A. A. Komar. *Neutral currents in the physics of weak interactions.* In the energy region accessible to modern experiments, the dynamics of weak interactions is well described by a phenomenological Lagrangian in the form

$$\mathscr{L}_w = \frac{G}{\sqrt{2}} J_i \times J_i^+,$$

where G is the weak-interaction constant and J_i are operators bilinear in the fields of the particles that take part in the weak process, and are called weak currents.

Until recently, all the known weak processes could be described on the basis of $\mathscr{L}_w$, using only the concept of charged weak currents $J_\mu^{CC}(\mu = 1, 2, 3, 4)$, i.e., vector operators that change the electric charge of the system of particles by unity (more accurately, J_μ^{CC} is represented by linear combination of the vector current **V** and the axial current A and this causes, in particular, the well known violation of spatial parity in weak processes). The corresponding Lagrangian $\mathscr{L}_w$ is of the form

$$\mathscr{L}_w^{CC} \sim \frac{G}{\sqrt{2}} J_\mu^{CC} \times J_\mu^{CC+}.$$

In 1973, weak interaction processes were observed[1] and could be interpreted by introducing also neutral weak currents J_i^{NC}, i.e., operator formations that do not change the electric charge of the system of particles. The corresponding interaction Lagrangian can be written in the form

$$\mathscr{L}_w^{NC} = \frac{G}{\sqrt{2}} \beta \cdot J_i^{NC} \times J_i^{NC+},$$

where β is a constant.

By now, the following processes generated by neutral weak currents have been observed:

$$\text{(I) } \nu_\mu + N \to \nu_\mu + \text{hadrons}, \quad \text{(III) } \nu_\mu + p \to \nu_\mu + p,$$
$$\text{(II) } \bar{\nu}_\mu + N \to \bar{\nu}_\mu + \text{hadrons}, \quad \text{(IV) } \bar{\nu}_\mu + p \to \bar{\nu}_\mu + p,$$
$$\text{(V) } \nu_\mu + e^- \to \nu_\mu + e^-, \quad \text{(VI) } \bar{\nu}_\mu + e^- \to \bar{\nu}_\mu + e^-.$$

On the basis of the study of these processes[2,3] we can draw the following conclusions:

1) The constant $\beta \lesssim 1$.

2) In processes I–VI that are due to neutral currents, spatial parity is violated.

3) As regards the transformation properties relative to the Lorentz group, the neutral current J_i^{NC} is neither scalar S nor pseudoscalar P, but a combination of the two, nor is it purely vector V or purely axial A.

4) It is most probable that J_i^{NC} is a linear combination of V and A, although small admixtures of other variants are not excluded.

5) From the point of view of the isotopic structure, J_i^{NC} is not a pure isoscalar and is most probably a combination of a third component of an isovector and an isoscalar.

All the observed manifestations of neutral weak currents are connected with strangeness-conserving neutral currents. Neutral weak currents with similar properties arise in natural fashion in models of gauge field theories, which describe in unified manner the electromagnetic and weak interactions (see[4]). The appearance of neutral currents in these models is due to the presence in them of one (or several) massive ($\gtrsim$ 80 GeV) neutral vector intermediate bosons. The neutral currents connected with the intermediate bosons are in the general case a vector plus axial mixtures. The available data on processes caused by neutral currents do not contradict as yet the predictions of the simplest model of this kind—the Salam-Weinberg model.[5] Variants have been proposed for the construction of similar models[6] in which, besides neutral currents that conserve strangeness, neutral currents that violate charm are present. Charmed-particle decays of the type $D^\pm \to \pi^\pm l^+ l^-$ or $D^0 \to l^+ l^-$ afford in this case an additional possibility of investigating neutral currents.

Neutral currents reflect a new, still inadequately investigated aspect of the dynamics of weak interactions. An important task is the comprehensive study of neutral currents. Great interest attaches in this connection to an investigation of manifestations of neutral weak currents in atomic physics, connected with the weak interaction of the electrons with the nucleons and providing information on neutral currents, i.e., independent of neutrino processes (see[7]). The values predicted in this case (for example, the angle of rotation of the polarization plane) are quite sensitive to the chosen weak-interaction model.[8] Another interesting possibility of investigating neutral currents is connected with the analysis of the angular asymmetry in the reaction $e^+ + e^- \to \mu^+ + \mu^-$—in colliding beams at high energies.[9] A study of neutral currents will undoubtedly provide a deeper understanding of the nature of weak interactions.

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B. G. Erozolimskiĭ. *Beta decay of the neutron.* In the thirty years since the discovery of the beta decay of the neutron, some thirty experiments have been performed in which this elementary nuclear beta decay process was investigated, including five new investigations reported in the last three years, in which the measure-