tions as to why the quest for the laws of affinity was abandoned in mid-century by British natural philosophers and chemists only to be picked up with increased vigor by the French in the latter half of the century. In a chapter devoted to the more speculative British natural philosophers such as Bryan Robinson, Robert Green, and Gowin Knight, he points to the negative influence of Boscovitch on British attempts to quantify the laws of chemistry. Irony indeed! For although Boscovitch's system was predicated upon the view that matter is internally structured and composed of homogeneous (though dimensionless) units associated with quantifiable forces of attraction and repulsion, he maintained that the determination of particular chemical events from the general theory was quite beyond the capacity of the human mind. By contrast we have Buffon's bold profession, in 1765, of Newtonian faith that the law of chemical affinity was identical with the inverse-square law of gravitation, and that "this law seems to admit of no variation in particular attractions, but what arises from the figure of the constituent particles of each substances . . . ." The invitation of the influential Buffon to chemists was clear: determine by experiment the forces of affinity between different chemical species, and the departure of these force relationships from an inverse-square law will reveal the shape of the constituent particles.

One factor served to modify the thoroughgoing Newtonian program of Buffon for chemistry, even in France. This was the Stahlian influence, which called for a chemistry based upon quality-endowed elements or principles related to laboratory chemical experience and not upon physical atoms or principles which lay well below the level of observation. This view found much favor with practicing laboratory chemists such as Macquer and Rouelle and led to a certain agnosticism about the ultimate physical constituents of matter; it did not, however, preclude research on or consideration of the problem of affinity. This tension in late-18th-century French chemistry is most clearly seen in Lavoisier, who expresses agnosticism about atoms and bases his chemistry on empirically defined elements but at the same time expresses a faith in the ultimate success of such researches as Guyton de Morveau's on the quantification of the laws of affinity.

Ultimately this tension was to be relieved by John Dalton, who quantified chemistry not in terms of force laws but in terms of the macro-determined *weights* of the *atoms* of *elements*. In the last and best chapter of the book, Thackray places Dalton in the context of British popular Newtonianism of the 18th century, which followed the paths of the itinerant lecturers through dissenting rural England. Although Dalton's *New System of Chemical Philosophy* struck a fatal blow to the Newtonian dream of chemistry by its basic assertion of the heterogeneity of matter, it is testimony to the influence of Newton on chemistry that Dalton felt the necessity of doctoring a quotation from the 31st Query of the *Optics* to justify his position.

This essay offers many other provocative insights into 18-century chemistry, although the author shows a disconcerting reluctance to follow up many of his suggestions. Nevertheless, he has given the specialist much to ponder and provided the general reader with a very readable account of an important episode in chemical history.

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Galileo's Innovations

Galileo Studies. Personality, Tradition, and Revolution. STILLMAN DRAKE. University of Michigan Press, Ann Arbor, 1970. x, 290 pp., illus. $8.50.

The 13 essays collected in *Galileo Studies* elucidate the work of Galileo "as he himself approached it, performed it, regarded it, and evaluated it." Selecting from articles he has published earlier, Drake combines, modifies, and edits those selected to illustrate a major theme set forth in his introductory chapter. He remarks that intellectual historians are at present bent on attributing as much of Galileo's thought as possible to his predecessors and as little as possible to his own originality. Granting that valuable clues to the path an individual thinker is likely to pursue may be had from reconstructed trends and patterns of ideas, Drake insists effectively on the indispensability of a complementary biographical or "internal" investigation of Galileo's own writings. Only by following out the steps Galileo took in his work can one do justice to this innovating thinker and correct mistaken attributions regarding the sources, burden, and contexts of his ideas. Did a concept of inertia first emerge in Galileo's mind in connection with projectile motion? Did Galileo believe circularity to be an essential component in inertial motions? Was Galileo indebted to, and building on, the Merton rule (mean-degree theorem of uniform motion) in his analysis of falling bodies? Affirmative answers to all three questions have become generally accepted by historians of ideas. In three essays ("Galileo and the concept of inertia," "Free fall and uniform acceleration," and "The case against 'circular inertia'"), Drake submits that the evidence afforded by strict attention to relevant texts accurately rendered does not warrant the affirmative answers.

To understand and appreciate Galileo's contributions to the advancement of science, one must indeed be informed about prior developments and traditions. Drake supplies an excellent portrait of physical thought in 16th-century Italy in his first essay, "Physics and tradition before Galileo." In his fifth essay, "The effectiveness of Galileo's work," he relates Galileo to his contemporaries as follows: Galileo was born into a world that already had a highly developed and technically advanced mathematical astronomy, but it had no coherent mathematical physics and no physical astronomy at all. It was Galileo who, by consistently applying mathematics to physics and physics to astronomy, first brought mathematics, physics, and astronomy together in a truly significant and fruitful way. The three disciplines had always been looked upon as essentially separate; Galileo revealed their triply paired relationships and thereby opened new fields of investigation to men of widely divergent interests and abilities. Mathematical astronomy, mathematical physics, and physical astronomy have ever since constituted an inseparable triad of science at the very base of modern physical science. Therein, I think, lies the primary explanation of Galileo's effectiveness [p. 97].

In setting forth Galileo's program for the reform of physical science and in showing how his work contrasted with that of his predecessors Drake ably defends the claims of priority that have been made for Galileo. Also, in several essays, he is concerned with personal factors—with facets and traits of Galileo's character—as these contribute to historical understanding of his breach with traditions and of positions taken and leadership exerted in scientific disputes. A controversial figure in his own day, Galileo has remained a subject of controversy in conflicting interpretations and assessments of his contributions. The essays in *Galileo Studies* deliver important insights into relations of ideas to one another in Galileo's work, and into how he actually proceeded in effecting reformations of scientific inquiry.

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