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THE TIME-SCALE OF THE UNIVERSE¹

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It is beyond our power—and may be beyond the bounds of reason—to specify the age of the material universe precisely, like an old epitaph: "Aged 82 years, 6 months and 17 days." But human life has not only an individual duration, but a general time-scale. Only under exceptional circumstances does a man change greatly in thirty days—and rarely does he fail to change greatly in thirty years. There are, therefore, more than astronomical reasons for measuring our ages in years—they afford a scale commensurate with the changes which accompany them.

It is certainly legitimate to inquire, Can we set up a similarly rational time-scale for the description of natural phenomena in the large? Will the units of

this scale be thousands of years, or millions, or billions, or greater? and will different scale-units be appropriate for different ranges of phenomena—just as the rapid development of a child in his first year makes it reasonable to give his age in months?

In my student days, at the turn of the century, no definite answer could be given to these questions. We had very strong reasons indeed to believe that millions, rather than thousands, of years formed an appropriate scale for the greater geological processes; but there was no trustworthy evidence concerning how many millions of years were involved.

We realized, too, that, unless wholly unknown forces or influences of some sort were imperceptibly at work, the history of a finite material universe must run its course in a finite interval of time. This conclusion

¹ The ninth James Arthur Lecture, delivered at New York University, May 14, 1940.