letters

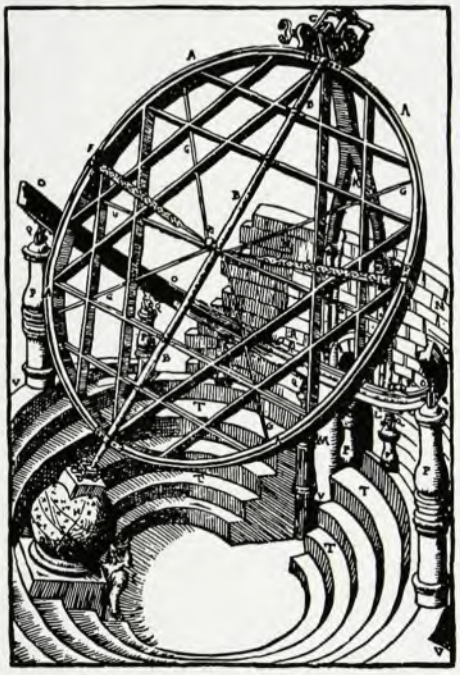
The astronomical establishment in 1570

There is a fascinating admonitory excursion into folklore by Robert J. Yaes in your December issue (page 11), in which he imagines a mammoth astrolabe built during the 1570's by the astronomical establishment to measure planetary positions to the thousandth of a second of arc. (This is an order of magnitude better than the resolving power of Michelson's stellar interferometer, but no matter.) Through this mischanneling of funds, young astronomers were deprived of needed support even down to 1667 when young Isaac Newton, despairing of a future in science, turned down a Fellowship at Trinity to migrate to the Inner Temple and study law.

Extrapolation is an interesting process, especially when one projects into a region in which the data are known. It is just possible that Yaes's appeal to the past may be an argument in favor of scientific gigantism and the generous support of fat cats. The data seem to show that Newton himself depended upon in-house funding, but that the theoretical structure on which his advances were based had grown from the concentration of lavish resources into the hands of a single prestigious operator.

In 1576, Tycho Brahe received an enormous government grant for the construction and operation of an astronomical observatory. He did not equip it with an astrolabe, to be sure, but with a wide variety of triquetra, armillas and divided circles in the form of quadrants and sextants. Some of these instruments were relatively small and portable, some were large and fixed, a few were gigantic. All were built to a standard of workmanship beyond the means of other astronomers, and they were housed in special buildings, specifically designed for their use.

To carry out his observations, Tycho employed a crew of research assistants, who were probably paid the customary pittance. As not infrequently happens, they turned out better work under his direction than they managed for themselves in later life. While they did not achieve that thousandth of a second of arc, they did push the precision of their measurements to one or two minutes.



Tycho Brahe's great equatorial armilla

This is hardly so glamorous, but it was enough to make Kepler's eight-minute discrepancy intolerable.

If we are to draw salutary lessons from history, we should no doubt applaud Tycho's grant and probably also the change of administration, which later cut back his funds and induced him to switch institutions. We might applaud in addition those ideological pressures that presently enabled him to pick up an inexpensive theoretician, a refugee scholar named Johannes Kepler. (It is an interesting sidelight that in the seventeenth century the unorthodox were forced to leave the country, whereas in the twentieth they are usually prevented from doing so.) We should certainly notice how the precision of the observations from Tycho's data factory forced Kepler to abandon both the Ptolemaic and the Copernican formalisms for representing the heavenly motions. Perhaps we need not dwell on the unattractive scheme involving an Apollonian conic with which we replaced them.

A good novelist, no doubt, could produce half a dozen scenarios that would be morally more acceptable. The facts are that Newton *did* use Kepler's laws, that Kepler *did* use Tycho's observations, and that Tycho's observations *were* produced by the extraordinarily generous funding of a single, extravagant, overbearing, conceited aristocrat.

The comforting thing about history is that it either may or may not be applicable to the present.

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The letter by Robert J. Yaes (December, page 11) is well taken for the most part. My only quibble would be at his suggestion that Newton would study law.

I suggest that he would be much more likely to study theology, since he actually wrote a respected commentary on the Book of Daniel. The Church of England was quite literally "the establishment" of his day, and thus a safer refuge for a prospectively unemployed scientist than his other possibilities in mathematics and chemistry or alchemy. He did, of course, get a good "civil service" job, anyway, as Master of the Mint.

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Physics & society conflict

While it is refreshing to see George Brown's "Physics and Social Change" (October 1971, page 23) as a lead article, and while I welcome his general purpose, I fear that much in the article is based on misconception of the way in which physics has evolved and of the way by which societies, especially in their economic and political aspects, are changing. This can only lead to illusion and false hope concerning the way in which future change (both in physics and in society) will take place.

The very examples that Brown cited near the end of his article—the replacement of the Ptolemaic cosmology by the Copernican, the classical mechanistic physics of Newton by the relativistic physics of Einstein and also by quantum mechanics—have to be viewed in