efficient operation of these branches of the Government will be abandoned, while valuable apparatus and equipment will lie idle. Unemployment will be increased at the very time when other branches of the Government are incurring large expenses in the effort to put men back to work.

Moreover, the savings which can result from these reductions are only a few millions, while at the same time the Government is making new appropriations of hundreds of millions of dollars for other purposes.

The undersigned believes that to neglect scientific research and to discharge highly trained research workers is a step backward and will prove very costly to the Government, and therefore most respectfully appeals to you to restore the appropriations for the scientific work of the Government.

For detailed information as to the situation in the Government Scientific Bureaus see *Science News Letter*, July 8, p. 31; July 15, pp. 35–39; July 22, pp. 51, 61; July 29, pp. 77–78; SCIENCE, July 21, pp. 53, 61; July 28, p. 86. The undersigned urge readers of SCIENCE to send to President Roosevelt the above or a similar appeal.

GEORGE B. PEGRAM
ARTHUR H. COMPTON
BERGEN DAVIS
DAVID SINCLAIR
WILLIAM F. BROWN

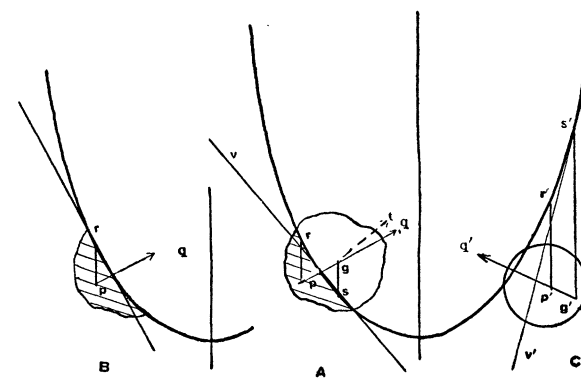
DEPARTMENT OF PHYSICS
COLUMBIA UNIVERSITY

THE RESULTANT FORCE ACTING ON A SOLID BODY FLOATING IN A BOWL OF ROTATING LIQUID

THE phenomenon here noted does not appear to have been recorded in any of our books of reference.

Since all points in the surface of a fluid in steady rotation about a vertical axis are on the same equipotential, the normal to the surface at any point gives the "apparent vertical" and the tangent, the "apparent horizontal" for that point. Further, due to the fact that the acceleration of each particle in the fluid has no vertical component, equipotential surfaces in the body of the fluid are paraboloids of the same dimensions as that formed by the free surface, and they have the same axis. All the particles in a given line parallel to the axis of rotation are in one and the same condition as regards velocity, acceleration, etc., and thus will have a common direction for their "apparent vertical," and their "apparent horizontals" will all be parallel to the plane tangent to the free surface at the point where the line in question cuts that surface.

Let the figure at *a* represent a solid (say a ping-pong ball) floating on the surface of a steadily rotating fluid. The hatched part represents the volume formerly occupied by the displaced fluid. To get the direction and line of action of the resultant of all the forces exerted on the solid by the fluid, consider the solid removed and the hatched portion again occupied by fluid, as in *b*. Next suppose that this portion of fluid acts as a solid, losing all mobility of one part relatively to another, but retaining its shape and density. Let the center of mass of this solid be at *p*. Then as the resultant force ($m\ r\ \omega^2$) and the weight ($m\ g$) of the portion both act through the center of mass, the necessary condition for steady rotation is



that the resultant of the forces due to the fluid external to this solid also act through *p*, and that it lie along the "apparent vertical" for the point *p*, *i.e.*, along *p q* parallel to the normal to the surface at *r*, *p r* being parallel to the axis of rotation.

Return now to the floating body at *a*. This, when in a steady state, will move with its center of mass *g* on the line *p q* (otherwise it would rotate in the plane of the diagram). Here we meet two cases with different results. First, bodies with their center of mass on *p q* but nearer the axis than *p*, and those which float with the center of mass farther from the axis than the center of mass of the fluid they displace, as shown at *c*. In the first case, as has been shown, the force due to the fluid pressures acts along *p q*, which is normal to the tangent plane at *r*, while the "apparent vertical" for the body (its center of mass) is *g t* normal to the tangent plane at *s*. Thus there is a component of the force *p q* along the "apparent horizontal" for the body, *v s*, and it moves towards the axis of rotation to reach equilibrium only at the vertex of the paraboloid, where its center of mass is on the axis of rotation of the fluid. On the other hand, consider a wooden ball loaded with lead so that it will just float (as shown at *c*, center of mass at *g'*). The same argument shows that the resultant force due to the fluid pressure is along *q' p'* (normal to the tangent plane at *r'*, but that the "apparent horizontal" for the system is parallel to the tangent plane at *s'*. So there is a component along that plane *v' s'* away from the axis, and the body moves "down hill" to a

position as far from the axis as possible. In each case the action is due to the difference in direction of the "apparent vertical" for the center of mass of the floating body, and that for the center of mass of the displaced fluid.

The phenomenon is easily observed by placing a crystallizing dish on the turntable of a victrola, fastening it centrally, half filling it with water, and after steady rotation has been established using the ping-pong ball and the weighted wooden ball as described above.

The experience recalls Edgar Allan Poe's tale "A Descent into the Maelstrom," where the old fisherman saved himself by abandoning the faster moving ship (center of mass above the water surface) for the cask that barely floated him. If Poe's tale were not merely a wild dream, one would look for the explanation of the motions of the floating objects, not in the reference he gives to the second book of a hypothetical work by Archimedes on *Hydrodynamics* (!)[1] but in the principles herein described. The vortex imagined by Poe would be probably more like a free vortex with the curvature convex to the axis, in which case it would have been better perhaps if the fisherman had stuck by his ship.

WILL C. BAKER

QUEEN'S UNIVERSITY,
KINGSTON, ONT.,
CANADA

SELENIUM AS AN INSECTICIDE

A RENEWED interest in the use of selenium compounds as insecticides prompts this communication, which may serve as a warning against such use without adequate investigation as to the possible dangers involved. In the search for better insecticides attention has been directed from time to time to the fact that selenium compounds possess many desirable qualities for this purpose. A number of patents have been granted in this country and abroad covering the use of selenium compounds for making insecticides. Although the use of such compounds may be very limited, it is believed that the danger of even minute quantities of selenium in soils on which food products are grown has not been fully appreciated.

Studies carried out during the past year in the Bureau of Chemistry and Soils and the Bureau of Plant Industry of the Department of Agriculture show that selenium in the soil is assimilated by plants and that a particularly toxic compound is elaborated. Fifteen parts per million of selenium in the soil, added as sodium selenate, and under some conditions even lower concentrations, produce distinct chlorosis and stunting of wheat plants. Quantities as small as one part per million permit growth and maturation with no visible symptoms of injury to the plant. However, when the grain or straw from such plants is fed to experimental animals, such as rats and guinea-pigs, it produces a pronounced toxicosis characterized by retardation in growth, and death occurs in a few weeks. Wheat which has been found by analysis to contain 8 to 10 parts per million of selenium, absorbed from the soil, produces fatal injury with, in many cases, readily detectable macroscopic changes in the liver. Selenium is present in the grain in intimate association with the protein, but in what form has not yet been determined.

In the case of common insecticides used in spraying fruit trees and vegetables, complete removal of the spray residue from edible food products, where this is possible, should eliminate the danger of the food being toxic. However, selenium can be assimilated from the soil by at least some and possibly all plants, and the degree of toxicity of the particular compound used in spraying a plant is not a measure of the toxicity of the compounds formed in the plant. Furthermore, there is evidence that selenium compounds may be reduced by soil organisms, so that spray residues ordinarily considered innocuous may be made available to the plant and be converted into highly toxic combinations.

E. M. NELSON
A. M. HURD-KARRER
W. O. ROBINSON

U. S. DEPARTMENT OF AGRICULTURE

THE CHROMOSOMES OF XIPHOPHORUS, PLATYPOECILUS AND THEIR HYBRIDS DURING MATURATION STAGES

IT has been known for several years that two genera of poeciliid top minnows, *Xiphophorus* and *Platypoecilus*, will readily hybridize and produce some fertile offspring.

An investigation of the chromosomes during the maturation stages of two species of *Xiphophorus*, *Platypoecilus couchiana* and *Platypoecilus maculatus* and of *Platypoecilus-Xiphophorus* hybrids has just been completed, and the detailed results of the investigation will appear in print in several months. Part of the material studied was collected in the field in Mexico and part was obtained from dealers.

The haploid number of chromosomes is twenty-four in *Xiphophorus*, *Platypoecilus* and in the hybrid. The chromosome picture is so nearly identical in all three that it is difficult to find any distinctive differences. In the primary spermatocyte division the heterotypic chromosomes are seen as nineteen spherical chromosomes of about equal size and five slightly larger ones, one of which is the sex chromosome.

[1] I take Poe's spelling *incidentibus* not for a misprint for *insidentibus* but as deliberate, and as a joke that he is trying to pull on the reader.