# SCIENCE

VOL. 86 FRIDAY, NOVEMBER 5, 1937 NO. 2236



SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

# THE NATIONAL ACADEMY OF SCIENCES[1]

## PRESENTATION OF THE COMSTOCK PRIZE

As Dr. Millikan, chairman of the Committee of Award of the Comstock Prize, is unable to be present, it has become my pleasant privilege to tell you the grounds on which the committee recommended to the academy that the prize be awarded to Dr. Ernest Orlando Lawrence.

Prior to 1919, we had no definite information concerning the interior of the nucleus of the atom. We knew that it had a positive charge equal to the sum of those of its extra-nuclear electrons. In addition to this, it was clear that the nuclei of the various chemical elements were all constructed from the same building blocks. But nothing was known about the nature of these blocks nor of the forces holding them together. The constitution of the nucleus was, then, one of the most fundamental problems that had ever presented itself to physical science.

It was Lord Rutherford who opened the door to this rich storehouse of scientific knowledge. By shooting alpha particles into nitrogen he was able to disintegrate the nitrogen nucleus with the formation of protons and an oxygen isotope. His classical experiment was followed by the bombardment of other elements with natural alpha particles and, in this way, the nuclei of nearly all the lighter elements up to calcium were transformed. With one exception, however, all attempts to transform the nuclei of the heavier elements had failed. Thus arose the urge to produce, artificially, particles having a higher energy content than those projected spontaneously from the radioactive elements. It was clear that, given sufficiently high voltages, such particles could be produced, provided suitable tubes could be developed to withstand these difficulties and seemingly serious limitations.

Dr. Lawrence envisioned a radically different course —one which did not have those difficulties attendant upon the use of potential differences of millions of volts. At the start, however, it presented other difficulties and many uncertainties, and it is interesting to speculate on whether an older man, having had the same vision, would have ever attained its actual em-

[1] Meeting at Rochester, N. Y., October 25, 26 and 27, 1937.

## AN ECONOMICAL AIR COMPRESSOR[1]

DOUBTLESS in many laboratories the need has been felt for a practical and economical type of air compressor, and perhaps the idea of converting a car motor into one has occurred to many. Such an apparatus has found sufficient application in our laboratory in operating the air turbine ultracentrifuge[2] to warrant a description of it here.

Briefly, the compressor consists of a second-hand model T Ford motor (other types of car motors would probably do equally well) in which the following modifications were made. In order to increase the compression ratio and thus increase the efficiency of the motor as an air compressor, it was necessary to partially fill the combustion chambers of the head with babbit metal. However, before doing this we inserted a completely threaded pipe six inches long into each of the spark plug holes so that when the head was assembled there would be a space of about one half inch between the level of the pipe and the level of the piston when the latter was in its uppermost position. A metal pin inserted through a small hole bored near the end of the pipe extending into each of the combustion chambers was found to aid considerably in anchoring the babbit metal in position.

The head was placed in a level position with the combustion chambers up. Melted babbit metal was then poured into each of the combustion chambers to the level of the end of the protruding pipe. This filled the combustion chambers of the head so that when it was assembled there was only about one-half inch space between the babbit on one side and the pistons on the other when the latter are in their uppermost position. (Perhaps a flat metal plate machined so that there is just sufficient space in the head to allow the air to enter and escape would be an improvement.) After the head is assembled four check valves with the gate valve opening upward were screwed on to the four short pipes extending out of the spark plug holes. (We used Jenkins one-half inch air check valves; ordinary water check valves are not satisfactory for this purpose.) It is desirable for greater efficiency of the compressor to place the check valves as close to the head as possible. The check valves are then connected by pipes to a storage tank tested to the maximum pressure desired.

The ends of the exhaust valves are cut off so that they do not contact the rotating cam shaft, thus permitting them to remain closed at all times. The ends of the intake valves are likewise cut off so that they, too, do not contact the cam shaft. The intake valve springs are weakened by cutting off the ends until only a slight tension exists when the valves are completely closed. Thus, when the machine is operating the intake valves work automatically, opening on the down stroke and closing on the upstroke of the pistons.

The compressor was then mounted on a suitable frame and an eleven-inch pulley attached to the crankshaft. We have used a five horse power electric motor with a six-inch pulley to drive the compressor, but if such were not available a second-hand car motor would perhaps do equally well. Because of the heat generated by the compressing of the air, it is advisable to retain the original water cooling system of the motor or, perhaps more conveniently, to attach the circulatory system of the compressor to the water tap. Oil is placed in the crank case to the proper level.

With the air compressor just described we were able to obtain 100 pounds pressure in a 30 gallon tank within one minute and maintain a constant pressure of 80 to 90 pounds while operating the air turbine ultracentrifuge, which has an escape at this pressure of approximately 12 cubic feet of air per minute. More or less pressure may be obtained by increasing or decreasing the speed of the compressor.

A number of variations for this type of air compressor made out of a converted car motor are no doubt possible. In fact, it seems feasible that certain of the cylinders might be modified to compress air, while the remaining ones are used as the driving motor. However, we have not attempted to construct such an apparatus.

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[1] Aided by grant from the Rockefeller Foundation for research in cellular biology.

[2] J. W. Beams, A. J. Weed and E. G. Pickels, SCIENCE, 78: 338, 1933.

## BOOKS RECEIVED

DUBLIN, LOUIS I., and ALFRED J. LOTKA. *Twenty-five Years of Health Progress.* Pp. xi + 611. Metropolitan Life Insurance Co.

ELDER, ALBERT L. *Demonstrations and Experiments in General Chemistry.* Pp. viii + 247. 86 figures. Harper. $2.00.

FURNAS, C. C. *Man, Bread and Destiny.* Pp. xix + 364. Reynal and Hitchcock. $3.00.

HEALD, FREDERICK D. *Introduction to Plant Pathology.* Pp. xi + 579. 200 figures. McGraw-Hill. $4.00.

HOGG, JOHN C., and CHARLES L. BICKEL. *Elementary Experimental Chemistry.* Pp. xvi + 288. Illustrated. Oxford University Press. $2.00.

O'HARA, C. W., and D. R. WARD. *An Introduction to Projective Geometry.* Pp. ix + 298. 60 figures. Oxford University Press. $4.00.

ORTON, J. H. *Oyster Biology and Oyster Culture.* Pp. 211. 57 figures. Longmans, Green. $2.00.

RICKARD, T. A. *Retrospect.* Pp. xi + 402. Whittlesey House, McGraw-Hill. $3.00.

# The American Naturalist

*A Bi-Monthly Journal, established in 1867, Devoted to the Advancement of the Biological Sciences with Special Reference to the Factors of Organic Evolution and Heredity*

JANUARY—FEBRUARY

Joint Symposium on Experimental Populations of the American Society of Zoologists and the Ecological Society of America: Experimental Populations of Microscopic Organisms. Dr. W. H. Johnson. Experimental Studies of Insect Populations. Dr. Thomas Park. Population Density as Related to Sex and to Evolution in Cladocera. Dr. A. M. Banta. On Biological Principles Affecting Populations—Human and Other. Prof. Raymond Pearl.

New Experiences with Oenothera mut. pollicata. Prof. George H. Shull.

Shorter Articles and Discussion: Does the Quantity of Chromatin Produce a Genetic Effect? Prof. R. Goldschmidt. Modifications of the Compound Eye of Drosophila melanogaster Arising under X-irradiation: Dr. C. P. Haskins and E. V. Enzmann. Development of Eye Colors in Drosophila: the Mutants Bright and Mahogany: Dr. G. W. Beadle and Boris Ephrussi. The "Myth" of the Lemur's Comb: Prof. Frederic Wood-Jones, Dr. M. R. Stein.

MARCH—APRIL

Genetics and Development: Phenomena of Embryogenesis and Their Significance for a Theory of Development and Heredity. Prof. E. E. Just. The Genetic Control of Developmental Relationships. Prof. Edmund W. Sinnott. The Development of Eye Colors in Drosophila as Studied by Transplantation. Dr. G. W. Beadle. The Influence of Nuclear Factors in Hybrid Development Studied by Transplantation. Dr. Victor C. Twitty. The Inheritance of the Mutation "Pearl" in the Flour Beetle, Tribolium castaneum Herbst. Thomas Park. Transplantation of Wing-Thoracic Primordia in Drosophila melanogaster. Prof. Ruth B. Howland, B. P. Sonnenblick and E. A. Glancy. Studies on the Life Cycle of Campeloma rufum, a Freshwater Snail. Prof. Harley J. Van Cleave and Dorothy A. Altringer.

Shorter Articles and Discussion: A Case of High Mutation Frequency without Environmental Change: Prof. H. H. Plough and C. F. Holthausen. Additional Evidence of Repeated Chromosome Division without Mitotic Activity: Prof. Charles A. Berger. Chromosome Numbers in the Convolvulaceae: G. B. Wolcott.

MAY—JUNE

The American Society of Naturalists: Haploid and Diploid Generations. Prof. C. E. Allen. Symposium on Supra-Specific Variation in Nature and in Classification. From the View-point of Zoology. Prof. A. C. Kinsey. From the View-point of Botany. Dr. Edgar Anderson. From the View-point of Paleontology. Dr. G. G. Simpson. A Few Examples from Mammalian Paleontology. Dr. W. K. Gregory.

Shorter Articles and Discussion: The Inheritance of the Color of Malpighian Tubes in Drosophila melanogaster: Dr. G. W. Beadle. Second Record of Rare Fresh-water Jellyfish for Missouri: E. L. Atwood, Jr. and J. A. Steyermark.

SUPPLEMENT

Contributions to the Study of Evolution: I. Temporary Heredity and the Mechanism of Adaptation. Prof. C. P. Martin.

JULY—AUGUST

The Effect of Variation on Fitness. Dr. J. B. S. Haldane.

On the Evolution of Photosynthesis. Dr. Harold F. Blum.

Sargasso Weed Fish "Nests." Dr. E. W. Gudger.

The Hydroid Polyp Corymorpha Palma as Gestalt and as History. Dr. Francis G. Gilchrist.

Genetic Nature of Species Differences. Professor Th. Dobzhansky.

Shorter Articles and Discussion: Variation in Scutes and Plates in the Box-Turtle, Terrapene carolina: Dr. W. Gardner Lynn. Segregation of Mutant Characters of Deer Mice: Professor Horace W. Feldman. The Effect of Compression on Bristle Growth in Wild Type Self-implants of Drosophila melanogaster: Dr. Ruth B. Howland and Dr. E. A. Glancy. Notes on the Habits of the Triple-tail, Lobotes surinamensis: K. F. Hughes.

SEPTEMBER—OCTOBER

Can Artificial Selection Produce Unlimited Change? Dr. H. D. Goodale.

Notes on the Cleavage Rate of Scaphiopus bombifrons Cope, with Additional Remarks on Certain Aspects of Its Life History. Prof. Albert H. Trowbridge and Minnie Stambaugh Trowbridge.

Experimental Sexual Photoperiodicity in the Male Turtle. Dr. J. Wendell Burger.

Soil Amoeba Coalesce to Form a Plasmodium. Dr. Philip M. Jones.

Growth and Life Span of the Field Mouse. Dr. W. J. Hamilton, Jr.

Shorter Articles and Discussion: Cynips and Lymantria: Dr. Richard Goldschmidt. The Physiology of Heterosis: Eric Ashby. Pollen Tube Behavior in Self-fertile, Self-sterile and Interspecific Pollinated Resedaceae: Dr. O. J. Eigsti. The Viability of Ten-year-old Didinium Cysts (infusoria): Dr. C. Dale Beers. Hatching Pheasant Chicks on Christmas Day: Prof. Thomas Hume Bissonnette and Albert G. Csech.

NOVEMBER—DECEMBER

The Sex Ratio. Prof. F. A. E. Crew.

Evidence Indicating that Facet in Drosophila is Due to a Deficiency. Prof. C. P. Oliver.

The Time of Action of the CLB Lethal in Drosophila Melanogaster. K. S. Brehme.

Chemicals Attracting Drosophila. Dr. S. H. Hutner, H. M. Kaplan and E. V. Enzmann.

Chromosome Homology in Races of Maize from Different Geographical Regions. Prof. D. C. Cooper and Prof. R. A. Brink.

Some Observations on the Behavior of the Periodical Cicada Magicicada Septendecim L. H. A. Allard.

Shorter Articles and Discussion: Persistence of Cytoplasmic Differentiation during Mitosis: Prof. Alden B. Dawson. The Isotropic Character of the Salivary Chromosome: Prof. Edgar Altenburg. Synthesis of Hypertetraploid Types of Aquilegia: M. Skalinska. The Brine Shrimp of Great Salt Lake: Gladys M. Relyea. The Spurious Nature of the Linkage between Length of Laying Year and Sexual Maturity in the Fowl: Dr. I. Michael Lerner and Dr. Lewis W. Taylor.

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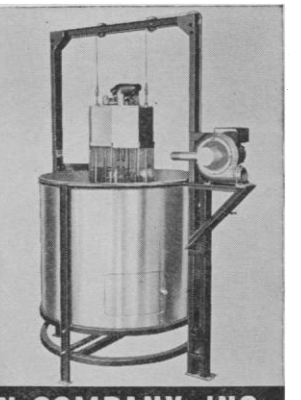

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