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GALACTIC EVIDENCES FOR THE TIME-SCALE OF THE UNIVERSE[1]

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AN important phase of modern astronomical research is concerned with the time scale of the universe, *i.e.,* with the specification of a natural unit of time in which it would be most convenient to describe the changing aspects of the astronomical universe. Stated in this manner, it is apparent that the solution to the problem of the time scale will not permit us (not at any rate in the first instance) either to "date" the present epoch in a "fundamental" calendar or to forecast with definiteness the "end." What it would allow us, however, is to specify an interval of time in which various aspects of the astronomical universe may be expected to change appreciably. Conversely, the solution to the problem of the time scale will ultimately depend on the study of a variety of different aspects of the universe and the establishment in each case of a time interval during which the aspect studied might change to an appreciable extent. And if such studies should lead us in most instances to time intervals which are of the same order of magnitude, it would not be unreasonable to attribute to a unit of time of this order of magnitude a fundamental significance. It would appear that this is the only manner in which a rational approach to the problem of the time scale can be made. However, in formulating the problem in this manner it is evident that a certain element of arbitrariness has been introduced into the discussion. But this is unavoidable and inherent in a problem in which the emphasis is on an order of magnitude and not on an absolute measure.

During the past twenty years many attempts have been made to establish a time scale in the sense de-

[1] Address given before the Philosophical Society of Washington on December 4, 1943.

E is made from a Pyrex 2 liter flask which has a 24/40 ground glass joint D sealed into it. The tubing sealed

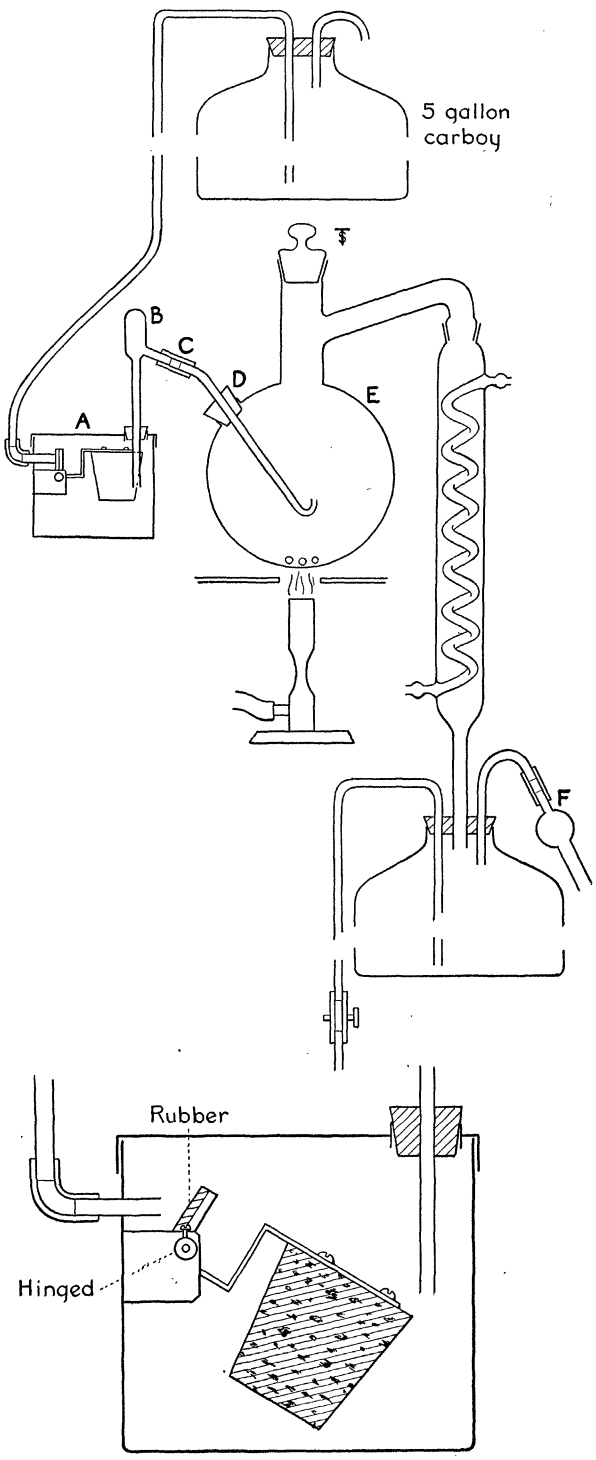

FIG. 1

into the male part of the joint should be constricted slightly at the bottom and turned up to prevent the ingress of air bubbles during boiling. The siphon is equipped with an air trap. It is made by sealing a side arm into the bulb of a broken 10 ml pipette; the upper part of the bulb is sealed. The siphon tube should be sloped from the bulb into the flask so that if any bubbles form they will collect in B. Over a period of months only a small amount of air collects in B. The rubber tubing C should permit the insertion of a clamp when the apparatus is not in use. The soda lime tube F should contain only coarse particles; otherwise it offers too much resistance to the distillation and may blow the stopper out of the flask. Sometimes it is advisable to remove the soda lime tube during the distillation.

Two mls of 85 per cent. phosphoric acid and a few glass beads are put into the flask. A Day pinch clamp is left on the rubber tubing at C until the water starts to boil. The siphon can be filled from the rubber tubing on the end of the delivery tube from the large carboy. When the siphon and the air trap B are filled, the clamp is put on at C. When the first distillation is started the flask E should be filled to a level a little below that in A; otherwise when the water starts to boil it will force some of the solution out of the flask into the leveling box.

The entire apparatus can be assembled in an area $24 \times 15 \times 65$ inches, which includes a 5-gallon carboy reservoir for single distilled water. Where there is a supply of running distilled water, a line can be brought over to the 5-gallon carboy and so facilitate filling the reservoir. The carboy rests on a shelf supported by wall brackets and a $\frac{3}{8}$ inch pipe which serves as a support for the rest of the equipment.

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Physics. Three Parts—"Mechanics," "Heat, Sound and Light" and "Electricity." Illustrated. Pp. xxvi + 1314. Henry Holt and Company. $4.50 a set. $1.50 each.

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