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Philip J. Pauly, *Fruits and Plains: The Horticultural Transformation of America*. Cambridge, MA and London: Harvard University Press, 2008. Pp. xi+336, ISBN 978-0-674-02663-6. £29.95 (hardback). **Alan L. Olmstead and Paul W. Rhode, *Creating Abundance: Biological Innovation and American Agricultural Development*. Cambridge: Cambridge University Press, 2009. Pp. xii+467. ISBN 978-0-521-67387-7. £15.99 (paperback).**

Berris Charnley

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establish himself, his intellectual and social networks, his personal tragedies – all are sensitively explored and make for a rich study in and of themselves.

Ayres pays attention to broader contexts, including institutional settings such as Cambridge University, the roles of horticulture and agriculture in fuelling the study of plants across a range of disciplines in the late nineteenth century, and the introduction of new techniques and instruments as part of ‘the new botany’. He also gives due attention to the rich interactions and personalities through no less than five generations of Darwins. But the book’s real strength is in the technical explication of the scientific work. We learn much about the logical development of each study undertaken, as well as the details of experimental design and execution, along the way gaining an appreciation of the history of the British plant sciences as a whole. Ultimately, the reader is persuaded by Ayres’s bold statement that ‘no one person or laboratory did more than the Darwins, *collectively*, to prove that plants are sensitive beings, responding continuously to changes in their biotic and abiotic environments’ (p. 170, emphasis in original).

VASSILIKI BETTY SMOCOVITIS
University of Florida

PHILIP J. PAULY, **Fruits and Plains: The Horticultural Transformation of America**. Cambridge, MA and London: Harvard University Press, 2008. Pp. xi + 336, ISBN 978-0-674-02663-6. £29.95 (hardback).

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The history of scientific efforts to cultivate plants is one of the most important and yet least-studied areas of interaction between science and society. The books under review offer welcome introductions to newcomers and provocations to established scholars. Of the two, Philip J. Pauly’s *Fruits and Plains* is more recognizably a work of history of science. It is an original and joyful read, stylishly written and thoroughly researched; anyone with an interest in America, science and culture will get a great deal from this book. Indeed, Pauly plays skilfully throughout on the two meanings of ‘culture’, showing us exactly how the culturing of organisms by American growers, gardeners and breeders – including breeders of humans – was related to trends in the wider culture.

The book opens with a chapter on the relationship between views of degeneracy in early modern America and Thomas Jefferson’s failed attempts at viticulture. In the second chapter we see how a wheat pest during the Revolutionary War was named the Hessian fly in order to link it to the Hessian mercenaries used so counterproductively by the British. Subsequent chapters explore subjects as diverse as the development of new fruits, including the iconic American apple; the problem of the prairies; and the development of Florida. Two central chapters deal thematically with the ambiguous and contested categories of ‘alien’ and ‘native’, and these two words are dissected in much the same way that Pauly treats ‘culture’, with the tensions between meanings in horticultural and general contexts teased out. The final chapter presents three take-home lessons. First, cultivators of all stripes have played significant roles in the historical development of the meanings, literal and symbolic, of America. Second, within the long run of scientific discourse, horticulturalists have been surprisingly influential, especially through the creation of societies of national and international exchange. Third, horticulture has mattered for culture not least because it has been thought to be enriching, for the individual and for the nation.

Within this triumvirate of reappraisals, the second is the only one I find fault with; the existing scholarship is rather better informed on what the breeders did for science than Pauly suggests, in particular when it comes to connections between breeding societies and academic

elite science. But this is a small criticism of a book that will entertain and challenge in equal measure. Pauly's death is a great loss to the community; one can only hope that others will take up the ambitious project that this book begins.

Alan L. Olmstead and Paul W. Rhode's *Creating Abundance* seems, on the face of it, a less elegant survey of similar ground. But theirs is a different type of enterprise, located firmly in the genre of economic history, and heavier on data and data analysis. The major thesis, put in several different ways, is that biological innovation – defined in the broadest of terms – has mattered in American economic life for far longer than has tended to be recognized. In overcoming previous prejudices on this issue, the authors have two giants to slay. One is the belief that constant-yield data over much of nineteenth and early twentieth centuries show that new varieties failed to improve yields and therefore had little impact. The other is the 'induced-innovation' model of technological change, according to which American innovators in a land-rich, labour-poor nation had a vested interest in producing labour-saving technologies. For fans of this model, the only innovations before the 1940s were mechanical ones.

Drawing on a range of case studies mostly from the nineteenth and early twentieth centuries, the authors reply as follows. On the question of yields, they argue that the constancy hides a persistent uphill battle to keep yields from falling (for reasons I shall come to in a moment). And on the question of induced innovation, they suggest that the model as applied to American agriculture suffers from two flaws: first, land prices were actually rising relative to labour prices during the nineteenth century; and second, land and labour-saving technologies cannot be cleanly differentiated. They begin with a look at the wheat industry in America. The nineteenth century witnessed a massive expansion of the wheat-growing area westward. As farmers moved west, they had to deal with increasingly inhospitable climates and new crop pathogens; and, on Olmstead and Rhode's showing, it was the new wheat varieties that such farmers bred and used which allowed them to deal with these conditions and so maintain the same yields as their counterparts back in the more favourable eastern areas. Biological innovation thus emerges as just as important as mechanization in agricultural development – a theme that runs throughout the book. Time and again the authors convincingly eschew narratives based on agricultural data alone, expanding their analytic frame to include the conditions of farming, and going on to reach somewhat surprising conclusions. In the case of corn, for example, we learn about the extensive and successful breeding programme that – before the introduction of the double-cross hybrid method – was used to change indigenous corn, during its own westward expansion, into 'America's crop'. In the cotton plantations of the South, new varieties of cotton facilitated mechanization and helped defend against the threat of crop pests. For tobacco and the crops of California, meanwhile, the trends ran in entirely the opposite direction to that suggested by standard models; farming in both areas witnessed increased labour costs as production intensified. The latter chapters of the book cover animal breeding, also an important domain of biological innovation.

Although the individual chapters are sometimes linked only loosely, the argument overall is convincing. Historians of science will have their grumbles – about the catch-all term 'biological innovation', for example, or the relegation of the first hybridization of wheat in America to footnote status. But they will find much to admire in what Olmstead and Rhode have done and – almost as importantly – how they have done it, combining data sets with the types of textual evidence more usually deployed in our discipline. Although *Creating Abundance* is not a book written, as Pauly's is, with historians of science specifically in mind, taken together the books complement each other, generating new questions in a subject area that has for too long lain fallow.

BERRIS CHARNLEY
University of Leeds