episode was the pre-mission identification of the hilly Apollo 16 landing site at Descartes as a collection of volcanic landforms; it turned out to lie in the middle of the heavily cratered lunar highlands. "The moral of the story of Apollo 16 is that investigators should have stood back and viewed the big picture. . . . Basically, we goofed. . . . Geologists were too captivated by terrestrial analogues", says the ever-honest and dispassionate Wilhelms. This theme, that comparisons with the geology of the Earth usually prove misleading, occurs throughout the book. Wilhelms's judgement that the Moon is not a little Earth should be heeded by all those engaged in the currently fashionable study of comparative planetology.

The Apollo missions are treated in detail, with much understanding of the difficulties of fieldwork by the astronauts in an alien terrain. Some missions were better than others; the Apollo 15 flight to Hadley Rille at the foot of the Apennine Mountains was perhaps the most outstanding. Wilhelms laments, as we all do, the political decision to cancel the three final missions (Apollos 18–20, for which the hardware existed) to such mouth-watering sites as Copernicus, Gassendi and the Marius Hills. Even the spectacular rayed crater Tycho, deep in the southern highlands, would have been accessible at that stage to a manned landing. In the event, the final mission to return samples was the Soviet Luna 24 unmanned flight to Mare Crisium in 1976.

The successes of the Apollo missions have caused us to forget the many hazards involved. In unemotional prose, Wilhelms provides the best account I have read of the drama of the first lunar landing. As the Apollo 11 astronauts were on their final descent to the surface of Mare Tranquillitatis, the onboard computers signalled faults with the lunar lander. The cool-headed navigation controller at Houston, a 26-year-old MIT graduate, correctly judged the alarm signals to be due to computer overload, and the landing went ahead. Wilhelms notes that the Apollo missions, with all their complex technology, suffered many fewer problems than the later Space Shuttle programme.

He also answers the inevitable question 'Could less costly automated return of samples have accomplished the same results as the manned missions?' with a frank no. This view coincides with the considered opinion of most scientists. After all, documented rock samples, and not merely soil and small rock fragments as returned by the Soviet Luna unmanned missions, were needed to obtain correct isotopic ages and to unravel the history of the Moon. □

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The outsider

W. F. Bynum

Archibald Garrod and the Individuality of Man. By Alexander G. Bearn. *Oxford University Press: 1993. Pp. 227. £35, \$65.*

To many, Archibald Garrod (1857–1936) is at best a name associated with a phrase: 'Inborn errors of metabolism', the title of his 1908 Croonian lectures to the Royal College of Physicians, subsequently published as a moderately sized volume. Even in his own lifetime, Garrod never achieved the visibility that the outward trappings of a highly successful career might have bestowed: consultancies at the

IMAGE
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REASONS

Garrod — metabolic sleuth.

Hospital for Sick Children in Great Ormond Street and at St Bartholomew's Hospital in London; co-authorship of a pioneering textbook of paediatrics; fellowship and the vice-presidency of the Royal Society; a knighthood; directorship of the first academic medical unit to be established in a British medical school, at St Bartholomew's; and the Regius Chair in Medicine at Oxford, in succession to his friend Sir William Osler.

Garrod thus rose to the top of the medical profession without anyone much noticing. There were several reasons for this. His personality did not provide the stuff of anecdote; he attracted admiration but no idolatry; his clinical teaching was wonderfully informed but esoteric and therefore unlikely to inspire adulation by the general run of medical students; and, at Oxford, Osler was an impossible act to follow. Nor, despite Garrod's close friendships with the geneticist William Bateson and the biochemist Frederick Gowland Hopkins, did the scientific community follow his lead. The metabolic diseases Garrod studied were mostly rare and clinically unimportant. He appreciated their hereditary character, but he was uninterested in the developing science of mendelian genetics, and although he was

adept at the biochemical analysis of bodily fluids, he was not by nature an experimentalist. He was in essence a biologist in the clinic, at his best puzzling over diagnostic minutiae but less at home with routine treatment of common diseases.

In explaining Garrod's relative isolation in his own time, Alexander Bearn provides ample grounds for a modern appreciation of his subject. This admirable biography has two principal virtues. First, it is based on sound and extensive archival research. Bearn has followed Garrod to St Bartholomew's, to Oxford, to the Royal Society and other London institutions, and to Malta, where Garrod was stationed as a colonel in the Royal Army Medical Corps during the First World War. More importantly, he has uncovered and exploited Garrod's correspondence and other private papers still in the hands of his collateral descendants. This allows Bearn to offer a sympathetic account of Garrod's career, family life, friendships and self-image. It provides a moving gloss on his Oxford years and retirement; his life was shattered by the death of his two sons in the First World War and the loss of the third in the influenza pandemic of 1919. Only his daughter Dorothy survived, her distinguished career in archaeology partly stimulated by Garrod's own discovery of the subject during his years in Malta.

Of equal virtue is Bearn's eloquent analysis of Garrod's scientific ideas. Garrod's original four inborn errors of metabolism were alkaptonuria, albinism, cystinuria and pentosuria; he added a further two, haematoporphyrinuria and congenital steatorrhoea, in the second edition of his book. But for Bearn, Garrod's elaboration of the concept and methods of diagnosing inborn errors was not his most enduring intellectual contribution. Rather it was his notion of biochemical individuality, repeatedly invoked in his lectures and articles and the focus of his final book, *The Inborn Factors of Disease*, reluctantly published by Oxford University Press five years before his death. Bearn sees this as a foundation text of modern molecular medicine and human genetics and assesses the claim that the 'one gene, one enzyme' insight also originated from Garrod.

In his later years, Garrod became an apostle of what he liked to call the "higher medicine", the systematic application at the bedside of results gained in the laboratory. He practised what he preached even if those who listened were for the most part already converted. Bearn's volume is unlikely to turn his subject into a household name, but Garrod has been well served by his first biographer. □

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