Book Reviews

The Eradication of Smallpox: A Revisionist View

Edward Jenner's Cowpox Vaccine. The History of a Medical Myth. PETER RAZZELL. Caliban Books, Firle, Lewes, Sussex, England, 1977. 130 pp. Paper, $16.50.

The Conquest of Smallpox. The Impact of Inoculation on Smallpox Mortality in Eighteenth Century Britain. PETER RAZZELL. Caliban Books, Firle, Lewes, Sussex, England, 1977. x. 190 pp. $16.

Here, in modest dress, are two books of immodest aim. In them Peter Razzell seeks to pursuade us of two bold and heretical propositions: first, that Edward Jenner's famous "vaccine" against smallpox was not cowpox virus, as has generally been supposed, but an accidentally attenuated form of smallpox virus itself; and, second, that "variolation" (the pre-Jennerian method of prophylaxis against smallpox, involving the intentional inoculation of smallpox virus) was remarkably safe and effective—so much so that it contributed importantly to the modern rise of population. Razzell marshalls evidence from a wide range of sources, chiefly from the 18th century but including also recent research in clinical medicine and virology. His arguments are suggestive, to say the least, and will have to be confronted by future workers in the field.

In the scandalously overpriced book on Jenner's vaccine, Razzell concedes that Jenner's initial (and somewhat inconclusive) trials involved true cowpox virus. But he claims, on the basis of letters exchanged between Jenner and his contemporaries, that most of his stock of "vaccine" (and, indeed, most of the smallpox vaccine used by everyone up until 1840 or so) derived immediately from the arm of Ann Bumpus and ultimately from the arm of Jane Collingridge, a patient at the London Smallpox Hospital who, in January of 1799, had been inoculated with both cowpox virus and smallpox virus, in that order. Razzell argues that it was the smallpox inoculation rather than the cowpox inoculation that "took" in Collingridge and that the subsequent "vaccination" of Ann Bumpus thus also involved the inoculation of a strain of smallpox virus.

Razzell bases this claim upon three somewhat separate lines of evidence. First, until he turned to the "Ann Bumpus virus," Jenner had mixed success in his efforts to infect humans with cowpox virus, whereas his inoculations invariably "took" after 1799 (the Ann Bumpus virus, that is to say, was much more infective than the cowpox viruses Jenner had earlier used). Second, the symptoms produced in the early inoculations of the Ann Bumpus virus—notably the number and appearance of pustular eruptions—were virtually indistinguishable from the symptoms produced by the inoculation of classic smallpox virus. (The subsequent restriction of such pustules to the site of inoculation, Razzell argues, can be ascribed to an unwitting attenuation of the Ann Bumpus virus through repeated arm-to-arm transfers of virus selected from the point of inoculation of the previous host.) Third, stocks of vaccine certified by Jenner apparently gave rise at least twice to minor epidemics of smallpox—at Petworth in England in late 1799 and at Marblehead, near Boston, Massachusetts, in 1800 (when 68 people died). If the use of Jennerian "vaccines" did in fact lead to occasional outbreaks of smallpox, as Razzell insists, then those vaccines obviously contained smallpox virus.

Taken as a whole, Razzell's case is persuasive. He may also supply a useful corrective through his rather unflattering portrait of Jenner, whom he accuses of deliberate distortion of evidence as well as of self-deception. But it is only in *The Conquest of Smallpox* that Razzell reveals the full ambition and iconoclasm of his revisionist history of variolation and vaccination. In essence, *Conquest* is a brief on behalf of variolation, and especially the mild "Suttonian" version of the technique as practiced from the 1760's in England. Razzell even goes so far as to suggest that smallpox would have been eradicated whether or not Jenner had ever lived and whether or not vaccination had ever been invented. He also argues (despite an odd disclaimer on p. viii) that variolation was an important, perhaps even the major, factor in the dramatic rise of population in 18th-century England. Skeptics should examine closely the body of evidence Razzell adduces in support of these remarkable claims. Most will, I suppose, admire the ingenuity but remain unconvinced.

Exploiting such sources as *Gentlemen's Magazine*, local histories, parish registers, overseer-of-the-poor accounts, even newspaper ads and church monuments, Razzell is especially eager to establish the benefits of variolation in isolated English villages, where (he reminds us) the vast majority of Englishmen lived throughout the 18th century. There smallpox recurred in periodic epidemic waves, threatening adults as well as children and promoting the widespread adoption of variolation. In much of rural England, Razzell insists, "Repeated general inoculations [that is, the simultaneous variolation of all vulnerable inhabitants] led to the inevitable consequence: the almost total elimination of smallpox" (p. 92). In London, by contrast, smallpox was an endemic disease of children and the benefits of variolation were much less apparent. Since bills of mortality exist only for London and other large towns, where variolation was less rapidly and less widely adopted, Razzell insists that the efficacy of the technique has been systematically undervalued. He offers instead a variety of rural data that seem to show a dramatic decline in smallpox mortality during the late 18th century (that is, prior to the introduction of vaccination) despite an increase in the inherent virulence of the disease (as measured by case-fatality rates). For Razzell, only safe and effective variolation could have produced such a result.

All of this is very interesting and suggestive. But Razzell himself warns us that "the way [statistics] are arranged and interpreted can completely alter the conclusions reached from them" (p. 148). We need rather better evidence that the data he chooses to present are truly representative and relevant to the issues. At times—as, for example, in his discussion of the alleged under-registration of smallpox deaths in the prevariolation period—Razzell's special pleading can become quite blatant. And even if it could be decisively established that the standardized death rate from smallpox declined dramatically as variolation spread, one might properly hesitate to draw a causative link between the two. Razzell's own favorite piece of evidence for the value of variolation is his chart of smallpox mortality from epidemics in Boston between 1677 and 1792 (p. 142). Yet his interpretation of those data (pp. 93–94, 143) ignores the possible contribution of quarantines or other measures to isolate smallpox cases and overlooks the fact that the most dramatic de-

cline in mortality took place before variolation had even been introduced to the American colonies. The decline of smallpox, like the decline of other infectious diseases during the 18th and 19th centuries, surely requires a more nuanced explanation than the sort of monocausal hypothesis that Razzell offers us here.

Nonetheless, Razzell's work deserves better than the cavalier rejection it has met (in earlier versions) from some virologists and medical authorities. One thinks, for example, of Thomas McKeown's *The Modern Rise of Population* (Academic Press, 1976). McKeown rightly insists upon the contributions that current medical knowledge can make to historical inquiry. But serious objections can be lodged against his own effort to ascribe the modern rise of population chiefly to improved nutrition, and he has admitted the need for considerable tolerance in the face of uncertainty. Given the complexity of the factors that affect mortality from infectious diseases at different times and different places, it is unfortunate that McKeown seems as impervious to Razzell's historical evidence as Razzell is to standard medical opinion. We might all benefit from a modus vivendi between the two approaches.

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Microbial Ecology

Microbial Interactions. J. L. REISSIG, Ed. Chapman and Hall, London, and Halsted (Wiley), New York, 1978. x, 436 pp., illus. $39.50. Receptors and Recognition, Series B, vol. 3.

The inclination to view microbes as independent entities separable from each other and from their natural environment emerged in the 19th century as the dominant strategy in microbiology and was a direct consequence of the spectacular successes of the pure culture approach of Robert Koch and his colleagues. For the next hundred years the attention of most microbial physiologists was focused on the dispersed growth of pure cultures in laboratory media. Any microbial activities that depended on attachment, attraction, communication, or development were oddities and out of the mainstream.

However, a second school of thought arose from the work of Sergei Winogradsky. Winogradsky was the first true microbial ecologist, the first to begin to formulate the activities of soil bacteria in chemical terms and certainly the first to think in terms of process, cycles, and interacting members of an ecological niche. Out of this school emerged microbiologists such as Selman Waksman and René Dubos who pioneered the concept of antibiosis and emphasized that the microbe was only one member of a complex interaction, whether that interaction be disease or a process occurring in the soil.

The past decade has seen the reemergence of this more holistic microbiology, and *Microbial Interactions* exemplifies the excitement and sophistication of the field. The book consists of nine reviews of various kinds of microbial interactions plus an excellent overview by the editor. There are chapters on aggregation and cell surface receptors in cellular slime molds (Newell), bacterial receptors for phages and colicins as constituents of specific transport systems (Braun and Hantke), bacterial chemotaxis (Hazelbauer and Parkinson), attachment of bacteria to the surfaces of animal cells (Jones), and five chapters on interactions manifested by the exchange of genetic material ("Binding and entry of DNA in bacterial transformations" by Lacks, "A redefinition of the mating phenomenon in bacteria" by Achtman and Skurray, "Cell-cell interactions during mating in *Saccharomyces cerevisiae*" by Manney and Meade, "Mating interactions in *Chlamydomonas*" by Goodenough, and "Cell-cell interactions in ciliates: evolutionary and genetic constraints" by Nanney).

Although the chapters vary widely in the extent to which they present detailed, mechanistic analyses of the interactive phenomena, they are uniformly excellent—readable, analytical, and well organized. They emphasize the overview, yet contain enough data to illustrate their points or to convince the skeptical reader.

One is almost always inclined to quarrel with the emphasis and choice of topics in such a collection. There is no mention of the developmental biology of prokaryotes, where investigations of cell interactions among the myxobacteria or the cyanobacteria are opening up whole new areas of inquiry. There is no discussion of the *Bdellovibrio*-host relationship, of chemostat studies on two- and three-membered interacting populations, of cross-feeding microbial consortia, or of lectin-mediated interactions between plants and microbes. However, in spite of its necessarily limited scope, the volume does illustrate the wide range of interactive microbial activity.

The investigation of interactions among microbes offers us the almost unique option of applying immensely powerful concepts of molecular and regulatory biology to interacting populations that are experimentally tractable. It is not unreasonable to hope that the examination of microbial behavior can uncover and clarify new strategies of interaction or new aspects of the evolution of multicellularity.

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Gold and Its Compounds

The Chemistry of Gold. RICHARD J. PUDDEPHATT. Elsevier, New York, 1978. x, 274 pp., illus. $49.75. Topics in Inorganic and General Chemistry, 16.

Surveying the chemistry of an element, even one as little studied as gold, is an extensive undertaking. Puddephatt has prepared a well-organized, cohesive, and clearly written book that will be required reading for research groups studying the chemistry and biochemistry of gold or using gold and its compounds in technological applications. After an introduction to gold and its chemical properties, the chemistry of its binary compounds, stable oxidation states (I, II, III, V), and organometallic compounds is discussed in detail. Other topics discussed include gold-metal bonds, reaction mechanisms, spectroscopy, and analysis of gold compounds. Finally, the uses of gold and its compounds are summarized.

The book is divided into well-defined chapters, which will facilitate its use for reference. Only two topics seem misplaced—gold-boron complexes, which are discussed in the chapter on gold-metal bonds, and gold(III) fluorophosphates and nitrates, which are discussed in the chapter on binary compounds—and they can be located in the carefully prepared index and table of contents. Running heads would have facilitated both the use of the references at the end of each chapter and cross-referencing between chapters.

The most exciting subjects of current inorganic research are thoroughly explored: organometallic chemistry, gold-cluster compounds, oxidative-addition-reductive-elimination reactions, and gold(II) and gold(V) complexes. Yet earlier research on basic chemistry and reactions is discussed in sufficient detail to