

THE ARTIFICIAL SILK INDUSTRY.—I.*

CONVERTING WOOD INTO SILKEN FABRIC.

BY W. P. DREAPER, F.I.C.

In the French Exhibition of 1889 Count de Chardonnet exhibited his now well-known process of manufacturing filaments of nitrocellulose by squirting collodion under suitable conditions into the air. The progress from this early production of highly inflammable filaments to the present production of the large output of artificial silk manufactured by this process, which exhibits none of these inflammable properties, and resists the disintegrating action of water has been achieved by careful research. To-day the production of the material by the original method, starting with a solution of guncotton, has met with signal success; and even in the absence of any competing process would have led to the building up an industry of a permanent nature, from which the textile industry generally would have derived much benefit. This process of manufacture may in time go the way of most original processes, and give way to the more direct methods of later date. At present it is responsible for about 50 per cent of the world's output. I have been informed in the Elberfeld-Barmen district, where 500,000 kilos are worked up every year, that for some manufactures the nitro-product is absolutely essential, while for others the newer products are of more value. If time proves that this is a normal condition, then the mere cost of production will not be the only determining factor in the situation.

Any way it is patent to all those interested that great economies have been effected in this process, more especially in the recovery of the solvents, and their re-use; in the rapidity of production; and in other ways of which no one outside the actual works can have definite knowledge.

Of the processes which have survived to this industrial stage, the three systems called, respectively, the nitrocellulose, the cuproammonium, and the viscose ones may be specially mentioned. These have been so controlled, that they now produce a marketable product, which is in such demand that delivery can only be obtained for the second half of next year at the earliest. This latter point is an important one, for it is an indication that the newly-founded industry is based on a genuine demand.

These yarns, which range in size from 100 deniers upward, are not adapted to the manufacture of such materials as are prepared from ordinary silk fibers of from 15 to 32 deniers, or even upward; but they enter into a whole range of articles, and have had a profound influence on certain manufactures, such as the braid industry, and given employment to a large number of hands. The new uses which are being found almost daily for these products also indicate a steady and increasing demand for the yarns in the future. For example, it is possible to manufacture a heavy cloth from these high denier yarns.

The early samples of the nitrocellulose product were extremely brittle and inflammable, and lost 50—70 per cent. of their strength on wetting. They were, however, extremely brilliant, and this satisfactory factor certainly led to further research and improvements in other directions, which gradually decreasing these objectionable features, caused such a demand for the yarn in comparison to the possible supply, that the price of this artificial silk for a time actually exceeded that of the real material. The extreme brightness of the goods made from it, and their peculiar feel, was undoubtedly the cause of this. With this state of affairs there is no wonder that the industry in France and Germany expanded, and several companies were undoubtedly formed to work processes which had little chance of commercial prosperity. The patent list of these times also indicated the gradual expansion of the experimental work which naturally followed, and was destined to give to these countries an absolute monopoly of manufacturing, which they have held to all purpose until the last year or so; and also to give to the textile manufacturers of these countries a first call on this important and novel product. The absence of the yarn itself in this country was one of the chief factors causing our neglect of this matter. The many difficulties of the process were emphasized by the failure of the English company (starting to manufacture under the Chardonnet rights) due, it was then said, to local atmospheric conditions, the actual solution prepared in France refusing to spin at the Coventry factory.

Dr. Lehner demonstrated his process in London, but it was in Switzerland that he built up the enormous

business which is associated with his name, and which to-day turns out such large quantities of the nitro-product. Chardonnet had to work with very high pressures, but Lehner, by modification of the solution, was able to squirt at very low ones. He also squirted into water, and in this way recovered the major portion of the solvent. The threads of nitrocellulose were wound on to bobbins and dried.

Factories producing such a product were destined, sooner or later, to come under the notice of the insurance companies. Serious fires took place, and were unpreventable. It was found that the nitrocellulose yarn in the dry state, like silk, became highly charged with electricity, and that self-ignition took place. The risks were subsequently modified by keeping the yarn in a wet state until it entered the "denitrifying" bath. There was still the alcohol-ether to be reckoned with, and it is, I believe, still impossible to insure such a factory. This mattered little, however, to companies making such profits. The Tubize Company rebuilt part of its factory a few years ago out of the year's income and still paid a good dividend.

Great speculation in shares; high and fluctuating prices for the yarn; fire at the works—but, most important of all, an increasing demand for the product, characterized the early days of the industry, the slow and steady progress of which was assured and never in doubt.

HISTORY OF THE INDUSTRY.

In 1855 the well-known French investigator Reaumur suggested the production of what might be termed artificial silk, and in 1885 Andemars patented the production from a nitrocellulose base, but nothing more was heard of the process. In 1884 Count de Chardonnet deposited with the Academie des Sciences a sealed document which was opened on November 7, 1887; it bore the title "Sur une matière textile artificielle ressemblant à la soie." He had sufficiently worked out his process of manufacture to obtain a Grand Prix at the Paris Exhibition in 1889 for his product. He lodged his first patent on November 17, 1884 (Fr. Pat. 165,349). The first apparatus actually used for trials is shown in a photograph published in a work published by T. Foltz in 1903 (*Fabrication de la soie artificielle parisienne*).

In 1889 Du Vivier produced a product termed "Soie de France," but except in small details the production, and product, was very similar to that of Chardonnet. In 1892 Lehner patented his modification of the Chardonnet process (Fr. Pat. 221,901, May 25, 1892).

As a result of these early inventions the following centers have produced this nitrocellulose product in large quantities. Works at Besancon in France; at Tubize and Droopgenbosch-Ruysbroek, in Belgium; at the four factories of the Vereinigte Kunstseide Fabriken, of Frankfurt; at Kelsterbach S.M., at Robingen near Augsburg; Glattbrugg and Spreitenbach, near Zurich; at Padua in Italy, and in Hungary.

The first patent connected with the production of artificial silk from cellulose dissolved in a cupro-ammonia solution was that of Despeissis (Fr. Pat. 203,741, Feb. 12, 1890). The only remaining record of this appears in a French publication, as under the French law of that date the specification was not printed, and being abandoned, owing, I believe, to the untimely death of this investigator, is not available for reference. Nothing more was heard of this process until Pauly in 1897 patented a process on very similar lines. The English specification has since been restricted by amendment so that the original suggestion of Despeissis, viz., the addition of a proportion of some albuminoid substance to the solution, has been omitted in the latter specification. In 1899 (Eng. Pat. 6556, 1899), Fremery and Urban took out their first patent, dealing with details in the manufacture. In the same year (Eng. Pat. 18,260, 1899), Bronnert patented his first improvement in connection with the direct solution of cellulose, although he had previously, in 1886 (Eng. Pat. 6858) taken out a patent for improvements connected with the nitrocellulose process.

Pauly, Bronnert, Fremery, and Urban are for ever associated with the industrial application of the copper-ammonia process on the large scale; they have through their investigations led to the development of the celebrated Glanzstoff Company, which to-day employs over 7,000 hands, and manufactures such large quantities of this product. Its headquarters are at Elberfeld, and works at Niedermorschweiler and Oberbrück in Germany, and it is also interested

in work at Givet, and at Izieux, in France (Messrs. Gillet et Fils). I believe that a Spanish company, the Sociedad Espanola de seda Parisien, has ceased working. The British Glanzstoff Co., Ltd., has recently started works at Flint, which, it is said, will give ultimately employment to 2,000 hands. It is understood also that works will shortly be erected in Russia.

In 1902 Thiele took out his first patent for improvements which enabled much finer filaments to be spun than heretofore. This and subsequent patents suggested a possible development in the industry (Fr. Pat. 320,446) in competition with the natural article.

Since that date the patents registered in connection with this copper-ammonia process have been very numerous. Only time will demonstrate their respective merits. In some cases copper carbonate in ammonia is used to dissolve the cellulose. Many patents deal with the use of different precipitating solutions, and details in the process, such as, for instance, the preliminary mercerizing of the cotton.

In the early days there were in this country several investigators of note working on the subject of artificial filaments, amongst whom may be mentioned Crookes, Swinburne, Wynne and Powell, and Swan; also the first patent for a direct process of manufacturing from allulose was taken out by two Englishmen in 1884. It was not until six years after this date that Despeissis took out his first patent, which formed the basis for the early working of the cupro-ammonium process. It remained for France and Germany to bring this industry to a successful issue. However, having recently reached a state of manufacturing efficiency, as at the Coventry Viscose Works, we have made up for lost time.

It was natural that France, with the silkworm industry so firmly established in the South, should look with greater interest upon the possible manufacture of an artificial product, which might supplement the natural supply. The fact that Pasteur was instrumental in saving that industry from decay may also have had an influence in intensifying the belief that the problem was capable of commercial realization through the aid of scientific research.

(To be continued.)

THE BAT.

THE small brown bat (*Vespertilio subulatus*), despite its unpopularity, is a creature not devoid of interest. It is hoped that the following observations recently made upon a live specimen of this animal may be worth mentioning.

The most noticeable characteristic about the animal was the peculiar, stale odor which accompanied it. Another equally unpleasant characteristic was the fact, disclosed by an examination of its fur, that it was quite numerous populated by a species of louse. The respiration of the animal was plainly visible, and the average number of counts, when the animal was in a state of repose, gave as a result 160 respirations per minute. Naturally, the respiration suggested the taking of the animal's pulse. This at first seemed difficult to do, but the problem was solved when the observer bethought himself of a stethoscope that happened to be available. This was one of the "telephonic" type of instrument, the diaphragm being connected with the ears of the experimenter by two rubber tubes. The bat was placed in a Mason jar, over the mouth of which was tied a paper cover. The jar was now inverted and placed upon the diaphragm of the stethoscope, so that there was nothing between the bat and the instrument except a thin layer of paper. The heart beat of the little creature was now plainly heard, but was far too rapid to be counted. In order to estimate the number of beats it was necessary to catch the rhythm of the heart beat by tapping alternately with the two hands upon the table, counting the taps of one hand only, and doubling. This gave as the result an average of 448 heart beats per minute. This is approximately three times the number of respirations per minute. The rate of respiration and heart beat was very much influenced by the nervous condition of the creature. Before each trial it was necessary to wait some little time, with everything quiet, until the frightened animal became composed.

Cement for Repairing Hard Rubber or Vulcanite.—This is a mixture of molten guttapercha and natural asphalt, and is applied hot. The hard rubber articles must be kept pressed together till the cement cools.

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