the smells from privies and carts, and, above all, from the process of emptying by ladle, are a nuisance which no Western community would tolerate. A simple pail system, in which the sewage is collected and removed in the same vessel, has been used at Roch­dale ; another, with an absorbent lining in the pails, at Halifax.

A plan much used in Continental cities is to collect excrement in tight vaults, which are emptied at intervals into a tank cart by a suction pump or injector. A more recent pneumatic system is that of Liernur, applied at Amsterdam, where sewage reservoirs at individual houses are permanently connected with a central reservoir by pipes, through which the contents of the former are sucked by exhausting air from the reservoir at the central station. A similar plan has been tried at Lyons and Paris by M. Berlier.

*References.—* The blue-book literature of sewage disposal is very voluminous. Special reference should be made to the *Reports of the Rirers Pollution Com­missioners,* from 1866 ; *Report of the Referees on Metropolitan Main Drainage,* 1857; *Reports of the Commission on the Sewage of Towns,* 1858-1865 ; *Reports of Select Committees of the House of Commons,* 1862 and 1864 ; *Reports of the British Association Committee on the Treatment and Utilization of Sewage,* 1869-1876; *Report of the Birmingham Sewage Inquiry Committee,* 1871 ; *Reports of the Local Government Board ; Reports of the Royal Commission on Metropolitan Sewage Discharge.* 1884 (the second and final report contains a valuable historical résumé of the subject. See also the following books Corfield, *Treatment and Utilization of Sewage,* 1871; Burke, *Handbook of Sewage Utilization,* 1873; Robinson and Melliss, *Purification of Water-carried Sewage,* 1877 ; Robinson, *Sewage Disposal,* 1882; J. Bailey-Denton, *Intermittent Downward Filtration,* 2d ed., 1885. Engineering details of sewerage are given in Baldwin Latham’s *Sanitary Engineering,* 2d ed., 1878; and particulars of the drainage of individual towns will be found in numerous papers in the *Minutes of Proceedings* of the Institution of Civil Engineers. The domestic aspect of sewerage has been treated by E. Bailey-Denton, *Handbook of House Sanitation,* 1882 ; W. P. Buchan, *Plumbing and House Drainage,* 4th ed., 1883; W. Eassie, *Healthy Houses,* 1876; Gerhard, *House Drainage,* New York, 1882 ; Waring, *Sanitary Drainage of Houses and Towns,* Boston, 4th ed., 1883 ; F. Jenkin, *Healthy Houses,* 1878 ; and many other writers. (J. A. E.)

SEWIN, or Sewen. See Salmonidæ, vol. xxi. p. 222. SEWING MACHINES. The sewing machine, as is the case with most mechanical inventions, is the result of the efforts of many ingenious persons, although it would appear that the most meritorious of these worked in entire ignorance of the labours and successes of others in the same field. Many of the early attempts to sew by machinery went on the lines of imitating ordinary hand­sewing, and all such inventions proved conspicuous failures. The method of hand-sewing is of necessity slow and intermittent, seeing that only a definite length of thread is used, which passes its full extent through the cloth at every stitch, thus causing the working arm, human or otherwise, to travel a great length for every stitch made, and demanding frequent renewals of thread. The foundation of machine-sewing was laid by the invention of a double-pointed needle, with the eye in the centre, patented by Charles F. Weisenthal in 1755. This device was intended to obviate the necessity for inverting the needle in sewing or embroidering, and it was subsequently utilized in Heilman’s well-known embroidery machine.

Many of the features of the sewing machine are dis­tinctly specified in a patent secured in England by Thomas Saint in 1790, in which he, *inter alia,* describes a machine for stitching, quilting, or sewing. Saint’s machine, which appears to have been intended principally for leather work, was fitted with an awl which, working vertically, pierced a hole for the thread. A spindle and projection laid the thread over this hole, and a descending forked needle pressed a loop of thread through it. The loop was caught on the under side by a reciprocating hook ; a feed moved the work forward the extent of one stitch ; and a second loop was formed by the same motions as the first. It, however, descended within the first, which was thrown off by the hook as it caught the second, and being thus secured and tightened up an ordinary tambour or chain stitch was formed. Had Saint hit on the idea of the eye- pointed needle his machine would have been a complete anticipation of the modern chain-stitch machine.

The inventor who first devised a real working machine was a poor tailor, Barthélemy Thimonier, of St Etienne, who obtained letters patent in France in 1830. In Thi- monier’s apparatus the needle was crocheted, and descend­ing through the cloth it brought up with it a loop of thread which it carried through the previously made loop,

and thus it formed a chain on the upper surface of the fabric. The machine was a rather clumsy affair, made principally of wood, notwithstanding which as many as eighty were being worked in Paris in 1841, making army clothing, when an ignorant and furious crowd wrecked the establishment and nearly murdered the unfortunate inventor. Thimonier, however, was not discouraged, for in 1845 he twice patented improvements on it, and in 1848 he obtained both in France and the United Kingdom patents for further improvements. The machine was then made entirely of metal, and vastly improved on the first model. But the troubles of 1848 blasted the prospects of the resolute inventor. His patent rights for Great Britain were sold ; a machine shown in the Great Exhi­bition of 1851 attracted no attention, and Thimonier died in 1857 unfriended and unrewarded.

The most important ideas of an eye-pointed needle and a double thread or lock-stitch are strictly of American origin, and that combination was first conceived by Walter Hunt of New York about 1832-34. Hunt reaped nothing of the enormous pecuniary reward which has been shared among the introducers of the sewing machine, and it is therefore all the more necessary that his great merit as an inventor should be insisted on. He constructed a machine having a vibrating arm, at the extremity of which he fixed a curved needle with an eye near its point. By this needle a loop of thread was formed under the cloth to be sewn, and through that loop a thread carried in an oscillating shuttle was passed, thus making the lock­stitch of all ordinary two-thread machines. Hunt’s inven­tion was purchased by a blacksmith named Arrowsmith, and a good deal was done towards improving its mechanical details, but no patent was sought, nor was any serious attempt made to draw attention to the invention. After the success of machines based on his two devices was fully established, Hunt in 1853 applied for a patent; but his claim was disallowed on the ground of abandonment. The most important feature in Hunt’s invention—the eye- pointed needle—was first patented in the United Kingdom by Newton and Archbold in 1841, in connexion with glove-stitching.

Apparently quite unconscious of the invention of Walter Hunt, the attention of Elias Howe, a native of Spencer, Mass., was di­

rected to machine­sewing about the year 1843. In 1844 he com­pleted a rough model, and in 1846 he patented his sewing ma­chine (fig. 1).

Howe was thus the first to patent a lock-stitch ma­chine, but his invention had the two essential feat­ures—the curved eye-pointed needle and the under­thread shuttle— which undoubted­ly were invented by Walter Hunt twelve years previously. Howe’s invention was sold in England to William Thomas of Cheapside, London, a corset manufacturer, for £250. Thomas secured in December 1846 the English patent in his own name, and engaged