plane of polarization, in light reflected from the boundary layer, and to measure the change in the light flux from the studied portion of the ferromagnetic region, magnetized normal to the surface to a value $2J_S$. The direct proportionality between the two measured quantities leads to the ratio

$$\Delta\Phi / \Delta\Phi' = ld / S',$$

where $\Delta\Phi$ is the change in the light flux from the boundary layer, $\Delta\Phi'$ is the change in the light flux from the studied section of the specimen normally magnetized to a value $2J_S/\pi$, l is the length of the boundary layer bounded by the area of the section considered, d is the width of the boundary layer, and S' is the area of the studied portion of the specimen.

As can be seen from this expression, d is determined by comparing the light fluxes and the areas.

We used an integral-balance circuit in conjunction with the FEU-18 photomultiplier[4] and a compensating setup, the MBI-6 microscope, and the SI-1 pulse synchroscope. The variation of the light flux reflected from the boundary layer was estimated from the value of the capacitor-charging photocurrent at the instant when the boundary layer was brought into the field of view of the microscope and the system was unbalanced. The variation of the light flux from the section of the ferromagnetic region normally magnetized to a value $2J_S/\pi$ was estimated from the value of the flux as measured directly by the galvanometer.

The area of the studied region was measured under the microscope with an ocular micrometer and an object micrometer.

The width of the boundary layer was determined for single crystals of iron silicide containing 3% silicon. The longitudinal measurements give a value of 0.8 microns for the width of the boundary layer.

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NEGATIVE IONS OF IRON, COBALT, AND NICKEL

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IN all cases known at present, it is possible to attribute formation of atomic negative ions to the penetration of an additional electron into an incomplete outer group of equivalent electrons. It appeared to us that an electron affinity could be possessed also by such atoms that have an "open position" not on the periphery of the electron cloud but in its deeper portions. In connection with this, we undertook a search for negative ions of iron, cobalt, and nickel. In these elements there are two outer 4s electrons and an incompletely filled 3d group. We chose these elements also because we found mention made in the work of Schaefer and Walcher[1] of weak nickel lines in the spectrum of the negative ions emitted by an oxide cathode with a nickel core.

In our experiments we used a magnetic mass spectrometer with a resolving power of about 100. We obtained negative ions by exposing molecules containing the investigated atoms to the action of an intense beam of electrons. For working substances we chose the anhydrous dichlorides $FeCl_2$, $CoCl_2$ and $NiCl_2$. Analysis of the composition of the negative ions obtained upon introduction of vapors of these substances into the ion source of the mass spectrometer gave the following results:

$FeCl_2$. With operation of the ion source as usual for mass-spectroscopic determinations, lines for Cl^-, Cl_2^-, $FeCl^-$ and $FeCl_3^-$ were observed in the negative ion spectrum. For a higher temperature of the oven which contained the $FeCl_2$, lines appeared corresponding to Fe^- ions (masses 54 and 56). Pushing the operation of the source (25 ma, 70 v), the current of Fe_{56}^- ions could be raised to 5×10^{-13} amp (along with which the current of $FeCl^-$ and $FeCl_2^-$ ions was of the order of 10^{-10} amp).

$CoCl_2$. With ordinary operation of the ion source, ions of Cl^-, Cl_2^-, $CoCl^-$, $CoCl_2^-$ and also a weak line of Co_{59}^- were observed. By increasing the intensity of the electronic current and the density of the $CoCl_2$ fumes in the source, we could drive the current of Co^- ions to 3×10^{-13} amp.

$NiCl_2$. In the spectrum of negative ions, the lines Cl^-, Cl_2^-, $NiCl^-$, $NiCl_2^-$ and also weak Ni^- lines (masses 58 and 60) were observed. With forced operation of the ion source, the intensity of the Ni_{58}^- and Ni_{60}^- lines substantially increased and a Ni_{62}^- line became noticeable. The current of Ni_{58}^- ions was successfully raised to 1×10^{-12} amp.

We have thus discovered the existence of Fe^- and Co^- ions and have confirmed the existence of Ni^- ions.

One can make two different hypotheses about the electronic structure of the Fe^-, Co^- and Ni^- ions. Either the additional electron starts a new 4p group in these ions, or, upon its penetration, a rearrangement of the electronic shell proceeds which results in one of the electrons going into the 3d group. The second hypothesis seems to us the more probable. If it is correct, then the Fe^- ion should have the structure $1s^2 \ldots 3d^7 4s^2$, differing from the structure of the Fe atom ($1s^2 \ldots 3d^6 4s^2$) by an odd electron in the 3d group. Analogously, a Co^- ion must have the structure $1s^2 \ldots 3d^8 4s^2$, and a Ni^- ion the structure $1s^2 \ldots 3d^9 4s^2$. In connection with this, one should note that according to spectroscopic data,[2] upon the removal of one of the outer 4s electrons from atoms of Co and Ni the second 4s electron goes over into the 3d group.

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THE UNIVERSAL FERMI INTERACTION AND THE CAPTURE OF THE μ MESON BY THE PROTON

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GELL-MANN and Feynman,[1] and independently Suderman and Marshak,[2] proposed principles leading to a definite form of the interaction between four fermions. Depending on whether the A, B, C, D are "particles" or "antiparticles," these principles yield two distinct possibilities: the interaction (V − A), which is invariant under different pairings of the particles,

$$H_1 = 8^{1/2} G (\bar{\Psi}_A \gamma_\mu a \Psi_B) (\bar{\Psi}_C \gamma_\mu a \Psi_D) \qquad (1)$$

[where Ψ_A, Ψ_B, Ψ_C, Ψ_D are the wave functions of the "particles," $a = (1 + \gamma_5)/2$], or the interaction (V + A),

$$H_2 = 8^{1/2} G (\bar{\Psi}_A \gamma_\mu \bar{a} \Psi_B) (\bar{\Psi}_C \gamma_\mu a \Psi_D) \qquad (2)$$

[where Ψ_A, Ψ_B are the wave functions of the "antiparticles," $\bar{a} = (1 - \gamma_5)/2$], which for a different pairing of the particles[3] has the form (S − P):

$$H_2 = 2 \cdot 8^{1/2} G (\Psi_A a \Psi_D) (\bar{\Psi}_C \bar{a} \Psi_B). \qquad (2')$$

In all formulas we consider here one and the same process A + C = B + D and, by convention, call "particles" all those particles which have a left longitudinal polarization for v/c = 1; their antiparticles have the opposite sign of polarization.

The difference between the interactions (1) and (2) is particularly clear when we look at the formula (2'). Gell-Mann and Feynman note the extremal properties of (V − A) and (V + A) from the point of view of the asymmetry of the decay of the polarized neutron. We note that even before the discovery of parity non-conservation one of us has shown[4] that the difference of the Fermi and Gamow-Teller interactions with equal coefficients of (S − T) and (V − A) (which does not satisfy the Tolhoek-de Groot symmetry[5]) yields full polarization of the slow electron, whereas the sum yields complete depolarization of the slow electron in the β decay of the polarized neutron. The capture of the μ meson by a proton from a definite state of the hyperfine structure is evidently the reverse process to the emission of a slow particle. Expressions for the capture probability of the μ meson in different states of the hyperfine structure are given in reference 6. It follows from these expressions that in the variant (V + A), which goes over into (S − P) when written as $(\bar{P} 0 \nu)$ $(\bar{\mu}^- 0 N)$, the (S − P) probabilities for the capture in the states F = 0 and F = 1 (F is the combined spin of the proton and μ meson) are exactly the same, while in the variant (V − A) the probability for capture from F = 1 is zero,