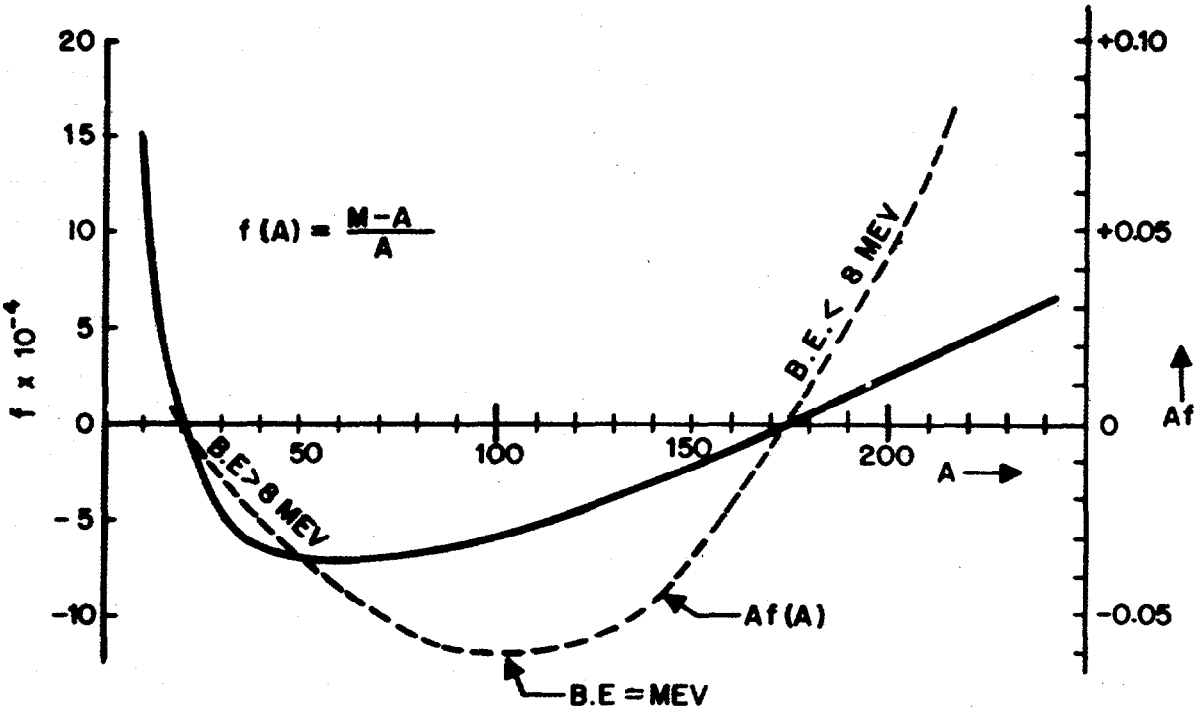

Figure 15. Packing Fraction.

The packing fraction can be determined from mass spectrometric data, solid curve of Figure 15. It can be seen that the packing fraction is slowly varying over all the stable nuclei except the very light ones.

It is possible to use the observed packing fraction curve to determine any regular variation of the binding energy with atomic number. Solving equation (3-3) for M(A) and writing the corresponding equation for M(A + 1), the atomic weight when A is increased by one yields:

$$\begin{aligned} M(A) &= A\,[1 + f(A)] \\ M(A+1) &= (A+1)\,[1 + f(A+1)] \\ \Delta M &= M(A+1) - M(A) = 1 + (A+1)\,f(A+1) - Af(A) \end{aligned} \qquad (3\text{-}4)$$

The ΔM is the increase in atomic mass if one neutron (or proton) is added. Subtracting this from the average mass of neutron and proton, 1.0085, gives the binding energy of the added particle:

$$\begin{aligned} 1.0085 - \Delta M &= .0085 - [(A+1)\,f(A+1) - Af(A)] \\ &= .0085 - \frac{d}{dA}[Af(A)] \end{aligned}$$

Writing the difference as a derivative makes it possible to estimate the binding energy by observing the slope of the function Af(A). The broken line in Figure 15 shows how Af(A) varies with A. Where Af(A) has a zero slope the binding energy of a neutron (or proton) is .0085 mass units or 8 Mev; where the slope is negative the binding energy is greater than 8 Mev, where positive it is less than 8 Mev. The minimum occurs near A = 100.

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