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<i>The American Association for the Advancement of Science:</i>	
<i>Tuberculosis, Leprosy and Allied Mycobacterial Diseases:</i> DR. ESMOND R. LONG	23
<i>Obituary:</i>	
<i>David William May:</i> CARMELO ALEMAR and ATHERTON LEE. <i>Recent Deaths and Memorials</i>	31
<i>Scientific Events:</i>	
<i>The Japanese Research Institute of Industry and Labor; The Floating Expedition of the U.S.S.R. in the Arctic Ocean; Annual Report of the Commonwealth Fund; The Columbia University School of Medicine; The Savannah Meeting of the Electrochemical Society; Retirement of the Director of the New York State Experiment Station at Geneva</i>	32
<i>Scientific Notes and News</i>	35
<i>Discussion:</i>	
<i>Our National Monuments:</i> PROFESSOR G. R. WIELAND. <i>The Lower Sonoran in Utah:</i> F. R. FOSBERG. <i>Experimental Study of the Survival Value of Acridian Protective Coloration:</i> PROFESSOR F. B. ISELY. <i>Columnar Structure in Extrusive Basalts:</i> PROFESSOR HENRY S. CONARD	37
<i>Societies and Meetings:</i>	
<i>The Tennessee Academy of Science:</i> DR. JOHN T. MCGILL. <i>The Florida Academy of Sciences:</i> PROFESSOR J. H. KUSNER. <i>The Oklahoma Academy of Science:</i> DR. G. L. CROSS	41

<i>Special Articles:</i>	
<i>Sulphanilamide and Virus Diseases:</i> PROFESSOR EARL B. MCKINLEY, ELLEN GRAY ACREE and JEAN SINCLAIR MECK. <i>The Skin Infectivity of Polio-myelitis Virus:</i> DR. JAMES D. TRASK and DR. JOHN R. PAUL. <i>The Effect of Copper in the Production of Nutritional Anemia in Rats:</i> PHILIP L. HARRIS and GEORGE L. POLAND. <i>The Absorption of Selenium by Citrus and by Grapes:</i> DR. W. M. HOSKINS	43
<i>Scientific Apparatus and Laboratory Methods:</i>	
<i>Growth Substance Determinations:</i> DR. SAM GRANICK and H. W. DUNHAM. <i>A Body Plethysmograph for Measuring Respiratory Volumes with High Respiratory Rates:</i> PROFESSOR ALLAN HEMINGWAY	47
<i>Science News</i>	8

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TUBERCULOSIS, LEPROSY AND ALLIED MYCOBACTERIAL DISEASES¹

By Dr. ESMOND R. LONG

HENRY PHIPPS INSTITUTE, UNIVERSITY OF PENNSYLVANIA

IN the earliest epochs of medical history diseases were classified empirically according to simple symptoms and obvious signs as fevers, tumors, declines and the like, and it was centuries, even, before a more exacting science added an organic incrimination so that physicians could speak more expertly of lung fever, renal dropsy, splenic anemia or pancreatic diabetes. To-day the trend is to set diseases apart on the seemingly rational basis of etiology. Thus lung fever has given way to pneumonia and brain fever to meningitis, with a definite causal association in the mind of speaker and listener with respect to the latter terms. To the ancient physician a febrile disease in which the patient remained in a stuporous or "typhoid" state

was typhoid fever; the physician of a more enlightened age, recognizing its intestinal localization, called it enteric fever; physicians of to-day still use this term or the older one of symptomatic reference "typhoid fever," but instinctively think of the disease in terms of its cause, the "typhoid bacillus" (*Eberthella typhi*).

And just as the science of bacteriology took apart certain previous groups, like inflammations of the lungs, and set them in separate categories, so it also grouped together certain ailments once thought distinct. Formerly processes apparently as unrelated as chronic ulceration of the lungs, general swelling of the lymphatic glands, progressive destruction of the spine and cheesy degeneration of the kidneys, were separate clinical entities, although their frequent association led to some suspicion of a common underlying

¹ Address of the vice-president and chairman of the section on the Medical Sciences, American Association for the Advancement of Science, Indianapolis, December, 1937.

eliminate the above sources of error, the recording plethysmograph shown schematically in Fig. 1 was built.

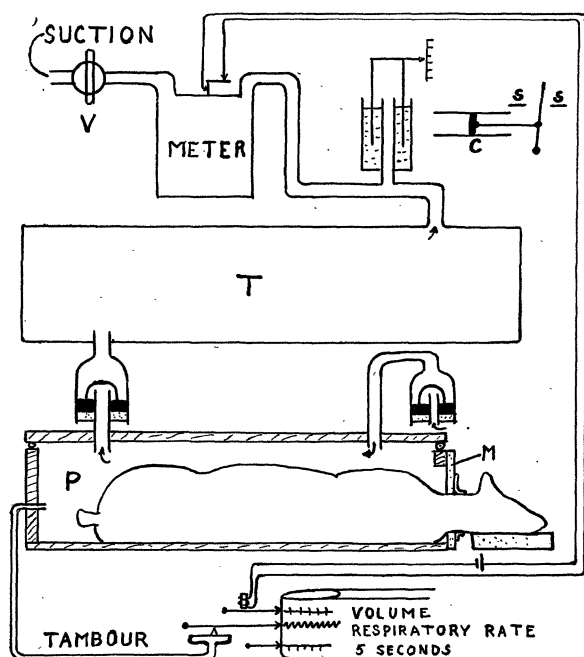


FIG. 1

The recumbent dog lies within a box (P) closed except for valves and tambour outlets, with head protruding through a seal. The seal consists of a spongy rubber mat with a hole just large enough to permit the head of the dog to go through. A circular hole is cut in a piece of dental rubber dam and this is placed around the dog's neck to fit tightly. Adhesive tape seals the rubber dam to the dog's neck and the rubber mat, which is then clamped by a brass frame tightly to the edge of a large hole in the plethysmograph. When carefully placed a dog experiences no discomfort and a trained animal will lie quietly for six hours in the apparatus. The lid of the apparatus is clamped on tightly, soft rubber tubing acting as a washer.

Each of the two box valves consists of a half ping-pong ball seated on mercury. The inlet valve admits room air to the plethysmograph during expiration. During inspiration this air is forced through the outlet valve into a large 150 liter sealed tank (T). From the tank (T) an outlet tube leads to a sensitive spirometer and a dry gas meter. The cylinder of the spirometer is of aluminum, displaces 20 ml per cm and is carefully counterweighted. The meter has electrical contacts which record every one fifth of a revolution representing about 750 ml between contacts. A manually operated valve (V) controls the measured amount of air drawn from (T).

In operation the dog draws air into (P) by expira-

tion and forces the air into (T) during inspiration. Pressure builds up in (T) causing the cylinder of the spirometer to rise. Suction then withdraws air from (T) until the spirometer has returned to its original position. During rapid respirations of 300 per minute, to which the small spirometer can not respond, the large air volume in (T) has added to it by rapid pulsations relatively small quantities of air which build up the pressure. The large air volume acts as a pneumatic cushion to the air pulsations. It is important to have the tank (T) at a slight positive pressure, otherwise air would be drawn through the entire system without breathing. A kymograph record contains a 5 seconds time line, a tambour tracing of rate and a record of the volume of air passing through the plethysmograph, as indicated by the meter contacts.

The apparatus was tested by using a cylinder and piston arrangement (C). The free open end of this cylinder was placed through a hole in the mat (M). Closed containers approximately equal in volume to the dogs were placed in (P). The piston was then moved back and forth between stops (S) at rates simulating respiration. The volume of air drawn into and expelled from (P) could be computed from the stroke and area of the piston.

With this testing procedure the following methods of recording the ventilation rate were tested: (a) a large tambour over a large hole in (P); (b) the small spirometer directly connected to (P); (c) the inlet valve connected to the spirometer and the outlet valve discharging to the room air; (d) the inlet valve opening to the room and the outlet valve discharging air through a wet or dry gas meter; (e) the differential method as described above. As a result of these tests it was found that for respiratory rates exceeding 100 per minute method (e) was the only one giving satisfactory checks. The other methods (a)-(d) depended on some mechanical recorder stopping and starting with each respiration. For rapid respirations the starting inertia was too great to be overcome by the low driving pressures of the plethysmograph.

ALLAN HEMINGWAY

YALE UNIVERSITY SCHOOL OF MEDICINE

BOOKS RECEIVED

- BARD, PHILIP, Editor. *Macleod's Physiology in Modern Medicine*. Eighth edition. Pp. xxxv + 1051. 355 figures. Mosby. \$8.50.
- MORTON, AVERY A. *Laboratory Technique in Organic Chemistry*. Pp. x + 261. 122 figures. McGraw-Hill. \$2.50.
- Science Reports of the Tôhoku Imperial University, Sendai. Second Series (Geology). Vol. XIX, No. 1, 1937.* Pp. 148. 20 plates. Maruzen Company, Limited, Tokyo.
- Zoologica: Scientific Contributions of the New York Zoological Society. Vol. XXII, Part 4, Nos. 21-28, December 31, 1937.* Pp. 297-407 + viii. Illustrated. The Society, New York.

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Assistant Director of the Research Laboratory, General Electric Company

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by C. E. TURNER, *Professor of Biology and Public Health in the Massachusetts Institute of Technology.*

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