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THE LAW OF DIMINISHING RETURNS[1]

By Dr. JOEL STEBBINS

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IN the Encyclopaedia Britannica under the heading, "Law of Diminishing Returns," we find that this law was first stated in relation to agriculture:

An increase in the capital and labor applied to the cultivation of land causes in general a less than proportionate increase in the amount of produce raised unless it happens to coincide with an improvement in the arts of agriculture.

In economics, then, the law of diminishing returns is merely a precise statement of what is ordinarily recognized in the affairs of the working world. Everybody knows that, after a certain point, work in given conditions yields a diminishing return unless a better method is invented applicable to those conditions.

We in this society naturally include astronomy in the affairs of the working world, and it may be instructive to trace some of the applications of the law of diminishing returns in our own field. To begin with, this law took hold of the increasing size of refracting telescopes and brought further development to a close with the completion of the 40-inch refractor some fifty years ago. True, it was the rediscovery of the possibilities of the reflecting telescope that turned the construction of new instruments into the other form. But even if there had been no reflectors it was obvious from geometrical and optical principles, not to mention atmospheric limitations, that each increase in size of the objective of a refractor was accompanied by less than a proportionate increase of power.

The same law is now holding for reflectors even if the 200-inch, as we hope, should turn out to be a complete success. I understand that at Mount Wilson the 100-inch reflector cost about four times as much as the 60-inch, while the 200-inch will cost ten times as much as the 100-inch. No one thinks for a moment that the resulting gain in power will be proportional to the outlay. These facts are elementary to astronomers but to the laymen we might quote the simple

[1] Address of the retiring president of the American Astronomical Society, November 6, 1943.

described conditions is well below freezing until all the water has been removed. The rate of evaporation may be increased by blowing a current of air over the flasks or immersing them in cold water. Materials

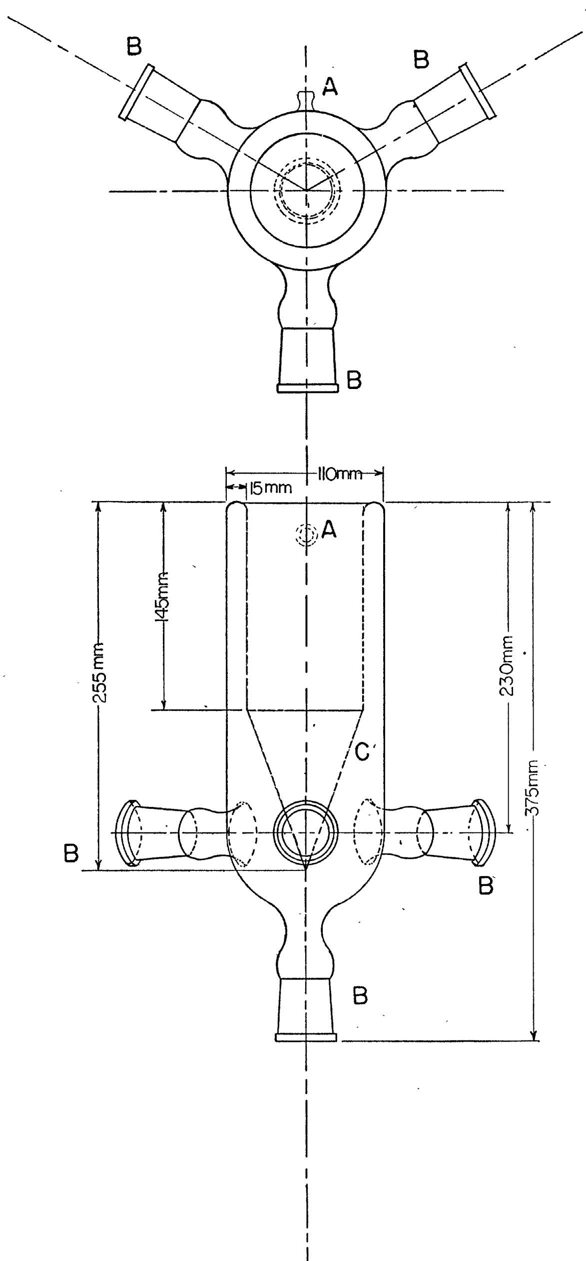

FIG. 1. Diagram of lyophil apparatus showing side and cross section views.

being dried from very dilute solutions have a tendency to be carried out of the flask with the current of water vapor; this may be prevented without causing any appreciable decrease in evaporation by placing a gauze screen over the opening of the flask.

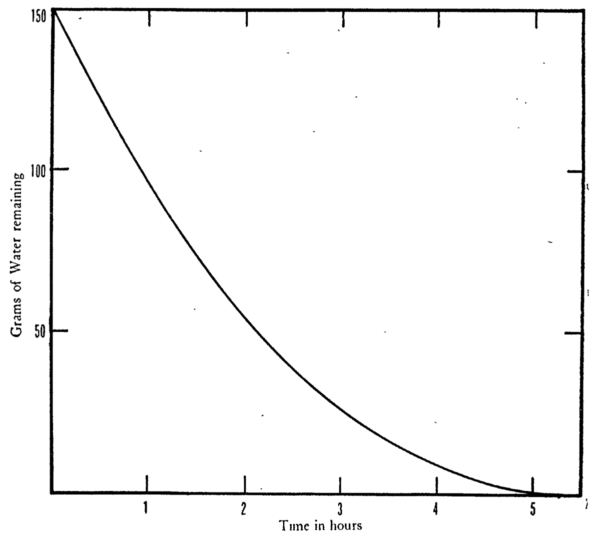

FIG. 2. Amount of water remaining in flasks, plotted against time.

Fig. 2 shows the amount of water remaining as a function of time for 150 gms of distilled water distributed equally among three 200 ml flasks. Complete dryness was achieved in about five hours. The decrease in rate at the end is mainly due to decrease in surface of the subliming ice. Water is evaporated from protein solutions at a comparable rate, depending to some extent on the hygroscopic nature of the material.

DAN H. CAMPBELL
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BOOKS RECEIVED

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CARLISLE, NORMAN V. and FRANK B. LATHAM. *Miracles Ahead. Better Living in the Postwar World.* Pp. xi + 288. Macmillan. $2.75.

FEJOS, PAUL. *Archeological Explorations in the Cordillera Vilcabamba, Southeastern Peru.* Illustrated. Pp. 75. Viking Fund. $3.50.

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GAMOW, G. *Mr. Tompkins Explores the Atom.* Illustrated. Pp. 97. The Macmillan Company. $2.00.

GLASSER, OTTO, EDITH H. QUIMBY, LAURISTON S. TAYLOR and J. L. WEATHERWAX. *Physical Foundations of Radiology.* Illustrated. Pp. x + 426. Paul B. Hoeber, Inc. $5.00.

LINDER, FORREST E. and ROBERT D. GROVE. *Vital Statistics Rates in the United States, 1900–1940.* Pp. vii + 1051. U. S. Government Printing Office. $1.75.

LOBECK, A. K. and WENTWORTH J. TELLINGTON. *Military Maps and Air Photographs.* Illustrated. Pp. x + 256. McGraw-Hill Book Company. $3.50.

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Fifth Edition: 117 pages; 6 by 8¾; $2.50

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