leishmanias. They did not attack any of the carbohydrates of the series.

Leishmania tropica, L. brasiliensis, L. infantum, and *L. donovani* resemble one another in morphological features, but in serological reactions *L. infantum* and *L. donovani* proved to be very closely related. In fermentation tests the leishmanias resembled most nearly the strains isolated from blue bottle flies. No immune serum prepared with other strains had any effect on the leishmanias, nor did the leishmania immune sera have any action on the insect or plant strains.

The foregoing observations indicate unmistakably the value of serological and fermentation tests as a means of identifying the strains of flagellates; by the application of these methods it may be possible to determine the presence or absence of leishmanias in invertebrate hosts suspected of harboring them.

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GYROMAGNETIC ELECTRONS AND A CLASSICAL THEORY OF ATOMIC STRUCTURE AND RADIATION

A CHARGED sphere in rotation was shown by Maxwell as long ago as 1870 to give a uniform internal field, and an external field equivalent to that of a magnetic doublet. The writer has considered the problem of determining the fields due to a spinning electron moving with uniform velocity v making any direction with the axis of spin, taking into account the deformation or contraction of the electron boundary into an ellipsoid of axes a and $a(1-v^2/c^2)^{1/2}$, the short axis being in the direction of motion. Regarding this as a real, physical deformation, the energy of the electrostatic and magnetic fields, internal and external, separates into two terms, one translational, the other due to components of spin $(\omega_1\omega_2\omega_3)$. The final result is

$$T = mc^2 + \tfrac{1}{2}(A\omega_1{}^2 + B\omega_2{}^2 + C\omega_3{}^2) + constant \qquad (1)$$

In the first term, $m = m_0/(1-v^2/c^2)^{1/2}$ where $m_0 = \frac{2}{3}e^2/a$ and account is taken of the boundary stresses (probably magnetic in origin) which keep the electron in equilibrium. The electrodynamic moments of inertia may be rigorously evaluated for the simple type of spinning electron considered, and in general may be expressed in powers of $\beta^2 = v^2/c^2$ in the form

$$A = I(1 + a_1\beta^2 + a_2\beta^4 + \ldots),$$
$$B = C = I(1 + c_1\beta^2 + c_2\beta^4 + \ldots) \qquad (2)$$

where $I = \frac{2}{5}m_0a^2$ is the moment of inertia of the spinning electron at rest. Applying Lagrange's equations to the rotations expressed by T as kinetic energy, the precessional motion of the electron is determined by Euler's equations,

$$A_1\dot{\omega} = L_1 \qquad C\dot{\omega}_2 - (C-A)\omega_1\omega_3 = L_2 - Ck\omega_2$$
$$C\dot{\omega}_3 + (C-A)\omega_1\omega_2 = L_3 - Ck\omega_3 \qquad (3)$$

$(L_1L_2L_3)$ being couples from nuclei in atomic systems, or due to the magnetic forces of the radiation field. The precessing electron has magnetic moments proportional to $(\omega_1\omega_2\omega_3)$ whose periodic variations thus give rise to electromagnetic radiation of the same frequency. The constant k is a simple type of damping factor due to the loss of rotational energy by radiation. Under no forces the stable configuration of the electron is easily seen from (3) to be with the axis of spin along the direction of motion. When disturbed the frequency of precessional motion and of emitted radiation is seen to be, if Ω_1 is the intrinsic spin,

$$2\pi\nu = \Omega_1(C-A)/C = \Omega_1(c_1 - a_1)\beta^2(1 + b_1\beta^2 + b_2\beta^4 + \ldots) \qquad (4)$$

If we denote

$$h\Omega_1 = \pi c^2 m_0/(c_1 - a_1), \qquad (5)$$

where $(c_1 - a_1)$ is a numerical constant equal to $\frac{2}{5}$ for the simple model considered, we have to a first approximation a relation between *precessional electron radiation* and *velocity* in the form

$$h\nu = \tfrac{1}{2}m_0v^2, \qquad (6)$$

the well-known photo-electric equation, while *Planck's constant h becomes a fundamental characteristic of a rotating electron expressed in terms of spin by equation* (5).

This purely classical interpretation appears to be the key to radiation problems generally. With similar hypotheses as to spinning protons as constituents of atomic nuclei, the theory of slightly perturbed, simple orbits under an inverse-square law of electrostatic attration from the nucleus, with the fundamental relations (6), leads to the series formula for hydrogen and helium spectra and in more complex cases to the S,P,D and F series, with the correct value for the Rydberg constant. Perturbations of orbits due to variation of mass with velocity, external electric and magnetic fields, with in some cases slightly different interpretations, lead to formulae the correct type for fine structure, Zeeman (normal and anomalous) and Stark effects. The fundamental formula (6), used in conjunction with a Maxwellian distribution of electron velocities, also leads with reasonable hypotheses as to electron orbits in a space lattice to Planck's formula for black-body radiation and the associated formulae for specific heats.

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