Hans-Werner Schütt; the original editor's preface appears (as it always did) at the beginning of Volume Two.

Duke University ANDREW SPARLING

Fermentation: Vital or Chemical Process? By JOSEPH S. FRUTON. Pp.: xv + 141, index. Brill: Leiden and Boston. 2006. €75.00; $98.00. ISBN: 978-90-04-15268-7.

In his book *Fermentation: Vital or Chemical Process?* Joseph Fruton recounts the history of the phenomenon of fermentation. The first chapter begins with the theories of the Greek philosophers and Aristotle's definition of concoction in his *Meteorologica*. Aristotle's concept of *pepsis* included not only natural processes, such as the ripening of fruit, but also the generation of metals, initiated by the earth's heat. This idea would soon become part of Western alchemy, and provided the stimulus for the search for a *ferment* (Philosophers' Stone, *elixir*) that could transmute base metals into gold and cure human diseases. After a brief outline of the most important Arabic and Latin alchemical works, Fruton proceeds with Paracelsus's doctrine and his project to make drinkable medicines, and he mentions some intriguing contributions of the iatrochemists. The chapter ends with the publication of Libavius's *Alchemia* and some widely accepted definitions of fermentation.

The second chapter starts with Van Helmont's studies of human digestion and his Neo-Platonic thoughts about fermentation. Both the esoteric definitions of the alchemists and Van Helmont's mystical views were replaced during the seventeenth century by the mechanical philosophy of Descartes, Newton and Boyle. Many chemists adopted the corpuscular theory of matter, Willis's interpretation of fermentation serving as an important example. John Mayow defined fermentation as a combination of a nitro-aerial spirit with the sulfur of matter, while Lemery espoused a spicule-pore model. Stahl, among several other prominent chemists, accepted Becher's idea of phlogiston and applied it in his definitions of fermentation. The chapter closes with the significant rediscovery of Van Helmont's *spiritus sylvestris* by Black, who coined this air "fixed air" and demonstrated its formation during fermentation processes.

The third chapter opens with Lavoisier's well-known experiments on alcoholic fermentation and his use of balance sheets. Apart from the affirmation of the principle of the conservation of weight, Fruton emphasises the importance of Lavoisier's assumption that sugar was converted into carbonic acid and alcohol. Of special interest was the discovery in 1837 by Caignard de la Tour, Schwann and Kützing that the agents of fermentation were living organisms. At about the same time, Berzelius introduced the concept of catalysis, and Liebig presented his ideas about fermentation. The identification of diastase, pepsin, emulsin, lipase and others clarified the role of individual ferments and led to a debate with the advocates of the organismic theory. Another debate ensued between Liebig and Pasteur. Pasteur's vitalistic thoughts were also contradicted by Berthelot's advocacy of Bernard's theories. Traube suggested that ferments are chemical substances in the microscopic organisms. Finally, Kühne introduced the word enzyme, and Fisher proposed a lock and key analogy for the enzyme–substrate interactions.

In the last chapter, Fruton continues with Buchner's preparation of a cell-free yeast extract. The pioneering work of Wróblewski, Harden and Ivanov during the early twentieth century led to the proposal of several schemes and theories of alcoholic fermentation by Baeyer, Wohl and Neuberg. Warburg presented a physiological theory of cellular respiration, but soon came into conflict with Wieland and his theories about biological oxidation reactions. The enzymes of the intermediary stages of the Embden–Meyerhof pathway twelve-enzyme pathway of alcoholic fermentation were identified thanks to the research of Embden, Meyerhof, and Parnas, three key players in the revolution in muscle physiology. The research of Sumner and

Northrop made the crystallisation of enzymes possible and stimulated the Warburg group to isolate these enzymes in crystalline form.

Katholieke Universiteit Leuven PIETER THYSSEN

The Salt of the Earth: Natural Philosophy, Medicine, and Chymistry in England, 1650–1750. By ANNA MARIE ROOS. Pp. xvi + 293, illus., index. Brill: Leiden and Boston. 2007. €99.00; $129.00. ISBN: 978-90-04-16176-4.

A. M. Roos intends to demonstrate the centrality of salt in early chemistry (and matter theory), chiefly because natural philosophers and physicians in the seventeenth and eighteenth centuries considered these "salts" to be fundamental to science and medicine. Of course, the salts are at the intersection between chemistry, physiology, and medical sciences. The author shows how the experiences with this material (in particular among early Royal Society members) were also important in the intellectual changes of the time.

In the first half of the seventeenth century, Paracelsian physicians and chemists utilised different combinations of the four Aristotelian elements (water, earth, fire, and air) and Paracelsian principles (mercury, sulfur, and salt) to suit their practical and philosophical beliefs about saline chemistry. Nevertheless, the work of Johann Rudolph Glauber was influenced by Van Helmont, most specifically in his concept of the *alkahest* and in water as a method of transport for his *sal mirabile*. Roos explains how some "chymists" at the end of the seventeenth century (such as Robert Boyle, Martin Lister, Robert Moray, and Nehemiah Grew) interpreted Van Helmont's chemical work for the purposes of their own work in natural history.

The author analyses the works of Martin Lister (chiefly his *De Fontibus medicates Angliae*, 1684) and those of Grew (especially his *Anatomy of Plants*, 1682). At that time, belief in the "salt principle" diminished, and there was growing interest in the idea of a "universal acid" as the basic mover in processes of nature (usually identified as sulfuric acid). Roos presents a clever discussion of William Simpson (*Zymologia Physica*, 1675), who based his work (just like the Frenchman Nicolas Lemery) on Sylvius's iatrochemistry (acid against alkali, and "fermentations"). She shows how Simpson's search for a vital agent in the process of fermentation, as well as his assertions about acids and sulfurs (in the Paracelsian sense), have some striking parallels with Newton's thought. The new role of "saline spirits" (or acids) as proposed by Simpson affected early modern medical theory and applications. Roos also analyses Bryan Robinson's practical medicine (*Animal Oeconomy*, 1734). Robinson used acids and alkalis to appropriately strengthen or weaken the "animal fibres" and blood to attain bodily balance and treat diseases.

In another chapter, Roos presents salts and "saline spirits" in the medical marketplace and literature. She first analyses the use of salts in patent medicines and popular medicaments, and she then examines the role that salt chemistry played in popular literature, primarily that which satirised alchemy and chymical medicine. It is surely the most original part of the book; chiefly the presentation of J. H. Cohausen's work *Hermippus Redivivus* (1742). After a discussion of saline particles in the breath, Cohausen explained how the exhalations and inhalations of the body played a role in prolonging life, particularly the emissions from the pores of the skin.

In the final chapter, the author studies the transition from saline acids to acidifying oxygen by the evocation of Stephen Hales (and his "aerial acids") and the "acidifying principle" propounded by Lavoisier. She closes her book with an appendix, which is the translation from Latin of Martin Lister's *De Fontibus medicates Angliae* (On the Healing Springs of England).

Until now, no study devoted to the concept and uses of salt in early modern science has been available. Consisting of a series of case studies, this book is therefore important for