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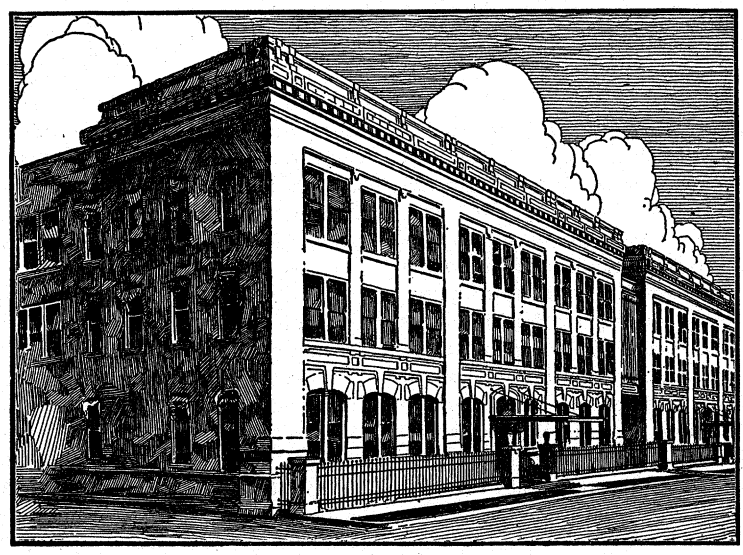
AVAILABLE ENERGY[1]

ASTRONOMY is often called the most useless of the sciences, and so it is from the standpoint of the man whose time-horizon extends ten years forward and ten years backward; and that man, too, probably represents ninety per cent. of all mankind. But for the smaller fraction of men who have been able to rise above the mole's outlook, who have studied enough of the past and understood enough of the present to have acquired a three hundred year time-horizon, for all such the foregoing statement is grotesquely incorrect.

If utility consists in nothing more than feeding and clothing the generation now living, then there are indeed *useless* sciences, and astronomy is perhaps one of them. But again, if utility consists in nothing more than feeding and clothing ten successive generations, then, even by that narrow standard, the verdict of history has definitely been that astronomy is one of the most useful of all the sciences, more useful probably than physics, chemistry, geology or engineering, and that for the simple reason that without it there would presumably never have been any modern physics, chemistry, geology or engineering. Eliminate it and you probably eliminate with it the development of the whole of Galilean and Newtonian mechanics: you certainly eliminate the discovery of the law of gravity, and of all the principles of *celestial* mechanics, and you probably eliminate even the discovery of the laws of force and motion. All these discoveries which came out of the labor and travail of two long centuries, the seventeenth and the eighteenth, which had to create even a new mathematics in order to be able to handle the new group of physical ideas, constituted an indispensable foundation for the crowning achievement of the nineteenth century, namely, the *application of these same laws to the development of terrestrial mechanics,* an achievement out of which has grown most, if not all, of the *distinctive* features of *modern* civilization.

Utility can only be properly defined as all that contributes to the finer, fuller, richer, wiser, more satisfying living of the race as a whole, and there is scarcely a bit of knowledge of the external world or of man himself that does not definitely help toward

[1] Address before the Society of Chemical Industry, New York, September 4, 1928, on the occasion of the conferring on Dr. Robert A. Millikan of the Messel Medal in honor of his work on the structure and relations of atoms.



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