

## LANDSTUHL 2 $\pi$ HUMAN COUNTER

### 1. Measurement of Cesium-137 and Potassium

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The 2  $\pi$  liquid scintillation counter which was designed and built at the Los Alamos Scientific Laboratory for demonstration at the Second International Conference on the Peaceful Uses of Atomic Energy has been in operation at Landstuhl, Germany for a little more than one year.

The US Army Medical Research Unit, Europe was activated for the specific purpose of operating the counter. Under the supervision of F. Newton Hayes and with the assistance of Alexander Pfau the counter was reassembled at its present location in May 1959.

Briefly, to review some of the characteristics of the counter; it is designed so that the subject walks into the counter and stands erect during the measuring process. The tank is six feet high and is filled with 280 liters of terphenyl-POPOP in triethylbenzene. There are six photomultiplier tubes, sixteen inches in diameter, which are inserted directly into the tank without windows. The shielding is composed of lead three inches thick (1).

One of the primary uses of the counter has been to survey the European population for their cesium-137 content. At the same time, the potassium is also determined by measuring the potassium-40.

In order to make an accurate determination of the quantity of these two isotopes, calibration is the primary requisite. Fortunately, both of these isotopes are fairly well uniformly distributed throughout the human body. Therefore, the calibration standards were prepared by placing a known amount of each isotope in plastic bottles filled with

distilled water. Our initial calibration efficiency factors were based solely on weight. Bottles of uniform diameter and twelve inches high were placed one on top of the other in the position which was to be occupied by the subject. The efficiency graphs thus obtained are shown in Fig. 1 and 2.

It is obvious, however, that height is of some importance. Unfortunately, not everyone who weighs 150 or even 190 lbs has the same or similar geometry. Some 190 lbs individuals are tall and thin, others of that weight are not tall and obviously not thin. To apply the same efficiency factor to both individuals can cause more error than we would like.

Therefore, the present calibration method was introduced. Isotope containing plastic bottles of six different diameters were used, thereby obtaining efficiency points for six weights each at heights from 3 feet to 6 feet 4 inches. These were obtained at 2 inch intervals. By applying calculus, Dr. Oberhausen was able to calculate an accurate calibration factor based on each subject's height as well as his weight. Fig. 3 and 4 were prepared from the efficiency charts thus obtained.

An examination of this data shows that identical net counts per second in two subjects of the same weight - one tall and thin; the other short and fat - can result in differences of up to about ten per cent in the calculated amount of the isotope present.

The potassium concentration levels plotted in Fig. 5 were obtained using our latest method of calibration. The lines represent the findings reported by Anderson and Langham (2) while the points are our results. Higher values found during adolescence with gradual decreasing levels among the older age groups were noted at both Los Alamos and Landstuhl.

Unfortunately, the newer method of calibration has not yet been applied to our cesium measurements. Fig. 6 shows the distribution of our first one thousand German residents. The average level was 80  $\mu\mu$  curies cesium-137/gm potassium.

#### References:

- (1) E.C. Anderson, F.N. Hayes, R.D. Hiebert, *Nucleonics*, 16, 106 (1958)
- (2) E.C. Anderson, W.H. Langham, *Science*, 130, 3377 (1959)

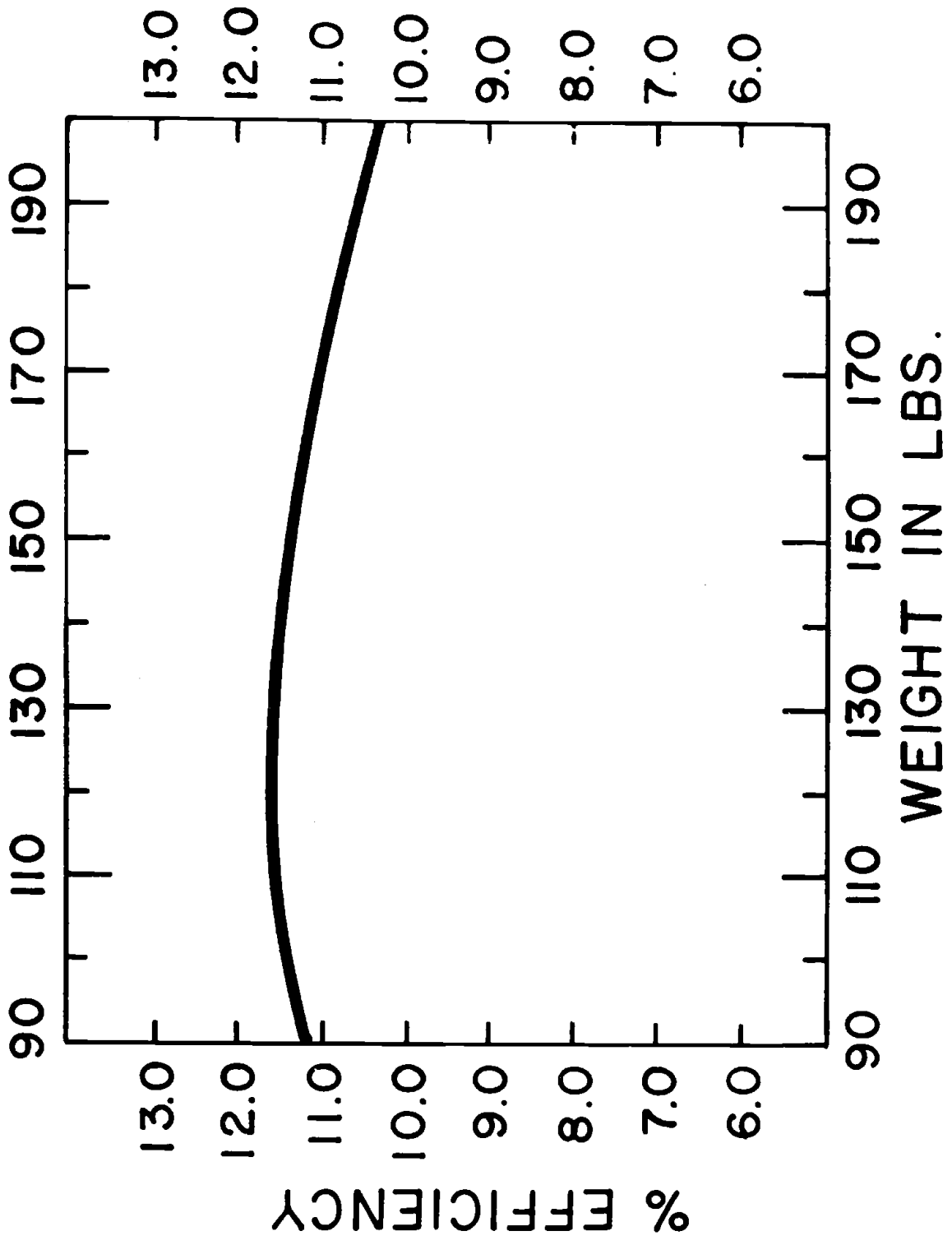


Fig. 1. Cesium<sup>137</sup> efficiency versus weight.

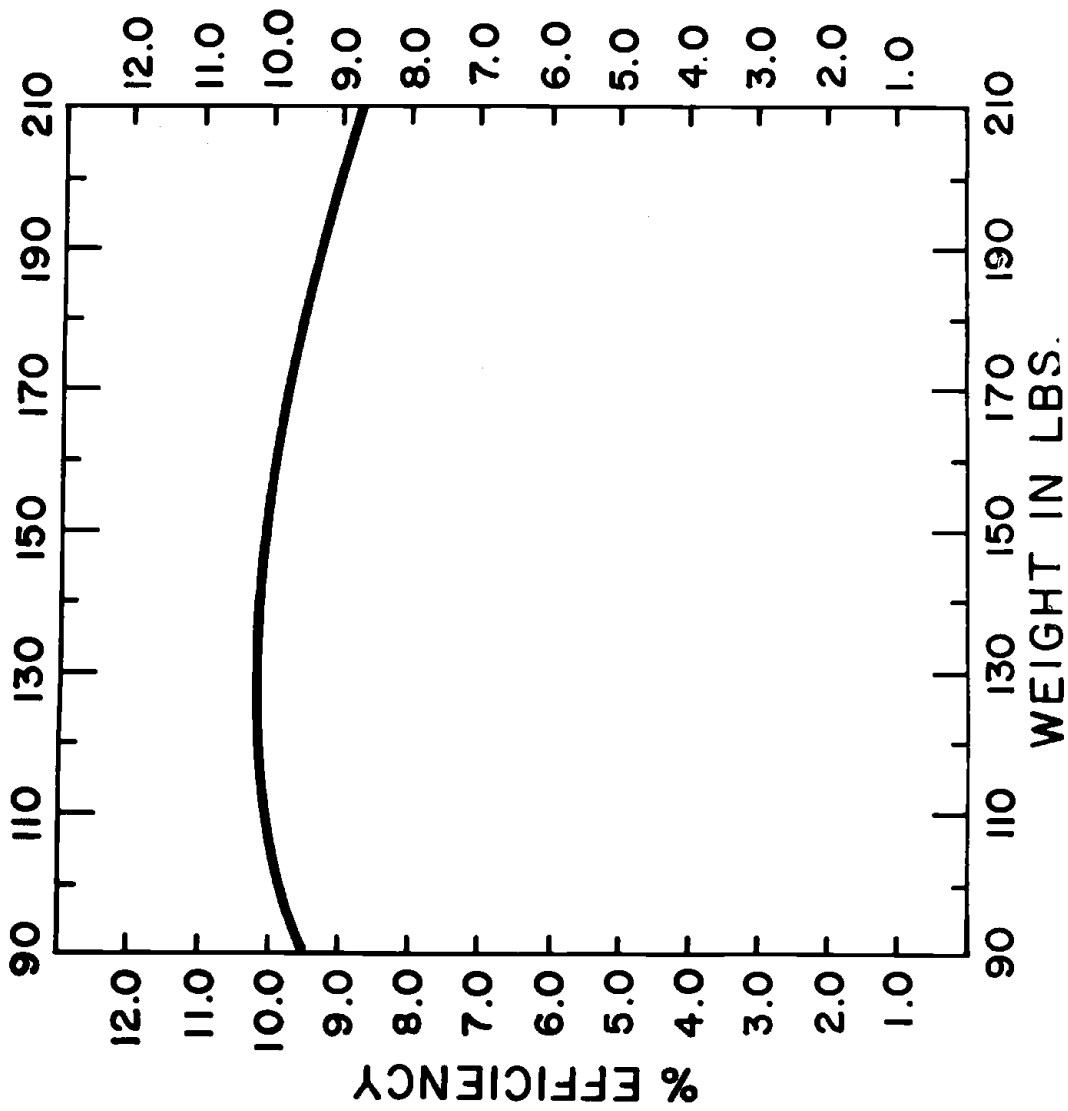


Fig. 2. Potassium<sup>40</sup> efficiency versus weight.

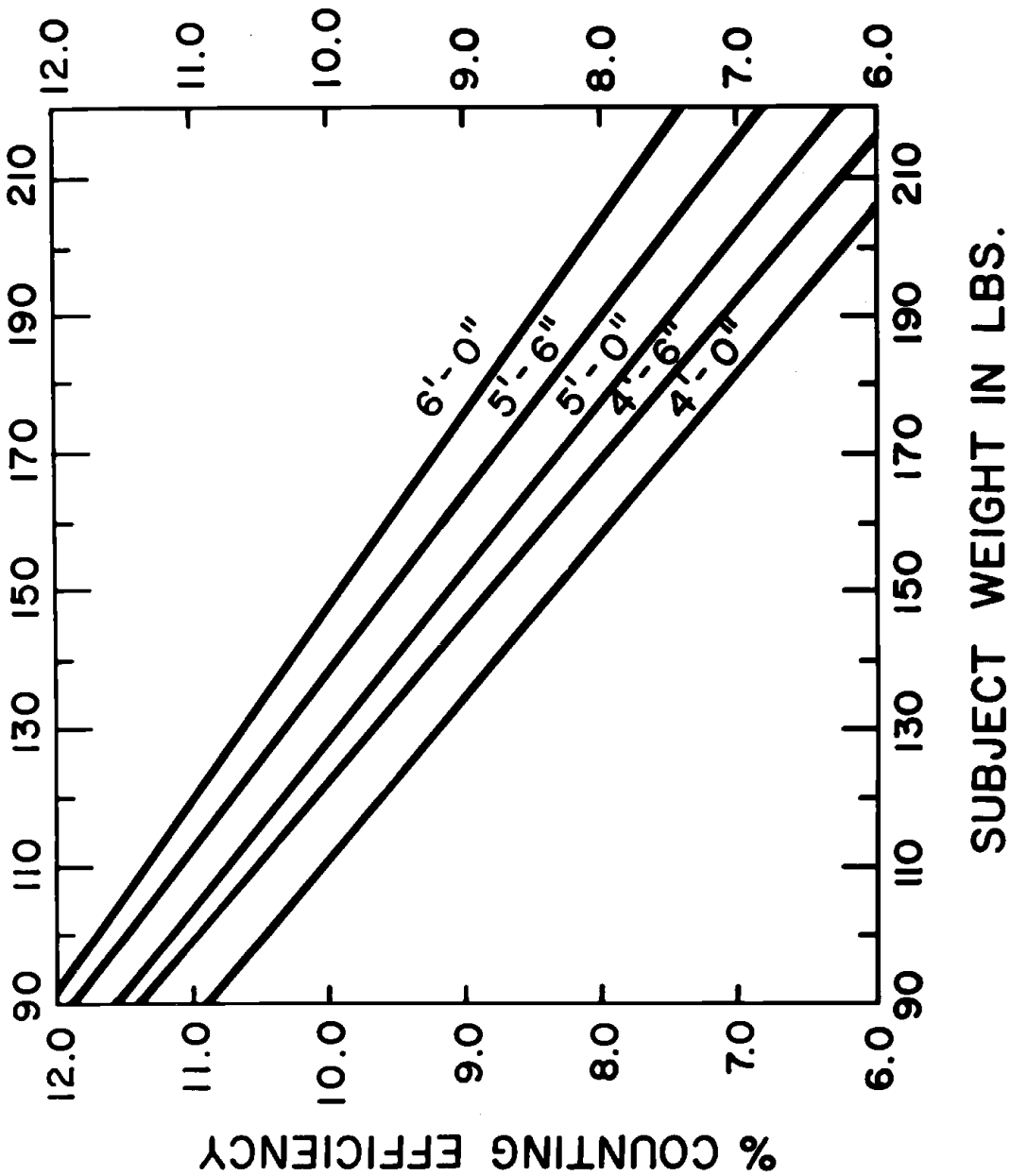


Fig. 3. Cesium<sup>137</sup> counting efficiency versus subject's height and weight.

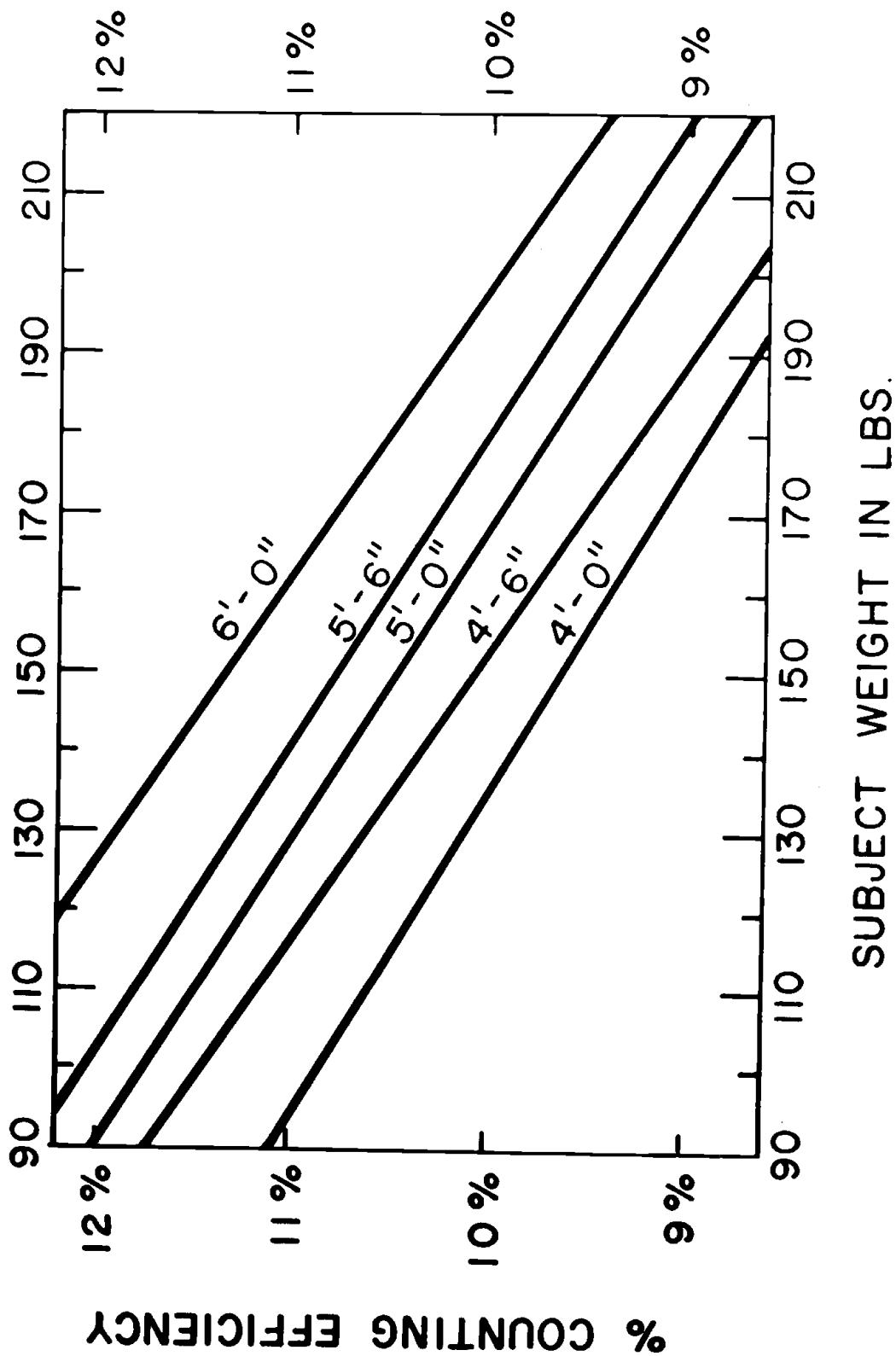


Fig. 4. Potassium<sup>40</sup> gamma counting efficiency versus subject's height and weight.

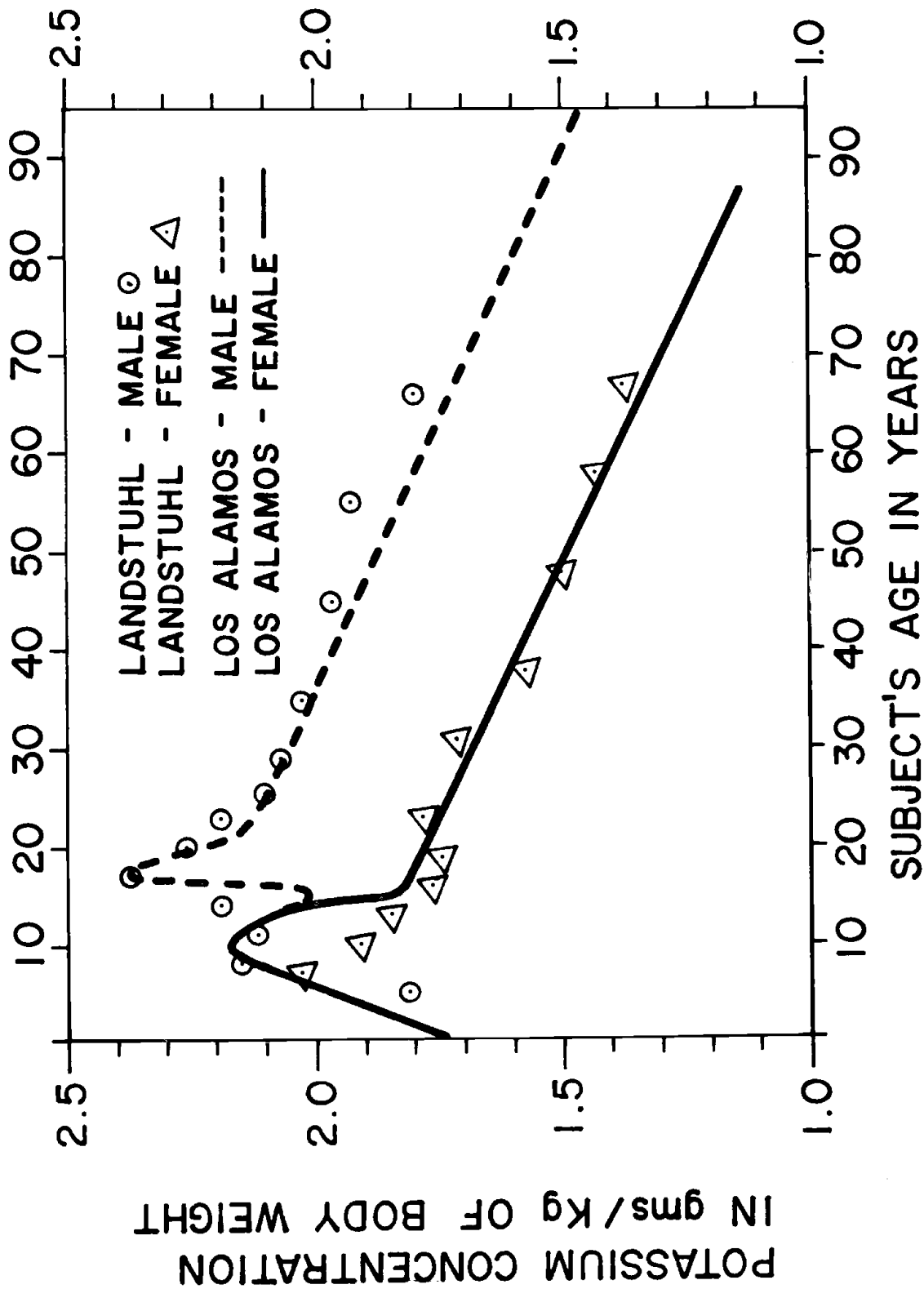


Fig. 5. Potassium concentration in gm/kg of body weight versus age.

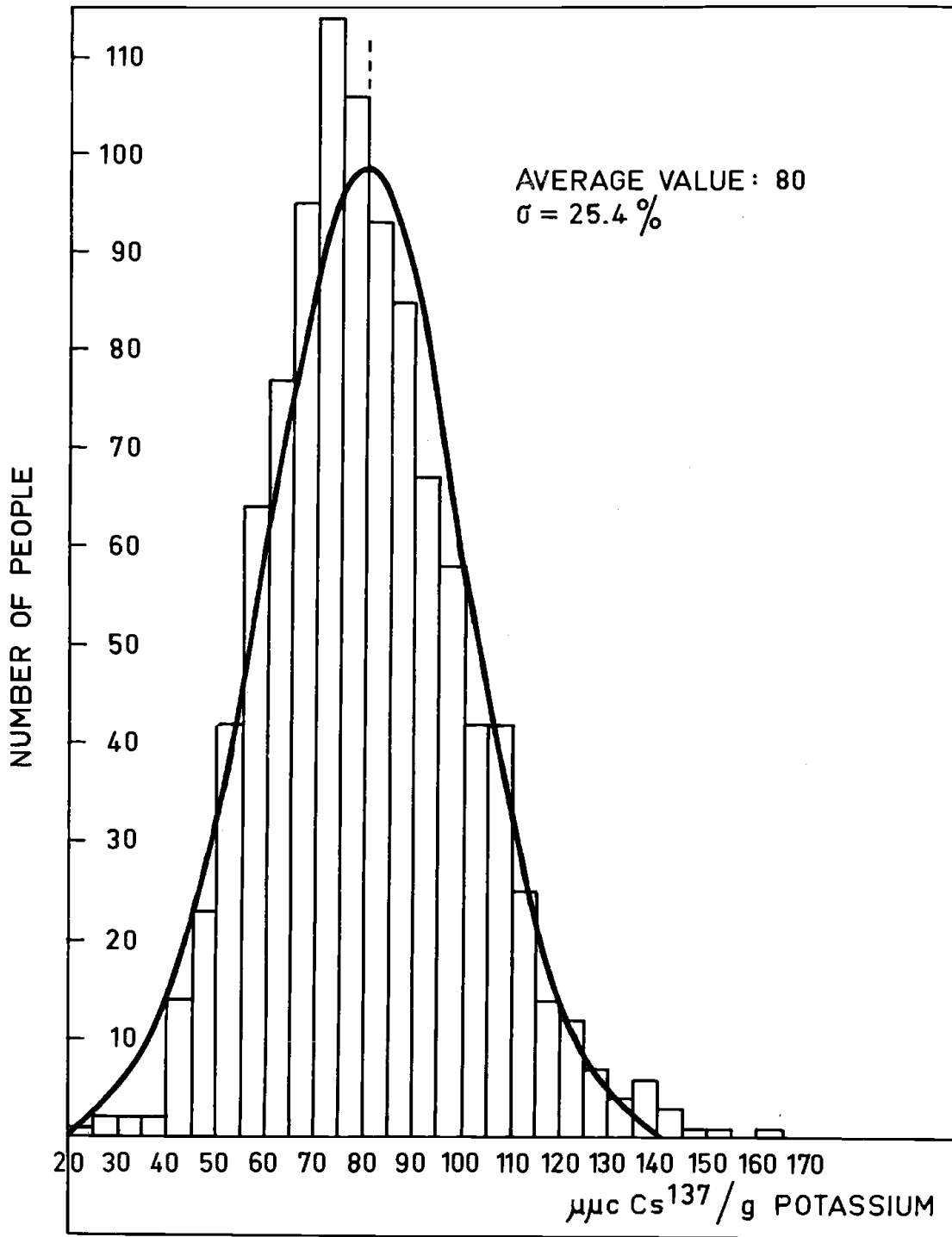


Fig. 6. Distribution for males and females in  $\mu\mu\text{c Cs}^{137} / \text{g}$  potassium.