

## THE DEVELOPMENT OF COTTON WOOL AS A WOUND DRESSING

THE use of unwoven cotton fibres, in the form of cotton wool, has only been developed in orthodox surgical practice since the early part of the nineteenth century, although cotton itself was introduced into Europe over 2,000 years ago.

Raw cotton, consisting of the untreated fibres of the cotton plant, was occasionally mentioned by writers in the Middle Ages as being suitable (i) for forming pads over dressed wounds, thus protecting them from undue pressure much as its modern counterpart is used today; (ii) for applying directly to the skin in cases of burns or scalds, when it served to protect the area from the effects of movement and pressure; and (iii) for use in wicks, to keep the edges of wounds open and allow discharges to escape from them, thus taking the place, in a primitive sort of way, of the modern drainage tube. However, there was a strong feeling both among the ordinary people and the medical men of the day that cotton was a dangerous material, and thus it was not generally used or recommended. This fear was probably well founded, for the fibres were likely to be heavily infected with spore-bearing organisms from the soil, and in addition may have harboured plague-infested rats, or their fleas.

Dr. Anderson<sup>1</sup> of Glasgow published a paper in 1828 on 'The employment of cotton in the treatment of burns', in which he described the use of cotton, carded into narrow fleeces, and thin enough to be translucent. This appears to be the first work published by a medical man dealing with the use of carded cotton as opposed to the raw product. By 1839, Mathias Mayor<sup>2</sup> was attracted to carded cotton because it was whiter, softer, lighter and more resilient than the charpie made from old rags commonly used on the European continent. He also pointed out that, since the earliest times, the people had been afraid to use ordinary raw cotton because of its bad reputation, but he claimed that carded cotton differed from this older material. It had been cleaned and washed before carding; it covered four times the area of an equal weight of charpie; it was also considerably cheaper and easier to obtain. The man who did most to popularize its use in England was Sampson Gamgee, who, in one of his lectures at Birmingham, gave Burggraeve<sup>3</sup> the credit of introducing it as a general application in the treatment of a great variety of surgical injuries. In France, in 1870, Alphonse Guérin, at the Hôpital St. Louis, had also reported favourably on this dressing. He was much struck by statements of Pasteur, Tyndall and others concerning the dust and germ theory of disease and thought that carded cotton might be used to filter out these noxious agents from the air in

contact with amputation stumps. He therefore dressed these areas by winding successive layers of the material around the wound and extending the covering well beyond the site of operation before applying an ordinary cotton bandage to retain it in position. He made no use of the carbolic acid dressings which had been recommended by Lister two or three years earlier, but simply washed the wound in camphorated alcohol after operating. The dressing was not removed, except in exceptional circumstances, for three or four weeks, after which period healthy granulation tissue was said to have been formed and very little pus was found in the folds of the cotton. His method was brought to the notice of British surgeons in an article in the *Lancet*, in 1871,<sup>4</sup> but four years later this journal<sup>5</sup> found it necessary to make the comment that 'the method seems to deserve more careful and extensive trial in England than it has yet received'.

The best cotton wool available in this country between 1870 and 1880 was, according to Gamgee,<sup>6</sup> that sold for use by jewellers, in thin sheets, about 18 × 12 in., interleaved with tissue paper. The fibres were long, and it was free from dust, but it was not capable of absorbing fluids to any great extent. This wool was used as a pad beneath bandages to ensure an even distribution of pressure, or as a covering for oakum, which was the standard absorbent dressing of that period. In 1879 an absorbent cotton wool<sup>7</sup> was being sold for surgical and dental use by W. G. and J. Strutt, of Belper in Derbyshire. They claimed that it had been treated to remove every trace of greasy or fatty matter, and whereas ordinary cotton wool floated on water, this product rapidly became saturated and sank. In the next year Gamgee<sup>8</sup> demonstrated the difference between the jewellers' wool which he had previously used, and which floated on water for many days, and the new absorbent wool which sank in a few seconds. This wool he enclosed between pieces of a specially prepared absorbent gauze, and the pads so formed were recommended as being of great value whenever it was necessary to absorb fluids. Great assistance was given by Messrs. Robinson and Son of Chesterfield, one of the early pioneers of the dressings industry in England, who still make a similar dressing under the trade name of 'Gamgee Tissue'.

As antiseptic dressings were becoming increasingly popular, Professor Bostock Hill<sup>8</sup> medicated some of his absorbent wool with tannin, with borax and with iodine, and proved that these substances did not destroy its absorbent properties. Soon after this time a large number of medicated cotton wools were being used by surgeons, some containing antiseptics and others astringents.

In 1890, Martindale and Westcott, in the *Extra Pharmacopoeia*,<sup>9</sup> described the preparation of absorbent wool, and stated that the bleached cotton should be alternately treated with dilute hydrochloric acid and solution of

soda, and then well washed. It is interesting to note that, except for surgical purposes, cotton is never bleached in the raw state. In 1922 a supplement to the *British Pharmaceutical Codex* (1911) set the first standards for dressings in this country and among them it described the preparation of absorbent cotton wool. Impurities were directed to be removed from the fibres, and then they were freed from fatty matter by being boiled for half an hour in 5 per cent sodium or potassium hydroxide solution, thoroughly washed with water, bleached in 5 per cent chlorinated lime, again washed, and then transferred to an acid bath. After rewashing and treating in an alkaline bath, they were finally washed and dried. The fibres were then loosened mechanically and separated to make the normal carded 'fleece'. When the *British Pharmaceutical Codex* (1923) was published, a standard was set for an average staple length for the fibres of  $\frac{5}{8}$  in. and their absorbency was tested by a sinking test, both of which standards hold to this day. This volume described no less than fifteen medicated cotton wools, whereas the current *B.P.C.* (1949) has only two, namely, those of capsicum and boric acid.

Most of the medicated dressings were devised in the twenty years following the introduction of antiseptic surgery by Lister, when the chief method of keeping infection away from a wound was to prevent germs reaching the site of operation by means of chemical antiseptics. This was achieved by absorbing all discharges into materials which inhibited the growth of micro-organisms and filtered all air reaching the wound through a generous barrier of antiseptic cotton. The large number of antiseptics used to medicate dressings is an indication of the difficulty of the problem. Some were found to be inefficient, others were volatile, and thus the dressing could not be stored for more than a short time, and still others were irritating to the tissues. The perfect medicated wound dressing seems to have been very elusive, and some workers began to think that another line of attack was preferable. As early as 1879 Mr. Savory, of Bartholomew's Hospital, London, in an address to the British Medical Association<sup>10</sup> came very near to pointing the way to modern aseptic methods, even before antiseptic surgery was fully recognized. He said that surgeons should not forget the antiseptics of cleanliness; if chemical agents were to be trusted and the established precautions of hygiene ignored, evil would sooner or later overtake us. He concluded his address with the question, 'Is it rash to affirm that the future practice of surgery will be most successful when it is carried on, not where antiseptics are most largely used, but under conditions least in need of antiseptics?' Even though they had to use chemical antiseptics, some surgeons were impressed by the work of Koch and Wolfhügel<sup>11</sup> and of Vinay,<sup>12</sup> concerning the effect of wet and dry heat on various organisms and eventually they began to try to sterilize dressings. Thus C. B. Lockwood<sup>13</sup> while expressing doubt as to future practice, sterilized towels by steam, but relied

on cotton wool containing 2 per cent of sal alembroth (a double chloride of mercury and ammonium) as an outside dressing to soak up fluids and diminish the risk of air infection. Later, in the same year, he described his efforts to sterilize cotton wool by means of dry heat, and reported that the process was not always successful, but that when prepared in a Lautenschlager's steam sterilizer an aseptic product was obtained. Sir James A. Russell,<sup>14</sup> in 1902, mentions that it was well known that dry heat penetrated fabrics so slowly that they were injured before a sufficiently high temperature was attained throughout. However, by using a steam disinfector which had an outside jacket through which live steam could be passed, dressings in the inner chamber could be dried off after the sterilization process had been completed. A vacuum-attachment to the inner chamber was a valuable adjunct in assisting the drying. With this method of preparation, surgeons gradually became aware that aseptic cotton wool was preferable to the older antiseptic wools as a wound dressing, and I have not, in my twenty-five years' experience as a hospital pharmacist, ever been called upon to supply cotton wool medicated with an antiseptic.

In British hospitals it is usual for cotton wool and other surgical dressings to be purchased in bulk by the pharmacist, and for them to be sterilized, when required, within the hospital, but in chemists' shops the more general practice is for them to be purchased from the manufacturer already sterilized in sealed packets. It is necessary, therefore, for the pharmacist to have a knowledge of the raw materials, as well as the finished articles, used for surgical dressings, and it is for this reason that the student for a university degree in Pharmacy, or the Pharmaceutical Chemist Diploma of the Pharmaceutical Society, receives both practical and theoretical training in this subject.

Cotton wool, as we know it today, is very highly absorbent, but the test for absorbency given for this material in the *British Pharmaceutical Codex* only determines the speed with which liquids can soak into it, and does not take into account the total quantity of fluid which it can retain. In experiments to determine the absorbing capacity of dressings,<sup>15</sup> it was found that this property varied with the degree of disorganization of the fibre arrangement. Thus, when compared with an equal weight of a woven dressing, cotton wool can retain a much greater amount of fluid whether it is saturated and allowed to drain, or subjected to the normal range of pressures met beneath the bandages. Another interesting fact established by these workers was that both good and poor qualities of cotton wool are able to absorb and retain about the same amount of water.

During the last two or three years a product resembling cotton wool in appearance has been made from viscose rayon fibres, and a few samples of this new material have been subjected to a number of tests in order to

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determine whether it had any advantages over the better-known cotton wool. Based on a limited experience obtained with these experimental samples, it is my opinion that rayon wool, in its present form, is not likely to replace cotton wool in surgical practice.

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REFERENCES

1. ANDERSON, A. *Glasg. med. J.*, 1828, I, 205.
2. MAYOR, M. L. *Nouveau Système de Deligation Chirurgicale*, 3rd ed., Paris, 1838.
3. BURGGRAEVE, A. *Nouveau Système de Pansements Inamovibles*, Brussels, 1853.
4. Foreign Hospital Reports. *Lancet*, 1871, II, 322.
5. Annotation. *Lancet*, 1875, I, 298.
6. GAMGEE, S. *Lancet*, 1876, I, 885.
7. Analytical Records. *Lancet*, 1879, II, 281.
8. GAMGEE, S. *Lancet*, 1888, I, 127.
9. *Extra Pharmacopoeia*, 6th ed., 1890, p. 198.
10. Leading Article. *Lancet*, 1879, II, 246.
11. KOCH, R., and WOLFHÜGEL, G. In *Recent Essays on Bacteria in Relation to Disease*. Selected and edited by W. Watson Cheyne, New Sydenham Soc., 1886, p. 519.
12. VINAY, C. *Manuel d'Asepsie. La Stérilisation et la Disinfection par Chaleur*, Paris, 1890.
13. LOCKWOOD, C. B. *Aseptic Surgery*, 2nd ed., 1899.
14. RUSSELL, SIR JAMES A. *Quain's Dictionary of Medicine*, 3rd ed., 1902, p. 413.
15. SAVAGE, R. M., BRYCE, D. M., and ELLIOTT, J. R. *J. Pharm. Pharmacol.*, 1952, IV, 944.