

One would imagine that this part of Mr. Razzell's thesis was a matter for virologists, who, if they have not already settled it, will eventually do so by modern field work and research. It is not really a problem that can be solved by studying the ingenious but rough and ready experiments of a hundred and sixty years ago. Re-examination of these might throw some fresh light on the relationship between cowpox and smallpox but could not be decisive on the intrinsic nature of either of them. The trend at present is to regard cowpox virus as an irreversible mutant of variola virus and Professor Downie evidently thinks that the origin of the vaccinia virus in use today is obscure and may have been derived from variola virus.

Attenuation is of course a well known phenomenon and the story of Dr. Walker diluting variola virus with water and passing it off as vaccinia only confuses the issue. No wonder he was dismissed from the Jennerian Institute!

Among the implications of Mr. Razzell's thesis one would seem to be that our guardians of public health erred in discouraging inoculation, since he maintains that its infectiveness is a myth and that the elimination of smallpox at the time was a very real thing. One cannot feel that he proves these points beyond all reasonable doubt with his quotations from contemporary writings.

Another is that the historians have equally erred in adopting an attitude against inoculation without making sufficiently critical examination of the evidence. This imputation cannot possibly be allowed by anyone who has dipped into the literature.

On a theoretical level Mr. Razzell considers it a myth that cowpox virus is something different from smallpox virus. The implication of this is that our present-day virologists do not know their business, and that can hardly be judged in an historical journal.

On a practical level the implication is that vaccination was never necessary and so Jenner's services to mankind were mistakenly magnified to the proportions of a myth. This is a matter of opinion and probably always will be.

There may be something to be said for his final suggestion of going back to variola inoculation if the immunity period of vaccination proves to be as short as the U.S.A. immigration authorities would have us believe. At the same time it is doubtful if any safe variolous inoculation would give as much as a lifelong immunity.

When all is said and done, how does Jenner's reputation stand up to all this bombardment? It is always difficult to be fair in apportioning credit, but the plain fact is that after 1796, vaccination proved a successful and welcome alternative to the frightening ordeal of inoculation. It was originally linked up with cowpox and if Jenner was not the first person to think of it, or even the most successful practitioner of it, he was the first to make it work and to bring it before the public so that in effect it is through him that smallpox lost its terrors. Whatever modifications or theories may be developed in the future, it is certain that for most men and all women, Jenner's achievements in the past stand firm, and so one hopes will his statues.

NORAH SCHUSTER

## INOCULATION AND VACCINATION: SMALLPOX, COWPOX AND VACCINIA

The historical details of Mr. P. E. Razzell's paper (Edward Jenner, 'The History of a Medical Myth', *Med. Hist.* 9, 216) were dealt with by Professor A. W. Downie, and will probably be dealt with by others. However, there are some general viro-

logical aspects in the paper which invite comment, and although some of these have been mentioned briefly by Downie it seems that the significance of these was not apparent to Mr. Razzell.

He purports to show 'that vaccination is a more attenuated form of . . . inoculation', and his statement (p. 221, last sentence) 'Thus the so-called vaccine was none other than the smallpox virus . . . attenuated . . .' implies that vaccinia virus derives from, and is little, if any, different from, 'attenuated' smallpox virus. The significance placed upon Walker's work (pp. 220, 228) seems unjustified. From the evidence presented it appears that Walker's vaccine was not attenuated but merely *diluted*. On inoculation of 'attenuated' smallpox he says (p. 222) 'Arscott, Longworthy and Mudge had rejected this technique . . . as they felt it would give insufficient protection . . . (in this they were right)'. Jenner's own comments on the same subject were:

A medical man who . . . inoculated . . . preserved the variolous matter . . . on a piece of lint, which, in its fluid state was put in a vial, corked, and conveyed in a warm pocket; a situation certainly favourable for speedily producing putrefaction . . . It was inserted into the arms . . . brought on inflammation of the incised parts, . . . fever and eruptions. But what is this disease? Certainly not smallpox . . . and many fell victims to it (smallpox) who thought themselves in perfect security . . . (*Inquiry*, . . . 2nd ed., 1800, p. 51)

Possibly variola virus can be attenuated so that its *effect* is identical to that of vaccinia, but is the *cause* the same? (Jenner's paper was entitled 'An Inquiry into the *Cause and Effect* . . .'). The question remains as to how the other characters of the attenuated virus compare with fully virulent variola virus, and vaccinia and cowpox viruses (since the last two are not identical).

Razzell also states (p. 222) ' . . . We must still try to explain . . . the relationship between cowpox and smallpox viruses . . . it is not even agreed whether the one virus is autonomous of the other'. We must also include vaccinia in the comparison. The close relationship between these viruses and the fact that immunization with one will protect against the others is well known. But they are now quite distinct and the differences can be readily shown by techniques generally available to the virologist. Some of these differences may be briefly mentioned: (i) Subtle serological differences have been shown by complement-fixation, neutralization and gel-diffusion techniques. (ii) Differences in the appearance, size, colour and time to develop, of the lesions produced by the viruses on the chorio-allantois of the developing chick embryo. (iii) The haemorrhagic character of the cowpox lesion and the different form of the inclusion body formed by this virus. (iv) Their different ceiling temperatures—being the highest temperature at which each virus will produce lesions on the chorio-allantois. (v) Differences in the growth of the viruses in tissue-culture, (Bedson & Dumbell, 1964 and various unpublished observations.), and the very limited host range of variola virus.\*

As for the origins of vaccinia virus: derivation has been claimed from both cowpox and smallpox by passage through suitable hosts—in Razzell's case from variola by arm-to-arm passage. One suggestion which must not be overlooked is that vaccinia may have arisen as a genetic hybrid between variola major and cowpox viruses, as recently suggested by Bedson & Dumbell (1964). As demonstrated by these authors cowpox and variola between them possess almost all the characters of vaccinia; genetic hybrids are obtainable without undue difficulty, and it was apparently the

\*Details of these investigations and references to the original papers will be found in the reviews listed. One original paper is listed which is too recent to have appeared in the reviews.

practice to increase the potency of the original vaccine by occasionally adding variola virus. This derivation could also result from vaccination in smallpox hospitals.

Razzell's statement (p. 228) '... it has been impossible to infect cows with smallpox virus *i.e. produce cowpox*' (my italics)—his incorrect interpretation of Downie (p. 225), is hardly scientific. An objective experimenter would first try to infect cows with variola, and then if successful would investigate the properties of the virus produced. Jenner himself said:

They who are not in the habit of conducting experiments may not be aware of the coincidence of circumstances necessary for their being managed so as to prove perfectly decisive.

(*Inquiry*, . . . 2nd ed., 1800, p. 44)

Razzell has 'not disputed the power of cowpox to protect against smallpox.' That being so, and assuming he does not dispute the power of vaccinia to so protect, one questions the reason for the plea for inoculation in his last paragraph (p. 229). If he is advocating arm-to-arm inoculation, then conventional vaccination is simpler, at least as safe, less objectionable to vaccinees, and removes any danger of variola becoming attenuated by arm-to-arm passage. If he is advocating conventional 'vaccination' using variola, he forgets the danger involved in producing such a vaccine and the difficulty entailed in producing large quantities of a virus with such a limited host range.

To re-place the emphasis on Razzell's last sentence: a *great deal* of both observation and experimentation is necessary before smallpox inoculation can be used in certain limited circumstances.

#### REFERENCES

- ANDREWES, C. H., *Viruses of Vertebrates*, London, Ballière, Tindall & Cox, 1964, Chap. 12, pp. 247–290.
- BEDSON, H. S., & DUMBELL, K. R., 'Hybrids derived from the viruses of variola major and cowpox,' *J. Hyg. (Camb.)*, 1964, 62 147–158.
- DOWNIE, A. W., 'Smallpox, cowpox and vaccinia,' in Rivers, T. M., & Horsefall, F. L. *Viral and Rickettsial Infections of Man*, Philadelphia, Lippincott, 3rd. ed., 1959, Chap. 32, p. 673–700 (also 4th ed. In press.)
- DOWNIE, A. W., & DUMBELL, K. R., 'Poxviruses,' *Ann. Rev. Microbiol.*, 1956, 10, 237–252.
- FENNER, F., & BURNET, F. M., 'A short description of the poxvirus group: (Vaccinia and related viruses.),' *Virology*, 1957, 4 305–315.

DERRICK BAXBY

---

## A CONSIDERATION OF THE NATURE OF THE ENGLISH SWEATING SICKNESS

Professor Patrick has put forward the interesting idea that the 'sweat' was not an infectious disease but the result of mass food poisoning by fungi or some other contamination of cereals (*Med. Hist.*, 1965, 9, 272–279). This explanation admittedly fits the descriptions of the symptoms of the fever, but many difficulties are thereby left unresolved.