water, 18.4 and 15.7; plasma, 5.5 and 5.5; whole blood, 8.5 and 6.8. Since the plasma volumes are identical, the higher blood volume of the lamprey can only be a reflection of its higher average hematocrit value (33 percent cells) than that of the dogfish (18.2 percent).

The similarity of the fluid compartments of these two relatively primitive groups is striking in view of the very low values obtained by those who have measured the plasma or blood of the more advanced teleost Osteichthyes (*2, 3, 5, 8*). The values for the latter range from about 1 to 4 percent of the body weight, with an average of approximately 2 to 2.5 percent. The only published figure for extracellular fluid in teleost fish is that of 4.0 percent (Prosser and Weinstein, *3*) obtained with the use of NaCNS in the yellow bullhead, *Ictalurus natalis.* Extensive data accumulated but not yet published by myself will raise that figure appreciably, but it will not approach that of *Petromyzon* or

Table 1. Summary of data on fluid volumes of 12 sea lampreys.

Measurement	Mean value for 12 animals	Range	Standard deviation
Weight (g)	190.0	154 to 261	9.05
Length (cm)	46.0	42 to 50	0.66
Respiration rate (per minute)	122.0	80 to 178	7.51
Pulse rate (per minute)	31.0	24 to 44	1.65
Specific gravity, plasma	1.018	1.017 to 1.019	.0002
Specific gravity, blood	1.040	1.034 to 1.048	.0014
Hematocrit (percentage of cells)	33.0	28 to 37	.87
Plasma volume* (T-1824 space)	5.5	4.1 to 7.3	.32
Blood volume*	8.5	6.5 to 10.9	.43
Extracellular fluid* (sucrose space)	23.9	20.0 to 28.7	.79
Interstitial fluid* (sucrose space minus plasma)	18.4	13.6 to 21.8	.66
Total body water*	75.6	73.7 to 79.8	.51
Intracellular fluid* (total water minus sucrose space)	51.7	46.3 to 58.0	.90

* Expressed as percentage of body weight.