which leads to the appearance of an interaction *exchange* energy (Heisenberg's *Austausch*) between proton and neutron, quite in the same way as Coulomb interaction can be conceived as arising from the birth and absorption of a photon in the case of two electrons. Instead of e^2/r one gets here an interaction of the order g^2/chr^5, which is easily verified dimensionally. The exact calculations were first carried out by Prof. Ig. Tamm, who also insisted on development of this method. With $g \sim 10^{-50}$ (the computations were carried out by V. Mamasichlisov), which value is required by the empirical data on heavy radioactive bodies, we get an interaction energy of a million volts, not at a distance of 10^{-13} cm. but only at $r \sim 10^{-15}$ cm., which is inadmissible. We may ask about the value of r, which would give a *self-interaction* energy of the order of the proper energy of a heavy particle. This value is of the order 10^{-16} cm., which is that of the classical radius of a proton.

The appearance of these small distances is very surprising and can be removed only by some quite new assumptions. Fermi's characteristic coefficient g appears to be connected also with distances of this order of magnitude.

D. IWANENKO.

Physical-Technical Institute,
Leningrad.

[1] cf. D. Iwanenko, *C.R. Ac. Sci. U.S.S.R.*, Leningrad, 2, No. 9, 1934.

Barium in Ancient Glass

THE recent interesting exhibition of Chinese glass and beads—the property of the Royal Ontario Museum, Toronto—at the Courtauld Institute (University of London), arranged by Prof. Yetts, prompts us to put on record the results of some work we have done on ancient beads and the presence of barium in them.

The more ancient of the specimens exhibited—for the most part beads—are derived from graves (likely to be known in future as the Han Chün graves) near the village of Chin Ts'un in Honan. Careful consideration by Prof. Pelliot of the circumstances of their discovery leads him to place the date of these graves, and therefore of the beads, in the second half of the third century B.C. In China in 1929, and later by correspondence, we were able to collect a number of beads so closely resembling those of Han Chün that they may well have come from that site, and may definitely be regarded as of the same period and make. Struck by the weight of a number of these specimens, we proceeded to compare their specific gravity with beads of 'Mediterranean' origin, and when we found this generally higher a number of analyses were performed. It is not now our purpose to discuss our conclusions, but simply to direct attention to the following results:

	Specific gravity	Analysis	
Blue glass bead with white inlay (Fig. 1)	3·57	SiO_2	41·9 per cent
		PbO	24·5 ,,
		BaO	19·2 ,,
		CaO	4·5 ,,
		Fe_2O_3 } Al_2O_3 }	4·4 ,,
		Alkalis	4·5 approx.
		CuO	trace
Glass ear ornament ..	3·5	Contains 10 per cent mixed calcium and barium oxide; of this an appreciable amount is barium oxide.	

The ear ornament is of the type sometimes known as 'capstan bead', and there is good evidence for regarding it as of Han date (202 B.C.–A.D. 221).

In modern times barium glass was not made until about 1884, when it was one of the new glasses with a high refractive index and low dispersion put on the market by Messrs. Schott of Jena, nor have we any knowledge of any ancient glass or bead containing barium.

We do not suggest that the ancient Chinese used barium purposefully in their glass—no doubt it was present in the material from which the glass was made; we do, however, consider that its presence may in the future allow of the determination of origin of beads in certain doubtful cases, and thus have some value in questions of early culture contacts between West and East; indeed it was the study of these that led us to our discovery.

FIG. 1. Bead of Han Chün type. Natural size.

It must not, however, be supposed that all Chinese glass of a high specific gravity, or all Han glazes, contain barium. Dr. F. M. Brewer, who has kindly examined by arc spectroscopy two specimens of Chinese glass and a piece of typical green Han glaze, reports that "there was not in any of them any barium either as main or minor constituent". Of the two pieces of glass, one of T'ang age (A.D. 618–907) has specific gravity 2·5, the other—believed to be of this period—a specific gravity of more than 5.

H. C. BECK.
C. G. SELIGMAN.

Rapid Growth-Rate and Diminishing Heterogony

A STUDY of relative growth in the pistol-crab, *Alpheus dentipes*[1], has disclosed an interesting modification of the simple heterogony law, as expressed by the relation $y = bx^k$, where y and x are magnitudes of organ and body respectively, and b and k are constants, k representing the coefficient of growth-partition between organ and body[2].

This relation may hold over very long periods—for chela-weight in fiddler-crabs, for example, apparently during a two-hundred-fold increase in total weight[2]. The principle, however, may be modified in various ways. One modification in particular may be mentioned here, namely, that found in the mandibles of Lucanidæ. Here, in the upper part of the absolute size-range, the actual values for organ-size fall progressively further below the expected values. This has been interpreted as due to growth occurring in a closed system, namely, the pupa: if the heterogonic organs are very large, they will not be able to complete their growth before the rest of the body has appropriated most of the reserves of nutrient material[3].

Something analogous appears to occur in the chelæ of *Alpheus*. In males (for brevity's sake the only sex considered here) between the smallest and largest classes of the size-range 3–10 mm. carapace length, the small (nipper) claw has a greater growth-partition coefficient than the much larger (crusher) claw ($k = 1·22$ as against $1·19$)[1b]. When all the class-means are considered, however, the log-log curve, instead of being a straight line, is concave down-