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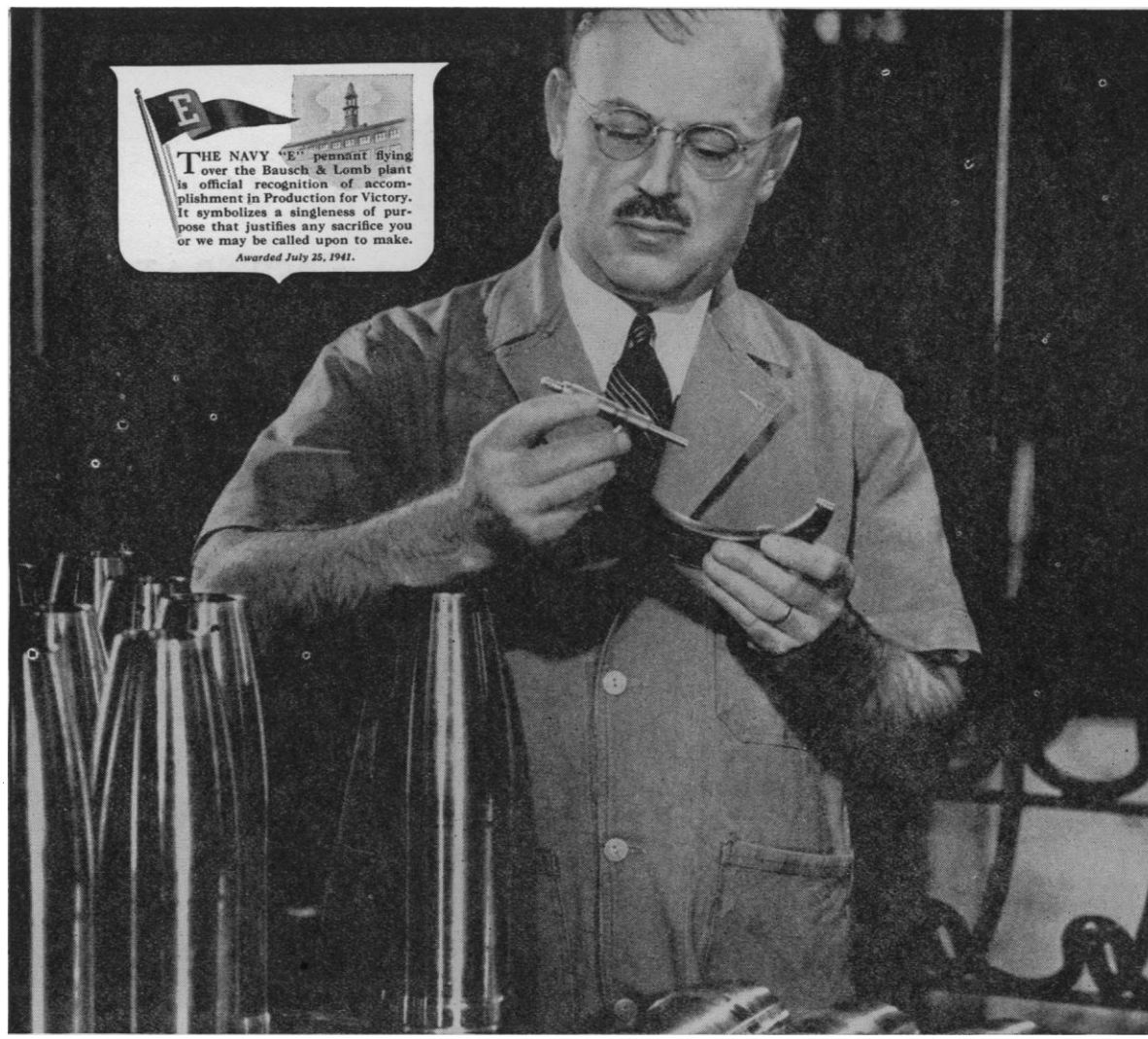

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THE VENOPRESSOR MECHANISM

By Professor YANDELL HENDERSON

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"WE have yet to explain in what manner the blood finds its way back to the heart from the extremities by the veins." So wrote William Harvey:[1] and now 300 years later the explanation is still not wholly complete. As a major factor in the venous return, Harvey described the valves in the veins and showed, by moving a finger along a vein in the arm, that "while these valves readily open in the right direction," *i.e.*, toward the heart, they "entirely prevent all contrary motion." And he accompanied the description with a drawing, copied from Fabricius,[2] showing a man's forearm with a ligature above the elbow and the hand grasping a rod, while the veins swell. In the grip of the hand in that drawing is the first suggestion of a venopressor mechanism.

It is always dangerous to read subsequent knowledge back into the words of the first author in any field. Yet one can not resist the impression that Harvey, in this drawing along with his account of the valves in the veins, recognized that the vigorous contraction of the muscles of the forearm propels blood from the muscles into the veins and on toward the right heart. If so, he would have been entirely in accord with the modern view that any muscle that is rhythmically relaxed and contracted, so that its capillaries are alternately filled from the arteries and emptied into the veins, acts as a peripheral pump, a "booster,"[3]

[1] W. Harvey, "The Motion of the Heart and Blood in Animals." London, 1628. Chap. 13. Everyman's Library, New York, 1906. Also translation by C. D. Leake, published by C C Thomas, 1931.

[2] H. Fabricius, "DeVenarum Ostiolis," 1603. Translation by K. J. Franklin, published by C. C Thomas, 1933, pp. 80, 81.

[3] Booster: A pump used to increase the pressure of

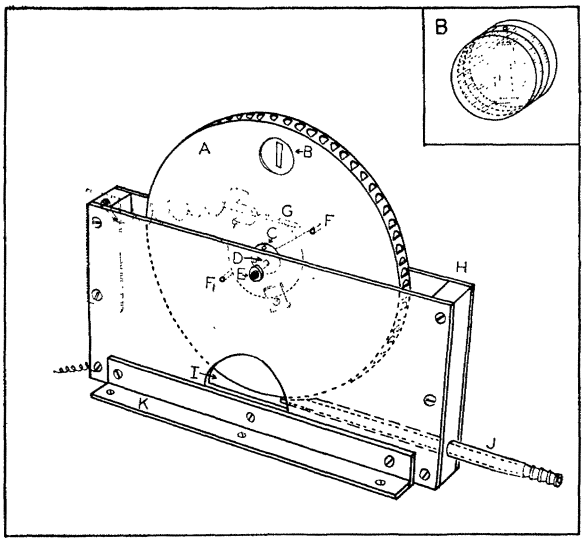

FIG. 1. Air-turbine Ultracentrifuge with Plastic Rotor. A, Lucite rotor, 0.5 inches thick, 6 inches diameter, with flutings milled into the periphery; B, analytical fluid cell (see below), inserted in cylindrical cell hole; C, brass disc, connected with similar disc on other side of rotor by brass bushing and screws; D, axle, made from 3/16 inches thick drill rod, fastened to C and turned down and surface-hardened at ends to fit E; E, Torrington needle bearing, 3/16 inches, mounted in casing, H, and carefully aligned with bearing on opposite side, F, F_1, brass contacts, inserted in rotor surface; G, contact brush, made from spring bronze, insulated from casing H, adjustable in position; H, centrifuge casing, made from sheet brass; I, semi-circular opening in casing, H, to permit free escape of expanded driving air; J, air-jet, 7/32 inches lumen, trumpet-shaped at inlet end and conforming with rotor shape at outlet end; K, angle for mounting on wooden base. Insert B, analytical fluid cell, made by cementing, with Lucite cement, two outer discs of colorless Plexiglas resin to central disc of red Plexiglas into which a sector-shaped opening of 12 mm. height and 3 mm. depth has been cut, connected with periphery by narrow drill hole, through which the solution under study is introduced with a hypodermic syringe. When in use, the cell is inserted into cell hole in rotor with the drill hole pointing towards the rotor center and the broad base of the sector pointing towards the periphery. During operation, the centrifuge is covered by a steel guard, made from 0.5 inch thick boiler plate by welding, equipped with openings opposite the cell holes and slots near the base to permit escape of air stream.

tobacco mosaic virus protein,[4] with sedimentation constants of $s_{20} = 60 \times 10^{-13}$ and 175×10^{-13} and molecular weights of 3×10^6 and 40×10^6, respectively, has been photographically recorded (Fig. 2), employing the 6-inch Lucite rotor.

The definition of the sedimenting boundaries, as

[4] The writer is indebted to Dr. W. M. Stanley for a sample of this material.

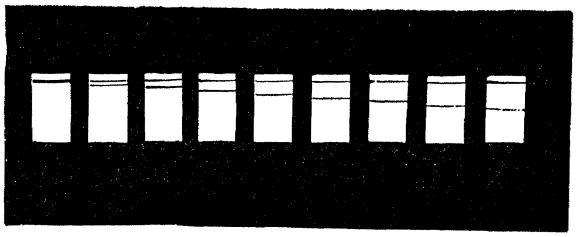

FIG. 2. Sedimentation Diagram of Stanley's Crystalline Tobacco Mosaic Virus Protein obtained with 6-inch Plastic Airturbine. 1 per cent. virus solution; 9,000 r.p.m. (5430 × g.); Toepler schlieren band method; 20 sec. exposures on Eastman contrast lantern slide plate; light source, Mazda 200 watt projection lamp; schlieren lens, Kodak projection lens, F = 4 inches; camera lens, Kodak anastigmatic lens, F = 4 inches.

exemplified in Fig. 2, the regular rate of sedimentation during the individual intervals, and the values of the sedimentation constants obtained for the virus with this centrifuge ($s_{20} = 157$ and 161×10^{-13}) as compared with that determined in our Beams ultracentrifuge ($s_{20} = 175 \times 10^{-13}$) for the same preparation, may be regarded as evidence that sedimentation in the plastic rotor proceeds essentially undisturbed by mechanical vibration or thermal convection currents.

The plastic rotors may be adapted to use in *centrifuge microscopes* as well as in *analytical ultracentrifuges.* The contact arrangement indicated in Fig. 1 (parts F and G) has been used to synchronize a stroboscopic light source (*e.g.,* Strobotak of the General Radio Company) with the rotor and to examine living cells during centrifuging with a low-power microscope.[5] In this manner, the stratification of Arbacia eggs has been observed with as yet not wholly satisfactory results.

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[5] The author is indebted by Professor N. E. Harvey for valuable advice and the loan of a Strobotak lamp.

NEW BOOKS

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