Betti,[4] it is possible to obtain the average rate at which the cell elongates in a specified direction under the action of the above-mentioned forces. The requirement that this average rate be < 0 for stability of a sphere slightly elongated in that direction gives another stability criterion. For the ellipsoidal case[5] this again reduces to that of Feenberg.

With these methods it is possible to go further and study finite deformations from the spherical shape. Slow deformation against viscosity is formally equivalent[4] to small deformation against elastic forces. Some of the work is applicable in an approximate way to a rather general class of convex shapes;[6,7] while ellipsoidal shapes have been studied more exactly.[4,5] It appears that once a cell becomes unstable it will continue to deform to a finite amount. This is the analog to the potential barrier for nuclear fission.

By sectioning the cell and applying Betti's theorem to each section, a beginning has been made in the study of the equatorial constriction which precedes the final division into two halves. In a rough way it can be shown[5] that as the cell elongates it will tend to pinch in at the equator and round up at the poles, so that it passes into a sort of dumbbell-shaped system.

Some aspects of rhythmic phenomena have also been considered,[7] without, however, trying to take into account the inertial terms in the hydrodynamic equations of motion. It would presumably be necessary to include these terms for application to the nuclear model.

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[1] E. Feenberg, Phys. Rev. **55**, 504 (1939).
[2] N. Rashevsky, *Mathematical Biophysics* (1938), Chapters 8, 9.
[3] N. Rashevsky, *Mathematical Biophysics* (1938), Chapter 13, appendix.
[4] G. Young, Bull. Math. Biophys. **1**, 31 (1939).
[5] G. Young, reference 4, p. 75.
[6] N. Rashevsky, Bull. Math. Biophys. **1**, 23 (1939).
[7] N. Rashevsky, reference 6, p. 47.

The Approximate Equality of the Proton-Proton and Proton-Neutron Interactions for the Meson Potential

The comparisons of the proton-proton and proton-neutron potentials in ^1S states have indicated[1] that the attraction for the proton-neutron interaction is slightly stronger than that between two protons. The object of this letter is to call attention to the fact that the new measurements of L. Simon[2] on the scattering cross section of slow neutrons and protons combined with the new proton-proton scattering experiments of Herb, Kerst, Parkinson and Plain, and of Heydenburg, Hafstad and Tuve[3] speak in favor of a still closer equality of the two interactions and that this equality becomes practically perfect for the meson type of potential—$Ce^{-r/a}/(r/a)$. The relatively high values of minus the potential energy at small distances for this potential are responsible for the relative reduction of the difference between the two interactions in comparison with "square wells" and the Gauss error potential.

In Table I the ratio of the proton-neutron and proton-proton potentials is given for the "square well," the Gauss error potential and the meson potential. In all cases the Coulombian potential e^2/r is supposed to be superposed on the specific nuclear interaction for the protons.

TABLE I.

$\sigma_{\pi\nu}$	SQUARE	GAUSS	MESON
20×10^{-24} cm^2	1.03(5)	1.03(6)	1.01(5)
14.8×10^{-24}	1.01(5)	1.0(15)	1.00(2)

The first row corresponds to the value of Cohen, Goldsmith and Schwinger[4] and the second to that of Simon.[2]

In computing the table the ranges of the interactions were chosen so as to fit the proton-proton scattering data. This gave for the contributions to the slow-neutron scattering cross section due to the triplet state $3.2(2)\times10^{-24}$ cm^2 for the "square well" and $3.1(5)\times10^{-24}$ cm^2 for the Gauss error well. For the latter $\alpha=20$ in Feenberg's notation was used. For the meson potential the contribution due to the triplet state was assumed to be the same as for the "square well." This assumption is perhaps one of the most speculative made above inasmuch as the effect of the triplet state should be computed by using spin-spin couplings derived from the meson theory. It is doubtful, however, that these effects can be computed with certainty on account of the necessity of cutting off the potentials to avoid divergence. We have been informed by Dr. Schwinger[5] and by Professor Bethe[6] that in their calculations with spin-spin terms the contribution of the triplet state to the slow neutron scattering cross section is practically the same as for "square wells." This result is reasonable since for other potentials this cross section is determined primarily by the binding energy of the deuteron and the approximate range of force. The effect of the shape of the potential energy curve, on the triplet cross section, is usually of the order of 10^{-25} cm^2 while the change due to Simon's value of the scattering cross section is $\sim5\times10^{-24}$ cm^2. There appears to be thus no special danger from this uncertainty.

It may be premature to claim an exact equality of the two interactions at this time. It is nevertheless fair to point out that the reasons for believing the proton-neutron attraction to be stronger[1] have disappeared through a combination of changes in experimental results and the introduction of the meson potential. It appears, therefore, more satisfactory than previously to use the same specific interaction in the ^1S state provided the interaction is concentrated at small distances as in the meson potential.

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[1] G. Breit, E. U. Condon and R. D. Present, Phys. Rev. **50**, 825 (1936); G. Breit and J. R. Stehn, Phys. Rev. **52**, 396 (1937); G. Breit, H. M. Thaxton and L. Eisenbud, Phys. Rev. **55**, 603(A) (1939) and p. 1018 of this issue.
[2] L. Simon, Phys. Rev. **55**, 792 (1939).
[3] R. G. Herb, D. W. Kerst, D. B. Parkinson and G. J. Plain, Phys. Rev. **55**, 603(A) (1939) and p. 998 of this issue. N. P. Heydenburg, L. R. Hafstad and M. A. Tuve, Phys. Rev. **55**, 603(A) (1939).
[4] V. W. Cohen, H. H. Goldsmith and J. Schwinger, Phys. Rev. **55**, 106 (1939).
[5] J. Schwinger, Phys. Rev. **55**, 235 (1939).
[6] H. A. Bethe, Washington meeting of American Physical Society p. 1130 of this issue. Also private communication.