ENGINEERING.

TEXTILE INDUSTRY AT THE VIENNA EXHIBITION.—No. I.

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NEVER at any previous Universal Exhibition was the vast importance of textile industry so well shown as it is at the great gathering from all nations now being held at Vienna. For if former exhibitions brought into general public notice inventions which have since exercised an important influence on this branch of industry, or new raw materials such as jute, China-grass, and esparto, never before was there brought together a series of exhibits so complete or so significant of the progress in all branches of this industry, as that now presented at Vienna.

We, in fact, find the textile industry so prominently represented at Vienna that we feel almost inclined to say that it surpasses in importance its industrial companions, coal and iron; while it is undoubtedly a fact that the state of its development, as compared with that of these other industries, affords an index to the degree of cultivation and manufacturing progress of the various nations. This relation between the developments of the textile and other industries is expressed with unusual distinctness at the Vienna Exhibition.

Let us examine, for instance, the exhibits sent by the Eastern tribes—Persia, a state without any really perceptible progress, appears entirely enveloped in carpets and coverings; and no product, no manufacture, no industry of any kind whatever could justly be placed at the side of this branch of manufacture in the case of this primitive state. In the same manner appear Turkey, Tunis, Egypt, the colonies of England, Holland and France, and also Brazil, that wonderful treasure-house for textile raw materials from the vegetable kingdom. China and Japan have already another face; these countries have long been in a high state of culture, and if amongst their manufactures the textile products are yet represented with special prominence, still a number of other manufactures form not unimportant rivals to this the first industry of mankind. In our modern state of civilisation, coal, iron, and textile fibres may be said to range in importance in the order in which we have mentioned them; but even here the general importance of the latter products is striking, as the textile industry may be said to fight for each foot of space of which other branches of manufactures are trying to deprive it.

We have intended in the foregoing sentences not only to indicate the peculiar and always characteristic grouping of the chief branches of industry as created by the progress of civilisation, but also to sketch out the features of the Exhibition as a whole. In order to make the picture clearer we will now proceed to consider details. As stated already, Persia, Tunis, Turkestan, Caucasia, Turkey, and Egypt have brought together very rich collections of webs and tissues, the productions of manual labour according to old usages and inherited methods, and distinguished by native taste and hereditary colouring. In the case of the colonies of England, France, and Holland, textile manufactures have, as we have explained, to compete with other industries which the interchange of ideas with Europe has developed and made profitable. Here we find cotton and jute have obtained a place and have received regular culture as agricultural products. In the exhibits of China and Japan there is less indication of the predominance of textile industry, while that predominance becomes still less striking in the case of countries in a higher state of culture—such as Italy, Russia, Portugal, Holland, Sweden, and Denmark. In the case of these latter states we find art and science, metal work, and the industries required for the production of articles of luxury, more powerfully represented. States of the highest range of culture, again, such as England, Germany, Belgium, and France, show clearly enough the harmony existing between the various branches of their manufactures. In the exhibits of these countries textile products still hold an important position; but they cease to be obtrusively prominent, and they are equalled in their extent by the products of other branches of industry.

It would, however, be erroneous to suppose that those countries which are especially distinguished by the predominance of their textile exhibits have, more than others, contributed to the development of this branch of industry. Such a delusion might, however, easily enter the mind on comparing the wonderful Persian webs and tissues with the English and German manufactures, for the latter countries have scarcely exhibited anything that equals for beauty and richness of design the products of their Eastern rival. The question is to-day no longer only whether a product is beautiful, but for the general interest it has to be considered whether the product is of any practical value, whilst the artistic value is left to be decided afterwards. The practical value, however, involves certain factors which are dependent upon the mode of manufacture, and which are, shortest time of production, cheapest mode of production, greatest durability, and use; factors which could certainly not be attributed to Persian products in comparison with those of the Western countries.

It is no easy task to obtain in a short time a general view of the various exhibits at Vienna connected with textile industry, as these exhibits are to be found in all parts of the Exhibition. The Agricultural Hall contains raw materials and machines for cultivating them, the contents of the Industry Palace include a confused collection of textile products, and finally the Machinery Hall shows in each department, except that of Russia, something belonging to textile industry. It should be remarked, however, that notwithstanding it exhibits no machinery of the class of which we are now speaking, Russia nevertheless possesses an extensive textile industry, which has been founded by the help of English and German machinery, and which occupies already a high position. The slow growth of mechanical engineering in Russia at first prevented, however, the full and timely development of the textile branch of this class of industry, as that branch required a higher degree of skill in the construction of machines than was, until lately, available in Russian engineering factories. But we may be sure that it will not be long before the rapidly increasing industrial enterprise of the Russian people will cultivate jealously this branch of mechanical engineering.

In our articles on textile industry, as represented at Vienna, we propose first to investigate the raw materials and examine the new channels they open for manufacturing operations; next to consider the various fabrics and to obtain from them evidence as to mechanical progress and the development of the chemical branch of this manufacture, and finally to deduce from the exhibits generally some data as to the artistic industrial position of the various countries. As closely connected with the fabrics, we have to examine the agricultural department in order to learn what materials are available, and how they have been cultivated, and the Machinery Hall, in order to see how and with what appliances these materials are being worked. The chief data for a judgment as to the state of textile industry lies thus always in the quality of the finished product.

Textile industry is divided into almost numberless branches—a fact distinctly shown at Vienna—and in proposing to give a report on the state of that industry, as represented at the Exhibition, we have before us a not very easy task. We have, in fact, to treat of the raw materials, the spinning and the weaving, and closely connected with it the dyeing, cloth printing, and finishing. The spinning department is divided, according to the raw materials, into a number of special branches, such, for instance, as the spinning of flax, of short and long wool, of cotton, and of silk. The latter is again subdivided into reeling, spooling, and the spinning of floret or floss silk.

The department of weaving is proportionately more uniform, but it includes the hand looms, the looms for fancy weaving and for ribbons, the mechanical looms, and also at the present time the knitting, lace, and bobbin-net-making machines. As a special branch of weaving, or rather as an intermediate operation between weaving and spinning, we have to consider the manufacture of cords and of fringes, as the corresponding machines supply partly products which are absolutely webs, partly products which are scarcely anything else but complicated yarns, and finally products which are both webs and yarns. Considered from the manufacturing point of view, these products belong partly to the spinning and partly to the weaving department. As an important annexe to the latter, the manufacture of weaving appliances has to be considered. The department of dyeing is simple, whilst that of the finishing is more complicated, in so far as it has to be divided, firstly, according to the fibres used for the tissues, into five departments, and, secondly, according to the manipulations of the warp, the washing, the dyeing, the fulling, the singeing, &c. The printing of cloth and cotton is related to the dyeing and finishing, to which latter, and to the ornamenting of the tissues by figuring and stitching, time has added embroidering, whilst finally the invention of the sewing machine has facilitated, in a wonderful manner, the working up of the finished materials.

We have thus drawn the circle which limits our proposed review of the exhibition of textile products at Vienna, unless we also include the artistic industrial side of the subject. The number of exhibitors for textile industry is:

For Germany about	1100
„ Hungary and Austria	2500
„ France	750
„ England	300
„ Switzerland	400
„ Italy	300
„ Sweden	50
„ Denmark	75
„ The Netherlands	60
„ Russia	220
„ Greece	223
„ Turkey	300
„ Tunis	200
Altogether	6478

The wonderful official catalogue of the Exhibition does not give numbers for the other states, but we may say that the textile industry is represented by 10,000 exhibitors, as the numbers given above do

not include exhibitors of fibres nor of apparatus in the agricultural department.

RAW MATERIALS.

It is not our intention to give here a detailed report of *all* the raw textile materials exhibited at Vienna, but we shall speak especially of those fibres to which a higher interest is attached, or which are of special value, and which may thus become of importance in the future. Former exhibitions have already told us that we in Europe make but a very limited use of the abundance of fibres which nature has stored up in the vegetable kingdom. India and our colonies have always been represented by large collections of fibres used and to be used, while Brazil has never failed to astonish us by the extraordinary abundance of fibres that it contributes. America, with its numerous States, has done nothing less, and so also Asia and Africa. We recognise, therefore, again at Vienna, all the *Liliaceæ*, *Apocyneæ*, and *Urticeæ*, the fibres of the palm, agave, and aloe, which have been used by the natives for centuries.

During the last ten years, and chiefly since 1867, much attention has been paid to the fibres of the class of nettles, which were used extensively during the Middle Ages, when all the vessels navigating the Volga carried sails made of the fibres of these plants, which were cultivated in Switzerland, Silesia, and Sweden. Supplanted by cotton, the use of the fibres of the nettle became limited to the Himalaya and China, and some other parts of Asia and the Oriental islands. At the exhibitions of Paris and London the fibres were again exhibited; but only in 1867, when the beautiful products obtained from them were exhibited, was renewed attention paid to the fibres; and since then experiments on their cultivation have been made with great success in Germany, Belgium, France, and Algiers, in Tunis, Portugal, and especially in North America, Mexico, Havana, and Brazil. The Government has introduced and uninterruptedly assisted the cultivation of the rhea-grass in India according to the Chinese fashion, a prize of 5000*l.* having been offered for the construction of a machine which should clean the beautiful fibre from the bast. We find, therefore, the fibres of these plants, especially of *Urtica nivea*, well represented at Vienna, this having been done in the best manner by Dr. Collyer in the American department. Dr. Collyer shows us the stem of the plant, the fibres taken out of it, and the bleached fibres; he used ripe stems, whilst the natives of India and China cut off the stem when green, and try to isolate the fibres from their green surroundings.

The Brazilian department contains very valuable products. Severino Lourerrio da Costa Leite, of St. Barbara, in the province of Minas-Geraes, exhibits a long fibrous textile product, of which much may be expected; it is similar to the mohair. Unfortunately, the exhibitor does not give any botanical name, and the catalogue calls it "Fibras vegetæs extrahidas de um cipo," which means extracted from the stems of a bulbous plant. The exhibitor shows this new product, firstly, as stems in the natural state, and, secondly, in the various degrees of treatment (cardadas ponteadas). Next to this exhibit we find the fibrés from Tucum (*Artocarpus vulgaris*), which, when only roughly treated, are similar to sheep's wool; it contains brown, yellow, and white fibres, which can be exceedingly well treated, and which offer a useful material for ropemakers' work as well as for coarse and fine weaving. This material is especially used in the provinces of Bahia and Panama, and its importance and applicability are proved by the fact that it is shown by five exhibitors, especially in good qualities by Antonio de Freitas Paranbros, of Bahia, and José de Souza Dias Negro, of Panama. Brazil shows also seed-wool from the sugar-cane as stuff for felt, applied in Pernambuco to the manufacture of hats, and further, the seed-wool from the *Corvata*, *Tyberina*, *Sumauma*, &c. In the American department our attention is called to the collection of seed-wools, which are used as a substitute for cotton, such as *Catotropis*, *Bombax*, *Marsdenia*, &c.

With respect to cotton, the exhibition will not allow of a comparative criticism of the various sorts. America has a large collection, and shows immense pods of cotton, and we have especially to mention the beautiful samples of the Sea-Island species. Brazil also has a rich exhibition of cotton, the samples including some of excellent quality cultivated from American seed. Central America exhibits cotton of *Ochroma lagopuy*, and excellent Sea-Island cotton from Guiana. The other examples of cotton from Venezuela, Aragua, Tocoron, Paraguay, &c., are interesting for learning the state of production in these countries. The fibre of *Bombax cumanuensis* is of interest, and England's colonies also, as well as Egypt, China, Syria, Algeria, and Russia, participate in the exhibition of cotton.

It is interesting to see how Russia is trying to get into her own hands the production of all raw materials for weaving. The culture of cotton in Southern Russia, in the Caucasus, and Turkestan, is not unfavourably represented. Considering the perseverance and steadiness of the Russian Government in all industrial matters, it is surely to be expected that the culture of cotton will eventually attain such an extension within that country that Russia will not require any further importation. The Syrian cotton is not so good as it ought to be, considering that the countries of Asiatic Turkey are very favourable to its culture; and the industrial mind appears to have died out in this state. Egypt, however, makes progress in the culture of cotton, which is carried through with a certain amount of intelligence, as proved by the excellent exhibits. Equally valuable are the Algerian experimental cultures, and it is remarkable how exceedingly profitable these districts of the North African coast are. *Urtica nivea* also is now cultivated in large quantities and with great success in Algeria. The Tunisian exhibition contains a fine assortment of fibrous materials, amongst which should be mentioned those of Mr. Dauphin, whose samples of raw and treated products of *Typha latifolia* are highly interesting. In the exhibition of products from Java we are struck by the presence of *Bombax ceiba*, which carries in long capsules on the bottom of the flower long and soft seed-wool widely known, and applied under the name of "kapok" on the Continent of Europe as a material for upholsterers. In the Russian department we find the fibres of *Apocynum*, which, like the nettle, was also cultivated in Germany until the end of the last century. Subsequently the plant seemed to be forgotten, and was known only for its seed-wool, when in 1870, the fibres of *Apocynum* came from Southern Siberia and Turan as well as from the other districts bordering the Caspian Sea to the Exhibition at St. Petersburg. At the Moscow Exhibition of 1872 these fibres were represented by the whole field of their application, of which the collection at Vienna is a poor copy only. The label on the sample exhibited states that the Province of Semiredje is the chief district for the cultivation of the fibres, but the latter extends over the wide area mentioned above. *Apocynum syriacum* is the species chiefly found in Turkestan, whilst *Apocynum venetum* is used in other places; the fibres of *Apocynum cannabinum* are called in India "Indian hemp," and the fibres of *Apocynum Divi Lardner* are a much required material at Ceylon. The "Pita fibres" of *Fourcroya gigantea* (Mauritius), and other varieties of aloe are of considerable value, and have become already a mercantile article. The term "Pita fibres" designates all fibres of the *Amaryllideæ* and of many *Liliaceæ* that could be used for spinning. The extensive application of the palm bast is known. As *Chamærops humilis* supplies to the inhabitants of Algeria a large quantity of fibrous material which can be used for fabrics, so another palm (*Chamærops excelsia*) gives garments to the inhabitants of the Chinese coast, and of the island of Tchusan, whilst other species (*Chamærops Martiana*, *Livistonia Australis*, *Diplothenium Torelli*) offer their fruits and fibres to other tribes. Kitool fibre of Caryota, which probably receives a peculiar treatment, as it possesses an oily smell, is obtained from Malabar, Bengal, Assam, and other Oriental districts. The natives are said to bathe these fibres in cocoa-nut oil, in order to make them elastic and preserve them from damage by moisture. Brazil exhibits the Piassaba fibre of *Attalea fumifera*, a material that is widely known in that country, and which is used to an enormous extent for ropes, nets, cords, fabrics, &c.

The application of the fibre of the cocoa palm is well known, and belongs to all tropical countries where *Coco nucifera* grows. The date-palm and the Areca palm also provide fibres. To the family of the latter belongs further the Carnauba palm, which is so much valued in Brazil, and which might in fact be considered as a store for the satisfying of most human requirements.

In the North American department we find the bark of a tree which contains excellent bast for textile material. The label attached to this exhibit says only: "Estopa, 171ª, Rio Negro," this really amounting to nothing, and none of the American commissioners can give any further information. This tree, however, belongs, no doubt, to the *Ficus* family, the fibres of which are much used.

In the same department we find the delicate bast structure of the fruit of a species of *Momordica*, the inner structure of which consists of five compartments arranged longitudinally, and built in regular ties, arches, and beams of bast material. If the seeds are taken out of the five chambers, and the whole fruit is dried, the outside skin peels off, and the bast structure only remains, like a large cocoon, but finely perforated. The treatment of this residue in such a manner as to form leaves, of which hats and articles for women are made, is an art of the natives of Brazil and the inhabitants of the Rio Negro.

The application of the bamboo is also represented at Vienna. These *Gramineæ* supply enormous quantities of fibrous material for textile and paper products, besides the large area of their numerous other applications. The bamboo contains about 80 per cent. of fibrous material, and in order to abstract the latter, baths of lime water were formerly used, the bamboo being placed in these baths in small pieces, and allowed to remain for a few days, when a bath of acid water was applied; for these alkaline baths were afterwards substituted. Now, however, the bamboo is treated with leys of high percentage in covered boilers under steam pressure.

Jute is represented at Vienna as a fibrous material of great importance, not because the columns, walls, and ceilings of the Industry Palace have partly been covered with this material, but because, besides the many exhibits of jute as a raw material, a large number of manufacturers exhibit yarns and tissues made from it. We see this in the English, as well as in the German, Austrian, Dutch, French, and Belgian departments. Jute has now become an important material for yarns, and is applied to different purposes, according to its fineness and to the length of its fibres; it is now generally used in carpet weaving as a substitute for the hemp yarn, giving to the carpets more strength and durability. The Exhibition does not contain anything illustrating how the jute is treated, but when approaching the exhibits of the Brünner Jute-Fabrik, our sense of smell tells us at once of the application of train oil, a method which, for instance, does not seem to be any longer used in the Wolfenbüttel districts. We should mention here the material for the so-called Panama hats, which is exhibited in the Central American and Brazilian departments. The material consists of strips of the leaves of *Carludovica palmata*, and has the home name Bambonassa or Bambonaxa. These leaves divide into longitudinal strips of increasing fineness; the green upper skin is taken off when the fibre is bleached.

The *Phormium tenax*, or the New Zealand hemp, which is often used, is represented by several varieties in full culture in the garden annexe, whilst its fibres and products are shown by Tunis, Ceylon, and East India, as well as by Scotland. Manilla hemp is also exhibited at several places.

Our home flax is represented by numerous samples, but, it being impossible for our limited space to give in these articles a comparative examination of the flax products, we will state only that the flax-cultivating districts of Germany have sent exceedingly good exhibits, amongst which we mention the collective exhibition of the Silesian district, those from Eastern Prussia, Hanover, Rhineland, Baden, Wurtemberg, Alsace and Lorraine, &c. Next to the German products as an exhibition are those of England, Ireland, and Scotland. The Austrian flax culture, also, is represented by exhibits from Bohemia, Moravia, Lower Austria, and Hungary, whilst the exhibits of the experimental flax culture of Italy especially attracted our attention. Italy makes enormous progress in all branches of industry, and shows her intention of making use of her treasures. Equally well represented is the culture of hemp, expecially that of Russia.

It is not our intention to deal separately here with all the other textile materials from the vegetable and animal kingdoms, as nothing is more difficult, we may even say impossible, than to institute a comparative criticism of the whole exhibits at Vienna. We must simply confine ourselves, therefore, to stating that the exhibition of wool from all countries is enormous, that the best cloths of English and German manufacture are represented, that Austria proves that her old breeding establishments for sheep are still in existence, and that

Hungary gives us a good idea of how it maintains its flocks. Neither are there wanting the numerous varieties of goats' hair from Turkey, Armenia, Caucasia, Peru, Ecuador, &c., nor the colonial wool from Buenos Ayres, Cape of Good Hope, and Australia.

Silk is also well represented, and the Vienna Exhibition teaches us more about its quality and treatment than any book or treatise could do. But not only that, for all species of moths, the webs of which have been applied for the manufacture of silk, are represented at the Exhibition in long series. These varieties are to be recognised already in the cocoons themselves, which vary considerably in size and colour from the gigantic cocoons of Persia and Turkestan to the elegant cocoons from China. All the sizes between these two are shown by a fine collection of cocoons in the Italian department, where the same exhibitor shows a collection of all existing deformations of cocoons, caused by a spinning together by accident, and by diseases during the spinning time. The caterpillar and cocoons of the moths of Ailanthus and Yamamai are to be found in this collection, as well as in others exhibited by America, Tunis, and Japan. The most interesting exhibits in this branch, however, are shown by Turkestan, Caucasia, China, and Japan, as they illustrate, besides the materials, the tools and apparatus for making silk. In the Japanese department we find a complete silk-spinning mill, which is highly interesting. Finally, we have to mention the fibrous material obtained in fine and fair fibres from the beard of the *Pinna nobilis*. This material is obtained in South Italy, especially in the bay of Tarent. It has the appearance of women's hair, and is used for imitating fur, &c., samples of which are to be found in the Italian department.