lized substance corresponds in chemical and physical properties to a hexuronic acid, and is apparently identical with the hexuronic acid described by Szent-Gyorgyi[2] and reported as a reducing factor in adrenal cortex, cabbage and other sources. Feeding approximately 0.5 mg daily protects growing guinea-pigs from scurvy and permits normal vitality in the animals when on a vitamin C-free diet. A detailed account of the experimental work will be published in the near future, but this involves only a few steps beyond the work previously published.

As in all such work, there is a possibility that contaminating active material has adhered to the crystals fed, but that seems unlikely, since the maximum activity has reached an approximate constant with recrystallization, and much of our previous work has indicated such a chemical nature for the active factor.

The recent report of isolation and synthesis of vitamin C by Dr. Ottar Rygh[3] is not in accord with many of our findings, and we believe his experimental results were misinterpreted. It is perhaps sufficient to point out from his paper: (a) That experimental animals receiving his synthetic o-diphenol derivative of narcotine in addition to their basal vitamin C-free diet survived no longer than those receiving the basal diet only; and: (b) That the animals receiving a partial supply of vitamin C in addition to the synthetic compound showed a physiological response not greatly different from that of the group which received only the partial supply of natural vitamin.

C. G. KING
W. A. WAUGH

DEPARTMENT OF CHEMISTRY,
UNIVERSITY OF PITTSBURGH

STUDIES IN MOTOR AND MECHANICAL SKILLS

RECENT experimental articles and reviews on the field of "mechanical ability" have advanced important experimental data and widely varying interpretations. The latest review by O. L. Harvey[1] suggests possible reconciliations of the divergent views so far published and in closing suggests that "It might be an interesting piece of research to analyze in terms of the tetrad difference technique the data obtainable from a homogeneous group in response to (a) a test of verbal intelligence, and (b) a combined battery including tests such as (1) the Minnesota assembly and spatial relations tests (for mechanical ability); (2) a selected group of Cox's models, explanations, etc. (for mechanical aptitude); and (3) either the Minnesota tests for steadiness, card sorting, packing blocks and tapping, and Link's machine operators' test or some form of motor skills battery, similar to that developed by Seashore (for motility)."

In view of the numerous discussions aroused in these fields of motor and mechanical performances it may be of interest to note that a study which brings together most of these as well as numerous other measures is now in its second year of progress at the University of Oregon with the assistance of grants-in-aid from the National Research Council and the University of Oregon.

The two main objectives of this research are (1) to determine the interrelations of individual differences in fine and gross motor skills with mechanical skills, and (2) to trace the differentiation of fine motor skills in the early years of life. Tests included in this study are the six motor tests comprising the Stanford Motor Skills Unit[2]; the spatial relations tests, assembly tests and paper form boards from the Minnesota Mechanical Ability Tests; measures of postural steadiness, using the Miles Ataxiameter; measures of arm tremor in two dimensions, using the Beall and Hill Ataxiagraph, a graded series of measures of tapping and other hand and arm motions; simple reaction times to light and sound stimuli; the Cozens tests for measurement of general athletic ability; as well as measures of height and weight. Scores on the A. C. E. College Entrance Test are also available for all observers.

By the end of the present academic year the data on these tests should be complete on fifty male university students and it is hoped to continue the study for a third year in order to have one hundred observers. The desirability of using the tetrad difference technique rests largely upon other findings, which will be discussed in a future article.

In previous studies at Oregon boys of age 6, 10, and 15 years were given shorter lists of the same tests, and data on three motor tests given to preschool children at the University of Iowa are also available. Several studies under way are investigating the stability of the individual differences over long periods of time. Two other studies on the prediction of practical skills in typing and handling of knitting machines indicate that the whole field of aptitude hypotheses must be reformulated to determine the relative importance of selecting personnel,

[2] *Biochem. Jour.*, 22: 1387, 1928.
[3] *Zeit. f. Physiol. Chem.*, 204: 105, 1932.
[1] O. L. Harvey, "Mechanical 'Aptitude' or Mechanical 'Ability'?—A Study in Method," *Jour. of Educ. Psychol.*, 22, 517–22, 1931.

[2] Several studies using this battery have demonstrated the high degree of specificity of its component tests. For this reason it should not be considered a test of "motility" as suggested by Harvey. *Cf.* R. H. Seashore, Stanford Motor Skills Unit., *Psychol. Monographs*, 1928, 39, 51–66; and *ibid.*, "Individual Differences in Motor Skills," *J. General Psychol.*, 3, 38–66, 1930.

length of training, and improvements of work methods and conditions.

ROBERT H. SEASHORE
IVAN N. MCCOLLOM

UNIVERSITY OF OREGON

HOW BIG IS A CELL?

IN classes in elementary biology some attempt is usually made to relate the world revealed by the microscope to the world as we know it with our unaided eyes. In these attempts it has been particularly difficult to compare the scales of the two worlds. For the comparison one needed an every-day object large enough to come within the range of a microscope's field of view. In teaching a class in elementary botany, it occurred to me that the thickness of a page in a book might be so used. The students were asked to determine the figures for themselves, by measuring the thickness of 100 pages of an actual book, dividing by 100 to obtain the value for one page, and then multiplying by 1,000 to convert the reading into microns. Most text-book paper is around 50 microns thick.

In one laboratory course the idea was pushed even further and the students were required during the first exercises with the microscope to rule their drawings with faint lines, 55 microns apart in the scale of the drawing. The finished work then showed what the cells in question would have looked like if seen against the ends of pages in the text-book. I can not be sure that all this was much help to the students, but I have found from experience that it has been very useful to me. Not only has it helped to relate more effectively the two worlds in which I spent most of my time, but it has given me a much better working knowledge of the relative sizes of different plant cells.

EDGAR ANDERSON

ARNOLD ARBORETUM
HARVARD UNIVERSITY

SCIENTIFIC BOOKS

Halley's Comet in its Appearance of 1909–1911. By NICHOLAS T. BOBROVNIKOFF. Publications of the Lick Observatory, Vol. XVII, 309 to 482, 1931.

EVERY one interested in comets to the slightest degree knows of the important papers already published by Bobrovnikoff upon this subject. It is therefore no surprise to find this last perhaps the most complete study of a comet's appearance that has ever been published. Its length and the great detail in which the author describes striking phenomena are justified both by the importance of Halley's Comet, as a typical comet and historically, and by the wealth of data at his disposal.

Working at the Lick Observatory, he used as the basis of his discussion the 438 plates of the comet secured there and 271 selected reproductions from plates taken elsewhere. The former were taken mostly by Dr. Heber D. Curtis, with the writer of the present review much of the time as his assistant. Curtis had intended to work up these himself, but the opportunity for fully doing so never came, though he did publish a preliminary paper (Pub. A.S.P., 22, 117, 1910), and made a number of calculations and notes for the longer one. Therefore Curtis generously turned over everything to Bobrovnikoff, who has, here and there, used some of these calculations in his discussion.

In the space available here, one can call attention to but few of the salient points among the great number of interesting conclusions. The nucleus is proved to have exerted appreciable repulsive forces upon matter forming the jets; in it, however, no rotation was shown, and on several occasions changes of an explosive character were detected therein. For instance, on May 24 a five-fold increase in its size was noted during the exposure of one plate. The threatened breaking up, however, was always followed by a collapse. The jets, composed of cyanogen, were actual matter being expelled. For those in the prolonged radius-vector the nucleus showed repulsive forces of from 1 to 6 times gravitation. The envelopes, in the forms of approximate catenaries, expanded outward at the rate of about half a kilometer per second. The velocity of expansion of the halos was of the same order.

A new determination of the mass of the comet comes out to be of the order of 10^{-10} that of the Earth. This confirms the growing conviction of many of us that some older estimates of the masses of comets were absurdly low. The tail of the comet proved to be double, Tail I having a slight departure from the prolonged radius vector of the orbit, but Tail II making an angle of about 40°. Apparently CO^+ was the chief constituent of Tail I, Tail II shown by diffused solar light and to a lesser degree also by the light of glowing CO^+. In I, the average repulsive forces ranged from 10 to 20, but for the condensations in I these numbers increased to from 20 to 150; in II they were in general < 0.3. He concludes, therefore, that, while the Bessel-Bredichin mechanical theory of comets' tails is sufficient to explain the observed facts, the latter's actual classification is inadequate and that at least four classes are needed, with a great extension of his ideas as to the maximum magnitude of the repulsive forces. It was further shown that not only