From the observations reported above, the following facts emerge: (i) the dianion does not show any change on REE. The temperature and solvent shifts are normal. (ii) for cation the emission spectra at low temperature show emission corresponding to the neutral species on REE and lifetime and intensity of the phosphorescence also changes, (iii) there is a large shift in ν_{max} at intermediate temperature for a particular frozen solution which also varies with λ_{exc}, (iv) there is a large Stoke's shift in the cation emission which is not present in the dianion. This shift is viscosity dependent and (v) while there is very little shift (200 cm^{-1}) in absorption spectrum, the emission spectra change in some cases by about 2320 cm^{-1} between 287 K and 80 K. All these seem to suggest that the spectral shifts on REE, temperature, viscosity and solvent are due to proton transfer from the cation to either a surrounding water molecule in the solvent cage and/or to outside the cage. Probably the small shift in boric acid glass or as observed at intermediate temperature (800 cm^{-1}) is due to a proton jump to the solvated water molecule and the large shifts of 2300 cm^{-1} may be due to the diffusion out of the cage. It may be mentioned that the pK value of the dianion does not change to any appreciable extent while cation becomes acidic in the exicted state. Further work is in progress.

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TRENDS IN (*n*, γ) CROSS-SECTIONS

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ABSTRACT

The experimental data on (*n*, γ) reaction at neutron energies of 30 keV, 300 keV and 3 MeV have been examined for the possible persistence of "shell effects".

So far no attempt has been made to see whether shell effects remain unaffected as the neutron energy increases. In the present work the experimental data on (*n*, γ) reaction at neutron energies of 30 keV, 300 keV and 3 MeV have been examined for possible shell effects.

Large discrepancies in the experimental results reported by different groups of workers might put a limit to the establishment of neutron shell effects. That is why we have taken cross-section values from graphs given in recent BNL report[1] along with 15% error. This choice of error limit ensures us the reliability of σ (*n*, γ) values as this limit covers the range of clusters of experimental points (through which, curves have been drawn in BNL report). To examine the shell effects we have chosen the experimental data on (*n*, γ) at 30 keV, the neutron energy at which a large number of measurements have been made with a pulsed Van-de-Graaff accelerator using Li (*p*, *n*) reaction at threshold. Many activation measurements have also been made at 23 keV with Sb–Be photoneutron source, and these results have been extrapolated to 30 keV by a ~ 15% reduction in capture cross section. It is apparent from Figs. 1 and 2 that the experimental data on (*n*, γ) at 30 keV show separate systematic trends with neutron number for even and odd-Z nuclei. The odd-Z nuclei, generally limited to two isotopes exhibit pronounced minima at the magic neutron numbers N = 20, 50, 82 and 126. A similar effect is observed for the even-Z nuclei but

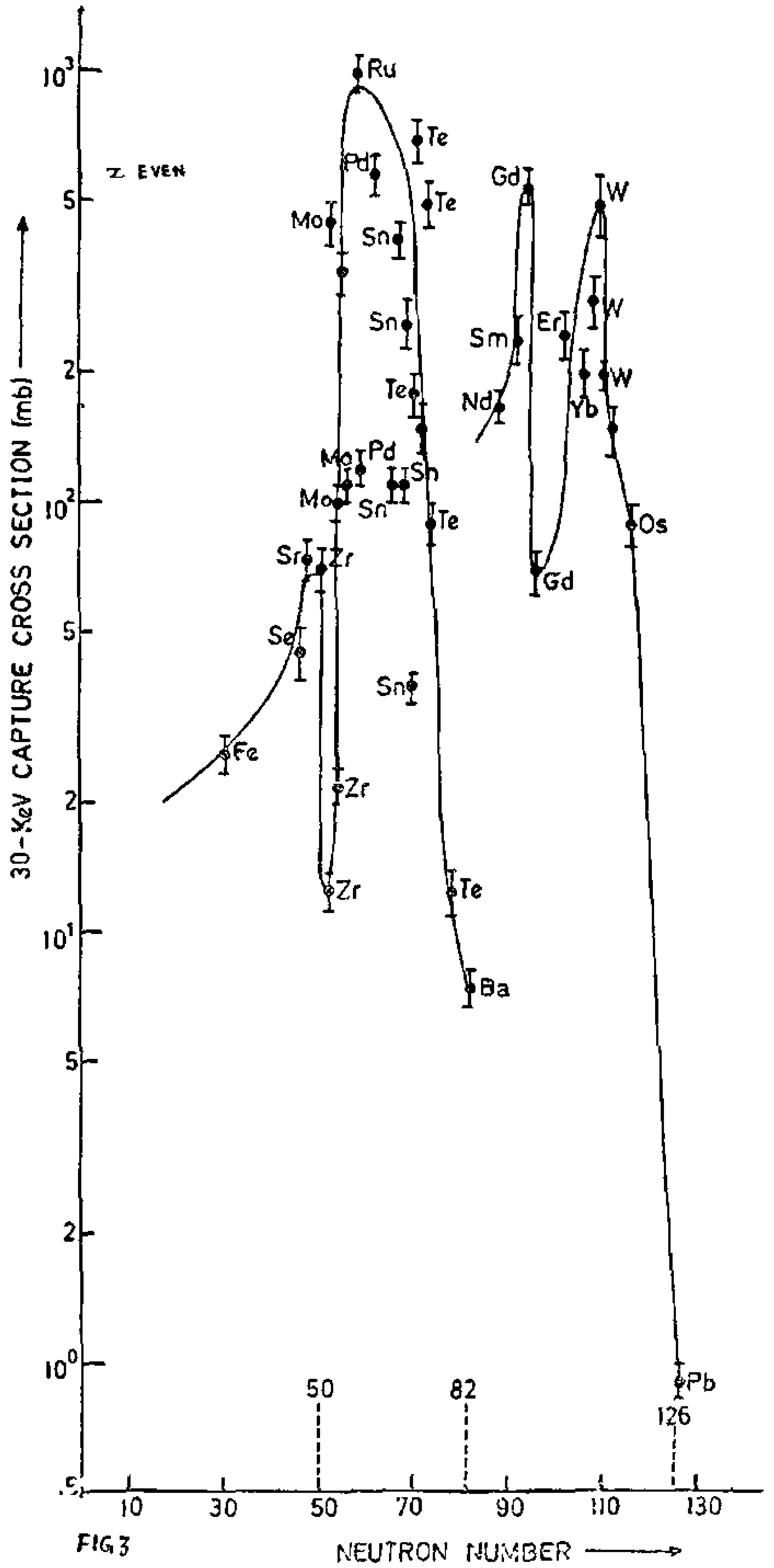

Fig. 1. σ_{exp} at $E_n = 30$ keV for even Z nuclei *vs.* neutron number N.

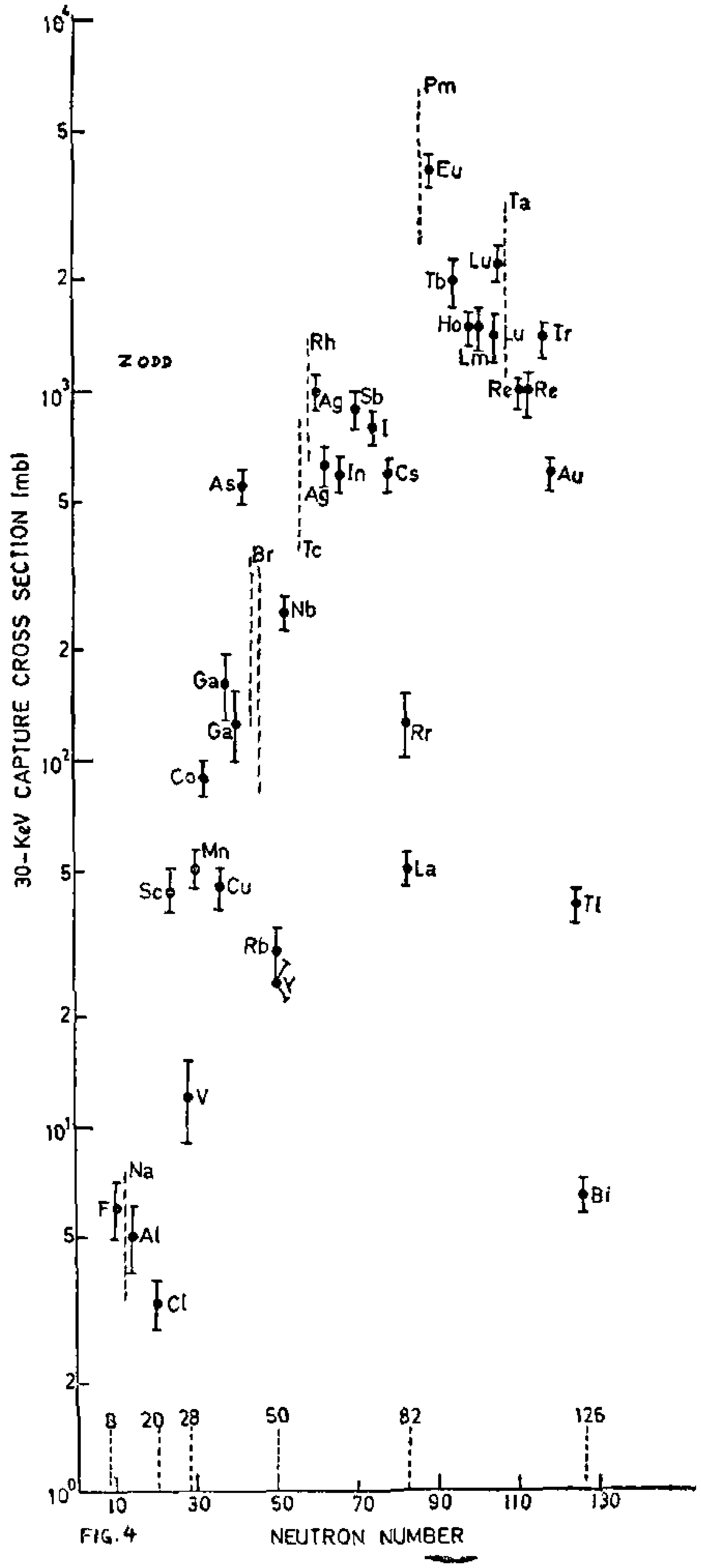

Fig. 2. σ_{exp} at $E_n = 30$ keV for odd Z nuclei *vs.* neutron number N.

less pronounced because of complex situation as a result of large number of isotopes. Isotopic cross-sections at 300 keV (wherever they are available) are plotted against neutron numbers for odd-Z nuclei. The cross-sections are seen to increase immediately after neutron shell is filled. A nucleus containing a closed shell of neutrons (20, 50, 82 and 126) would be expected to show a low binding energy for an additional neutron, a low excitation energy after neutron capture, a small level density; and hence a low capture cross-section. In contrast to the marked minima at N = 20, 50, 82 and 126 the magic neutron number 28 appears to have little effect on cross-sections in keV region.

It was thought worthwhile to see whether the shell effects remain unaffected as the energy (E_n) increases. In pursuit of this goal we have also plotted the cross-section for odd-Z nuclei at 3 MeV against neutron number. It is clear from these figures (1–4) that shell effects are clearly apparent at low energies (upto 300 keV) but seem to be on the verge of disappearing at high energies (≳ 3 MeV). The knowledge of level

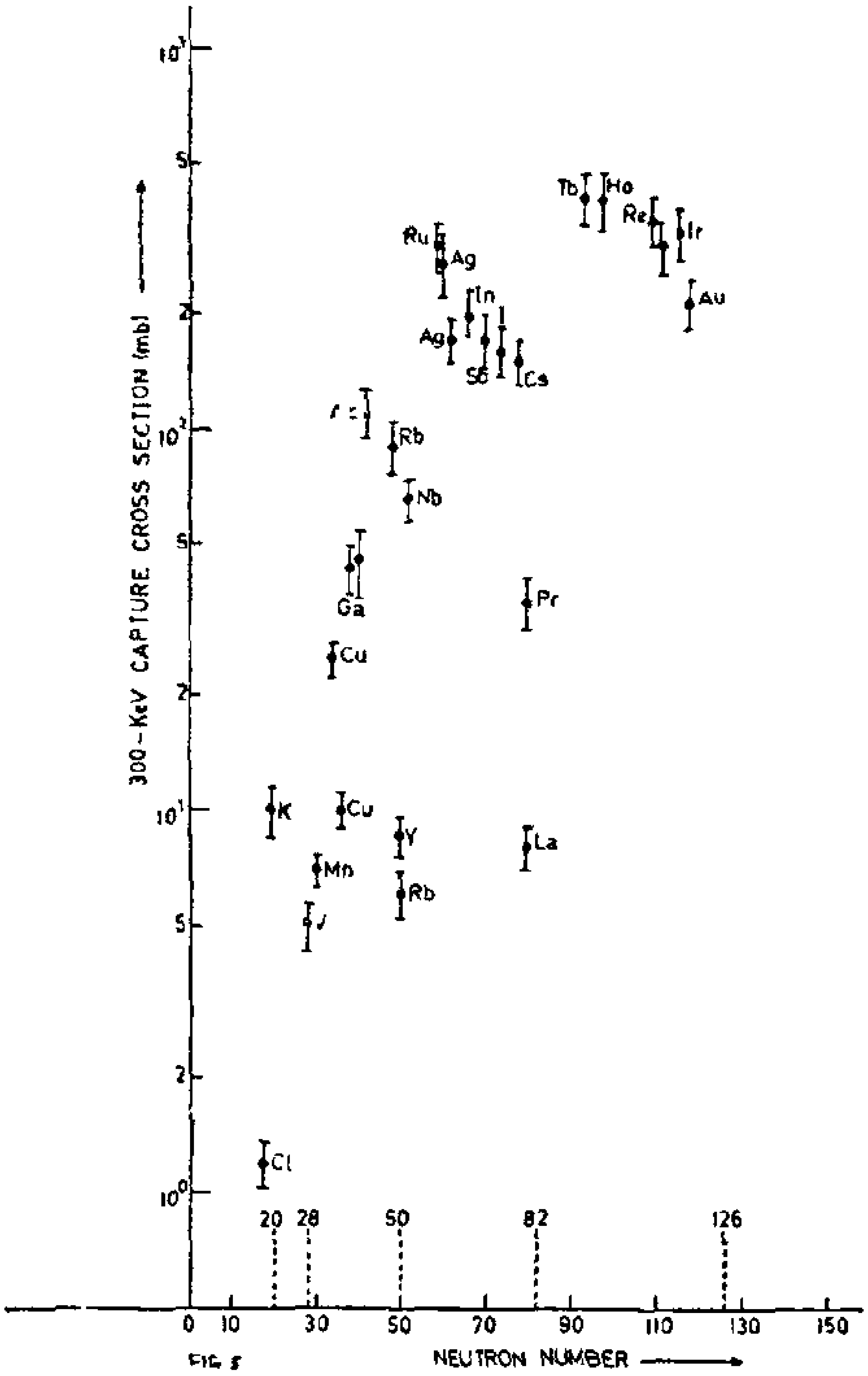

FIG. 3. σ_{exp} at $E_n = 300$ keV for odd Z nuclei *vs.* neutron number N.

density plays an important role in the statistical theory of nuclear reactions. The decreasing tendency of observed shell[1] effects in (n, γ) data, if interpretable within the framework of statistical theory, may also be due to the fact that at high excitation energy shell effects on level density tend to disappear[2].

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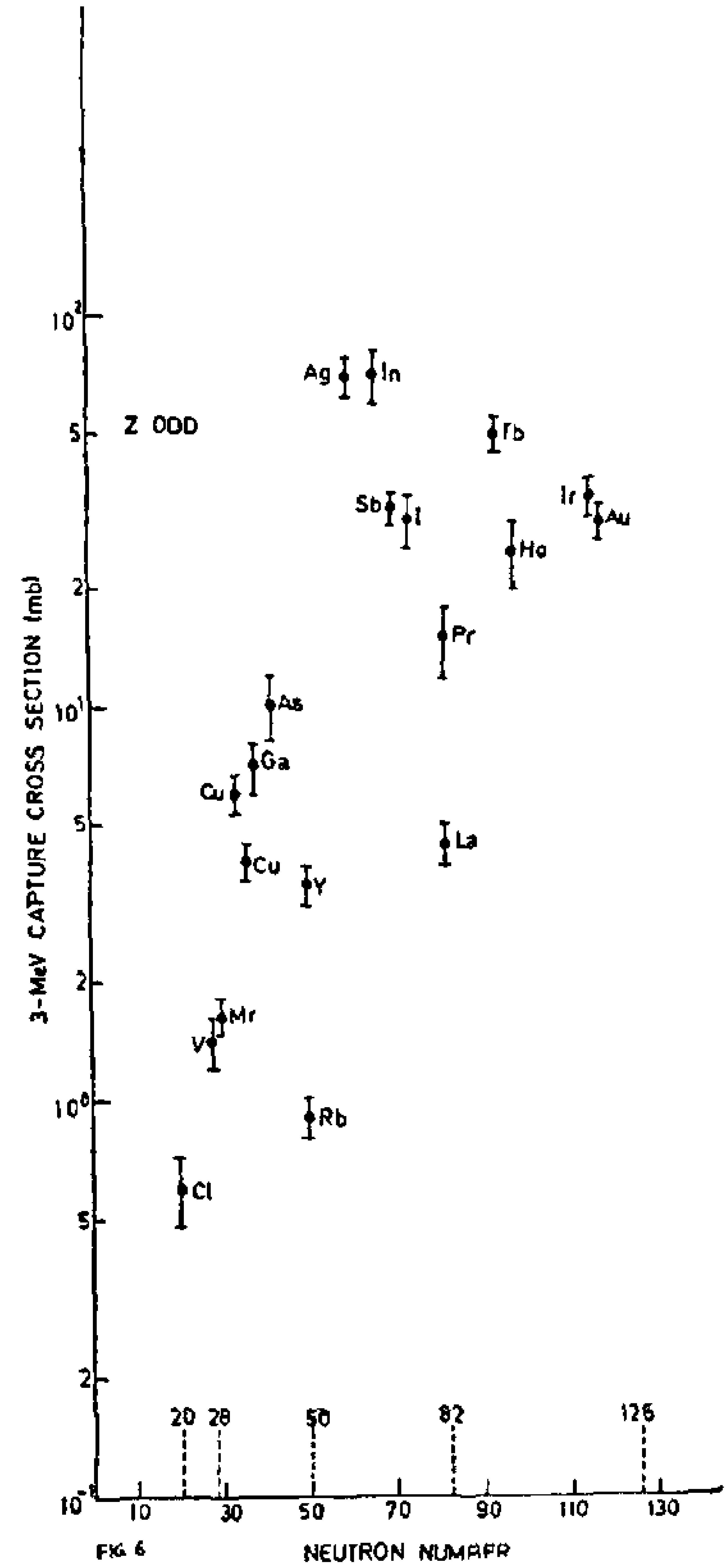

FIG. 4. σ_{exp} at $E_n = 3$ MeV odd Z nuclei *vs.* neutron number N.

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