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EARTH AND HEAVEN, 1750-1800: ENLIGHTENMENT IDEAS ABOUT THE RELEVANCE TO GEOLOGY OF EXTRATERRESTRIAL OPERATIONS AND EVENTS

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ABSTRACT

A conceptual and methodological tension can be discerned among Enlightenment advocates of earth science, as regards extraterrestrial events and processes. True to the fundamental traditions of Theories of the Earth, many scientific thinkers exhibited clear recognition of the Earth's planetary status, as a member of a celestial family. To some this legitimated integration of a geological perspective into that of cosmology and astronomy. In extreme instances it even entailed an ideal of establishing earth science by deduction from principles of celestial mechanics. However, this integrative aspect of Theories of the Earth ran counter to another important element in the geological thinking of this era, one which asserted the overriding value of empirical investigation. In the minds of many empirical-minded champions of a natural history of the Earth, a true geology could only be built up through inductive discovery focussed exclusively on accessible terrestrial phenomena. Sometimes explicitly, often by merely tacit exclusion of extraterrestrial considerations, much geological investigation before 1800 tended to identify the integrity of the emerging science with the distinctively Earth-bound nature of the objects of study. The ideal of an autonomous geological science thus tended to be intertwined with a concept of terrestrial autonomy.

ALFRED WEGENER AND THE ORIGIN OF LUNAR CRATERS

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ABSTRACT

Alfred Wegener is universally known for his work on continental drift, but Wegener also made an interesting contribution, just after the First World War, to the study of lunar craters. Wegener reviewed the various hypotheses for lunar cratering, evaluated them from the standpoint of physics, and then performed a series of simple but ingenious experiments from which he concluded that the craters were impact phenomena, occasionally accompanied by secondary melting. This work was probably more important for the theory of scale models in geophysical experiments than it was to the history of selenology, but Wegener's view that lunar craters were impact phenomena and (perhaps more significantly) the reasoning on which he based this conclusion are now generally accepted, along with his once-scorned ideas on continental mobility.

THEORIES OF TERRESTRIAL MASS EXTINCTION BY EXTRATERRESTRIAL OBJECTS

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ABSTRACT

Theories of mass extinction by extraterrestrial objects have been intermittently proposed by European and North American scientists for at least 250 years. Until the late twentieth century, such theories usually treated biological extinction as a single aspect of global cataclysm. Proposed ultimate causes of mass extinction have included the passage of planetesimals close to Earth, impacts of comets or asteroids, and transient increases in cosmic radiation.

These theories have consistently extrapolated from astronomical observations to suggest that extraterrestrial objects had affected Earth at some time in the past. However, until the late twentieth century, none of these theories proposed definitive tests of temporal coincidences between mass extinctions and the terrestrial effects of extraterrestrial objects. Harold Urey's (1973) cometary impact hypothesis was the first to propose such a test. The impact-extinction theory of Luis Alvarez and his colleagues (1980) was the first to provide direct evidence of such a coincidence. Such tests were probably not possible before the middle of the twentieth century. The failure of earlier theories to generate sustained scientific interest can be most simply attributed to their lack of such evidence.

Theories of extraterrestrially caused mass extinction have almost always combined hypotheses of ultimate and proximate causes of extinction. The stability of these combinations has varied greatly from category to category and age to age. In general, these combinations evolved much more rapidly when they were presented and discussed in

mainstream scientific literature. Despite their ubiquity, hypotheses of proximate causes have served a limited role in the reception of these theories. Scientific critics of these theories have consistently required hypotheses of proximate causes to appear plausible. However, the recent history of impact theories indicates that an ultimate cause of mass extinction may be widely accepted without definitive proof of the proximate cause of extinction.