Capture of slow neutrons by silver, gold and antimony
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The present thesis deals with the resonance absorption of slow neutrons. The apparatus used for the production of the neutrons is a cascade accelerator (Chapter I). Deuterium ions obtained in a high tension source (40 kV) are accelerated in two stages of 200 and 300 kV respectively. Now two improvements were made on the apparatus. First the vacuum tubes of philite were replaced by porcelain ones, as the former material showed several disadvantages. The most important failure of the apparatus, however, was bad focussing of the first accelerating field (200 kV). As the refractive power of this bipotential lens was too large a considerable part of the ion beam fell on the electrodes of the second lens and did not contribute to the neutron production. Now a new electrode had to be made for the first lens in order to increase its focal length. To calculate the dimensions of this electrode we derived the following theorems for thin axially symmetric bipotential lenses:

1. The dependence of the focal length $f$ on the ratio of the voltages applied to the electrodes is approximately the same as in the case of two flat electrodes having small central apertures. In the latter case $f$ can easily be calculated.

2. Of course $f$ is a complicated function of the form of the electrodes, but if the ratio of the aperture diameter and electrode distance is smaller than 0.2 the influence of the diameter of the aperture on $f$ is neglectable.

On using these theorems we could calculate that the dimensions of the new electrode ought to be 1.7 times those of the original one, whilst there was no need to alter the diameter of the narrow canal in the cathode of the ion source (the other electrode of the first lens).

In Chapter II a survey is given of the theory of nuclear processes initiated by slow neutrons. Feshbach et al. derived a theoretical relation between the neutron width $\Gamma_n$ and the mean level distance $D$. Obtaining data for checking this relation is the aim of the experiments.

In the following chapter (III) the experiments of de Vries and Diemer formerly carried out with the same apparatus have been re-examined. When the results on resonance energies obtained by the time of flight method became known in 1946 and later it appeared

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<tr>
<td>37</td>
<td>45</td>
<td>84</td>
<td>8.7</td>
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<td>6</td>
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$D \approx 25 \text{ eV} (A \approx 190)$

$D \approx 15 \text{ eV}$
that the values found by de Vries and Diemer were too high. We traced the cause of this discrepancy and after corrections had been applied the agreement was satisfactory. By the time of flight method three silver resonance levels have been found. It is shown in this thesis that the 5.1 eV-level belongs to Ag$^{110}$ and the 16 eV-level to Ag$^{108}$. As the constants needed for the evaluation of the experiments of de Vries and Diemer on level widths proved to be somewhat different from those assumed by them at that time we have recalculated their results.

In Chapter IV a new method for the determination of the energy interval between the resonance levels of two elements is described. We have called it the transformation method. In this method the energy loss suffered by a neutron at an elastic impact with a nucleus is compared with the energy interval considered. This is done for silver and gold and for antimony and silver (Chapter V). The energy intervals found were 0.31 eV and 0.7 eV respectively, in agreement with the time of flight measurements. The experiments on antimony and silver also indicate a level width of antimony of 0.1 eV or smaller. Using the result obtained for silver and gold we were able to determine the level widths of these elements by measuring also their self-absorption and mutual absorption coefficients. In the last section of Chapter V a survey is given of the values obtained for the widths of the lowest levels of silver and gold by various methods. The agreement of the results obtained in the chapters III and V is excellent. The characteristic quantities of both levels are found to be:

$Ag^{110}$: $E_r = 4.8$ eV, $\sigma_o = 26.10^{-21}$ cm$^2$/atom, $\Gamma = 0.165$ eV.

$Ag^{108}$: $E_r = 5.1$ eV, $\sigma_o = 18.10^{-21}$ cm$^2$/atom, $\Gamma = 0.18$ eV.

A correction for resonance scattering has been applied on the values for $\sigma_o$. In calculating the value of $\sigma_o$ for silver the abundance of the isotope involved has been taken into account.

From the values given above $\Gamma_e$ may be calculated. A theoretical relation between the average of $\Gamma_e E_r^{-\frac{1}{2}}$ and the mean level distance $D$, already mentioned in Chapter II, is checked using the results obtained by us and by other investigators. The agreement is satisfactory.