the conclusion in the author's own words: "The fact that superiority of the first born registers in childhood as clearly as in the achievement of adult life suggests that the causes are to be sought in native endowment rather than in environment and education." It is, however, not at all clear why it is better thus to assume that such vigorous heredity so readily peters out than to assume that, for various reasons, parents may do more for their first born, in the way of intellectual stimulation and advancement, than for their subsequent born.

An investigation of the economic status of 170 representative families of the group found a median income of $3,333. Thirty-five per cent. of these families reported an income below $2,500, which is about equal to that of the average skilled laborer; only 17 per cent. reported an income above $7,500 and 4 per cent. above $12,000. This finding would seem to indicate that gifted children and wealth are not associated, whereas the biographies of men of genius often indicate that the leisure which money *can* provide has made the fruition of genius possible.

One possibility which may bear on these various arguments is, as it seems to the reviewer, this: that the tests and teachers alike have selected as gifted or as geniuses those who as a result of their early training and influences at home have acquired scholastic interests or academic turns of mind and have overlooked those who have not.

Anthropometric measurements as well as records of the health of these children showed that the gifted as a whole were superior with respect to physical size and condition to the children of the control groups. Pubescence appears somewhat earlier in the gifted boy than among unselected boys—although this conclusion is tentative because of the small number of gifted boys in the study above twelve years of age—and menstruation appears earlier in gifted girls than in the girls of the control group. Eighty-five per cent. of the gifted children were found to be accelerated and not one to be retarded in school. The average progress quotient of the group was equal to 114, which means that the average gifted child is accelerated 14 per cent. of his chronological age.

The contrast between grade location and the performance in tests of school accompaniment, namely the Stanford Achievement tests, is striking. The superiority of the gifted amounts in most cases to from three to four times the standard deviation of the unselected group. In knowledge of the subject-matter of instruction gifted children are at a point 40 per cent. above their chronological ages, although, as noted, they are held back to a grade location only 14 per cent. beyond the norm of their chronological ages. Chiefly on this account, doubtless, their accomplishment quotients do not equal their intelligence quotients; the A. Q.'s tend to run only from three fourths to four fifths as far above the average as did the I. Q.'s.

The gifted children showed no greater specialization of abilities in school subjects than did the average child, a finding which may possibly be taken as another indication that such geniuses as the study has discovered are concealed as to their characteristics by the mass of simply bright children from whom they have not been differentiated. The author of this section of the book, Professor James C. DeVoss, also finds evidence of the relatively greater potency of heredity over environment in the fact that there is a lack of parallelism in the development of abilities to deal with school subjects which is too great to be accounted for, as he thinks, by the differences in training.

Remaining chapters of the book deal with the rating of the scholastic, occupational, play, reading and other intellectual, social and "activity" interests as well as of the character and personality traits, in all of which the gifted children are for the most part superior to the average child. These chapters provide a wealth of information which the specialist in the various fields may be able to relate to his special problems, and which the lay readers, including those especially who may wish to compare their own offspring in these respects with the subjects of the study, will find interesting although perhaps not particularly illuminating.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON THE RETENTION OF A BALL BY A VERTICAL WATER JET

There is a strangely wide-spread belief that the quasi-stable support of a light ball in a vertical water jet is due to forces that may be accounted for by the principle of Bernoulli. The experiment described below shows that at least 98 per cent., if not the whole of these forces, comes from the change in momentum of the water as its direction is altered by adhesion as it passes over the curved surface of the wet ball.

Fig. 1*a* and *b* show a light wire frame supported on needle points so that it may swing in one plane only. Near its lower end is carried a wooden ball *B* (about 7 gm diam., 2.6 cm) on which the jet *J* (Fig. 1*b*) may be adjusted to impinge. Just behind the ball are two light metal plates *CC* that may be separated, as shown in Fig. 1*a*, to let the deflected water pass freely through the frame or that may be

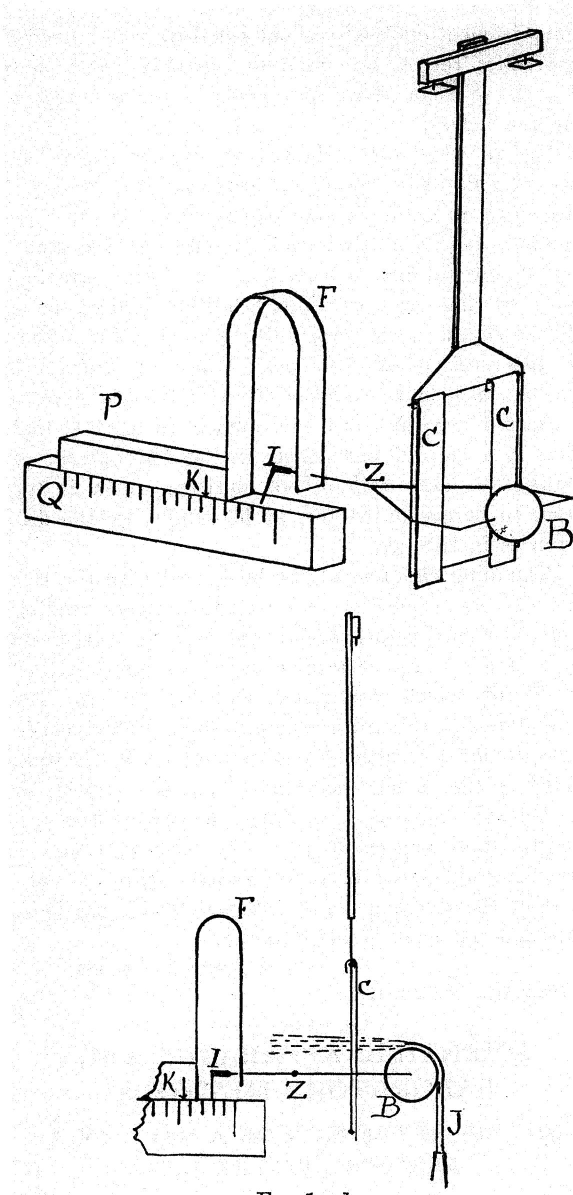

FIG. 1*a*, *b*

pushed together to receive the full impact of the deflected jet. The horizontal forces exerted on the ball by the jet, for any condition of impact, may be balanced by the force exerted by the deformation of a light steel spring *F*. The spring is attached to the wire frame by the yoke and straight wire *Z*, the latter passing through a hole in the end of the spring and terminating in an index *I*. The other end of the spring is carried by a block *P* that with its index *K* may be slid back and forth over the scale on the bar *Q*.

When no jet strikes the ball a slight tapping on *P* permits the wire *Z* to move to or fro in the hole until the index *I* comes to rest at some point on the scale which, when once noted, may be used to determine the equilibrium position of the frame under gravity alone. The block *P* is then moved back along the scale to the extreme position at which it *does not displace the index I,* then the reading of index *K* gives the extreme position of no strain on the spring. Now when the jet is allowed to strike the ball on the side remote from the spring the sphere is drawn into the jet, deforming the spring. *P* is now moved back until the index *I* returns to its zero position. The linear displacement required to do this, together with the determined stiffness of the spring, gives at once the total horizontal force exerted by the jet on the ball.

The following facts were established: When the ball is in the jet at the level at which its weight is just balanced by the vertical impact of the water, the plates *CC* being drawn back to allow the free passage of the water through the frame, it is acted on by a horizontal force towards the axis of the jet that depends on the point of impact. This force is, of course, zero in the symmetrical position on the axis of the jet, and as the point of impact is taken farther and farther from the vertical diameter of the ball the force increases to a maximum of about the weight of the ball *when the ball is allowed to spin freely on its own horizontal axis,* but to a maximum of only about 60 per cent. of this when it is clamped so that it may not spin. This difference is chiefly due to the frictional diminution of speed in the jet in the second case, as it passes over the surface of the ball, that is, in the latter case the momentum carried away horizontally is less than in the first. When the plates *CC* were moved together so as to receive the full impact of the deflected water the slightest observable displacement of *K* from its zero position is accompanied by a corresponding displacement of *I,* indicating that the force exerted on the ball by the jet is exactly compensated by the impact of the deflected water on the plates. Of course if the speed of the jet be too great some of the water may miss the plates in which case the horizontal momentum that is carried by the escaping water has its counterpart in a reaction that pulls the ball farther into the jet. As the displacement of *K* necessary to balance the maximum horizontal force on the ball was about 20 mm (corresponding to about 7 gm-wt.) and as a displacement of less than 0.5 mm. could be read with ease, it is concluded that at least 98 per cent. of the forces involved come from the change of momentum of the water and that if there be any force to be accounted for by the principle of Bernoulli it is a very small quantity, if indeed it exist at all.

One or two other points in this connection may be of interest. Fig. 2 shows an open end manometer *L*

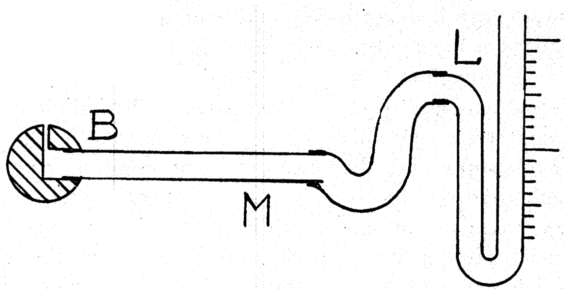

FIG. 2

connected by a bit of rubber tubing to a glass tube *M* which passes axially into a wooden ball *B* into which it is cemented. Connecting the tube *M* with the surface of the ball is a small hole (1 mm diam.) that runs radially in the sphere and at right angles to the axis of *M*. A ball similar to *B* is placed in a vertical water jet fed by the constant head from a large wall pocket. When this has found its level of quasi-equilibrium it is replaced in that position by the ball of Fig. 2, which is clamped rigidly in place. Now we may measure the pressure exerted on the sphere at any point simply by adjusting the ball so that the orifice in its surface is at the required spot. It is necessary to see that the whole tube from the orifice in the surface to the level of the water in the open arm of *L* be continuously full of water—no air bubbles being present that by their surface tension effects might mask the changes of pressure sought. It is also necessary, when one obtains the zero reading of *L*—*i.e.*, the level of the free surface of *L* when no jet strikes the ball—that water be slowly dropped on top of the ball *B* and allowed to run down over the orifice so that the surface of the water at the opening may have the curvature of the ball, as it has when the jet spreads over it. The stopping and starting of the jet would set up disturbances in the flow of the water from the wall reservoir, so it is best to keep the jet running continuously and to intercept it when necessary by a baffle plate between the nozzle and the ball. So after determining the zero reading at *L* one merely removes the baffle plate and observes the excess or defect of the pressure at the orifice from that of the atmosphere without the necessity of waiting for the flow to become steady again. Fig. 3 shows the order of values obtained with a jet of 3 mm diam., impinging on a ball of 2.6 cm diam. (about 7 gm) at a point where it is balanced in the jet (the velocity head being 75 cm). The pressure differences are given in mm of water *less* than atmospheric pressure. The unfeathered arrows indicate the point of impact of the jet. The -3 at the top of one diagram shows a pressure of 3 mm *greater* than atmospheric caused by water that in this symmetrical case fell back on top of the ball. The feathered arrows in the second case indicate the direction on which most of the water left the sphere. These observations are of value only in indicating the *order* of pressure differences set up. Calculations of pressures to be expected from the change of momentum as the water passes over the curved surface are easily made on the assumption that there is no splash and that the water passes uniformly over the surface of the sphere; but these have little value for comparison with experiment, as neither of these assumptions is even approximately fulfilled in the experimental case.

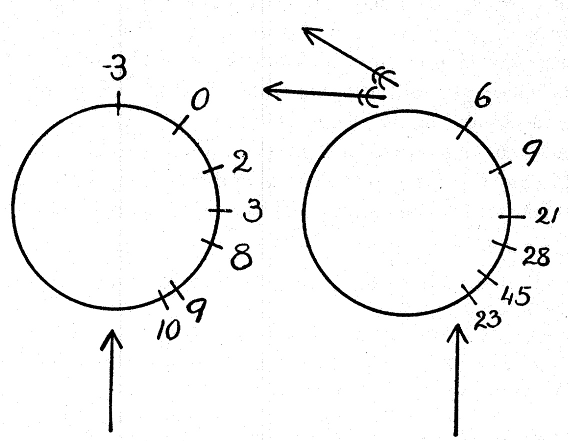

FIG. 3

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SPECIAL ARTICLES

THE BASIS OF REFLEX COORDINATION

IN some recent papers Weiss[1, 2] has proposed a new hypothesis for explaining reflex coordination, which invokes the conception of qualitative differences in excitation of nerve fibers. The nature of the reflex coordination involved is best illustrated by the fact that in movements of progression all flexor muscles contract together, while the extensors relax, and *vice versa*. Weiss contends that a single motor neurone, after branching, innervates muscle fibers which are widely distributed and may be components of antagonistic muscle groups. In order to reconcile this contention with the orderly coordination of the muscles, he assumes that the motor neurone may conduct "various specific forms of excitation, to each of which certain particular muscles are attuned, owing to their specific make-up." He suggests something analogous

[1] Weiss, 1924, Arch. f. mikroscop. Anat. u. Entwicklungsmech., cii, 635.

[2] Weiss, 1926, *Jour. Comp. Neurol.*, xl, 241.