We are indebted to Dr. J. Pennington, of the department of bacteriology, and to our nursing colleagues for maintaining high standards of care at all times.

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Medical History

One-Hundred-and-Fifty Years of Measurements of Hydrochloric Acid in Gastric Juice

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"Were it more the custom in this country to bestow honours on those who devote their time, their talents, and their lives to benefit their fellow-creatures, such researches as Dr. Prout's would not have passed unrecognized. But deeds in arms and in diplomatic arts, improvements in shells and rockets for the destruction of life, monopolise such distinctions, whilst the gratitude of the afflicted, with the good opinion of mankind, are the chief rewards to be looked forward to by the philanthropic physician."¹

Life of William Prout

William Prout¹⁻⁵ was born on 15 January 1785 in Horton, a remote village in Gloucestershire where his family had been landed gentry for generations. He was educated locally until he was 13. At 17 he went to a clerical academy at Sherston for 18 months, and after a further period at home spent two years at another clerical academy in Bristol before going to Edinburgh in 1808 to study medicine. He was taught anatomy by Alex Monro *tertius*, chemistry by Thomas Charles Hope, and physiology by Andrew Duncan. After graduating in 1811 with a thesis on intermittent fevers he came to London to study at the Guy's of the surgeon Astley Cooper, the physicians Thomas Addison, Richard Bright, and Thomas Hodgkin, as well as the animal chemist Marcet, who discovered xanthine. Prout was admitted a Licentiate of the Royal College of Physicians of London in 1812 and devoted the rest of his life to research, lecturing, and writing on chemistry while earning his living as a clinician. In 1813 he moved to 4 Arundel Street, Strand, and began there his lectures on animal chemistry. In 1814 he married, visited Paris, took a house in Southampton Street, Bloomsbury, and set up in practice. The same year

he was elected a Fellow of the Royal Medical and Chirurgical Society, and in 1819 became a Fellow of the Royal Society.

His practice grew slowly because of the prejudice of most physicians against chemical doctrines. In 1825 he moved to 40 Sackville Street, where he lived until his death in 1850. His consulting room was heaped with papers, letters, and chemical apparatus. He did his research in the morning, breakfasted at 7, and saw patients until 10 in the evening. Even after he became a leading London physician he never amassed the usual fortune because of his unbounded liberality regarding fees as well as his heavy expenditure on scientific equipment and research. He was al-

William Prout (1785-1850). Portrait by H. W. Phillips. (Reproduced by permission of the Royal College of Physicians of London.)

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ways studious and reserved and, though a founder-member of the Athenaeum, his disinclination for society increased as he became progressively deaf. His main outside interest had been music, and he composed anthems as well as building and playing his own organ.

"In appearance, Dr. Prout presented the beau ideal of a physician of the old school. He was of the middle height, and of slim figure. His head was notably developed, and the intellectual qualities strongly marked; the hair soft, and snowy white. His features were delicately chiselled, eyes brilliant, complexion very pale, but the expression of his countenance combined benevolence with great intelligence. There was a blandness in his manner which inspired confidence, and set the most nervous patient at ease. He always dressed with scrupulous neatness; usually in black, with gaiters or silk stockings."¹

His Work

Prout was a physician, physiologist, chemist, and meteorologist. As a physician he was noted for his work on the urine, kidney stones, and diabetes. His clinical reputation was made in 1821 by his first book, *An Inquiry into the Nature and Treatment of Gravel, Calculus, and other Diseases connected with a Deranged Operation of the Urinary Organs*.⁶

Chemists remember him for Prout's Hypothesis. In an anonymous paper published in 1815 "On the relation between the specific gravities of bodies in their gaseous state and the atoms" he proposed that the atomic weight of elements are the exact multiples of the atomic weight of hydrogen. Biochemists regard him as "a grandparent of British biochemistry"⁸ because he was one of the first scientists to apply precise chemical analysis to biological materials. He found circadian rhythms in his own expired carbon dioxide. His "secondary assimilation" included the concept that excretions such as urea, uric acid, and carbonic acid were derived from destruction of tissues.

His paper to the Royal Society in 1827 "On the ultimate composition of simple alimentary substances; with some preliminary remarks on the analysis of organised bodies in general" introduced the classification of foods into saccharinous (carbohydrates), oleaginous (fats), and albuminous (proteins) and earned him the Copley medal. He delivered the Gulstonian lectures of 1831 on the theme of his life's work, "The Application of Chemistry to Physiology, Pathology and Practice," and in 1839 was elected a Fellow of the Royal College of Physicians of London.

His contemporaries emphasized both his accurate and scrupulous experiments as well as his powers of generalization; they acknowledged him as "the person who led the way to that more intimate knowledge of the functions of life through the instrumentality of chemistry which has been one of the characteristics of the present century."²

Studies on Gastric Acid

On 11 December 1823 Prout read his paper "On the Nature of the Acid and Saline Matters usually existing in the

Stomachs of Animals" to the Royal Society of London.¹⁰ Since the time of Spallanzani the stomach had been suspected to contain acid, and Scopoli had suggested that the stomach secreted hydrochloric acid, but Prout's achievements were two-fold. Firstly, he definitively identified hydrochloric acid in the gastric juice of rabbits, hares, horses, calves, dogs, and man. Secondly, he made quantitative measurements of the concentrations of free and total hydrochloric acid (by exact neutralization with a solution of potash of known strength) as well as of chlorides (by titration with silver nitrate). Prout thus established the equation which we now express as

$$[\text{Total chloride}] = [\text{neutral chloride}] + [\text{titratable acid}]$$

and later postulated that chloride was secreted from blood to lumen by the power of electricity, and that when acid was secreted the blood became alkaline.

Though Prout's identification of hydrochloric acid was soon confirmed by William Beaumont when testing the gastric juice of Alexis St. Martin there were repeated statements throughout the rest of the nineteenth century that gastric acid was butyric, acetic, phosphoric, or lactic acid—and even Claude Bernard, Bence Jones, and Oliver Wendell Holmes favoured lactic acid.

GASTRIC FUNCTION TESTS

Prout measured the gastric juice of three patients with severe dyspepsia, expressing his results in grains of muriatic acid per pint (of 16 fl. oz.; 454 ml). Over the next 150 years the nomenclature of acidity measurements has passed from Prout's grains per pint, through cc N/10 NaOH per 100 cc gastric juice, degrees of acidity, clinical units, mN, mEq/l., to the new S.I. units of mmol/l. Rigid gastric tubes and then flexible nasogastric tubes have allowed easy aspiration of gastric juice, which can be stimulated in many ways, varying from test meals of water, gruel, caffeine, or alcohol to injections or infusions of histamine, histalog, pentagastrin, and insulin. Even today the clinical value of gastric function tests is still under debate.¹⁰

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