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EXTRA VOLUME.

THE

YEAR-BOOK OF FACTS

IN

The Great Exhibition

OF 1851:

ITS ORIGIN AND PROGRESS, CONSTRUCTIVE DETAILS OF THE BUILDING, THE MOST REMARKABLE

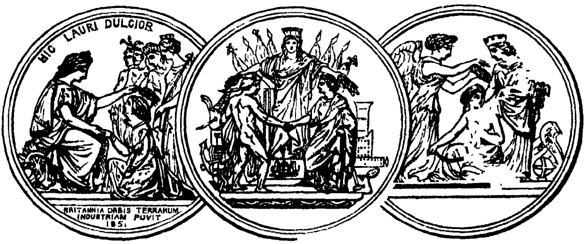
ARTICLES AND OBJECTS EXHIBITED,

ETC.

BY JOHN TIMBS,

EDITOR OF "THE ARCANA OF SCIENCE AND ART."

"To seize the living scroll of human progress, inscribed with every successive conquest of man's intellect, filled with each discovery in the constructive arts, embellished with each plastic grace of figured surface or of moulded form, and unroll this before the eyes of men, the whole stream of history furnishing its contingent, placing Archimedes, Arkwright, Davy, Jacquard, Watt, and Stephenson side by side,—leaving the instructive lesson to be learned that always lies in the knowledge and example of great things done;—this is, indeed, no mean design, no infelicitous conception."
EDINBURGH REVIEW, No. CXCII., *October*, 1851.



THE GREAT EXHIBITION PRIZE MEDALS.

LONDON:
DAVID BOGUE, FLEET STREET.
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1851

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THE GREAT EXHIBITION

OF 1851.

> ' All is the gift of Industry; whate'er
> Exalts, embellishes, and renders life
> Delightful." THOMSON.

RECORDS OF INDUSTRIAL PROGRESS.

THERE is no period in the history of this great country which merits more special commemoration than that in which England became the depository of the choicest productions of all nations, to form, with her own contributions, an Exhibition of the World's Industry. Such is the greatest event of the middle of the nineteenth century; and, however the narrative of its earlier years may abound with startling episode of renown, and the wreathed record of physical triumph, neither of them presents an object so pure in itself, and so important in its benefits to the human family, as the Great Industrial Congress of 1851:

> " So that to us no thing, no place is strange,
> While (this) fair bosom is the world's exchange."

Yet, such events have not invariably found fitting record. "Though it might be expected," says a sensible writer, "that the great share which new inventions and discoveries have at all times had in effecting happy changes among mankind would have secured them a distinguished place in the annals of nations, we find with regret that the pen of history has been more employed in recording the crimes of ambition, and the ravage of conquerors, than in preserving the remembrance of those who, by improving science and the arts, contributed to increase the conveniences of life, and to heighten its enjoyments."* Fortunately, this reproach does not apply to the present age; for men have learned better to appreciate their best benefactors. One of the most profound living philosophers recently

* Preface to Johnston's Translation of Beckmann's History of Inventions, Discoveries, and Origins.

have far surpassed them; the large and beautiful vases, the magnificent groups and the exquisite pictures of Sèvres china, enriched these saloons, already glowing with the *chef-d'œuvres* of the Gobelins and the Savonnerie. The Chamber of Mars was converted into a receptacle for porcelain, where might be seen the most beautiful services of every kind, vases for flowers,—in short, all the tasteful varieties which are originated by this incomparable manufacture." These beautiful productions were to be disposed of by lottery; but the decree of the Directory banishing the nobility of France from Paris, issued shortly after the opening, compelled the Marquis d'Avèze to leave the seat of his labours; and thus ended the first great Exhibition of Industry. The following year, however, the Marquis, being recalled, made preparations for a second and more comprehensive attempt, including all the principal branches of Parisian industry, at the Hôtel d'Orsay, whose principal suite of rooms was filled with produce chiefly obtained within the Barrières. In the first, we find the richest furniture and marqueterie produced by Boule, Riessner, and Jacob; the finest clocks and watches by L'Epine and Leroy; the superb porcelain and china of Sèvres, of Angoulême, and of Nast; the elegant bookbinding of Grolier and De Thoui; silks of Lyons; historical pictures by Vincent, David, Suvé; landscapes by Hue and Valencienne; flowers by Vandael and Pancoucke; and many other objects of an equally luxurious character, showing upon what class of the community French manufacture had, up to the period of the Revolution, mainly depended for support. In the further progress and development of these Expositions, we shall be able to trace the gradual expansion of the market to the supply of the wants of the masses.

At the end of the year 1797, Napoleon, on his return from his victorious campaign in Italy, determined that industry should have its ovation, as war had already achieved its triumph; and the first building raised for the purposes of an Exhibition of Industry was erected in the Champ de Mars. It was kept open three days—the crowd was excessive. Medals were awarded by a committee of nine, including some of the leading scientific men of the day, among whom the founder of the Ecole et Conservatoire des Arts, the then manager of the Government manufactory of saltpetre for the army, the eminent chemist, Chaptal, took a most active part. The since celebrated chronometer-maker, Breguet, was one of the 110 exhibitors of this the first Great National Exhibition; and here he obtained a prize, the first-fruits of his inventive genius.

This success led the Minister of the Interior to promise similar Exhibitions annually; but the next did not take place until after an interval of three years. In 1801, wooden galleries were erected round the quadrangle of the Louvre, to receive the contributions of the principal manufacturing towns of France and Belgium, of Milan and Aix-la-Chapelle, nearly all of which had been visited by the First Consul, accompanied by Chaptal, Berthollet, and Monge. Among the central jury for the award of the prize medals were Berthollet, Berthoud, Guyton de Morveau, and De Prony; Vincent, the painter; and M. Costaz. It was on this occasion that Jacquard obtained a bronze medal, and subsequently a pension of 1000 francs per annum, which was ultimately increased to 6000.*

The principal features of this Exposition, which lasted six days, were the improvement in the quality of wool, as a raw material, owing to the influence of the Rambouillet flock, and the exertions of MM. Tessier, Huzard, and Gilbert. The woollens of Louviers were represented by Decretot; those of Sédan, Rheims, and Vervins, by Ternaux, &c. Cottons were spun *à la Mulljenny*, and otherwise. The carpets of Sallandrouze; the china of Sèvres; the earthenware of Sarreguemines; the morocco leather of Choisy le Roi, which surpassed in beauty that of Turkey itself; and the perfect printing of Didot, Herhan, and Piranesi; claimed the attention of, and were especially commended by, the jury.

In the following year, the Third Exposition took place in the same locality as its predecessor, when the number of Exhibitors had increased from 229 to 540. The most striking features of this year were the extended application of mechanical and chemical science to facilitate production, and the consequent great reduction in price of all articles in common demand. The hydraulic-ram of Montgolfier; the stocking-frame of Aubert; the silk-spinning machine of Vaucanson; and the chemical products of the Decroisilles of Rouen, and Amfry and Darcet of Paris, were exhibited. One of the most important results of this year's Exposition was the establishment of the *Société d'Encouragement*, which has aided in an extraordinary degree the inventive talent of France, and the application of abstract science to manufactures.

The Fourth Exposition was held, in 1806, in a splendid building erected on the esplanade of the Hôpital des Invalides, and showed an amazing improvement in every department of textile fabric. Here, for the first time, appeared the printed colours of Mulhausen and Logelbach: and among other productions exhibited, were the beautiful imitations of Cashmere shawls; the improved manufacture of steel; porcelain printed from copper-plates, &c.

A long interval now ensued, when manufacturing France, isolated by wars from the producing powers of Europe, was compelled to supply alone what those kingdoms derived from mutual co-operation and dependence on each other; and, by this means, laid the foundation of that facility and universality of manufacture which so eminently distinguish her in the present day. Thus, we find France, at her Fifth Exposition in 1819, still honourably distinguished. The display was held in the court-yard of the Louvre: its leading features were the improvement of metal-work, as in the castings of the iron-works of the Loire; the admirably-rolled iron of the Cher; anchors, wire, tools of every description; jewellery, plate, and plated goods; Damascene-work, bronze, steel, stereotype-plates,

* It was in consequence of reading an advertisement published by the London Society of Arts, that Jacquard, a straw-hat manufacturer, was induced to turn his attention to the study of that loom which has since rendered his fame universal.

and oxides prepared as pigments for vitrification. Then, we had the exertions of Daniel Kœchlin, the Thomson of French calico-printing; of Raymond of Lyons, the inventor of the famous process for fixing Prussian-blue in silk-dyeing; and Widmer de Jouy, celebrated for his green; while Jacquard re-appeared, gaining a prize more worthy of his great abilities.

The Sixth Exposition, in 1823, extended to fifty days; and showed great progress in the application of the improved manufacture of iron to machinery and construction, and the consequent development of civil engineering as a profession. The most remarkable novelty exhibited was the model of the first suspension-bridge: it was designed by MM. Seguin, *frères,* to cross the Rhone between Tain and Tournon.

The Seventh Exposition, in 1827, showed great improvement in the arrangement and classification, introduced by M. Payen, the learned chemist.

The Eighth Exposition, in 1834, the first under the government of Louis-Philippe, called forth the ability and knowledge of Charles Dupin, and procured for France the most able Report which has yet been made upon her industry; tracing, in almost every department of manufacture, a steady progression in silk, in cotton-printing, flax-spinning, and tools, and chemical productions especially. Among the novelties were paper-hangings printed from cylinders, by Zuber, of Mulhausen; the revival of enamel and *niello,* by Wagner; the formation of India-rubber elastic tissues; the factitious ultramarine, now known as French ultramarine, by Guimet; the revival of wood-engraving; and the attempt to emulate the traditionary excellence of Boule and Riessner in marqueterie, and in-laid cabinet-work. The articles were exhibited in four pavilions, erected in the Place de la Concorde.

The Ninth Exposition, in 1839, showed the manufactures of France as far in advance of their condition in 1834, as in that year they had advanced from their state in 1827. The leading characteristic of this Exposition was cheapness of production, and the adoption by the manufacturers of the principle of "large sales and small profits," a system not previously very much favoured in France. The importance attached to these points is shown in the classification adopted by the jury:—1, Inventions and improvements, ranged with reference to the importance of their results in manufactures; 2, the extent of the factories and their situation; 3, the actual and commercial quality of the goods; 4, the cheapness realized by means of production. The adoption by the nation of this eminently popular *business* theory was mainly dependent on—1, the improvements in all machines, substituting the mechanical for the human hand, and the supply, through upwards of fifty engineering firms, of steam motive power to any extent; 2, the progress of popular education, in the formation of municipal libraries, open to all readers, of commercial and drawing schools, of local museums, of free exhibitions of works of art, &c.; 3, on the better comprehension of the theory of commercial, as connected with political and social economy, more especially by the master-minds of the manufacturers of Mulhausen, who demanded a vast special saloon for the exhibition of their products, and among whom the ratio of the means of education to the number of inhabitants was greater than in any other part of France; 4, on the interest which these periodical Exhibitions of Industry, and the publication of admirable critiques upon them, had excited in the public mind. Among the most striking products of this Exposition, were native silk and native nitre; the marbles of the Pyrenees, the lithographic stones discovered in France, the introduction of stearine, the fine wool, and the various qualities of ironstone. Among the machinery, in addition to the improved steam-engines, was the perfection in Jacquard looms, endless paper-machines, well-boring instruments, wool and cotton spinning apparatus, sawing and planing-machines; chronometers, now valued at half the price they fetched in 1834; and needles, bidding fair to rival those of Birmingham. In glass and porcelain manufacture, improvements had been no less rapid than in textile fabrics; and the art of preparing leather had advanced so far, with the aid of enlightened chemists, that France, which, in 1830, imported tanned leathers from England, now exported her prepared hides to the British markets. This Exposition was held in the great square of Marigny, in the Champs Elysées: the building contained eight principal apartments, a hall, and spacious gallery, and cost nearly £14,560. Every branch of French industry was represented within its walls, by 3281 exhibitors; and the Exposition far surpassed all previous attempts, as regards both the convenience of the building raised, and the display of the specimens produced.

The Tenth Exposition, in 1844, illustrated the successful results of the influence of long-continued peace and pacific government on the industry and producing powers of France. "The Expositions of 1834 and 1839," said the Baron Thénard, addressing Louis-Philippe, "have bequeathed us memories which have sunk deeply into our minds; that of 1844 will hand down to us others yet more worthy of remembrance." The Baron, in enumerating the most important departments in which notable improvement had been made, dwelt on the progress of steam navigation; on the distillation of salt water; on the perfection of iron casting; on the application of new systems of warming and ventilation, and of electro-metallurgy; on the manufacture of the best flint-glass for astronomical purposes; of pyroligneous acid; of sulphate of soda, of muriate of potass, and of artificial manures; of white lead, of sulphuric acid, of dyes and pigments; of silk and sugar; on the admirable arrangements of lighthouses; and on the increase in the supply, from national resources, of raw silk, of wool, sugar, and of flax: but most earnestly did he commend to his sovereign's attention the amazing advance which had been made in the construction, not only of machines, but of those mighty engines by which machines themselves are made—by which the stubborn iron is moulded to the will of man, with an ease of operation as far exceeding his uncertain efforts in regularity and precision, as in force and almost limitless power. When, in addition to these great and material acquisitions, we remember, that in all those handicrafts which rise from the industrial almost into the department of the *fine* arts,—that in silver and bronze working, in jewellery, ornamental modelling, and designing in every fabric, and in every material, France, in 1844, exhibited such a display as no other country could possibly have brought together,—we cannot but feel that the benefit derivable to her citizens, and to the world, from an inspection of this gorgeous collection of her products, must have been one of the greatest it has ever been the happy privilege of any one country to bestow upon the industry and producing powers of the world at large. The building for this Exposition was of vast extent, and occupied the same site as that of 1839; it was reared in the surprisingly short space of seventy days. The Report of the central jury (fifty-eight persons) is one of the most elaborate and able of the series from the commencement of these publications, and records the unexampled activity of the country in the happy five years preceding 1844. No fewer than 3960 manufacturers exhibited, of whom the merits of 3253 were more or less honourably recognised by the jury.

The Eleventh Exposition, 1849, was of greater extent than either of its predecessors. The site was the same as that of 1844, in the Champs Elysées; but the area of the building was increased to about five acres; it was, as before, rectangular in plan, and constructed with side galleries: to it was added an enormous shed for agricultural implements, produce, and live stock, this being the first occasion upon which they were admitted to compete for prizes. The whole of the buildings were of wood and zinc, and cost about 18,000*l.* for the hire of the materials for about three months; these remaining the property of the contractor at the termination of the Exposition. The public were admitted gratuitously on five days of the week. The objects exhibited evidence on all hands of the extent to which the education of French workmen had been carried; scarcely a piece of bad ornamental modelling could be seen, or the human figure ignorantly drawn. The only important branches of manufacture in which, to judge from the Exposition of 1849, France seemed decidedly behind England, were those of the application of mechanism to carving on a large scale; the manipulation of gutta percha; tin-plate and Britannia-metal working; earthenware, and japanning on papier-mâché; and generally, perhaps, in her immediate adaptation of new machinery to facilitate, and, consequently, cheapen production; while in many departments, such as the cultivation of the art of enamelling, of bronze-working, of the production of artistic stone-ware, the making and colouring of terra cotta, and of ribbon and silk weaving and dyeing, France appeared as decidedly in advance. The raw materials of Algeria seemed to promise much as a field for the outlay of French energy and capital. Altogether, the predominating feature of this year's Exposition in France was the manifestation of her *power* to get up those machines, on the possession of which our facility in production has long depended; and if she once attain in this department anything approaching our mechanical resources, at the same time retaining her present artistic capability, there is little doubt that she will be able to command many markets to which we alone now procure access.

We have condensed these leading characteristics of the eleven National Expositions in France from an able Report,* prepared for the guidance of the Society of Arts, in their preliminary arrangements for the Great Exhibition of 1851, by Mr. Digby Wyatt, who thus sums up the services rendered by the Expositions:—"When we consider that during *the last* fifty years constant and sedulous attention has been paid by the Government to the great interests of manufacture in France, by precept, example, premiums, public exhibitions, the institution of elementary schools, 'Societies of Encouragement,' and, above all, by an incessant attempt to elevate the social and intellectual condition of all engaged in the present great work of supplying the necessities, gratifying the tastes, and ministering to the resources of their native country, we cannot be surprised to find, in the year 1849, that the impulse *originally* conveyed to manufactures *limited* in extent, and serving chiefly for the use of a small proportion of the citizens, has been transmitted through infinitesimal ramifications, until it has become infused and incorporated into the very essence of the spirit of the people."

Mr. Wyatt then refers to the early excellence of French art: as, the stained glass, goldsmiths' work, Limoges enamel, carved ivory, and illuminated manuscripts, of the thirteenth century; the *Rénaissance* of the fifteenth century; the establishment of the silk trade at Lyons, about 1450; the ancient proficiency of Paris, St. Denis, Lagny, Beauvais, and Cambray, and all other branches of weaving—the Gobelin tapestry—the carpets of the Savonnerie—the Sèvres China institution—and the commencement of the employment of cotton, about the end of the 17th century. From the year 1797 we may date a gradual attempt to disseminate from the *few* to the *many* the luxury of beautiful design in all objects of daily and universal use.

"This generalization and dissemination of 'Art Manufacture,'" continues Mr. Wyatt, "has been much excited and aided by the establishment of great National Expositions, exhibiting from time to time the actual condition, advantages, deficiencies, capabilities, and variations of industrial exertion throughout the country. It may be scarcely necessary to *prove* the excellence, in principle and practice, of the institution of such a systematic stimulant to public emulation, since a recapitulation of the names of such men as François de Neufchateau, Chaptal, Napoleon, Berthollet, Dupin, Louis-Philippe, &c. (all of whom, though differing most widely in their political views, have united in prosecuting these Exhibitions with the greatest ardour), would alone suffice to convince the most sceptical, that France at least has acknowledged the great *public* benefit of such competitions. When, furthermore, we find that similar exhibitions have been organized in Belgium, Italy, Austria, Spain, Prussia, Sweden, Bavaria, and Russia, and that the number of exhibitors has augmented in one constantly increasing ratio, it is manifest that the

* "A Report of the Eleventh French Exposition of the Products of Industry. Prepared by the direction of, and submitted to the President and Council of, the Society of Arts, by Matthew Digby Wyatt, Architect."—London: Chapman and Hall, 186, Strand. 1849.

manufacturers themselves have derived a practical benefit, as direct and important as that received by the public."

EXHIBITIONS IN ENGLAND.

Having glanced at the Expositions of French Industry, which have, unquestionably, had the most marked influence in Europe, it will be interesting to show the attempts at similar displays which have been made in Great Britain; and it is worthy of remark that all these have been originated by individuals or Societies, independently of any Government assistance.

"As early as the year 1756-7, the Society of Arts of London offered prizes for specimens of manufactures, tapestry, carpets, porcelain, &c., and exhibited the works which were offered in competition. About the same period, the Royal Academy, as a private society, patronised by the sovereign more in a personal capacity than as representing the head of the Legislature, had organized its exhibitions of painting, sculpture, and engraving."*

Here should be recorded an event which was the means of promoting the formation of many of those minor collections of art and produce in this country, which have done so much towards improving the taste and increasing the knowledge of our working manufacturers and operatives. On the 11th of November, 1823, a public meeting was held at the Crown and Anchor, for the purpose of forming a London Mechanics' Institute. Dr. Birkbeck, who took the chair, had published in the *Mechanic's Magazine* of October 11, 1823, a paper of proposals on the subject; and, among his supporters who attended the meeting, we find the names of Jeremy Bentham, the promoter of the Panopticon plan of management; of David Wilkie, the painter; of William Cobbett; of Dr. Lushington, and other celebrities of that day. On the 18th of December, Dr. Birkbeck was elected president. The formation of provincial Mechanics' Institutes soon followed; and to them we are indebted for the first attempts, at Manchester and Leeds, to establish temporary exhibitions of specimens of improved manufactures.

In 1828, an Exhibition of the kind was attempted in London, by a subscription society, to whom King George IV. granted one of the long rooms in the Royal Mews, at Charing Cross, which occupied the site of the National Gallery, in Trafalgar Square. This institution, termed "The National Repository," was formed nearly on the plan of the Société des Arts et Métiers, at Paris. It originated with the Hon. G. Agar Ellis, M.P., and a few other patriotic gentlemen, who constituted the board of management, assisted by a committee of inspection, to decide upon the merits of the articles sent in for exhibition. Attached to the long-room above mentioned, were apartments particularly reserved for the reception of products as they arrived from our chief manufacturing towns,—as Birmingham, Leeds, Glasgow, Macclesfield, Manchester, Nottingham, Sheffield, &c. The Exhibition opened in May, 1828: in the catalogue we find new

* Mr. H. Cole, in the Introduction to the Official Illustrated Catalogue.

silk manufactures, silk looms to work at certain hours, English Mechlin lace, crystallo-ceramic ornamental glass, models of steam-engines, steam-boat paddle-wheels, suspension bridges, and public buildings, new kaleidoscopes, a self-registering rain gauge, improved musical glasses, a mill for husking Indian corn, Cook's life-buoy, patent metallic shutters and sun-blinds, &c. The Exhibition succeeded, but was not so attractive as Mr. Cross' menagerie, in the mews-rooms underneath, notwithstanding the King and his ministers, and some of the most influential nobility, took a lively interest in the "National Repository." On the pulling down of the Mews, the collection was removed to a house on the east side of Leicester Square It was, however, soon after dispersed; but, doubtless, suggested the Polytechnic exhibitions at the Adelaide Gallery, Strand; and in Regent Street.

As early as 1829, the Dublin Royal Society founded an Exhibition of works of art, science, and manufactures, to be held triennially; to which, however, Irish productions only were admitted until 1850.

The Cornwall Polytechnic Society appears to have been the first institution in England that systematically gathered specimens of local industry for periodical Exhibitions, of which there have been eighteen, the latest in 1850. The industry, the science, and the natural history of Cornwall here found their annual representatives; and the processes for cheapening the productions of its disembowelled wealth here received new and improved developments.

Manchester next claims notice for its endeavours after an Industrial Exhibition. The idea of forming a collection of "specimens of natural history, works of art, and mechanical contrivances," within the walls of a Mechanics' Institution, is attributed, in the Report of 1838, to its president, Mr. Benjamin Heywood, at whose suggestion, in 1837, a circular was issued to the manufacturing and scientific men of the country, which indicates the comprehensiveness of the Manchester scheme. A very interesting collection of models, manufactures, paintings, and natural curiosities, from 150 contributors, was opened at Christmas, 1837, and was visited by 50,000 persons, and realized £1078. The second Manchester Exhibition was held at Christmas, 1838, and had 360 contributors of 26,300 articles: including 31 models of steam-engines, 79 models of useful machines and ingenious mechanical contrivances, 20 models of ships, boats, &c., 400 specimens of manufactures, 12 models of public buildings, 40 specimens of papier mâché and cabinet-work, 90 philosophical instruments, 7000 mineral and geological specimens, &c. This Exhibition had 100,000 visitors, and realized about £2320. The fifth and last Manchester Exhibition took place in 1844.

Leeds followed the example of Manchester as early as 1839, and copied the plan of that town as closely as possible. This Exhibition was rather a bazaar than an illustration of local industries: it contained, however, some excellent specimens of machinery and produce; including surveying instruments, chemical and philosophical apparatus, steam-engines; a machine in action for making cards for *wool and cotton—by Messrs. Curtis and Co., Sowerby Bridge; Walton's Machine for raising the nap on woollen cloth, as a substitute for the teazle; flax machinery; and a peculiar machine, invented and constructed by Christian Schuster, who had been originally a cowherd.*

At Newcastle-upon-Tyne, in 1840 and 1848, Exhibitions were opened; but they contained few models or manufactures.

Birmingham was slow to adopt the plans of Manchester, which had already been imitated by Leeds, Newcastle, Liverpool, Devonport, Derby, and other manufacturing towns. Mr. Wallis, well known as the former director of the Manchester School of Design, claims the honour of having suggested that, in the plans for the establishment of a Birmingham School of Design, a periodical Exhibition of Manufacturing Art should be included. Although this suggestion fell from Mr. Wallis in 1842, it was not before September, 1849, that a great Birmingham Exposition of Industry was opened. This Exhibition was the most complete of any which had been yet held in this country. It filled the entire area of Bingley Hall; and represented very fairly the great variety of manufactures carried on in the vicinity of Birmingham. All the most eminent manufacturers contributed something representative of their several industries. A complete set of specimens, illustrative of the history of the English plastic arts, was not the least remarkable part of the collection; elaborate samples of electro-plating indicated the future importance of this beautiful process; and the Stafford potteries contributed some splendid wares. The completeness and high character of this Exhibition may be attributed, in the first place, to the stimulus which the adoption of schools of design had imparted to the manufacturing arts; and, in the second place, to the influence of the splendid French Exhibition of 1844, as well as the enthusiasm with which the great Free-Trade Bazaar, held in Covent-Garden, in 1845, had been received.*

It should here be mentioned that, so far back as 1836, Mr. Theophilus Richards, of Birmingham, was in treaty with the Board of Trade, for making an Exhibition of *foreign* manufactures; and, among many gratifying testimonies to the value of the proposal was the offer of Mr. Lea, of Astley, to give 100 guineas to any man, or set of men, who might invent a new article of any description, provided it were done in Kidderminster, and adapted for general use.

At Devonport, in 1844 and 1850, Exhibitions were held in the Mechanics' Institute building; but an "Exposition of Arts" had been proposed by Mr. R. Burnet in 1841. The Exhibition of 1850 was divided into ten distinct sections; 1, manufactures; 2, raw materials; 3, models, machines, &c.; 4, philosophical apparatus; 5,

* See an able *précis* of the Industrial Exhibitions of the Continent and the United Kingdom; by William Blanchard Jerrold, in the *Illustrated London News*. The Bazaar of the Anti-Corn-Law League, held in Covent Garden Theatre, in the spring of 1845, was a commercial demonstration in favour of a great political principle, and a splendid picture of manufacturing England. The League cleared by the speculation, in six weeks, £25,000, partly by admission money.

naval architecture; 6, *fine arts, modern masters; 7, fine arts, old masters; 8, water-colour drawings; 9, natural history; 10, antiquities, curiosities, &c. Prizes were awarded at a public meeting;* but there were no premiums distributed at the Newcastle or at the Manchester Exhibitions.*

PROCEEDINGS OF THE SOCIETY OF ARTS.

To the successive exertions of the Society of Arts through a period of seven years, may be distinctly traced the establishment of the Great Exhibition of 1851; though its originators doubtless kept in view the prosperity of our local Exhibitions we have already glanced at, and the more extensive Expositions of France and Belgium.

The Society of Arts was somewhat quietly pursuing its useful course in the Adelphi, but without the advantages of a periodical Exhibition of novelties, when, in 1842, Prince Albert, succeeded to the Presidency, hitherto filled by the late Duke of Sussex. In November, 1844, Mr. F. Whishaw, then Secretary of the Society, as its minutes record, "endeavoured to elicit some demonstration of public opinion in favour of a plan he had contemplated for establishing an Exhibition of the Products of National Industry." In the same minutes are mentioned Mr. Richards's "efforts to get up (at Birmingham) an Exhibition of Industry, including Foreign Manufactures," which efforts were commenced so early as 1836. In the same note, Mr. Wallis is referred to as "an early promoter of the plan of National Expositions similar to those on the Continent." To whichever of these gentlemen is most due the originating of periodical Exhibitions in England, the idea was but an adaptation from the examples of France and Belgium; and, before anything was known of these Continental displays, Cornwall had set the country an example; Dublin had her periodical Exhibitions; and annually the Society of Arts exhibited the specimens of manufactures, to the producers of which it had awarded its annual premiums.

The great success of the French Exposition of 1844 would appear to have stimulated the Society of Arts to the means of realizing a National Exhibition for their own country. In June, 1845, a Committee of members of the Society was formed to carry the proposition into effect, and funds were subscribed by this Committee to meet the preliminary expenses; and loans were placed at the disposal of the Council of the Society. "This attempt failed. The public were indifferent; manufacturers, lukewarm—some of the most eminent even

* To Mr. George Wallis, formerly head master of the Manchester School of Design, and his colleague, Mr. George Jackson, and to Mr. Thomas Belshaw, much credit is due for their activity in promoting the Manchester Exhibition of 1845, of which the Art-Union prophetically remarked: "the first pure Exhibition of Industrial Art, exclusively for its own sake, which has ever been held in England, will mark an epoch, not only in the history of Manchester, but also in the history of the empire. The example will not be lost: other Schools (of Design) will, no doubt, be roused to emulation; but the honour of leading the way can never be dissevered from the name of Manchester."

hostile to the proposition. The Committee met neither with sufficient promise of support in money, sufficient public sympathy, nor sufficient co-operation among manufacturers, to see their way to success. The attempt was abandoned. . . . . . The English people were then very imperfectly acquainted with the value of such Exhibitions —their influence on the character as well as the commerce of the nation. They required to be educated for that object; and education had to be provided."* The means to effect this desirable object are then stated as being "premiums for Works of Industrial Art, and Exhibition on a comparatively small scale." Mr. Scott Russell himself placed £50 at the disposal of the Council of the Society of Arts, to be offered in "prizes for a series of Models and Designs of useful objects, calculated to improve general taste;" and it was further proposed, "that they should collect and exhibit Models of the most exquisite Works in Art for the improvement of the taste of Workers and Manufacturers in Metal." Mr. Fothergill Cooke offered £50 in addition to the above; the Society offered £50 more; and, at this point, Mr. Henry Cole was consulted as to the best subjects in Decorative Art for some of these Premiums.† But the progress was slow: in 1846, scarcely any competitors came forward, and the judges could with difficulty find subjects worthy of reward.

The Prince Albert, as President of the Society of Arts, had, of course, been fully informed, from time to time, of their proceedings; and, towards the close of 1846, His Royal Highness urged upon a deputation who waited upon him, that the department "most likely to prove immediately beneficial to the public, was that which encouraged most efficiently the application of the Fine Arts to the various manufactures of the country;" and, added the Prince, after speaking of the excellence and solidity of British manufactures gene-

* "Statement of Proceedings preliminary to the Exhibition of the Industry of all Nations, 1851." By Mr. Scott Russell, late Secretary of the Society of Arts.

† Mr. Henry Cole had already, under the *nom-de-circonstance* of "Felix Summerly," commenced publishing a series of British manufactures, the object of which was to connect the best Art and the best Manufactures, and thereby raise the standard of general design, and of general taste, throughout all classes of the people. The prospectus observed, the mediæval artists—Francesco Francia, Leonardo da Vinci, Raffaelle, Holbein, Albert Durer, and many others, employed themselves in connecting the best Art with objects of utility in every-day use; a revival of the practice was promised. "Manufacturing skill is pre-eminent and abounds; but artistic skill has to be wedded with it." This defect was early observed by the Society of Arts, and by their exhibition of manufactures and distribution of premiums, they have in part attempted the remedy. It is the purpose of this collection to carry out the same object to a still greater extent, and to revive the good old practice of connecting the best Art with familiar objects in daily use. Among the artists who early assisted in this object were Absolon, Bell, Cope, Dyce, Horsley, Maclise, Mulready, Redgrave and Townsend. One new and very beautiful material, Parian, was first extensively applied in the Art manufactures.—*Year-book of Facts*, 1848, p. 8.

Nothing could exceed Mr. Cole's devotion to this object in the Exhibitions of the Society of Arts; and, having closely watched the progress of this kindred movement, we can testify, that, under the sanction of His Royal Highness Prince Albert, through the exertions of Mr. Cole, more than to those of any other individual, did the Great Exhibition become a national desire and a splendid reality.

rally, "to wed mechanical skill with high art is a task worthy of the Society of Arts, and directly in the path of its duty."

In 1847, the Council of the Society established a limited Exhibition of Manufactures, professedly as the beginning of a series. A portion of this collection was appropriated to an archæological illustration of the progress of British pottery and porcelain manufacture, from the reign of Elizabeth to the times of Anne, and George I. to that of Wedgewood. The display of modern manufactures was comparatively small; and the Exhibition was rescued from total failure by two individuals, "who made it a point of personal favour with a few great manufacturers, to be permitted to select from their stores a sufficient number of articles to make a show." Still, the result determined the Council to persevere, and to hold similar Exhibitions annually. "Accordingly, in the next year, the experiment was repeated with such greatly increased success, that the Council felt warranted in announcing their intention of holding annual Exhibitions, as a means of establishing a quinquennial Exhibition of British Industry, to be held in 1851. Having proceeded thus far, the Council sought to connect the Schools of Design, located in the centres of manufacturing industry, with the proposed Exhibitions; and obtained the promised co-operation of the Board of Trade, through the President, Mr. Labouchere. Moreover, with a view to prepare a suitable building, they secured the promise of a site from the Earl of Carlisle, then Chief Commissioner of Woods and Forests, who offered either the quadrangle of Somerset House, or some other Government ground.

PARIS, SOCIETY OF ARTS, AND BIRMINGHAM EXPOSITIONS OF 1849.

In the year 1849, three events proved tributary to the success of the proposed gigantic scheme:—The Paris Exposition of this year was the most comprehensive of the series; the Exhibition of the Society of Arts was of greater excellence than either of its predecessors, the collection consisting chiefly of works in the precious metals, some of which were graciously contributed by Her Majesty, whilst his Royal Highness the President offered two prizes—one for the encouragement of Colonial Manufactures, and the other for improvement in an important Art; and at the close of the session, medals and premiums were awarded to a large number of eminent manufacturers, and for a higher class of works in the department of Art-manufactures than had ever before been conferred. The third auspicious event was the Exposition held this year at Birmingham, contemporaneously with the Meeting of the British Association for the Advancement of Science, and the Musical Festival, in that town. The Birmingham Exposition was a fine assemblage of industrial skill and enterprise: it took place in Bingley House, and a large temporary room in the grounds, together an area of 12,800 feet; it was attended by 100,000 visitors; the receipts for admission were £3076 14*s.*; and it was honoured by Prince Albert with a special visit. Among the more attractive features of the collection were magnificent specimens of electro-plating; brilliant improvements in glass-making, including engraving, enamelling, and cutting, and splendid imitations of gems; applications of papier mâché, artistically painted; the most tasteful brass-working and iron-casting; gun-making in all its stages; the pottery of Stafford and Worcestershire; mechanical novelties of great ingenuity; and rare specimens of revived ecclesiastical furniture and decoration in gold, silver, and brass, and richly-stained glass, a class of appliances most liberally fostered in the restoration of our ancient churches, and in the building of new ones in mediæval taste. It should be added, that this Exhibition was held in the first building erected in England specially for such a purpose.

To aid in carrying out their intention of holding a National Exhibition in 1851, the Council of the Society of Arts next caused a Report on the French Exposition of 1849 to be made for them, and printed, accompanied by a careful record of experience in the practical arrangements of the other Expositions in France, from 1798 to 1849; which work we have already glanced at. A petition was also presented by the Council to the House of Commons, for the use of some public building for the Exhibition of 1851, which was referred to the Select Committee on the School of Design.*

THE PLAN PROPOSED BY THE PRINCE ALBERT.

Immediately after the termination of the Society of Arts' session of 1849, the Prince-President took the subject of the Great Exhibition under his own personal superintendence. "Now is the time," said His Royal Highness, "to prepare for a Great Exhibition—an Exhibition worthy of the greatness of this country; not merely national in its scope and benefits, but comprehensive of the whole world; and I offer myself to the public as their leader, if they are willing to assist in the undertaking."

On June 29, 1849, the general outlines of the Exhibition were examined by His Royal Highness; and, on the following day, at a meeting of several members of the Society of Arts, held at Buckingham Palace, the Prince proposed that the Exhibition should consist of raw materials; machinery and mechanical inventions; manufactures; and sculpture and plastic art generally. Various sites were suggested for the Building, when His Royal Highness pointed out the vacant ground in Hyde Park, on the south side, parallel with, and between, the Kensington drive and the ride commonly called Rotten Row, as affording advantages which few other places might be found to possess. It was at this meeting also that Prince Albert

* We may here state, once for all, that the Government has done little beyond promise for the Great Exhibition; indeed, from the first, they received the plan with "the cold shoulder." Mr. H. Cole, in his Introduction to the *Official Illustrated Catalogue*, remarks: "A great part of the success which has attended the institution of this Exhibition may be attributed to its independence of the Government; and it may be the boast of our countrymen, that the Exhibition was originated, conducted, and completed independently of any Government aid whatever, except its sanction. Assistance has only been sought from the Government when it was indispensable, as in correspondence with foreign countries, the provision of a site for the building, the organization of police, &c.; and, wherever such assistance, when granted, would have entailed expense, the cost of it has been defrayed from the funds of the Exhibition."

gave to the proposed Exhibition that grand feature of universality which has ever since formed the chief characteristic of the plan. The following are the words of the minute-book:—

" It was a question whether this Exhibition should be exclusively limited to British industry. It was considered that, whilst it appears an error to fix any limitations to the productions of machinery, science, and taste, which are of no country, but belong, as a whole, to the civilized world, particular advantage to British industry might be derived from placing it in fair competition with that of other nations."

It was further settled that the best mode of carrying out the execution of these plans would be by means of a Royal Commission, of which His Royal Highness would be at the head; and that a subscription to carry this object into effect be organized immediately.

At the second meeting, held at Osborne, July 14, the Prince stated that he had communicated his views respecting the Exhibition to some of the leading statesmen, and amongst them to Sir Robert Peel. Mr. Labouchere, as President of the Board of Trade, was present at this meeting, on behalf of the Ministry, who could not at once decide on the course they proposed to pursue. At the same time, a general outline of a plan of operations was submitted, which included a proposal of money prizes, the first to be £5000, and one, at least of £1000, to be given in each of the four sections: "Medals conferred by the Queen would very much enhance the value of the prizes." Upon the opening of the subscription list, it was headed by Her Majesty with the munificent gift of £1000; and the Royal President, Prince Albert, contributed £500. On July 31, His Royal Highness addressed a letter to the Home Secretary, to bring the subject officially to the notice of Her Majesty's Government; and Sir George Grey promised early consideration of the subject. Meanwhile, it was necessary to place the accomplishment of the undertaking, as far as possible, beyond doubt.

The proposed building for the Exhibition, and preliminary expenses, were estimated at the least at £70,000. After much fruitless negotiation with several builders and contractors, an agreement was made between the Society of Arts and Messrs. Munday, by which the latter undertook to deposit £20,000 as a prize fund, to erect a suitable building, to find offices, to advance the money for preliminary expenses, and to take the whole risk of loss on certain conditions. This contract was made August 23, 1849: the sum of £500 was immediately advanced by the contractors towards the necessary preliminary expenses; and the sum of £20,000 was subsequently paid. The deeds of contract were not, however, signed until the 7th of November following. In the interval, a most important addition was made to the agreement, upon the suggestion of Mr. H. Cole, providing that if the Treasury were willing to take the place of the contractors, and pay the liabilities incurred, the Society of Arts should have the power of determining the contract before February, 1850; in which case, compensation, to be settled by arbitration, should be paid to the Messrs. Munday.

To ascertain the readiness of the public to promote the Exhibition the Prince Albert, as President of the Society of Arts, next commissioned several members of the Society, in the autumn of 1849, to proceed to the manufacturing districts of the country, in order to collect the opinions of the leading manufacturers. Accordingly, sixty-five of the most important cities and towns of the kingdom were visited, public meetings held, and local committees formed in them, when nearly 5000 persons registered themselves as promoters of the proposed Exhibition.

Foremost among these demonstrations, was the great and influential meeting held October 17, 1849, in the Egyptian Hall, at the Mansion House, under the presidency of the Lord Mayor; at which Mr. Henry Cole, expressly deputed by Prince Albert to explain his views, addressed the meeting with excellent effect. The example of the City of London was soon followed in Westminster, where the good cause was greatly aided by an eloquent address by the Bishop of Oxford, which was subsequently printed, under the title of "The Dignity of Labour," and circulated to the extent of many thousands.

THE ROYAL COMMISSION.

Upon the presentation of the Reports of the above meetings to Her Majesty's Government, the Queen was pleased to issue a Commission, appointing Prince Albert, the Duke of Buccleuch, Earl of Rosse, Earl Granville, Earl of Ellesmere, Lord Stanley, Lord John Russell, Sir Robert Peel, Mr. H. Labouchere, and Mr. W. E. Gladstone; Sir A. Galloway, Chairman of the East India Company,* or the Chairman of the East India Company for the time being; Sir Richard Westmacott; Sir Charles Lyell, President of the Geological Society,† or the President of the Geological Society for the time being; Mr. Thomas Baring, Mr. C. Barry, Mr. T. Bazley, Mr. R. Cobden; Mr. William Cubitt, President of the Institution of Civil Engineers, or the President of the Institution of Civil Engineers for the time being; Mr. Eastlake,‡ Mr. T. F. Gibson, Mr. John Gott, Mr. Samuel Jones Loyd,§ Mr. Philip Pusey, and Mr. William Thompson, "to make full and diligent inquiry,—into the best mode by which the production of our colonies and of foreign countries may be introduced into our kingdom; as respects the most suitable site for the said Exhibition; the general conduct of the said Exhibition; and also into the best mode of determining the nature of the prizes, and of securing the most impartial distribution of them." Mr. John Scott Russell and Mr. Stafford Northcote‖ to be joint secretaries. Mr. Henry Cole, Mr. C. W. Dilke, Mr. G. Drew, Mr. F. Fuller, and Mr. Robert Stephenson to be the Executive Committee; and Mr. M. Digby Wyatt their secretary.

On January 3, 1850, the national sanction was conferred on the

* At his death, in 1850, he was succeeded by Mr. John Shepherd.

† Succeeded by Mr. William Hopkins, M.A., though Sir Charles Lyell still remains a Commissioner by election under the Royal Charter, afterwards granted.

‡ Now Sir C. L. Eastlake, President of the Royal Academy.

§ Now Baron Overstone.

‖ Now Sir Stafford H. Northcote, bart.

undertaking, by the sign manual of the sovereign; a Queen's messenger being specially despatched to obtain her Majesty's autograph, so as to secure the publication of the Commission in the *Gazette* of the next day.

Mr. Robert Stephenson, who had been gazetted as member of the Executive Committee, and appointed its chairman, was subsequently added to the Royal Commission; and the chairmanship of the Executive Committee was filled up by Lieut.-Col. Reid, R.E.

At the first meeting of the Commissioners, held January 11, 1850, availing themselves of the reserve clause in the agreement with Messrs. Munday, the Treasury undertook the liabilities, though not without taking a guarantee from the Commissioners themselves, with whom the whole of the responsibilities thus rested; and the outlay which the Messrs. Munday had made (about £23,000), with the interest which had accrued, was repaid to them.* The Commissioners now appealed to the country for subscriptions to carry out

* The compensation alluded to at page 17, was subsequently referred; and in July, 1851, an award was made by Mr. Robert Stephenson of the sum due to the Messrs. Munday for the determination of the contract. Of this award, the following is the operative part:

Now, know ye that I, the said Robert Stephenson, having taken upon me the burthen of the said reference, and having duly and in accordance with the powers and provisions of the said first-mentioned indenture, enlarged the time for making my award until the first day of September, one thousand eight hundred and fifty-one; and having been attended by the counsel and agents of the said parties respectively; and having heard and considered the several statements, allegations, and evidence made, tendered, and given before me on the matters so referred to me; and having also taken into consideration all the circumstances which I was required to take into consideration, do make this my award of and concerning the said matters so referred to me as follows; I award and determine that the amount of compensation to be made and paid to the said James Munday and George Munday, for the outlay, risk, liability, anxiety, trouble, and loss which they have incurred in the matter aforesaid, and in relation thereto, and on account of the said agreement being determined and put an end to, is the sum of five thousand one hundred and twenty pounds. And I further award and determine, that all the costs, charges, and expenses of and attending, and in anywise relating to this reference and arbitration, shall be borne and paid by the said Society; and that the costs, charges, and expenses of the said James Munday and George Munday therein, and in relation thereto, which I have settled and ascertained at the sum of five hundred and eighty-seven pounds one shilling and fourpence, shall be reimbursed and paid to them by the said Society, within ten days after notice to the said Society of this my award. And I declare, that I make no claim or charge for any compensation to me for my trouble in the matter of this reference; but, inasmuch as I have incurred certain charges and expenses in the payment of fees and compensation to counsel and other persons whose advice and aid I have required in the premises, the amount of which is not included in the said sum of five hundred and eighty-seven pounds one shilling and fourpence, I order and direct, that the amount of such last-mentioned fees and compensation, and the costs and expenses of this my award, shall be borne by the said Society; and that, if the said James Munday and George Munday shall pay the same, on taking up this award, the same shall be repaid to them by the said Society within the period last aforesaid. In witness whereof, I have hereunto set my hand and seal this twenty-first day of July, one thousand eight hundred and fifty-one.

Signed, sealed, and delivered by the said Robert Stephenson, in the presence of W. Meyrick, 16, Parliament-street. ROB. STEPHENSON.

the Exhibition: on January 25, they had reached beyond £10,000, and by April 22, 1850, the amount was £64,344.

CIVIC BANQUET IN AID OF THE PLAN.

We have next to chronicle a splendid festal event in the City of London, which greatly facilitated the labours of the Assistant Commissioners. To concentrate the high feeling for the national honour, felt to be bound up with the fortunes of the Exhibition, the Lord Mayor invited the municipal authorities of the United Kingdom to a banquet at the Mansion House, to meet Prince Albert, as President of the Royal Commission. For this measure of patriotic feeling and good sense, the Lord Mayor (Farncomb) must ever be gratefully remembered as one of the prime contributors to the *éclat* of the Exhibition. Never was the Great Hall of the Mansion House devoted to a nobler festival than to this entertainment of March 21, 1850; when, in responding to the toast, "Success to the Exhibition of 1851," Prince Albert declared his views in these terms, characterized by Lord Stanley as "the most truthful, the most able, the most feeling, the most religious, and the most eloquent statement."

"It must," said his Royal Highness, "be most gratifying to me to find that a suggestion which I had thrown out, as appearing to me of importance at this time, should have met with such universal concurrence and approbation; for this has proved to me that the view I took of the peculiar character and requirements of our age, was in accordance with the feelings and opinions of the country. Gentlemen, I conceive it to be the duty of every educated person closely to watch and study the time in which he lives, and, as far as in him lies, to add his humble mite of individual exertion to further the accomplishment of what he believes Providence to have ordained. Nobody, however, who has paid any attention to the particular features of our present era, will doubt for a moment that we are living at a period of most wonderful transition, which tends rapidly to accomplish that great end—to which indeed all history points—the realization of the unity of mankind; not a unity which breaks down the limits and levels the peculiar characteristics of the different nations of the earth, but rather a unity the result and product of those very national varieties and antagonistic qualities. The distances which separated the different nations and parts of the globe are gradually vanishing before the achievements of modern invention, and we can traverse them with incredible speed; the languages of all nations are known, and their acquirement placed within the reach of everybody; thought is communicated with the rapidity, and even by the power, of lightning. On the other hand, the great principle of the division of labour, which may be called the moving power of civilization, is being extended to all branches of science, industry, and art. Whilst formerly the greatest mental energies strove at universal knowledge, and that knowledge was confined to the few, now they are directed to specialities, and in these again even to the minutest points. But the knowledge acquired becomes at once the property of the community at large; whilst, formerly, discovery was wrapt in secrecy, it results from the publicity of the present day that no sooner is a discovery or invention made than it is already improved upon and surpassed by competing efforts. The products of all quarters of the globe are placed at our disposal, and we have only to choose which is the best and cheapest for our purposes, and the powers of production are entrusted to the stimulus of competition and capital. So man is approaching a more complete fulfilment of that great and sacred mission which he has to perform in this world. His reason being created after the image of God, he has to use it to discover the laws by which the Almighty governs his creation, and, by making these laws his standard of action, to conquer nature to his use—himself a divine instrument. Science discovers these laws of power, motion, and transformation: Industry applies them to the raw matter, which the earth yields us in abundance, which becomes only valuable by know-

ledge: Art teaches us the immutable laws of beauty and symmetry, and gives to our productions forms in accordance with them. Gentlemen,—THE EXHIBITION of 1851 is to give us a true test and a living picture of the point of development at which the whole of mankind has arrived in this great task, and a new starting point from which all nations will be able to direct their further exertions. I confidently hope the first impression which the view of this vast collection will produce upon the spectator will be, that of deep thankfulness to the Almighty, for the blessings which He has bestowed upon us already here below; the second, the conviction that they can only be realized in proportion to the help which we are prepared to render each other—therefore, only by peace, love, and ready assistance, not only between individuals, but between the nations of the earth. * * * * * Gentlemen, my original plan had been to carry out this undertaking with the help of the Society of Arts of London, which had long and usefully laboured in this direction, and by the means of private capital and enterprise. You have wished it otherwise, and declared that it was a work which the British people as a whole ought to undertake. I at once yielded to your wish, feeling that it proceeded from a patriotic, noble, and generous spirit. On your courage, perseverance, and liberality, the undertaking now entirely depends! I feel the strongest confidence in these qualities of the British people, and am sure that they will repose confidence in themselves--confidence that they will honourably sustain the contest of emulation, and will nobly carry out their proffered hospitality to their foreign competitors. We, Her Majesty's Commissioners, are quite alive to the innumerable difficulties which we have to overcome in carrying out the scheme; but having confidence in you, and in our own zeal and perseverance, at least, we require only your confidence to make us contemplate the result without any apprehension."

PROGRESS OF THE SUBSCRIPTION.

On the day after the banquet, about sixty of the Mayors met Earl Granville, Sir Robert Peel, Mr. Cobden, and other Commissioners, at Westminster, when was discussed the best mode of action between the Royal Commission and the Local Committees; the selection of the articles to be exhibited; the jealousy lest one manufacturer should know what another was doing, &c.; when the latter difficulty was remedied by a suggestion from Sir Robert Peel, that the Local Committees should forward to each manufacturer a form of return, in which, without revealing details, he should state, if possible, the space he would wish to have. At this meeting, also, the preference of subscription to Government aid was strongly insisted on; more emphatically by Mr. Cobden, who declared that if he thought his countrymen would beg one shilling of the House of Commons, he would not sit one hour longer on the Commission.

In appealing to the country for subscriptions to carry out the Exhibition, the Commissioners explained that the scale upon which this important undertaking would be conducted, must depend entirely on the amount of pecuniary support which it should receive from the public, who were urged to enable the Commissioners to make arrangements worthy of the character and position of this country, and of the invitation which had been given to the other nations of the world to compete with us in a spirit of generous and friendly emulation.

"It was announced that the amount of the funds which the public might place at the disposal of the Commissioners must determine the extent of the accommodation which could be provided for the Exhibition; and that should any surplus remain, after giving every facility to the exhibitors, and increasing the privilege of the public as spectators, Her Majesty's Commissioners intended to apply the same to purposes strictly in connexion with the ends of the Exhibition, or for the establishment of similar Exhibitions for the future."*

The direct control over the expenditure, subject to the approval of the Commissioners, was then entrusted to a Finance Committee, of which Lord Granville was appointed chairman, and Mr. E. A. Bowring, secretary; whilst Assistant Commissary-General Carpenter, as the financial officer, administered the actual expenditure of the Commissioners.

The proposition now daily grew in favour with the public, but the subscriptions as yet fell far short of the vastness of the undertaking: when it became necessary to make positive arrangements for the erection of the building, the actual receipts were only £35,000, not half the estimated cost. The Royal Commissioners were liable for every pecuniary engagement; from which, however, they were relieved by a Charter of Incorporation, and the formation of a Guarantee Fund. The latter insured both the completion of the undertaking, and the House of Commons from the liability of being required to make any grant of the national funds towards it. Thus the sum of £230,000 was raised by the majority of the Commissioners, and some other friends of the Exhibition; one of the former (Mr. Peto) heading the list with a subscription of £50,000; and, upon the security of this fund, the Bank of England consented to make the requisite advances of money.

PRINCIPLES OF THE EXHIBITION.

The general principles of the Exhibition (as recited in the Commission), were formally announced in February, 1850, so that there was a full year for preparation. It was declared that the productions of all nations would be admitted, and classified lists of objects were prepared by committees of eminent persons in each department, and published, to show the nature of the contributions which Exhibitors were invited to send, in the four departments of Raw Materials and Produce, Machinery, Manufactures, and Fine Arts. It was declared: "Nothing is suitable for the Exhibition, except such results of human industry as are capable of being preserved without injury during many months."

In the Fourth Section (Sculpture, Models, and the Plastic Arts), the following were the limitations:—

"Objects formed in any kind of material, if they exhibit such a degree of taste and skill as to come under the denomination of *Fine Arts*, may be admitted into this section.

"The specimens exhibited shall be works of living artists, or works of artists deceased within three years before Jan. 1, 1850.

"Oil paintings and water-colour paintings, frescoes, drawings, and engravings, are not to be admitted, except as illustrations and examples of materials and processes; and portrait busts are not to be admitted.

"No single artist will be allowed to exhibit more than three works."

* Introduction to the Official Illustrated Catalogue, p. 13.

It was also announced that the 1st day of May, 1851, was fixed for opening the Exhibition; that Her Majesty had granted a site for the Building, on the south side of Hyde Park; and that Exhibitors would be required to deliver their articles at their own charge and risk at the Building, which would be provided for them free from rent.

Prices were not to be affixed to the articles, which, however, might be marked as shown for economy of production; the price to be stated in an invoice for the information of the Juries.

Although it was proposed that the expenses of the Building and the Management should be defrayed by voluntary subscriptions, the receipt of any subscription from any foreigner, resident at home or abroad, was strongly discouraged. The admission of British articles was to be entirely controlled by the Commissioners; but the power of admitting Foreign articles was confided absolutely to an authority of the country whence they were sent.

In order to give Foreign countries the utmost time, long before the size of the Building had been determined, the Commissioners divided among all foreign exhibitors, a space amounting in the whole to above 210,000 superficial feet, or rather more than the entire area which France occupied for its two Expositions of 1844 and 1849. It was estimated that this amount would be about the size of the Building. Subsequently, the amounts placed at the disposal of foreign countries were increased in several instances. France, for example, obtained upwards of 65,000 superficial feet of exhibiting space, instead of only 50,000 feet.

Commissioners were nominated in each country, consisting of the most distinguished men in science, arts, and manufactures; the governments of the respective countries undertaking the gratuitous charge of the transport of all articles free of duty, either import or export, or any fiscal expense, from the place of their transport from or return thereto. Direct correspondence with individual exhibitors would have been too multitudinous to be practicable: central authorities, therefore, became indispensable; and the following instructions, transmitted with the allotment of space, sent to each foreign country and colony, worked well:—

"No articles of foreign manufacture, to whomsoever they may belong, or wheresoever they may be, can be admitted for exhibition, unless they come with the sanction of the Central Authority* of the country of which they are the produce. Her Majesty's Commissioners will communicate to such Central Authority the amount of space which can be allowed to the productions of the country for which it acts, and will also state the conditions and limitations which may from time to time be decided on with respect to the admission of articles. All articles forwarded by such Central Authority will then be admitted, provided they do not require a greater aggregate amount of space than that assigned to the productions of the country from which they come; and provided also, that they do not violate the general conditions and limitations. It will rest with the Central Authority in each country to decide upon the merits of the

* Stated to be so by the Government of the country. The above instructions strikingly illustrate the liberal spirit of the scheme.

several articles presented for exhibition, and to take care that those which are sent are such as fairly represent the industry of their fellow-countrymen."

A definite space (51,025 superficial feet) was, in like manner, offered to each of the British colonies, subject to the same rules for admission.

Colonial and Foreign productions were to be admitted, for Exhibition, without payment of duty, the building of the Exhibition being considered as a bonded warehouse.

The *self-supporting principle* of the plan is best shown in its spontaneous organization. The employment of the municipal councils throughout the country for this purpose would have been a well-graced revival of the functions of the mediæval guild: but this was found impracticable; and an independent management was appointed wherever a locality was disposed to form its own Local Committee. Before the issue of the Royal Commission, about 65 Local Committees had been formed, with the assistance of the Members of the Society of Arts, nominated by the President to visit the principal towns: subsequently, the mayors assisted in completing this system of Committees, whose functions consisted chiefly in recommending Local Commissioners, collecting subscriptions, encouraging the production of suitable objects, and facilitating the means of visiting the Exhibition. Upon the local knowledge and discretion of these Committees the Commissioners also relied for the rejection and selection of objects, their number, and character; and for communicating with these local bodies, Dr. Lyon Playfair and Lieutenant-Colonel Lloyd were appointed Special Commissioners. Exhibitors were not compelled to subscribe to the fund; but to give notice of their intention to exhibit, generally describe the articles, and the space required; such returns to be scrutinized by the Local Committee, and transmitted to the Commission before October 31, 1850. Upwards of 330 of these committees were formed in the three parts of the United Kingdom and the Channel Isles; and the importance of their labours is denoted by the necessity of intending Exhibitors obtaining the certificate of the nearest Local Committee, in approval of the articles sent for exhibition, before they could be received by the Commissioners in the building. Appeals against the decisions of the Local Committees were allowable, but were few; and to their discretion was left the allotment of space to each Exhibitor, as well as the reduction of demands, which originally exceeded the possible allowance. The first demands for horizontal (floor and counter) space in the Building exceeded 417,000 superficial feet, being about 210,000 feet more than the available space for the United Kingdom. The vertical, or wall space, demanded was only 200,000 superficial feet; the number of proposing Exhibitors upwards of 8200. The revised applications, when returned by the Committees, were tantamount to their unqualified approbation of the articles, as well as vouchers for their admission. In the metropolis, the rejection and selection of articles were decided by a united action of all the several committees; each Committee nominating Commissioners to represent a particular department of the Exhibition. By the above means, the articles of British Exhibitors were subjected to a preliminary judgment, which kept out many unsuitable contributions, and thus materially guaranteed the character of the Exhibition.

CIVIC BANQUET AT YORK.

The assistance of the Local Committees can scarcely be over-rated, in estimating the means by which the Exhibition has proved so eminently successful. The well-working of this part of the system was strikingly testified at a splendid banquet given at York, on October 25, to the Lord Mayor of London, in return for the magnificent entertainment at the Mansion House, on March 21. At the York festival, Prince Albert was also present; and the company included nearly one hundred mayors and heads of boroughs; the Lord Mayor of York filling the chair. The fine old Guildhall was characteristically decorated for the occasion, the symbols of the Houses of York and Lancaster, the red and white rose, not being forgotten. There was likewise a display of ancient maces and swords of state; the tables glittered with curious and costly plate; and the picturesqueness of the baronial building was heightened by the banners of the several cities and boroughs represented, and suspended from the roof and arcades. Some of these had been borne in battles of yore; but

> "Our armours now may rust, our idle scimitars
> Hang by our sides for ornament, not use;
> Children shall beat our atabals and drums;
> And all the noisy trades of war no more
> Shall wake the peaceful morn."—DRYDEN.

It is important to quote the speech of Prince Albert, in returning thanks for his health being drunk, especially as His Royal Highness glances at the prospects of the Exhibition. The Prince, having acknowledged the toast, observed—

"It was an idea honourable at once to the liberality and the discernment of the Lord Mayor of London, to invite you to assemble under his hospitable roof, before you started in the important undertaking upon which you were about to enter; when, according to ancient custom, the loving-cup went round, it was a pledge you gave each other that, whatever the rivalries of your different localities might be, you would in the approaching contest all act and appear as one, representing your country at the gathering of the products of the nations of the earth.

"I see, likewise, in your anxiety to meet us, Her Majesty's Commissioners, again, a proof of your earnest and continued zeal in the cause of the approaching Exhibition: it could not be by the impetus of a momentary enthusiasm, but only by a steady perseverance and sustained efforts, that you could hope to carry out your great undertaking, and ensure for yourselves and the nation an honourable position in the comparison which you have invited. If, to cheer you on in your labours, by no means terminated, you should require an assurance that that spirit of activity and perseverance is abroad in the country—I can give you that assurance, on the ground of the information which reaches us from all quarters, and I can add to it our personal conviction that the works in preparation will be such as to dispel any apprehension for the position which British industry will maintain. From abroad, also, all accounts which we receive lead us to expect that the works to be sent will be numerous, and of a superior character. Although we perceive, in some countries, an apprehension that the advantages to be derived from the Exhibition will be mainly reaped by England, and a consequent distrust in the effects of our scheme upon their own interests, we must, at the same time, freely and gratefully acknowledge that our invitation has been received by all nations with whom communication was possible, in that spirit of liberality and friendship in which it was tendered, and that they are making great exertions and incurring great expenses to meet our plans. Of our doings at the Commission I should have preferred to remain silent; but I cannot let this opportunity pass without telling you how much benefit we have derived in our difficult labours from your uninterrupted confidence in the intentions, at least, which guided our decisions; and that there has been no difference of opinion on any one subject between us and the Local Committees, which has not, upon personal consultation, and after open explanation and discussion, vanished and given way to agreement and identity of purpose." After paying a noble tribute to the memory of Sir Robert Peel, and to the essentially practical nature of the English character, His Royal Highness concluded by saying: "Taking this view of the character of our country, I was pleased when I saw the plan of the Exhibition of 1851 undergo its ordeal of doubt, discussion, and even opposition; and I hope that I may now gather from the energy and earnestness with which its execution is pursued, that the nation is convinced that it accords with its interests, and the position which England has taken in the world."

THE PRIZES.

Although the system of Money Prizes to Exhibitors had been relinquished as too costly, except in special cases, the Commissioners resolved to reward the genius of the Candidates by the bestowal of a larger number of honorary distinctions. For this purpose they proposed to substitute Prize Medals, which should be valuable as works of art of high class, besides serving as records of the Exhibition. They preferred bronze for the material in which these Medals were to be executed; considering it to be better calculated than any other for the development of superior skill in the medallic art; and, at the same time, the most likely to constitute a lasting memorial of the Exhibition.

Accordingly, on March 23, the artists of all countries were invited by advertisement to compete for designs for the reverses of three bronze Medals, illustrative of the objects of the Exhibition, and appropriate as the reward of successful competition; three prizes of £100 each being offered for the most meritorious designs. Three prizes of £50 each were also to be awarded for the three best designs which were not accepted; the Commissioners reserving to themselves the making of the arrangements for executing the Medals. One hundred and twenty-nine designs were sent in, and were publicly exhibited in the rooms of the Society of Arts. The Commissioners appointed the following gentlemen to act as a Committee for selecting the best designs:—Lord Colborne, Mr. Dyce, R.A., Mr. Gibson, R.A., M. Eugène Lami, Mr. C. Newton, of the British Museum; Herr J. D. Passavant, and Dr. Gustave Waagen; who, on the 29th of June, reported to the Commissioners that they had selected the following:—

No. 1.	Mons. Hippolyte Bonnardel,	of Paris,	£100 each.
2.	Mr. Leonard C. Wyon .	of London,	
3.	Mr. G. G. Adams . . .	of London,	
4.	Mr. John Hancock . .	of London,	£50 each.
5.	Mons. L. Wiener . . .	of Brussels,	
6.	Mons. Gayrard	of Paris,	

1. *M. Bonnardel's design* shows Mercury holding a female figure by the hand (apparently intended to represent Industry, from the anvil, locomotive, &c. near her), in front of a figure of Britannia, standing on a slightly raised platform, with both hands extended, holding wreaths: flags of different nations make up the background. *Motto*: "*Est etiam in magno quædam respublica mundo.*"

2. *Mr. Wyon's design*—Britannia, seated, is placing with one hand a laurel wreath on the head of an emblematical figure of Industry; and leading her forth with the right hand. Behind are representations of the four quarters of the world, who have brought Industry to Britannia. To the right are emblems of the four sections:—1, The cotton plant and wheatsheaf; 2, a wheel; 3, a bale of goods; 4, a vase. Motto: "Dissociata locis concordi pace ligavit."

3. *Mr. G. G. Adams's design* is a gracefully-modelled group, in low relief, of Fame, Industry, and Commerce. Motto: "Artificis tacitæ quod meruere manus."

4. *Mr. Hancock's design* consists of Britannia, with Wisdom on one side and Justice on the other, holding a wreath towards Painting, Sculpture, and Science.

5. *M. Wiener's design* is a crowded composition, representing the various nations of the world bringing produce to Britain.

6. *M. Gayrard's design* is a well-drawn single figure of Britannia, occupying the whole field of the medal; with a shield in one hand and a palm-branch in the other.

The Commissioners intimated the general principles of the award of prizes to be as follow:—

In Raw Materials and Produce, the value and importance of the article, and the superior excellence of the specimens; and in prepared materials, the novelty and importance, and skill and ingenuity in the preparation.

In Machinery, novelty in the invention, superiority in the execution, increased efficiency or increased economy in the use of the article exhibited, as well as the importance, in a social or other point of view, of the purposes to which the article is to be applied; the difficulties overcome in bringing the invention to perfection.

In Manufactures, increased usefulness, such as permanency in dyes, improved forms and arrangements in articles of utility, &c. Superior quality, or superior skill in workmanship. New use of known materials. Use of new materials. New combinations of materials, as in metals and pottery. Beauty of design in form, or colour, or both, with reference to utility. Cheapness, relatively to excellence of production.

In Sculpture, Models, and the Plastic Art: beauty and originality of the specimens exhibited, improvements in the processes of production, the application of art to manufactures, and, in models, to the interest of the subject.

THE GREAT EXHIBITION BUILDING:

ITS ORIGIN AND CONSTRUCTION.

"I dreamt I was
Within *a temple made of glass*."—CHAUCER.

THE most felicitous illustration of the success of the Great Exhibition is to be found in the Building itself, its graceful splendour, and the novelty of its constructive details. Its originality is scarcely surpassed by either of the masterly specimens of applied science which this "Palace of Glass" enshrines; and its realization shows the vast resources of the age, and its capabilities, in a higher view than any proof of industrial skill which it contains. The history of invention abounds with instances of the fortuitous application of industry and skill; but it would be difficult to find any example so completely characteristic of the time which gave it birth, as the construction of the Crystal Palace. It is alike indicative of the present industrial position of England, and the leading characteristics of her people, both personal and social; while it presents evidence of the extent of our national resources in the production of Raw Material, Machinery, Manufactures, and objects of Fine Art; as well as the organization of labour and co-operation in supply, developed by our great engineering works; and the combination and division of labour necessary to carry them out. The several steps in this interesting record of enterprise are worth tracing.

THE SITE FOR THE BUILDING.

First, of the site. As early as January, 1850, the Commission named a Committee "for all matters relating to the Building," consisting of the Duke of Buccleuch, and the Earl of Ellesmere, and three leading architects, Mr. Barry, R.A., Mr. Cockerell, R.A., and Mr. Donaldson; three leading engineers, Mr. W. Cubitt, Pres. Inst. C.E., Mr. Stephenson, and Mr. Brunel; the Duke of Buccleuch being skilled in engineering, and the Earl of Ellesmere a judicious and munificent patron of the Fine Arts. Mr. Cubitt was elected Chairman of this Committee, who, on Feb. 21, reported favourably on the fitness of the present site for the Building, originally proposed for it by Prince Albert, on June 30, 1849, and for the use of which her Majesty's permission had been obtained. It consists of a rectangular slip of ground, upon the south side of Hyde Park, situated between the Queen's Drive and Rotten Row, and contains about 26 acres; being approximately 2300 feet in length, by 500 feet in breadth. Its principal frontage extends from east to west, facing Prince's Gate.

THE FIRST BUILDING PROPOSED.

The Committee having advertised for plans, upwards of 245 designs and specifications were submitted: of these, 38 were to be contributed by foreigners; France sending 27; Belgium, 2; Holland, 3; Hanover, 1; Naples, 1; Switzerland, 2; Rhein Prussia, 1; Hamburg, 1; 128 by residents in London and its environs; 51 by residents in provincial towns of England; 6 by residents in Scotland; 3 by residents in Ireland; and 7 were anonymous. All these plans were publicly exhibited for a month, at the Institution of Civil Engineers, Great George Street, Westminster. After several meetings, the Committee selected some 68 plans, which they considered entitled to honorary distinction, though there was no single plan which they could recommend for adoption. Founded upon the plans of which they most approved (that from which most advantage was derived being the work of a young architect at Islington), the Committee themselves composed a design; and, assisted by Mr. Digby Wyatt, Mr. C. H. Wild, and Mr. Owen Jones, they prepared working drawings, which were lithographed: the building was to be open; to be formed into three main divisions (with side branches) by iron (water-pipe) columns, the middle aisle being the loftiest; the side walks to be comparatively low, and the clumps of trees included within the area made available for refreshment places. But the great and startling feature was to be a central dome, more than 150 feet high, and 200 feet in diameter; or 11 feet in diameter more than the cupola of St. Peter's at Rome, and 45 more than that of St. Paul's, London; this novelty in construction being the suggestion of Mr. Brunel. In plan, the building was more than four times the length of either Westminster Abbey, St Paul's Cathedral, or York Minster, at the transepts; it being above 2200 feet long and 450 feet in width. The roof and dome were to have been of iron, and not less than fifteen millions of bricks were to have been used in the construction of the walls.*

Whilst the merits of this design were being fiercely controverted in all directions, much querulous correspondence arose in the daily journals, as to the injury which, it was asserted, would be done to the Park by the erection of the building, and the enormous amount of traffic which it would bring there; at the same time, it was

* One of the earliest plans, if not the earliest plan, was that submitted by Mr. Turner, of Dublin, who constructed the new palm-stove in Kew Gardens; and, in conjunction with his son, Mr. T. Turner, prepared a model of a structure of iron and glass for the 1851 Exhibition. A plan and elevation of the design showed that it was to occupy an area 1440 feet long, and 1060 feet deep. The main building, in truth an enormous greenhouse, 1020 feet long, had five domes of iron and glass; the central one 200 feet high to the crown, the others 150 feet high! Covered ways surrounded the whole, and railways were provided, as well to convey the visitors from one end to the other, as the objects of manufacture to their standing places. Two steam-engines were to give life to the machinery, and at the same time drive in an ample supply of fresh air. The projector's idea was, that it should be erected *permanently* in the Green Park, by a Joint-stock Company, who would let it for the Exhibition, and at other times use it for monster concerts, "winter garden," &c. The cost was estimated at £300,000.

objected, that the public would be thus deprived of a large strip of the Park, and some of the trees must be removed.

This outcry was increased by the objectionable design for a huge brick-and-mortar edifice, the very materials of which were indicative of its existence beyond the year of the Exhibition: in addition to this, the design itself scarcely found a single admirer; and the propriety of *such a building upon such a site* was much disputed, whilst the residents in the neighbourhood raised special objections, and the subject was brought before both Houses of Parliament: in the House of Commons, on July 4, 1850, two divisions took place on the question, whether the proposed site should be used at all for any building for the Exhibition: in one division, the numbers in favour of the site were 166 to 47; and, in the second, 166 to 46. The practicability of the Exhibition was, however, still jeopardized by the objectionable *composite* design of the Building Committee, when there came to the rescue a bright emanation of genius just in the very point of time to save the entire scheme—

"A nicking more than half the bus'ness."

MR. PAXTON'S IMPROVEMENTS IN HORTICULTURAL BUILDINGS.

Among the practical men to whom the above design appeared objectionable was Mr. Paxton, the celebrated horticulturist of the Duke of Devonshire's princely seat of Chatsworth. Mr. Paxton had already effected many improvements in horticultural buildings, by discarding, as much as possible, all ponderous and opaque materials in their construction. He pared away all clumsy sash-bars, whose broad shadows robbed plants of the sun's light and heat during the best parts of the day; he abolished dirty and leaking overlaps, by using large panes, and inserting them in wooden grooves, rendered water-tight by a sparing use of putty. Again, in plain lean-to or shed-roofs, the morning and evening sun presents its direct rays at a low angle, and consequently very obliquely to the glass. At those periods, most of the rays of light and heat are obstructed by the position of the glass and heavy rafters; it therefore became evident that, by placing the glass more at right angles to the morning and evening rays of the sun, would be removed the obstructions to rays of light entering the house at an early and late hour of the day. This led to the adoption of "the ridge and furrow" principle for glass roofs, which so places the glass that the rays of light in mornings and evenings enter the house without obstruction, and present themselves more perpendicular to the glass when they are the *least* powerful; whereas at mid-day, when they are *most* powerful, they present themselves more obliquely to the glass. Upon this principle, Mr. Paxton constructed a pine-house in 1833, as an experiment, which continues in successful use to this day.

In commencing the Great Conversatory at Chatsworth, in 1837, it became desirable to abridge the great amount of manual labour that would be required in making the sash-bars for so large a structure. The only apparatus Mr. Paxton could find in the great workshops of London, Manchester, and Birmingham, was a grooving machine, which he at once connected with a steam-engine at Chatsworth, and which was subsequently so improved as to make the sash-bar complete. For this apparatus, the Society of Arts, in April, 1841, awarded him a medal; and from this all the sash-bar machines in use throughout the country at the present time are taken. Its peculiar working feature is, that the bar is presented to the saws below the centre of motion, instead of above it, (as is usual,) and to the sides of the saw which are ascending from the table, instead of those which are descending; this arrangement being necessary to suit the direction of the teeth to the grain of the wood. It is essential that the machine revolve 1200 times in a minute, to finish the work in a proper manner.

THE VICTORIA REGIA HOUSE AT CHATSWORTH.

It next became a question of importance how far an extensive structure might be covered in with *flat* ridge and furrow roofs, that is, the ridge-and-valley rafters placed on a level, instead of at an inclination, as in a large green-house built in 1834, after the experimental pine-house; or curvilinear, as in the Great Conservatory. Mr. Paxton prepared some plans for an erection with a flat ridge-and-furrow roof, about eleven years since, but the design was abandoned for a time, though subsequently tried with success in a conservatory attached to a villa in Darley Vale, near Matlock; and in 1848, in an ornamental glass covering for the conservative wall at Chatsworth. Neither of these structures was, however, the immediate progenitor of the Great Exhibition Building; this being a conservatory built for that Titanic water-lily of the Flora of South America—the Victoria Regia; "by a curious apposition, the first parent of the most extensive building in Europe, being the largest known floral structure in the world." This was the new Victoria Regia House built at Chatsworth, by Mr. Paxton: it is sixty feet six inches in length, and forty-six feet nine inches in breadth; and although, when compared with the Great Exhibition Building, the Lily-house is a very diminutive structure, yet the principle on which it is constructed is the same, and may be carried to an almost unlimited extent.* "The Victoria House, however, was so built as to retain as

* The Victoria Regia, or Royal Water Lily, has a very interesting association with the Palace of Glass in Hyde Park; since, it was in constructing rapidly a house for this beautiful aquatic that Mr. Paxton devised the principle of those plans, which he afterwards applied so successfully to the design of the gigantic building for the Exhibition of the Industry of all Nations.—(*Athenæum, No.* 1239.)

Notices of the earliest discovery of this plant appeared in the *Year-Book of Facts*, 1850, page 247; and it had been previously engraved as the frontispiece to the *Arcana of Science*, 1838; from specimens found by Sir Richard Schomburgk in the river Berbice, in British Guiana Seeds and roots were then brought to England, but for no purpose; the seeds would not grow, and the stems were decayed. Next, Dr. Hugh Rodie, and Mr. Lochie, of George Town, Demarara, sent some seeds in bottles of pure water to Sir W. J. Hooker, at the Royal Gardens at Kew. Here, soon after their arrival, in February, 1849, they gave signs of active vitality; and young plants were forwarded to Chatsworth and Sion. Though these were all at first received at Kew, those retained there much moisture and heat as possible, and yet to afford a strong and bright light at all seasons; whilst, on the contrary, the Industrial Building, being intended to accommodate a daily assemblage of many thousands of individuals, and a vast number of natural and mechanical productions, many of which would be destroyed by moisture and heat, is constructed so as fully to answer that end." A sort of twofold economy characterizes the entire building: the walls and foundations are, at the same time, drains and ventilators; the roofs, besides being the most extensive of known skylights, are light-and-heat adjusters; the sash-bars not only hold the glass together, but are self-supporting; and the rafters form perfect drains for both sides of the glass,—for draining off internal as well as external moisture; whilst the tops of the girders are conduits also; and the floors are dust-traps, and aid in ventilation.

MR. PAXTON'S PLAN FOR THE EXHIBITION BUILDING.

The Lily-house was scarcely completed, when the clamorous objections raised to the brick-and-mortar design of the Building Committee, first led Mr. Paxton to consider the practicability of applying his novel plan to the construction of a vast Exhibition House; but the circumstance of the Building Committee having invited tenders for the construction of their design, was supposed to shut out fresh competitors. The fact proved otherwise. On Friday, June 14, Mr. Paxton named his proposition to Mr. Ellis, M.P., who forthwith accompanied him to the Board of Trade Office, to ascertain whether it was too late to send in a design. The reply of the Executive Committee was, "Certainly not; the specifications will be out in a fortnight, but there is no reason why a clause should not be introduced, allowing the reception of another design." This Mr. Paxton undertook to prepare in nine days. Other business intervened; and it was not until the 18th of June that Mr. Paxton, while presiding at a com-

were the last to come to perfection, which seems to have arisen from the water they were supplied with being hard, whilst those at Chatsworth and Sion were reared in soft water. The construction of the tank at Chatsworth is described in the *Year-Book of Facts*, 1850; and in May, 1851, a fine specimen flowered in the open air at Messrs. Weekes's nursery, King's Road, Chelsea.

A large work, illustrative and descriptive of the *Victoria Regia*, has been published by Sir W. J. Hooker and Mr. Walter Fitch; the engravings in which represent the flower of its natural size,—3 feet 6 inches in circumference. The peculiar construction of the leaves, and the weight they are able to sustain, proved of suggestive service to Mr. Paxton: in an experiment made at Chatsworth, a young lady, when placed upon one of the leaves, was borne up for some time with perfect safety. In a lecture delivered to the Society of Arts by Mr. Paxton, upon the details of his design for the Great Exhibition Building, he exhibited a specimen of the leaf, 5 feet in diameter, of only five days' growth; and to prove that not only the house for the flower, but the flower itself, has a striking relation to the Palace of Glass, Mr. Paxton remarked: "The under side of the leaf presents a beautiful example of natural engineering in the cantilevers, which radiate from the centre, where they are nearly 2 inches deep, with large bottom flanges, and very thin middle-ribs, between each pair of which are cross-girders, to keep the ribs from buckling; their depth gradually decreasing towards the circumference of the leaf, where they also ramify." Upon this "natural engineering," Mr. Paxton assures us that he first devised the self-supporting principle, which he has applied in the roof of the Great Building in Hyde Park.

mittee-meeting of the Midland Railway, at Derby, sketched the first outline of the proposed Building upon a sheet of blotting-paper.* The plans and specifications were, however, completed by June 28th; and, in his railway journey to the metropolis, Mr. Paxton travelled with an influential member of the Building Committee, Mr. Robert Stephenson, who forthwith examined the plans, and promised to lay them before his colleagues. Next day, June 29th, the Royal Commission met, headed by Prince Albert. Mr. Stephenson was present, but, by a pressing engagement, was obliged to depart without an opportunity of submitting Mr. Paxton's designs; when he delegated that office to a very competent hand, Mr. Scott Russell, one of the Secretaries of the Commission. Both Prince Albert and Sir Robert Peel gave great attention to the drawings; and, subsequently, Mr. Paxton waited upon the Prince at Buckingham Palace, to explain the details.

The Paxton scheme was next referred to the Building Committee, who could not, in the regular routine of business, entertain it. However, the projector had the good fortune to secure for publication of a perspective view of the Building in the *Illustrated London News*, July 6, 1850: the simplicity and beauty of the structure were at once impressed upon the public mind, and even the respect of the Building Committee for their own offspring was shaken.

The original drawing was made with great nicety, and delicately tinted. The design must be regarded as the expansion of the Victoria House at Chatsworth: it presents a long, unbroken line of building, in three stories; in the lower one, at each end, is a large portico, or entrance verandah; and at each side there are similar entrances.

CONTRACT FOR THE PAXTON BUILDING.

Meanwhile, the design being fully approved of by Prince Albert; and the Commissioners having fully investigated the plans, on July 26, they adopted Messrs. Fox, Henderson and Co.'s tender to construct Mr. Paxton's building, as then proposed, for the sum of £79,800. To this design was added a transept, crossing nearly at its centre, so as to avoid the removal of the largest and loftiest trees within the area. The architectural details were also considerably improved, and certain additions made to relieve the somewhat monotonous effect of the long-drawn line of the building; for which purpose fresh working-drawings were commenced, under the superintendence of Mr. Cubitt, assisted by Mr. D. Wyatt, Mr. O. Jones, and Mr. C. Wild. Within a week, these drawings were completed, as were also the calculations of the cost; the contractors bound themselves, for a certain sum of money, and in the course of some four months, to cover eighteen acres of ground with a building upwards of a third of a mile long (1848 feet), and some 408 feet broad. In order to do this, the glass-workers promised to supply, in the required time, nine hundred thousand square feet of glass (weighing more than 400 tons), in separate panes, and these the

* This blotting-paper sketch was subsequently placed in the Fine Arts department of the Exhibition.

largest that were ever made of sheet glass, each being 49 inches long. The iron-master passed his word, in like manner, to cast in due time three thousand three hundred iron columns, varying from fourteen and a half feet to twenty feet in length; thirty *miles* of guttering tube to join the individual columns together, under the ground; two thousand three hundred cast-iron girders; besides eleven hundred and twenty-eight bearers for supporting galleries. The carpenter undertook to get ready, within the specified period, two hundred and two *miles* of sash-bar; flooring for an area of thirty-three millions of cubic feet; besides enormous quantities of wooden walling, louvre-work, and partition. All this was ensured by the

CERTAINTY AND RAPIDITY OF THE CALCULATIONS.

It should be explained that these were greatly facilitated by Mr. Paxton's original details of measurement. Thus, everything in the Building is a dividend or multiple of *twenty-four*. The internal columns are placed twenty-four feet apart, while the external ones have no more than eight feet (a third of twenty-four) of separation; while the distance between each of the transept columns is three times twenty-four, or seventy-two feet. This is also the width of the middle aisle of the Building; the side galleries are forty-eight feet wide, and the galleries and corridors twenty-four. Twenty-four feet is also the distance between each of the transverse gutters under the roof; hence, the intervening bars, which are at once rafters and gutters, are, necessarily, twenty-four feet long.

Again: in order to show the *modus operandi* in laying down the first ground-plan, we may suppose the whole surface of ground to be built upon divided into perfectly geometrical squares of eight feet each: and further, that every principal dimension in the ground-plan is an equimultiple of the figure eight, which may, therefore, in the present instance, be called *the magic number:* thus, in the total length of the building, there are *two hundred and thirty-one imaginary squares*, and in the whole width of the building *fifty-one imaginary squares.* Having a clear view of this main point in designing so large a structure to be executed in so short a time, the details will be rendered more easy of comprehension. The main features of the interior of the building are the central aisle and the transept, the former extending the whole length of the structure, and being 72 feet, *or nine squares* wide, and the latter extending the whole width of the structure, and of the same width as the principal aisle. On either side are five additional walks parallel therewith, and of the respective widths of 24 feet (or three squares), 48 feet (or six squares), 24 feet, 48 feet, and 24 feet.

OUTLINE OF THE BUILDING.

Before we detail the construction, it will be necessary to glance at the building in outline, as presented to the spectator on entering Hyde Park, by the Prince of Wales's Gate, from the Kensington Road, opposite which is the principal entrance to the Exhibition in the centre of the south side. The southern façade of the transept, with the gigantic hands of the electric clock, has a noble appearance seen from this gate. Through a vestibule, the visitor is admitted to the main building, or its grandest portion, the transept, with its semi-cylindrical roof, springing at 68 feet from the ground, the diameter of the vaulting being 72 feet. Its length from south to north is 408 feet, on each side of which is an aisle 24 feet wide. About midway from the transept, extends eastward and westward a nave, upwards of 900 feet in each direction; the entire length of the Building being 1848 feet. This nave is 64 feet high, and 72 feet wide; and is flanked with aisles 24 feet wide, above which, at the height of 24 feet, are carried galleries extending round the whole of the nave and transept. Beyond each of these first aisles is an avenue, 48 feet wide; and next, a second aisle of corresponding width, and in like manner covered throughout with galleries on the same level as those over the first aisles. The several lines of galleries communicate with each other by bridges, which cross the 48 feet avenues, and, at the same time, divide them into courts, each of which has a very unique effect, more especially when viewed from the galleries; and this arrangement materially aids the classification of the articles exhibited. The avenues and second aisles are roofed over at the height of 48 feet from the ground; the rest of the Building is but one story, 24 feet high to the roof. From the ground-floor of the whole Building, access to the several galleries is obtained by ten double staircases. The width of the nave is, within ten feet, double that of St. Paul's Cathedral; whilst its length is more than four times as great.

MATERIALS OF THE BUILDING.

The principal materials used in the construction of the Building are wrought and cast-iron, oak and fir woods, and glass; but no bricks whatever, except in the main drains for carrying the whole of the water from the roofs: then the columns, trussed girders, and rain-water pipes are of cast-iron; the iron ties in the gutter-trusses, bolts, rivets, screws, and nuts, of wrought iron; the gutters, ridge-pieces, frame-ribs for the roof of the transept, sham trussed girders, flooring, and external walls on the ground-level, of wood; the whole of this vast frame-work of iron and wood, sides, ends, and roofs, is filled with glass; except around the lower part of the Building, which is boarded. The materials are,—wrought iron, 550 tons; cast-iron, 3,500 tons; glass, 896,000 superficial feet, weighing 400 tons; wood, including that used for the flooring, 600,000 cubic feet.

THE COLUMNS.

The vertical supports throughout the Building are hollow cast-iron columns, 8 inches in diameter; those on the ground-floor being 18 feet 5½ inches high; and those between the galleries and roof, 16 feet 7¼ inches. These columns have not the ordinary circular form, but each length has four flat faces standing in relief from its surface at intervals of 90 degrees. This plan was suggested by Mr. Barry, and is not only artistically pleasing, but the several flat bands present surfaces best adapted for the connexion of the girders which support the galleries and the roof, and to tie the various portions of the Building into one vast network.

The columns are made hollow, and their thickness of metal varies from $\frac{3}{8}$ of an inch to $1\frac{1}{8}$ inch, according to the weight each column supports. This hollow structure is capable of resisting a greater stress in the direction of its length than any other form. The bones of the largest and most powerful animals, and the quills and internal structure of the working parts of the wings of birds, are exemplifications of the above rule of power of resistance. This principle was admirably illustrated by Professor Cowper, of King's College, London, in a lecture delivered by him in the building, on December 31, 1850, when he performed an experiment with two small quills, which, with a flat board placed over them, to distribute the pressure equally, actually supported 2 cwt.; and the Professor added that a straw, similarly treated, had borne a half-cwt. without yielding. Besides the strength which is obtained in this form of column, it ensures economy of material, and the draining of the roof of the building, by each column becoming a water-pipe.*

The lowest part or base of each column has been made separately from the shaft, or upper part, on account of the greater convenience of casting. The base consists of a length of column about 4 feet in height; and around this base, as well as beneath the capital, which surrounds the upper part of the columns, are projections, termed connecting-pieces, from their securely retaining, partly as brackets, and partly as hooks, the girders throughout the building.

THE GIRDERS.

The girders are of two kinds,—cast-iron and wrought-iron.

The cast-iron girders are employed to span the 24-feet spaces between the columns, and to support the gallery floor. They are castings of that length, less the width of one column, and small spaces at both ends for the connexions. They are 3 feet deep, and are cast open, with four struts or standards interposed between their upper and under flanges, which divide the rectangular space into three open frames, each of which is intersected by diagonal trusses. The girders thus designed have been cast in a very perfect manner by Messrs. Cochrane, of the Woodside Iron-Works, near Dudley, Worcestershire, one of the largest establishments in the kingdom, which produces weekly 240 tons of cast-iron. The girders were furnished at the rate of from thirty to forty a day, though the loam had to be remodelled at every casting; while, in another part of the establishment, the columns were turned out at the rate of from forty to fifty. Great care was taken in these castings to cool the metal at a uniform temperature, as nearly as possible, otherwise the straight lines would have become distorted by unequal cooling. Some of the

* In Trinity Chapel, East India Road, Poplar, commenced in 1840, the architect, Mr. W. Hosking, has employed columns as down drains. "The galleries and clerestory are supported by cast-iron columns, which, being hollow, are made to serve also as water-trunks to carry off the rain from the roof into drains beneath the floor."—*Companion to the Almanac*, 1842, p. 213.

24-feet girders, which had merely to carry the roof, are made of wood; while others, of cast-iron, not having to support galleries, are of a lighter construction than those which have.*

Next are the wrought-iron trussed girders. The introduction of wrought-iron into the construction of the roof was necessary in spanning the side aisles of 48 feet, and the nave of 72 feet, for which purpose its greater strength rendered it preferable. In addition to its suitableness for this and similar structures, where a great weight spread over a great width has to be supported, wrought-iron is also ductile, and can be cut, rolled, punched, drilled, or welded, to suit any particular purpose. All these operations were performed on the ground in Hyde Park, to make the girders longer; and the machinery employed, which was that commonly used in steam-boiler manufacture, was replete with mechanical interest.

As many as 358 of these complicated wrought-iron trussed girders were required; each to be made up of bars of "angle iron," "cambered," or bent, and, on an average, of eighteen flat trussing-bars, besides the end standards, and five or eight intermediate bearers of cast iron, according as the girder was large or small; and all these had to be fashioned according to a drawing of each part, and then put together by punching, boring, bolting, and riveting. The larger, or 72-feet girders of which there are seventy-four, are employed to span the nave of the Exhibition building, the width of which is 72 feet, or 4 feet more than the width of Westminster Hall. "These large girders, or 'trussed spanners,' as they are called, connect the tops of the third or highest tier of columns, at the level of the spring of the semicircular ribs, which cover in the transept, and which attain in the middle of the avenue an elevation of 108 feet from the ground. They are made 4 feet deep from the upper to the lower flange, and weigh about 4 tons each." The remaining 284 wrought-iron girders are used in supporting the roofs of the forty-eight aisles of the building, of which two on either side of the middle extend its entire length. On account of their smaller span, and the better bearing which they have from being erected at a less elevation, these girders are of smaller weight, and upon a more simple system of trussing, than those of 72 feet. Their depth, also, does not exceed that of the 24-feet cast-iron girders. Both classes of girders are mostly made from bars of wrought iron and angle-iron. The upper flange of the trussed girder is formed of two pieces of slightly-cambered angle-iron, the curvature of which is convex upwards, and the right angles opened outwards. For the lower part two lengths of bar-iron are placed with their narrow edges upwards, and to their sides the end bearers, struts, or standards, are riveted; as are also the intermediate bearers, which are made of cast-iron, because their office is merely to prevent the collapse, or the further separation of the upper and lower flanges. The struts and trussings were riveted through by strong wrought-iron rivets, upon the ground. "Each piece was

* A bar of cast-iron one inch square, cast horizontally, will resist 18,656 pounds horizontally, and 19,488 vertically; the latter quality for malleable iron being 27 tons, or 60,480 pounds.—*Barlow*.

cut of the proper length and angle to adapt it to its place in the girder, lines for this purpose being inscribed upon it in white paint, according to the drawing, and round spots, half-an-inch in diameter, and sometimes three-quarters, where the metal had to be punched to receive the rivets. When thus marked, the bars were taken to machines, erected on the ground, and impelled by a four-horse steam-engine mounted on wheels, where they were punched, cut, or drilled, as their situation and connexions required;"* and in a storehouse were enormous quantities of bolts, nuts, rivets, screws, and other appliances necessary to complete this part of the work.

As these girders were to support the gallery floor, in its construction it was determined to bring the accumulation of pressure at points of eight intervals, at which the strength was concentrated. Hence the vertical lines of the girders occur at every 8 feet, and connect the top and bottom tables; whilst diagonal lines connect the junction of these standards. On the good proportion of the latter to the load to be supported, and to one another, the main strength of the whole depends; the testing of which was the next operation.

THE CAST-IRON GIRDERS PROVED.

This has been termed a simply-elegant experiment, to which each of the 1500 girders was subjected; when three only were broken, and those intentionally, in order to ascertain their "breaking resistance." The proving was executed by a peculiar modification of Bramah's hydrostatic press, patented so long ago as 1796, and still deemed an invaluable engine for producing enormous pressure by simple means. Mr. Saunders describes the present adaptation to consist of two strong cylinders; one having a large, and the other a small diameter, and these being connected by a strong tube. The smaller cylinder is fitted with a solid plunger, working in an air-tight collar; and at the bottom is a metal valve which opens upwards, and leads into a pipe immersed in a small reservoir of water. The tube connecting the cylinders conveys the water expelled from the first into the second, or larger one; its return from which is prevented by a valve closing the mouth of the tube, and opening into the larger cylinder. By this arrangement, is forced into the last-mentioned vessel a great body of water, which is rendered available by furnishing the large cylinder with a solid piston, which it forcibly raises as it enters; "thus producing a force," states Mr. Saunders, "which, as a practical expedient, has, in fact, no limit, except in the extreme slowness with which the large piston ascends, as compared with the motion of the smaller one, when their diameters are very disproportionate. This great power arises from the pressure produced by the plunger on the water in the smaller cylinder being propagated to every equal portion of the larger piston, by virtue of the property of the equal distribution of fluid pressure, and that of the incompressibility of water." In other words, the power and the resistance which the machine can overcome are in the proportion of the area of the small piston to that of the larger one. So convenient is the hydrostatic press for

* The Palace of Industry: its Construction, Machinery, and Statistics. By W. J. B. Saunders. E. Wilson, 1851.

producing a large power, that, if the large and the small cylinders be a foot and an inch in diameter respectively, and the plunger be worked by a leverage of 10 to 1, a power of 10-horse applied to the lever will produce a pressure on the larger piston of 14,400lbs. or $6\frac{3}{7}$ tons.

The *Proving Machine* was placed upon the ground, west of the transept, and under the arm of one of Henderson's patent cranes. The machine consisted of two parallel beams of cast-iron, 24 feet long, and about 8 inches apart; there being in the intervening space, two small cylinders, accurately bored, and having an internal diameter of three inches. These cylinders were connected by a strong tube, and their situation was adjusted by a screw movement, which brought them exactly under the two struts of the girders when placed in the apparatus. At each end of the beams was a strong iron standard, or upright, firmly bolted to them, and having shoulders cast upon them, facing each other; the lower shoulders being on a level, slightly higher than that of the tops of the cylinders, and the upper ones higher up by rather more than the depth of a girder. The two cylinders in this arrangement correspond to the large one in the general form of the press; the "rams," or solid three-inch pistons in each, being the point, where the machine is effective; a valve at each end of the tube accomplishing this object. A strong metal pipe communicated from the pump to the tube connecting the cylinders.

The proving operation is thus described by Mr. Saunders: "when a wagon-load of girders was brought upon the ground, the crane was first employed to lift each of them out. The girder was then swung round to a dynamometer balance, which indicated its weight by inspection, immediately upon its being slung upon it. From the balance, the crane again raised the girder, and it was next swung further on to the two beams, and dropped upon the lower shoulders of the uprights. The pump was then worked, and the two 'rams' rose slowly, until they carried the girder off its previous bearings. The motion being continued, the top of the girder at length came in contact with the upper shoulders of the uprights; and as these were strong extensions of the castings which faced downwards, the girder was prevented by them from rising higher. In this way, the whole pressure of the machine was applied underneath the struts, and was resisted by the fixed projections in which the uprights terminated. The pressure was continued on the struts, until it reached an intensity suited to the requirements of the part of the structure in which the girder was to be placed. Girders having merely to carry the roof, were proved to the extent of nine tons on the two struts; those which support the galleries, to 15 tons; and those which support double galleries, to 28 tons. The machine, by a self-acting addition, indicated the precise moment when the required pressure was attained; when, if the girder survived, still intact, it was declared sufficient. This, and all the machines used on the ground, were very ably contrived by Mr. Cowper, junior."

For the "Grounds of the Proof," the reader should consult Mr. Saunders's Report, wherein the results are thus stated: "Girders proved to 9 tons may be considered to have been proved to 12 tons;

those proved to 15 tons, to 20 tons; and those proved to 28 tons, to 37 tons. So short was the time occupied in 'proving,' that a waggon containing a dozen girders was discharged, and the girders weighed, proved, and stacked away for use, in about half-an-hour."

It is not important to describe the casting of the columns and girders, further than to state that, at the Woodside Iron Works of Messrs. Cochrane and Co., within about a mile of Dudley, in Staffordshire, the smelting and casting were carried on incessantly; from 30 to 40 girders, and from 40 to 50 columns were made daily; and at the London works of Messrs. Fox and Henderson, at Smethwick, in Staffordshire, a number of columns, and from 80,000 to 90,000 separate castings for the fittings of various parts of the building, were designed, modelled, moulded, and cast, employing for the most of every twenty-four hours not fewer than 80 pattern makers and 120 moulders. No less than 316 girders were cast and supplied in one week; up to the 20th of September, 77 columns had been delivered; by the week ending the 25th of October, the average number fixed per week amounted to nearly 200; and that rate of supply was continued for several subsequent weeks.

Before we describe the preparation of the iron frame-work, it will be interesting to detail the

MANUFACTURE OF THE GLASS,

inasmuch as it presents certain peculiarities arising from the extraordinary size of the panes, which was necessary to glaze the sashes without overlapping, and which it required superior strength and skill to produce. With the exception of 40,000lbs., made by the Messrs. Swinburne, the whole quantity, about 4000 tons, was made by Messrs. Chance, Brothers, and Co., at their establishment in Spon-lane, near Birmingham, within two miles of the works of Messrs. Fox, Henderson, and Co., the contractors for the building. Messrs. Chance's glass-works is said to be one of the largest in the world, and devoted to the manufacture of plate and crown glass, and glass shades. In December, 1850, Messrs. Chance employed about 1200 men, including a few Belgians and Frenchmen, in the plate-glass department. The glass for the "Crystal" Palace required about 600 tons of fine sand, and other materials, for its manufacture, besides the combustion of about 3000 tons of coals. Owing to the injurious operation of the Excise duty upon glass—happily abolished by Sir Robert Peel—the English manufacture was long inferior to the French for plate-glass, and to the Bohemians for coloured and ornamental glass. Since the Exciseman was relieved from his attendance at the glass-house, the English have been gradually improving themselves in the manufacture of every variety of this beautiful article, by adopting processes new to England, but which had been long in use in other countries, where the manufacture was not impeded by the operation of impolitic laws; and among these new processes was that of making the glass for the Exhibition building.

When Messrs. Chance took the contract for the supply of this large quantity, the larre size f the sheets, (4 feet 1 inch by 10 inches,) and the extraordinary short time in which the whole had to be supplied, demanded the employment cf additional hands; and Messrs. Chance had to import a few foreign workmen, in consequence of a scarcity of English hands sufficiently skilled and experienced. The greater portion of the glass has, however, been made by Englishmen; they becoming such proficients in this branch of the manufacture as to justify the assertion, that, if they do not surpass the French and Belgians, they fully equal them.

The process employed is a great improvement upon the old system of crown-glass making; so as to avoid the variation of the thickness of the glass as it approaches the bull's-eye. The process is simple and beautiful, but requires a steady and practised hand. The workman first takes the requisite weight of metal from the furnace, and blows it into a spherical form in the ordinary manner. It is then re-heated in the furnace, and he swings it above his head and below his feet, by standing upon a stage with a pit or well beneath, until it assumes the form of a cylinder. He thus swings and balances the molten metal—firmly fixed to a knob of glass at the end of a long iron bar or blowing-tube, until it gradually expands to the size which the original quantity of metal was estimated to produce. When swung to the proper length, the cylinder is about 4 feet long, and 12 inches in diameter. It is next converted into a tube, by disconnecting it from the blowing-iron, and removing the bag-like extremity. These operations are performed by boys with strings of red-hot glass, which easily cut through the yielding metal. The boys then remove the tubes to another part of the building, where they are set on end, like chimney-pots, to await the operation which shall convert them into flat sheets of glass. This is done by cutting the tube down the middle, and, in this state, placing it in the flattening kiln, where moderate heat, aided by a gentle touch from the workman, brings it flat upon a slab, or stone. It is then gently rubbed or smoothed with a wooden implement, and passed into a cooler part of the kiln, where it soon hardens. It is then tilted on edge, and the manufacture is complete.*

The weight of the sheet-glass in the Building is 16 ounces to the square foot, which makes it about the twelfth of an inch in thickness; and, according to the distance of the sash-bars, viz., 10 inches, this is considered amply sufficient. Messrs. Fox and Henderson have used about 30 acres of this kind of glass in various works in the United Kingdom, during the last twelve years, and it has answered well. Glass of 13 ounces to the foot is also in use; but 16 ounce-glass is seldom exceeded. At the Admiralty, there is some glass of 21 ounces to the square foot.

We now proceed to—

THE COMMENCEMENT OF THE WORKS.

The site was first examined, and found to be above the Serpentine level, and particularly dry; it having been bored all round 20 feet without finding any spring.

The ground was next enclosed with a hoarding, so constructed as

* Abridged from the *Illustrated London News*, No. 460.

not to injure, by a nail, the boards that composed it. It was thus formed: two battens, about an inch and a half apart, were fixed upright in the ground at regular distances; between these, 1½ inch deals were laid, edge upon edge, the ends being clipped by the battens; and the top of the batten being fastened together by a piece of iron hooping, the whole was made firm and secure. The next operation was—

SETTING OUT THE GROUND.

The site is an average slope of 1 inch in 24 feet towards the south-east, which it was necessary to "set out," so as to fix with the utmost accuracy the situation of every column, and adjust every level. This labour of nearly two months was performed with great precision by Mr. Brounger, assisted by Mr. Ashton. Each column is cast in two parts—the base and the shaft; and it was first indispensable that the bases of the columns should be placed on concrete foundations, with their centres accurately 24 feet asunder, according to the plan of the building; and the slightest inaccuracy would have become multiplied throughout the whole length and width.

The four corners and centre line of the building were first determined by means of a theodolite; and from the fixed points thus ascertained, all the 1060 points, which were the sites of the centres of the columns, were afterwards set out. To measure off the above lengths of 24 feet with the requisite precision, poles of seasoned American pine, above 24 feet in length, were planed up perfectly straight, and fitted with gun-metal cheeks, whose inward faces were placed exactly 24 feet apart, and within a few inches of the ends of the poles, which, by two months' constant use, would have become worn and unfit for nice measurement. The distance (24 feet) was measured according to the standard of the Astronomical Society, from a metal standard scale, stamped by the Tithe Commissioners, and "as accurate as human senses, armed by the best means which science has hitherto contrived, can produce." This standard was used throughout the important parts of the building, particularly in the larger castings. Such nicety was indispensable; for had not the columns been fixed with this exactness, the girders to be mounted upon them would not have fitted.

The measurements being taken, stakes 2 inches square were driven into the ground, to indicate the position of the columns; and the precise centres of the stakes being ascertained by the theodolite, they were marked by tacks driven into the wood at the exact points. These stakes were then removed, that a pit might be sunk, with the long dimension across the building, to receive the concrete foundation of the columns. In order that the places of the tacks might be retained, a right-angled triangle was framed in deal, at the two ends of which saw-cuts were made; and before the stake was removed, the apex of this triangle was set to the nail indicating the situation of the centre of the column. Two other stakes were then driven beneath the saw-cuts, at the ends of which two nails were driven; and the wooden triangle being then removed, the centre stake was withdrawn and the hole made.

THE CONCRETE FOUNDATIONS OF THE COLUMNS.

The pits were sunk to a depth varying from 4 to 20 feet, until the solid gravel was reached; and of the gravel thus obtained, and mixed with quick-lime and water, was made the concrete. All the pits were cut of an elliptical form, to resemble the outline of the base-plates; and were filled with the soft concrete, the height varying with almost every column, the level being determined by pegs. The mass of concrete in each pit consolidated in about three days; upon its surface rested the base-plate; and "the tendency of the conglomerated mass, when thus loaded, was to divide at the edge of the plate in lines inclined outwards from the vertical at an angle termed 'the angle of fracture for concrete,' the value of which is 26½ degrees. The solid block foundation thus formed is capable of resisting a load of 10 tons to the square foot, but that which is imposed upon it by the heaviest column does not exceed 2½ tons. Supposing, however, that the load might bring the concrete to the point of fracture, and that the fracture actually took place, the central part of the column would be a truncated cone, supporting the column on its upper surface, and resting on the substratum by its lower one. Thus the entire section of the pit became available in supporting the column."—(*W. J. B. Saunders.*)

PLACING THE COLUMNS.

Each column consists of a shaft and base, cast separately; and the latter rests upon the base-plate, a flat piece of iron formed in the casting, and connected with the sides of the column by bracket-pieces; the shaft being maintained in its vertical position upon the base by its accurate joining by means of shoulders or flanges, pierced with holes, through which pass solid-headed bolts, secured by nuts. To insure the situation of the base-plate at right angles to the length of the building, and the column centre at the point previously occupied by the tacks, a triangle was employed, somewhat similar to that already described.

The connexion of the column shafts, or the making of them up in one continued straight line, was insured by Messrs. Fox and Henderson turning the ends of the columns and bases thus joined, as well as of the connecting pieces, or other lengths of column. Each piece, as soon as cast, was put into the lathe, and the bearing surfaces were turned at right angles to the axes of the columns. With this previous adjustment, the pieces were bolted together, and heights of 66 feet of straight columns, which occur all along the inner galleries, were united with equal ease and certainty. As the hollow columns serve for water-pipes, it was requisite to protect the turned faces from rust, which is done by pieces of canvas covered with white lead, and placed between two adjacent parts.

PROGRESS OF THE BUILDING.

The importance of conducting the preliminary operations with the nicety we have described, cannot be too strongly impressed upon the reader; and to show how severely this has taxed the energies of Mr. Fox, one of the contractors, we quote the following extract from an address by that gentleman at a dinner given to him at Derby, on June 21, 1851, by his fellow-townsmen. In the course of his speech, wherein he made a connected statement of the progress of the undertaking, Mr. Fox said:—"Before completing our tender, and with a view to a more precise appreciation of the magnitude of a building covering 18 acres—1848 feet long, 408 feet wide, and 64 feet high, irrespective of the arched roof of the transept—I walked out one evening into Portland Place; and there setting off the 1848 feet upon the pavement, found it the same length within a few yards; and then, considering that the building would be three times the width of that fine street, and the nave as high as the houses on either side, I had presented to my mind a pretty good idea of what we were about to undertake. Having satisfied myself on these necessary points, I set to work and made every important drawing of the building, as it now stands, with my own hand. These occupied me about eighteen hours each day for seven weeks, and as they went from my hand, Mr. Henderson immediately prepared the iron-work and other materials required in the construction of the building. On the 26th of September we were enabled to fix the first column in its place. And from this time I took the general management of the buildings under my charge, and spent all my time upon the works—feeling that, unless the same person who had made the drawings was always present to assign to each part as it arrived upon the ground, its proper position in the structure, it would be impossible to finish the building in time to insure the opening on the 1st of May; and I am confident that if any other course had been taken, or if, as is usual in the construction of large buildings, the drawings had been prepared by an architect, and the works executed by a contractor, instead of, as in the present case, these separate functions being combined by my making the drawings and then superintending the execution of the work, a building of such vast dimensions could not have been completed within a period considered by experienced persons as altogether inadequate for the purpose.

* * * *

"As the building progressed, I was assailed on all sides, not only by unprofessional persons, but by men of high scientific attainments, who, notwithstanding the careful calculations which had been made, and the satisfactory proofs to which all the important parts were individually subjected, as soon as these parts were put together, producing a structure of unparalleled lightness, doubted the possibility of its possessing, as a whole, that strength which was necessary to make it safe against the many trying influences to which it must necessarily be subjected.

"One gentleman, after complimenting me upon the beautiful appearance of the building, stated his belief that it would never come down unless it tumbled down, and which, he had no doubt in his own mind, it would; or that the first gust of wind would blow it down like a pack of cards. Another, holding a high scientific appointment under Government, after a long investigation of the various parts of the building, expressed, at the Institution of Civil Engineers, a belief in the entire want of safety in its construction; and after explaining the mode of connecting the girders with the columns by means of projections, technically called snugs, went on to indulge in an *airy* prophecy that a wind exerting a force equal to 10lbs. per superficial foot would bring such a strain upon these snugs as to break them all off, and cause them to fall down in showers. I may just remark, that, since the expression of this opinion, the wind-gauges around London have registered, in the late storms, upwards of 20lbs. per foot; and I have pleasure in informing you that the encouraging predictions of this gentleman, as well as those of many others, have not yet been fulfilled.

"It may be amusing to enumerate, briefly, some of the difficulties and dangers which were foretold:—

1st. We should never get through our work in time.

2nd. The foundations were defective, and would surely give way.

3rd. The Building was more like scaffolding than anything else, and was so light that it must tumble down.

4th. The weight of goods and people in the galleries would be sure to bring down the Building; and, if the mere weight did not produce the effect, the vibration caused by people walking, or more especially running, would be sure to do so.

5th. The girders expanding by the heat of the sun would push the columns out of their places, and in doing so would be sure to break them and let down the Building.

6th. That if it should happen that the weight and vibration did not produce the effects expected, the equinoctial gales would, at all events, finish the business.

7th. That if the Building was not blown down, the sashes or windows were so feeble that they would assuredly be blown in, or out, but it was difficult to say which.

8th. That the glass was so weak that it could not resist a gale of wind, but would inevitably be blown to pieces.

9th. That if the wind did not act as was expected, firing cannon in Hyde Park, on the opposite side of the Serpentine, could not fail to demolish the windows.

10th. That the first hailstorm would leave the whole roof without glass.

11th. That by the vibration of the moving machinery the Building would be gradually shaken loose in all its connexions, and must consequently fall down.

12th. That such were the fears entertained for the safety of the galleries containing the large organ and choirs, that a request was made to Dr. Henry Wylde by some members of the Jury for Musical Instruments, that he would, previous to the inauguration, urge upon my mind the necessity for an investigation into the results likely to ensue from the effect of the vibration which would be brought into action during the performance of the National Anthem.

13th. That the vibration caused by the diapason pipes of the large organ would shake out the glass, which would fall in showers upon the spectators; and our chairman was accordingly instructed by the Commissioners to make experiments with the view of ascertaining what the result would really be, and these experiments were officially made on the day previous to the opening."

It need scarcely be added, that these fears and predictions proved groundless; but they were brought about by a variety of circumstances, independent of the novelty of the structure and its details. Although it may be somewhat in advance of the present stage of the subject, it may be as well here to remark, that some of those apprehensions were caused by the strong feeling which prevailed upon the competing architects having failed to produce a suitable design for the Building; and the Commissioners, in this difficulty, having accepted Mr. Paxton's scheme without strict regard to its compliance with the advertised plans. In the general anxiety to do justice to the originality of Mr. Paxton's design, it was thought by some that the claims of other parties, to a share of the successful execution of it, had not received due consideration. Professor Donaldson, at a meeting of the Institute of British Architects, held May 25, observed: "It had been said that the architects had not rendered full justice to the designer of that wondrous edifice (the Crystal Palace;) but justice was not done to the profession in the accusation. He, like all his brethren, was ready to acknowledge merit wherever it was to be found; and certainly the highest credit was due to Mr. Paxton. It must be remembered, however, that Mr. Paxton was a man of one idea. Brought up as a gardener, he constructed with the greatest ingenuity a building for the reception of that noble plant the Victoria Regia; and, finding in that a construction capable of extension, he multiplied that idea till he produced the great building which had been so successful. No one could deny that this was a happy idea; but considering the scientific skill of Messrs. Fox* and Henderson, the valuable suggestions of Mr. Barry, and the artistic taste of Mr. Owen Jones, it must be felt that to such a combination we were indebted for the most successful edifice of modern times."

* Mr. Charles Fox is a remarkable instance of the power of natural genius when combined with great energy. At an early age, he was articled to his brother, Mr. Douglas Fox, the present Mayor of Derby, with a view to entering the medical profession; but a taste for engineering studies led him to devote to mechanical science every leisure moment; his indentures were cancelled, and he was allowed to follow the bent of his inclination. The immediate causes of this determination appear to have been a visit to the manufactories of Birmingham, and the impression produced upon his mind by the opening of the Liverpool and Manchester Railway. Captain Ericsson, who was fortunate enough to be Mr. Fox's first employer, speedily appreciated his remarkable mechanical talent, and rapidly increased the small emoluments on which the young aspirant to engineering eminence had been obliged to commence his career. But this beginning of prosperity did not last long. Captain Ericsson was compelled by adverse circumstances to relinquish business, and Mr. Fox lost at that time all his savings as well as his situation, and was by an accident deprived for three months of the use of his arm. He did not, however, lose courage; but, struggling on as a lecturer, as a scientific assistant, and even occasionally as a practical mechanic, he at length attracted the attention of Mr. Robert Stephenson, and was appointed one of the assistant engineers to the London and Birmingham Railway Company, at the commencement of the construction of that line. In this post he had only to profit by the admirable opportunity afforded him by the great works with which he was brought in contact, under the eminent engineer whom we have mentioned. Refusing every offer of pecuniary advantage, however tempting (and such were not wanting), to leave this position, he remained with the London and Birmingham Railway Company until a year after the opening of the line; and then only left their employment in order to join the late Mr. Bramah in forming the large manufacturing business which is now so well known as the firm of Fox, Henderson, and Co. Mr. Fox is a man of good family, and is highly connected. His father was the late Francis Fox, Esq., of Derby, and his venerable mother, who has lived to see her son's admirable success, is a daughter of the late Archibald Douglas, Esq.

At a meeting of the Institute, held on Jan. 13, Mr. Tite observed, that "the only feature which, in his opinion, redeemed the Exhibition Building in Hyde Park from downright ugliness, namely, the arched roof of the transept, was the suggestion of Mr. Barry, and they might therefore claim it on behalf of the architects."

Again, in the course of a paper read at the Institution of Civil Engineers, on Jan. 14, Mr. Digby Wyatt, to whom, from the commencement, had been entrusted the superintendence of the construction of the building, gave great praise to Mr. C. H. Wild and Mr. Owen Jones, who had been associated with him; to Mr. Barry and Mr. Brunel, who, as members of the Building Committee, had made very valuable suggestions; as well as to Messrs. Fox and Henderson, and to Mr. Brounger, Mr. J. Cochrane, and others, for their exertions in the execution of the construction; and he concluded by reminding the members, that the weight of responsibility, the arduous duty of supervision, the honour of acting as the master-mind, to weigh the requisites, to determine the design, and to govern the construction of this great apparatus, had been reserved for Mr. Cubitt, the president of the Institution of Civil Engineers.

We now resume the constructive details, with the mode of

CONNECTING THE COLUMNS WITH THE GIRDERS.

One of the peculiarities of the building was, in its being its own scaffolding, or very nearly so; which was seen to advantage in the operation we are about to describe.

As fast as the iron forest of columns was raised, they were joined with the girders by connecting pieces, or lengths of columns equal to the depth of the girders, which are furnished with the projections requisite for securing them firmly in their places. These connecting pieces terminate in castings adapted to receive the girders, and consisting of perforated flanges, corresponding with those cast in the ends of the columns; and, these being paired, a bolt was passed through them, and made fast by a nut and screw. The second tier of columns was then fixed in precisely the same manner on the connecting-pieces; and thus were securely joined the girders throughout the building.

The peculiar action of the connecting-pieces, however, should be further explained. The projections, or "snugs," upon their upper and lower portions, act not only as brackets, but likewise hooks; those on the lower ends bending upwards, and those on the upper ends downwards, so as between them to grasp the end struts or standards of the girder. To retain the girder in a vertical position, and prevent any lateral movement, its bottom and face have a tenon, which drops into a mortice-hole in the projection of the connecting-piece; while the top end face of the girder, over which the upper connecting-piece hook extends, is grooved to correspond with the projection, and the two surfaces are keyed together by a piece of iron. This system of attaching the girders to the projections of the connecting-pieces has proved very successful; and they were finally adjusted generally without the use of scaffolding, by men being hoisted in a chair, where there was little to do, so nicely had the parts been adapted to each other.

HOISTING THE COLUMNS AND GIRDERS.

The columns and girders were raised to their places by a pair of shear-legs, that is, two poles lashed together at their heads, whence ropes passed to stakes driven in the ground, to steady the apparatus. By this and similar means, the actual structure was much simplified. To each column, before it was raised, was attached a connecting-piece; and, when two columns were fixed, a girder was run up, slipped between the projection-pieces, and there secured. This operation was repeated opposite, and two sides of a square were thus formed, and kept in a vertical position by pole supports; the two other sides of the square were raised in like manner, and thus was constructed a 24-feet bay. A number of these bays being completed, formed the ground-floor, upon which were hoisted the columns for the first floor, by shear-legs, loftier than those hitherto employed; and this first floor, in its turn, became a base for the columns of the next floor; and thus the construction of the three floors was carried on simultaneously, without scaffolding, it being only necessary that the lower tier should be slightly in advance of the upper one.

The girders were raised with ease; horses being employed in the heavy work, to pull upon the fall of the tackle, led through a snatch-block. The hoisting of the larger girders, especially those which span the nave next the transept, was effected by bodies of men, whose movements, directed by a superintendent, worked with great precision, of which we shall speak more at length, when we describe the construction of the transept.

The columns are not of iron throughout the building; between every external column there are two intermediate framed deal semi-columns, corresponding externally with the form of those of iron, but internally being faced with ¾ inch deal.* At the level of the floor, a fir sill, 9 inches in width by 3 inches in thickness, *weathered* externally, to throw off the rain, runs longitudinally all round the building, into which are framed the intermediate wooden semi-columns. It should be added that these intermediate columns, having no weight to carry, are more for ornament than use; their supports consist of deal struts, 13 inches in width by 3 inches in thickness, the whole being properly wedged up from the ground. The next operation was—

RAISING THE TRUSSES.

In order to raise each of the 72-feet trusses which support "the ridge and furrow" roof over the centre aisle, a stout and tall "derrick," properly rigged with pulley-tackles and guide-rope, was fixed up midway between the two columns, to which the truss was to

* The building is believed to be self-protective from lightning; it being the opinion of scientific men, and those who have studied the effects of lightning, that each of the iron supports of the structure is a perfect lightning-conductor, which communicates directly with the earth, and is, therefore, quite safe.

be fixed. This derrick consisted of several fir scaffolding poles firmly bound together, and reaching to the height of 70 feet above the ground. When the truss was securely attached by means of a stout chain to the rope for raising, a signal was given, and the other end of the rope, which passed over a rope at the top of the derrick, and thence round a leading block at the bottom, was attached to a team of six horses; the horses, drawing the rope out "on end," raised the truss in a few minutes nearly to the position it was destined to occupy; but the whole process of moving the derrick from one intermediate point to another, securely fixing the truss, and entirely completing the operation of fixing it to the columns, occupied about two hours, so that four or five of these 72-feet trusses were fixed in a day by means of one derrick. Several men were required to attend to the guide and other ropes during the raising of the truss; and three men at each end of it to fix it in its proper bearings.

THE RIDGE AND FURROW ROOF.

The principle of the "ridge and furrow," or "ridge and valley," roof, as applied by Mr. Paxton in horticultural buildings, has been already described.* Its adaptation to buildings of vast extent, as

* (See pages 29 and 30.) Joseph Paxton is a native of Scotland; and his lineage has been traced in the *Berwick Advertiser*, to Berwickshire and the neighbourhood of the ancient town of Dunse. The fact that Paxton is a Berwickshire name, (having, it is thought, originated in that country,) induced the writer in the *Advertiser* to consult the parish register of Dunse, when he found therein that Joseph Paxton, together with a twin brother, named Henry, was born at the farm of Manderston Mains, in the parish of Dunse, on the 16th of March, 1804. His father, "Henry Paxton, rented the farm; and an uncle the farm adjoining (Manderston Mill); while another uncle held a commission in the army. His mother's maiden name appears in the session-book as Patric (doubtless, intended as a contraction for Patrician) Mack. At a very early age, Joseph Paxton was apprenticed as gardener, either at Manderston or Blackadder garden—perhaps the latter, as a Mr. Paxton, a cousin of his father, was gardener there at that time. Of his further career, nothing is known in this quarter, (says the *Berwick Advertiser*,) so far as we can ascertain; but here we have, at least, a Joseph Paxton, and a gardener, which we are but too glad to receive as sufficient grounds for lodging a claim on the part of Dunse as the birth-place of him, whose name will go down to all posterity in so honourable a connexion with the Great Exhibition of the industry of the world."

After leaving the North, Mr. Paxton is stated to have been employed at the Gardens of the Horticultural Society at Chiswick; but his first engagement in a responsible capacity as a landscape-gardener, was by His Grace the Duke of Somerset, at Wimbledon Park, Surrey, which was originally laid out by Browne. Hence Mr. Paxton passed into the establishment of His Grace the Duke of Devonshire, at Chatsworth; when that nobleman soon perceived Mr. Paxton to possess a knowledge and skill in financial arrangement, which he brought to the management of the Duke's estates, both in England and Ireland. With the name of Paxton have, for many years, been associated the landscape-garden glories of Chatsworth, and the sole contrivance of the vast conservatory, which the King of Saxony graphically compared to "a tropical scene with a glass sky." The house built from Mr. Paxton's design, for the flowering of the *Victoria Regia*, was, however, the immediate parent of the Great Exhibition Building; and Mr. Paxton gratefully acknowledges, that but for the enlightened views of the Duke of Devonshire, and his Grace's princely expenditure at Chatsworth, the idea of such a building might never have been entertained. The Duke, on the other hand has borne willing testimony to the well-directed that for the Great Exhibition, is, however, an entire novelty. It is especially calculated for this purpose by its extreme lightness; the whole of the roof weighing only, upon the average, 3¼lbs. per foot superficial. This is the result of the subdivision of surface in the light frame-work and rafters: the latter are the ridges, and though of comparatively small dimensions, they securely sustain the roof, the constructive simplicity of which is immediately applicable to the covering in of the whole Park, were that desirable, without imposing any additional weight on the larger number of supports which would be provided.

From a roof of such light construction, it became important to convey away the rain-water as soon as possible; for, it is estimated, that were a quantity of water, one-eighth of an inch in depth, suffered to remain upon the roof, an additional pressure of 275 tons, for the time being, would be the consequence. This is prevented by means of cambered or curved beams of wood, which divide the roof into spaces of 8 feet each, and are the gutters into which the water runs from off the glass roofs, which slope into them on either side. These cambered gutters run longitudinally 912 feet east, and 864 feet west of the transept roof; and, being repeated 55 times, their entire length is no less than 34 miles. These lines of gutter were made in 24-feet lengths, each cambered upwards, so that the water in the gutter has only to run down one-half its extent, and thus off the roof at one end of the furrow, where it discharges itself through a casting into a second and larger gutter lying transversely to the first, and resting upon the roof girders. The fall of the smaller gutter on either side is 2½ inches in 12 feet, or 1 inch in 4 feet 9 inches; so that the water is at once drained into the larger gutter, and thus conveyed to the hollow columns before it can accumulate at any one point throughout the building. Again, a light cambered rafter is fixed over the centre of the 8-feet spaces, and runs uninterruptedly east and west from the transept roof to the two gable-ends of the building, this rafter being the "ridge;" and from the "valleys" between, the entire roof rises at a slope of 1 in 2½, except in the arched roof of the transept, where the panes of glass meet at a larger angle. Not only is the roof drained externally, as above described, but small channels are provided in the longitudinal gutters to carry off the condensed vapour from the interior surface of the roof.

The glazing of the vast nave roof was executed with great rapidity. The sash-bars, having been painted, were received upon the

energies of Mr. Paxton. "I never," said his Grace at a public meeting held at Derby, "knew Mr. Paxton resolve to undertake what he did not fully accomplish." It was but a just recognition of his great share in contributing to the success of the Exhibition, that he led the pageant at the opening of the building, on May 1, 1851.

Mr. Paxton is a distinguished Fellow of the Linnæan and Horticultural Societies, and has produced a Botanical Dictionary of accredited worth; besides editing the *Magazine of Botany*, the *Flower Garden*, and other botanical and horticultural works. The gardens at Chatsworth form an excellent finishing school for young men; and many foreigners having received here instructions in horticulture, has invested Mr. Paxton's taste and skill with European celebrity.

roof, where both their grooves were filled with putty, as was also the rabbet in the ridge, and the sill in the furrow; the side edges of the pane were then inserted in the bar grooves, and the glass thus framed at the sides was laid in its place, prised up by the workman into the ridge, and fastened at the lower end by a nail driven into a drilled hole in the bar; but the larger sash-bars were fastened into the ridge by dowells. As the glazing required to be executed in a very short time, "glazing-wagons" were used for expedition, each of which accommodated two glaziers, and travelled on wheels in the Paxton gutters, as in railway trams, and spanned a width, or one ridge and two sloping sides, of the roof. The workmen sat at the end of the platform, which they moved backward by a winch, as they inserted a pane of glass before them; and thus they travelled throughout the nave roof, their supplies of sash-bars, glass, putty, &c., being, from time to time, hoisted through an opening in the stage of the wagon. In bad weather, the workmen were protected by a sort of tilt of canvas upon hoops. By aid of these wagons, eighty men, in six days, put in upwards of 18,000 panes, or 62,600 feet superficial of glass. The greatest number of frames inserted by a man in one day was 108, being 367 feet 6 inches of glazing.

The thickness of the glass was important, but the width was equally so. Thus, if a piece of glass of a certain thickness and width be broken by hailstones, reduce the width, and it will bear their force. Now, the panes used in the building are 49 inches long, and 10 in width: if, instead of 10-inch width, it had been 15, the glass, it is calculated, would have been broken in the first hail-storm.

The effect of the vast extent of roof upon the spectator traversing the furrows, is very striking; the immense vitreous surface reminding one of the *mer de glace* of Mont Blanc, with its beautiful play of prismatic colours.

This roof has also been termed "Vandyke," by the Rev. Mr. Carlisle, an Independent minister, of Romford, who claims the invention, and states that, in 1828, he constructed a glass roof with three aspects: the principle of this Vandyke roof he has since applied at Corbet's-tye, Hornchurch, and Dagenham, Essex; and at Mr. Henry Rudd's, Newington Green, near London. Mr. Carlisle adds, that between twelve and eighteen years since, the Vandyke roof was often the subject of conversation at meetings of Societies, where he occasionally met the Duke of Devonshire's gardeners, and others in the service of the aristocracy. "Had there been then such a roof in the possession of the Duke of Devonshire, or any other gentleman in the United Kingdom," adds Mr. Carlisle, "it is but a fair inference to draw, that I should have heard of it. Upon this reasonable supposition, I ask whether the admirable novelty of a Vandyke roof flowering the Victoria Regia, amidst the glories of Chatsworth, was the immediate parent of the Great Exhibition building?"*

One of the attractive points during the construction of the building was the inspection of the ridge and furrow glazed roof, though

* Communicated to the *Morning Herald*, and quoted in the *Builder*, July 9, 1851.

few visitors were permitted to avail themselves of the strange sight which the vast "sea of glass" presented. Such as enjoyed this privilege ascended by ladders to the lead-flats on either side of the arched roof of the transept, whence, looking east or west, the beautifully simple ridge and furrow principle of roofing was seen to great advantage. The clumps of trees rising from the open courts above the roof had a striking effect. The exterior of the upper tier of ventilators, partly concealed by handsome open cast-iron spandrels, and surmounted by a fascia, extending the whole length of the exterior of the gallery elevation, together with the flag-standards placed at intervals of 24 feet, from centre to centre, were most conspicuous in the view. This fascia is crowned to its full extent, between the respective flag-standards, with an ornamental cast-iron frieze. The prospects are strong contrasts: eastward the eye ranges over the Park to the huge metropolis, and westward are the hanging groves of Kensington Gardens; northward is the Serpentine, its *sheen* face vying with the vast vitreous surface of the roof itself; and southward is the busy Kensington road, with its terraces of newly-built mansions, and a thickly-peopled district stretching to the Thames' bank.

We may here state the leading details of the roofing, as enumerated by Mr. F. Whishaw, C. E., in the *Illustrated London News*, No. 464. The width of the south aisle, from centre to centre of columns, is 24 feet; and the avenue running parallel therewith, 48 feet; the height of the columns, from the top level of the floor to the under side of the girders, is 22 feet 2 inches; the weight of the columns, having only the roof to support, varies from 6 cwt. to 9 cwt. each; the cast-iron girders of the two side aisles, fixed at intervals of 24 feet from centre to centre, are each 23 feet 4 inches in length, and fit into sockets formed in the upper part of the columns; the depth of the girders throughout is 3 feet; deal-framed gutters, made up of 1½-inch deal sides secured to the bottom of the same material, and 2¾ inches in thickness, rest on the tops of transverse girders. The internal width of the gutters is 5 inches, and the greatest depth 5½ inches, being formed with false bottoms, laid with a proper inclination to carry off the water. These transverse gutters, which are fixed at intervals of 24 feet, from centre to centre, receive the water from the Paxton gutters, running in parallel lines longitudinally throughout the whole building, the ends being notched to the sides of the transverse gutters. The double-grooved skylight bars are notched on to the longitudinal gutters at bottom, and at top against the solid ridge-pieces, being secured by nails in drilled holes. Both the longitudinal gutters and ridge-pieces are cambered throughout the roofing; the former being kept in their position by tension-rods, screwed up to a cast-iron shoe at each end, and passing through the eye at the bottom of each of two cast-iron saddles, which are 9½ inches long. The top of each of these saddles is of a circular form, 4½ inches in diameter, and is properly secured to the under side of the longitudinal gutter. The skylight bars are formed with grooves to receive the glass; the advantage of which is the security it affords to the putty, being not so much exposed to alternations of weather as when fixed into ordinary rebated bars.

It is now time to describe the most remarkable novelty of the roof structure—

THE PAXTON GUTTER,

Previously used by the inventor at Chatsworth. It has also been termed a three-way gutter, from its having in its upper surface a semicircular groove, to receive the water from the external glass roof, which springs from it on both sides; and from its having also on each of the two vertical sides, lower down, an oblique groove to receive the condensed vapours from the inner surface of the glass; the ends of these gutters being connected by oblique cuts with the box-gutters.

The Paxton gutter is of the bell-shape inverted, from that form expanding upwards, and therefore being less liable than any other to become obstructed. The gutter is cut in lengths of 24 feet, which would bend or "sag," were they not trussed by rods of iron fixed beneath the gutter, secured to its two ends by cast-iron shoes, and pressed up by cast-iron standards at 8-feet intervals, with a rise of 2½ inches in the entire length; thus trussed, the gutter will support 1½ tons weight. Similar gutters were employed by Mr. Paxton in the Chatsworth conservatory in 1837: they were then made by hand, but machinery has since been employed in their construction—an improvement of great importance where no less than 20 miles of the Paxton gutter are required, as in the roofing of the Great Exhibition building. We shall, therefore, proceed to detail—

THE GUTTER MACHINERY,

At the Chelsea Wharf Saw Mills, by Messrs. Fox, Henderson, & Co. The power employed to give motion to the various machines used in preparing the timber for, and cutting out, the Paxton gutters, was that of an oscillating high-pressure engine, estimated to do the work of 20 horses or 110 men; in addition to which there were 40 men engaged at the establishment, 20 working by day and the rest by night, so that the machinery was kept almost constantly in motion.

"The engine and boiler," says Mr. Whishaw, "are placed in the basement. The cylinder is 20 inches diameter, the length of stroke being 30 inches, and the pressure of steam 45lbs. on the square inch. The conversion of reciprocating into circular motion is effected by means of a crank attached to the end of the first shaft, on which rotate a fly-wheel of 12 feet diameter, and a pinion of 39 inches diameter. From the fly-wheel motion is communicated to the main pulley-shaft on the first floor by means of a strong leather cross-band, 10 inches in width, which passes through the floor and over the friction roller, to the driving pulley of the main shaft, from which power is given off to a circular planing-machine, and also to the gutter-machines on the first floor; whilst two vertical saws on the ground floor, and a second planing and adzing-machine on the first floor, are set in motion through the medium of a second shaft in the basement.

"We shall endeavour, in the first place, to trace the working, through this second shaft, which is caused to rotate by means of a pinion 25 inches in diameter, worked by a pinion of 39 inches diameter, at the end of the engine-crank already mentioned; thus, the speed of the second shaft is nearly doubled. On this second shaft are two driving-pulleys, each 54 inches in diameter, from which two bands pass in the direction of the length of the building, and at right angles to the two shafts in the basement, to two pulleys, each 24 inches diameter; these, in connexion with cranks, reconvert the circular into reciprocating motion, for the purpose of moving the two vertical saws, which are used for cutting deals into planks for various uses in the galleries and other parts of the great building.

"By the two vertical saws, forty cuts, each 21 feet in length, and 11 inches in depth, are effected in ten hours; which gives a total length of 1680 feet in the twenty working hours.

"At the end of the *second* shaft, in the basement, is a third pulley of 54 inches diameter, by which motion is communicated to the planing and adzing-machine on the first floor, by means of a band passing round a 48-inch pulley on the upper shaft, from a 24-inch pulley, on which, a little removed from the 48-inch pulley, a strap passes down to the ground floor, and there turns, by means of a 12-inch pulley, a large circular saw, placed vertically in front of a long deal bench. By this saw, the half-baulks of timber (12⅜ inches by 5⅛ inches), as delivered at the mills, are cut nearly to the size of the timbers intended to be formed into lengths of solid 'three-way gutters.' Although this is the principal work executed at the saw-bench, other saws of various diameters are substituted for the large circular saw already mentioned, when required for various other works."

Next to be described is the *Circular Planing Machine*, by which the timber was prepared for cutting into gutters. This machine is but the second of its kind that has been made, and is patented by Mr. W. Furness, Lawton-street, Liverpool. When in action, it requires the attendance of two men and one boy. The planes, or cutters, rotate with considerable velocity, and plane at one time one side of three "quarter baulks;" the cutters being attached to a cross-arm between the uprights of a frame somewhat similar to a vertical saw-frame. The height of this frame above the level of the traversing platform is 3 feet 6 inches, and its width 2 feet 5½ inches; the arm being 24 inches in length. Each cutter is in length 3½ inches from the top to the edge of its blade, and ⅞ of an inch wide. On the spindle of a vertical pulley 23 inches long and 6 inches in diameter, placed centrally between the uprights of the frame, is carried the cross-arm to which the cutters are attached. At the bottom of the vertical 6-inch pulley, and in the same spindle, is a horizontal circular solid disc plate, 22 inches in diameter, by which the timbers to be planed are kept down close to the traversing frame, while subjected to the operation of planing. The vertical pulley and disc are adjusted by means of a screw working vertically into a fixed nut: this screw is moved through the medium of a 12-inch horizontal pulley, placed at the top of its spindle. From the 12-inch pulley a band passes horizontally to a second pulley of 6 inches diameter, which is fixed above the level of the cross-head of the frame of the machine. Motion is given to the whole by a handle at the bottom of a vertical spindle, which works in proper bearings fixed to one of the uprights of the frame. The vertical 6-inch pulley which rotates with the disc is moved by a band passing round a 17-inch pulley, on the spindle of which is a 12-inch pulley; this latter being in communication with a 32-inch pulley, fixed at the end of the principal shaft on the first floor.

The timbers to be planed by the machine are placed on the top of a traversing stage, which is moved in either direction by a rack and pinion, the rack being fixed under the whole length of the stage; iron slides, 2 feet apart, are placed on the two longitudinal bearers of the supporting frame, on which the traversing stage moves in either direction. When the traversing stage is to be set in motion, an apparatus, (consisting of two levers, a connecting-rod, and a clutch,) is brought into play, by the movement of the first lever either to the right hand or to the left, according to the direction in which it is to be moved. When *out of gear*, the first lever remains in a vertical position.

The quarter-baulks having been brought to an even surface on all sides by means of the circular planing-machine, they are conveyed towards the *feed*-end of the *Gutter-Cutting Machine*, next to be detailed.

It must be borne in mind that in the Paxton gutter, besides the rain-water channel in the top of the timber, there are two inclined channels cut in the sides for receiving and carrying off the condensed vapour from the inside of the glass of the skylights. When finished as to cross section, this three-way gutter is 5 inches in width, and 6 inches in depth: the top or rain-water gutter being 3 inches wide and 2½ deep; and the "condensation gutters," each 1 inch deep, and half an inch in width. The whole operation of giving it the form as above is performed by this very ingenious piece of machinery.

Motion is given to the gutter-cutting machine by means of two 48-inch pulleys, turning on the main shaft running across the building on the first floor; that nearest to the engine driving the feed-rollers by means of a strap passing round a 24-inch driving-pulley, on the axle of which is a cone-pulley, from which an endless rope passes to a grooved open iron pulley of 36 inches diameter, turning on a vertical plane, and in the axle of which is a 4-inch pinion working into a cogged wheel of 18 inches diameter. On the axle of the 18-inch pulley is the grooved feed-roller, of 3½ inches diameter; above which is a friction roller of the same diameter, adjustable by lever and weight. Between these two rollers the timbers pass on their way to the cutters, and also through a guide trough, extending to a length of 12 inches beyond the finishing cutters.

In the first place, the timber is subjected to the roughing-cutters, which take out a depth from the top of the gutter-timber of 1½ inch. The roughing-cutters are caused to revolve by means of a 9-inch driving-pulley on the same axle, which pulley is driven by a band passing round the 48-inch pulley on the main shaft. The circular body or stock of the roughing cutters is of solid cast iron, 12 inches in diameter, from which the cutters project. These cutters are four in number and 9 inches apart from edge to edge.

The three finishing cutters, which are, of course, placed in advance of the roughing cutters, are set in motion by as many bands passing round three respective driving-pulleys each of 9 inches diameter: on the axle of the three 9-inch pulleys, is a 24-inch pulley, to which a band is carried from the 48-inch pulley on the main shaft. The finishing cutter furthest from the engine finishes the rain-water gutters, while the other two give the entire form to the inclined condensation gutters. Eighty-four lengths (each generally exceeding 24 feet) of solid gutters were passed through and finished, as regarded their transverse section, in the twenty hours, or double day: thus a total length of 2037 feet was ready to be carted off to the Great Building works each day; and, although the gutters were discharged by the machine in a finished state, at the rate of about five feet per minute, the work was so perfectly executed that, when the gutters were delivered upon the ground at Hyde-Park, very few of them required the touch of the chisel to smoothe off.

In addition to the work performed by the 20-horse engine already described, we must not omit to mention the apparatus for sharpening the planes and other edged-tools used with the various machines at the Chelsea Wharf Saw-mills. From a pulley at the end of the main shaft nearest to the engine (on the first floor), a cross-band passes off at right angles to a 30-inch pulley, giving motion to two grind-stones and a sharpening disc; the grind-stone nearest to the driving pulley is of 42 inches diameter, while the smaller one has a diameter of 24 inches. At the other end of the shaft is the circular disc, having a flat annular rim of lead for sharpening the planes, which is effected by the addition of fine sand thrown against the lead while in the act of rotation: the disc is 22 inches in diameter.

Next is—

THE SASH-BAR MACHINE.

The apparatus which Mr. Paxton contrived in 1837, by connecting a grooving-machine with a steam-engine, has already been mentioned at page 31, and described by Mr. Paxton, in the 53rd volume of the *Transactions of the Society of Arts*, in a paper dated March 13th, 1840, wherein he says, that the invention, "in its first state, merely performed the part of a grooving-machine, but was subsequently improved so as to make the bar complete;" adding that, by its adoption, the labour of twenty men for one year was performed, and a consequent saving of £1200 effected in labour alone.

In the sash-bar machine employed for the Great Exhibition building, we perceive the same principle as that of Mr. Paxton's apparatus, with certain additions, by which double the amount of work was performed in a given time.

Thus, in forming the Chatsworth conservatory bars, each bar was passed twice through the machine; whereas, by the machine now used, the operation of moulding both sides is performed at once. It is the invention of Mr. Birch, of the Phœnix Saw-mills, near Cumberland Gate, Regent's Park, who contracted for the supply of the skylight-bars for the Great Building, as also the upright bars for the vertical lights, and ridge-pieces for the skylights. Mr. Birch's machine differs from Mr. Paxton's, principally in revolving cutters being substituted for saws, thus providing for any difficulties that may arise from the grain of the wood; whilst, by the addition of a second set of cutters, a plank passed between this has its under and upper surfaces operated upon at the same time.

Mr. Birch's steam-power amounts to from 20 to 25 horse, of which, from 4½ to 5 horse-power is appropriated to this machine. From a 24-inch pulley at the level of the floor, a leathern band passes to the driving-pulley of the cutters, which rotate at a speed of about 5000 revolutions per minute; the cutters being secured from dust by a metallic hood, which can be removed at pleasure. One man and a boy are required to attend to the machine: the former places the 9-inch planks on the table, to be received by the 3-inch *feed* rollers, which, having parallel indents throughout, in the direction of their length, cause the planks to move forward to the cutters; while the latter receives three, four, or more, of the finished bars, according to the width of the plank, and removes them to the floor, near to a bench, where they are examined, and cut to their proper length of 15 feet. If found to be shaky, they were rejected as unfit to be used in "the model structure." In addition to those used for cutting out the moulded or bevelled parts, cutters were also supplied for separating the bars; but circular saws, each 8 inches in diameter, placed in advance of the moulding cutters, are preferred for that purpose, as the latter are more easily blunted by knots in the wood.

Besides the two feed-rollers, there are also three *pressure*-rollers, of similar diameter and length, which are regulated by the width of the plank to be cut into bars. One of the pressure-rollers is placed in the rear of the cutters, and the other two in front; and in connexion with these rollers, under which the planks severally pass, are suspended weights from adjustable levers. About 307 planks passed through this machine in ten hours, allowing for a stoppage of about ten minutes in each hour, for sharpening the cutters, &c. Now, if only three bars were produced out of each plank, it gave a length of sash-bars of about two miles and three-quarters per diem.

In another part of Mr. Birch's premises, a moulding machine was applied, with suitable modifications, for cutting the ridge-pieces for the skylights, which were finished to 24 feet lengths, and cut out of fir-timber, 3 inches square. By this machine, which was worked with a power of about *five horses*, 100 lengths, or 2400 feet, were produced in the ten working hours, due allowance being made for sharpening the cutters, &c. In forming the skylights, the several lengths of ridge-pieces were put together with ½-inch dowels, 3 inches in length.

We now leave Mr. Birch's manufactory for the building in the Park, to describe the

MACHINERY FOR FINISHING SASH-BARS, RIDGE-PIECES, AND GUTTERS.

These were delivered at the building, cut only approximately to the required length, and had to be finished on the ground, before taken to the roof to be fixed. This finishing was executed by very ingenious machinery.

First, of the power employed to give motion: this was a steam-engine, calculated at *eight horse*-power (equal to the collective force of *forty-four men*), on the locomotive principle, working with steam at a pressure of 60lbs. to the square inch. The boiler (placed *east* and *west*) was furnished with twenty-seven 2-inch copper tubes, placed horizontally, coke being the fuel chiefly used. Two horizontal cylinders of six inches diameter, with pistons moving twelve inches forward and backward, (called *the stroke*,) and having proper cranks and connexions, gave motion to two vertical fly-wheels, each of four feet diameter, and placed one on either side of the chimney end of the boiler. From the fly-wheel on the *north* side of the engine, a gutta-percha band of two inches in width passed round the driving-pulley of a circular saw of ten inches diameter, which projected sufficiently above the level of the bench, in a slot of which it was fixed in proper bearings, to cut out wooden fillets and other portions of wood-work, either from planks or scantling timber, as might, from time to time, be required. Three men were required for this particular service: the first was the carrier of the materials to and from the bench or table; the second placed and adjusted them on the bench close to the saw, and also attended to the bands, &c.; and the third removed them from the table when cut. Another gutta-percha band, of the same size as that already mentioned, passed from the *twin* fly-wheel on the south side of the engine to the *first* of a *series of pulleys* which rotated on the principal shaft. This shaft was placed horizontally, and at right angles to the direction of the engine. A third gutta-percha band passed from the first of the series of pulleys which altered the direction of the power, to the driving-pulley of a circular saw of twenty inches diameter, forming part of a compound piece of machinery by which three distinct operations were performed; viz., cutting the ridge-pieces and gutters to their proper length, cutting out semicircular pieces at ends of gutters to receive the rain water heads, and drilling holes in the ends of gutter-pieces to receive the dowels.

Mr. Saunders describes this finishing for use as executed by a machine which, "in less than one minute, cut off the ends to the exact gauge, (24 feet,) and made a further hollow at each end to receive the castings, to discharge the drip-water into the larger gutters underneath, without splashing."

The first of these operations was performed by the circular saw, which was moveable in a vertical plane by means of a sliding plate, properly balanced by a counter-weight attached to a chain passing over an iron pulley, which was fixed at the top of a strong frame of wood. By means of a hand lever, the saw was either brought down to a proper position for cutting off the ends of the ridge-pieces or gutters, or for performing the second operation already alluded to—viz., cutting out semicircular pieces from the ends of the gutters. This second operation was effected by means of two short blades, or cutters, attached to the front face of the circular saw, and projecting one inch and a half. In order that the gutters and ridge-pieces might be cut off to their proper length, they were placed on the top of a long trussed supporting frame: by means of a jointed holdfast of iron at that end of the supporting frame opposite to the saw, the ridge-piece or gutter to be cut was firmly secured; by a hinged gauge-plate, also of iron, the timbers were cut off to their exact length; and as soon as one end had been cut off, the other was easily brought round to undergo a similar operation, as the timber rested midway, on a horizontal swivel plate, having two upright cheeks, between which it was moved round. By this machine, also, the gutters were bent precisely to the camber, to be given to them by tension-rods and struts, resembling iron bow-strings.

This cambering is the invention of Messrs. Fox, Henderson, and Co., and is a very useful addition to the Paxton gutter, since the level of the roof may be altered, if requisite, by a few turns of the nuts at the ends of the tension-rods.

When the *third* operation, viz., that of drilling, was to be performed, the saw was moved upwards, so that the ends of the ridge-pieces or gutters to be perforated might be brought close to the drills, which were placed one above the other at proper intervals: a man at the *other* end of the timber pushing it forward against the two drills, which rotated at the same time. Motion was communicated to these drills by means of a band from the principal pulley-shaft, which passed round the driving pulley of the upper drill. The lower drill was made to revolve by means of a pinion on the stock of the upper drill: thus, the two double holes were made simultaneously at one end of the ridge or gutter pieces; and immediately afterwards, those at the upper end were formed.

We now come to the process of finishing off the skylight bars, which were delivered at Hyde Park from the Phœnix Saw-Mills with each end cut off square. The first thing on their arrival at the works was to cause them to undergo a thorough examination as to their freedom from sap, shakes, and other defects.

On a saw-table, conveniently placed with respect to the communication of power, to give motion to the saws, were placed together *thirty* common sash-bars, which rested on a horizontal moveable traversing frame, to which they were properly secured by an adjustable bar. This frame was moved forward towards the saws by a man standing at the *west* end of the table, the saws being so placed that both ends of the *series* of *bars* might be cut off simultaneously. Two leathern straps passing from pulleys on the main shaft already mentioned, and passing round the driving-pulleys of the saws, gave motion thereto: that on the *north* side of the table, to an inclined circular saw of fourteen inches diameter, by which the *bevelled* ends of the bars were formed; and that on the *south* side, to two vertical circular saws, the exterior being fourteen inches diameter, and cutting the bars off to their proper length; and the interior one, of eleven inches diameter, making a cut half across the bar, but still leaving a *longitudinal cut* to be made in order to form the shoulder.

The bars were next carried to a bench, removed a little to the east of the saw-table, when, by a simple but ingenious contrivance (the invention of Mr. Wilson, one of the superintendents of the works,) the shoulder, with the requisite bevel of that end of the bar which abuts against the gutter, was performed at one operation. This little machine, which is constructed of iron, consists of a rounded handle, which the workman holds in his left hand. The handle is two inches and three-quarters in length, from which project two jaws, nine-sixteenths of an inch apart, made to fit into the ends of the grooves intended to receive the glass; between these jaws is a knife, which, by the pressure of the workman's hand, cuts off the square piece, the cross-cut for which is previously made by the smaller of the vertical saws above described. On the right-hand side of this machine is a second but moveable knife, which, including its handle, is five inches and a half in length. This knife, or blade, moves on a small pivot, fixed at the top end of the machine, and is placed at the proper angle for removing the bevelled piece to complete the gutter end of the bar. Two men attended to this operation; one to place the bars on the bench, ready for the operation, and to remove them when finished; and the other, to attend to the operation itself. Thus were completed the 205 miles of sash-bars to hold the glazing of the roof and sides of the great building.

We now come to the last stage in the progress of a skylight bar previously to its being painted.

On a horizontal bench, placed at right angles to the main pulley-shaft—were placed, in front thereof, a series of *four-inch* driving pulleys, with as many horizontal drills turning in proper brass bearings: these pulleys being made to rotate by means of a leathern strap, or band, from a pulley on the main shaft. The use of these drills was to make the nail-holes at either end of the bars. Four boys and one man were engaged at this branch of the operations: the man superintended the whole, and kept the machinery in order; while the boys each attended to one drill. There were additional drills on this and another bench, if required by a great press of work. Opposite to each of the *operators* was a wooden traversing plate, working in the direction of its corresponding drill: the lower end of the bar, resting on this traversing plate, was pushed forward with it against the drill, until the requisite perforation is entirely completed. While one end of the bar was being bored, the other end rested in an inclined position against a wooden rail placed longitudinally above the pulleys, having as many sinkings thereon as there were drills. The wooden rail, to which it was secured by a fillet, projected from an inclined frame of the same material firmly secured to the bench. At the outer end of one of the driving pulleys was a *cutting cup,* also the invention of Mr. Wilson, by which the ends of the wooden dowels, three inches in length, were rounded off, merely by being held therein by a workman or boy during the revolutions of the pulley.

These machines are described as above, by Mr. Whishaw, in No. 456 of the *Illustrated London News.*

The latter machine is not, however, a novelty, being essentially the same as the brush-maker's bit, long used for boring very thin substances with the utmost precision.

MORTISING MACHINE.

Among the various useful machines which have been made available in the construction of the Great Exhibition building, the contrivance known as the Mortising Machine merits notice. It is the invention of Mr. Furness, of Liverpool. Usually, mortises (excavations in timber to receive projecting tenons in another piece of timber, to fix the two together,) are made by hand; but, owing to the thousands of mortises required in the sashes of the great Building, this would have been a most tedious process. Accordingly, Mr. Furness contrived a machine, by which seven or eight mortises are cut out during the time that would be occupied in cutting out a single one by hand.

The machine is worked by the foot of the operator, who moves a treadle, which, with levers connected by round iron bands, gives motion to a vertical rod in front, to which is attached the chisel, varying in size from the eighth of an inch to two inches. Every time the treadle is depressed by the foot, this chisel is brought down into the wood; and, by a wooden spring attached to the beam fixed over the machine, the return of the vertical rod is effected, and thus a reciprocating motion is carried on.

The piece of timber to be mortised is placed on a *rest,* made of two pieces of hard wood, in front of a carpenter's bench, and a fence fixed at the top of the rest, leaving sufficient room for the timber in front. The workman, while the operation is in progress, presses the wood against the rest. In the middle of the frame of the machine is a gauge wheel, worked in connexion with a horizontal screw attached to the frame, by which contrivance the chisel may be moved backward and forward. The frame is attached to two horizontal round rods, working between front and back uprights; and, being connected with the vertical chisel-rod, the mortises are formed with great accuracy.

Another economical substitute for manual labour was—

THE SASH-BAR PAINTING APPARATUS,

in which the tedious process of hand-painting was superseded by a very simple contrivance. It consisted of a framework, with screws which fastened the brushes, and through which a sash-bar was occasionally passed, to keep them clean. After being primed, the bar was placed in a wooden tank, containing paint of the consistence suitable for the first coat; it was then taken out and passed through the brushes, to remove the superfluous paint, which ran off into a wooden shute, placed in an inclined position. By this means, the *miles* of sash-bars were painted with equal rapidity and precision, before they were glazed and fixed in the Great Building.

Hitherto we have described the construction of nave and side-aisles of the Building; there remains to be detailed—

THE TRANSEPT.

This is by far the grandest feature of the vast structure, not only as regards its stupendous beauty, but also for the ingenuity displayed in its constructive details. It was altogether a magnificent afterthought; and any one who is sceptical as to its improvement of Mr. Paxton's first design, has only to compare the first published view with a view of the Crystal Palace as it has been constructed, with the crowning addition of the transept and its lofty and elegant roof.

The transept is now acknowledged to have been suggested by Mr. Henderson, as the means of imparting strength and solidity to the Building, as well as increasing its beauty. Mr. Paxton at first objected to its introduction, but soon, becoming convinced of the improvement, he very sensibly gave up the point. The claim to the design of the semi-circular roof has not, however, been so clearly decided; but it is allowed to have been devised to satisfy the public demand for the saving of certain lofty and venerable elms, which had been condemned to be removed, but were saved by the semicircular shrine of glass.

This is claimed by Mr. Paxton, who states that, "in order to get the tender in, it was necessary the Building should cover the exact space marked out by the Building Committee; but, in conforming to this plan, the transept was obliged to be put into one side of the Building, for the purpose of avoiding the great trees which now stand within it, but which, according to the tender sent in, were to be in an open court. At one of the meetings with the Building Committee, it was suggested by them that the transept should include the great trees; but there appeared at first sight a good deal of difficulty in accomplishing this, as at that time all the roofing was designed to be flat. We promised to see what could be done before the next meeting of the Committee. I went," continues Mr. Paxton, "direct with Mr. Fox to his office; and while he arranged the ground-plan, so as to bring the trees into the centre of the Building, I was contriving how they were to be covered. At length I hit upon the plan of covering the transept with a circular roof similar to that on the great conservatory at Chatsworth, and made a sketch of it, which was copied that night by one of the draughtsmen, in order that I might have it to show to Mr. Brunel, whom I had agreed to meet on the ground the next day. Before nine the next morning Mr. Brunel called at Devonshire House, and brought me the heights of all of the great trees; in the note containing the measurements, Mr. Brunel wrote thus:—'I mean to try and win with our plan; but I have thought it right to give your beautiful plan all the advantages it is susceptible of.' I then showed Mr. Brunel the plan I had made the night before, for covering in the trees, with which he was much pleased. I have been led into these minute details, *first,* to show that the circular roof of the transept was designed by myself, and not by Mr. Barry, as currently reported; *secondly,* to show the kindness and liberality of Mr. Brunel. At the time of the tender being accepted, the Building Committee asked me if I had any objection to my design being improved in some of its details; my reply was to the effect, that I should have great pleasure in agreeing to anything that could be shown to be an improvement."

This statement was made by Mr. Paxton, at a dinner given in the New Assembly Rooms at Derby, on August 5, 1851; and, later in the evening, Mr. Henderson attempted to explain the discrepancy, as follows:—"One Saturday night," said Mr. Henderson, "when the Commissioners sat late, it was suggested that some plan should be adopted for covering the trees. Mr. Barry had been absent every day during the week until that evening, and he knew the difficulty. Mr. Paxton had suggested that the covering should be by a circular roof. He did not think that Mr. Barry knew that arrangement; and on Monday morning, Mr. Barry produced a sketch, giving to the transept a circular roof."

These proceedings have produced the following counter-statement from Mr. Barry, addressed to the Editor of *The Times* of August 9:—

SIR,—In your report of the dinner which was given to Mr. Paxton at Derby, on the 5th inst., I find, from the speech of that gentleman, that he considers the idea of the vaulted roof over the transept of the Crystal Palace to have originated with himself alone. Without wishing in any way to detract from the distinguished talents of Mr. Paxton, or the well-merited honours which have been conferred on him for designing and carrying into effect one of the most striking edifices of modern times, or to say one word about any assistance which I may have afforded to him and the contractors in working out the principles and details of that building, I cannot allow it to be supposed that, by not contradicting the current report which has attributed to me the suggestion of a vaulted roof, I am tacitly assuming a merit which does not belong to me. I therefore beg to state that, at the first presentation of Mr. Paxton's design to the Building Committee, as well as to the Royal Commission, and before Mr. Paxton made any suggestion on the subject, I recommended very strongly the addition of a vaulted roof, not only over the transept, but also over the nave, and submitted a sketch—now in my possession—to show the Commissioners the effect of such an addition, without having any knowledge whatever that such an idea, as I must infer from what Mr. Paxton states, had already occurred to him. Both the Royal Commission and the Building Committee can bear testimony to my anxiety for the addition of the vaulted roof over the nave as well as the transept, which addition was, in fact, adopted, and the extra cost of it arranged with the contractors at one of the meetings of the Commission. That arrangement, however, so far as regards the nave, was set aside at a subsequent meeting, from fears, which I was then persuaded, and am more convinced by subsequent events, were altogether groundless—namely, that the vaulted roof over the nave could not be executed within the time assigned for the opening of the Exhibition, on the 1st of May.

I am, Sir, your obedient Servant,

CHARLES BARRY.

Westminster, August 7.

Mr. Digby Wyatt, on the other hand, in his description of the Building, in the *Official Illustrated Catalogue,* distinctly claims the transept design for Mr. Paxton, at the same time acknowledging Mr. Barry's tasteful aid. "From the north-west angle," says Mr. Wyatt, the most picturesque view is to be obtained, and from that position may be best appreciated the grand effect produced by *Mr. Paxton's happy idea of raising the semi-cylindrical vault of the transept-roof* above the tiers of terraces which extend on either side of it. For much of the grace of proportion and beauty of form, which, from this point of view, the visitor cannot fail to notice, the building is indebted to Mr. Barry. Upon the form and distribution of the arches and filling-in frames, as well as of the columns, the suggestions of that gentleman exercised a happy influence."—(*Part* I. *page* 67.)

We now proceed to the mechanical details of the Transept, which the reader will the better understand from the construction of the nave, already explained. The arrangement of the transept columns, girders, and galleries, corresponds with that of the nave. At the level of the flat roof, the main difference commences by the springing of the lofty semi-circular roof, the two end faces of which are handsomely distinguished by their radiating frame-work. The transept consists of a main avenue, 408 feet long by 72 feet wide; and two aisles, each 408 feet long by 24 feet wide. The larger of these areas is spanned by the semi-cylindrical roof, formed of semicircular ribs, the ends of which are inserted in the hollow columns; these ribs are strengthened by stout timbers, placed between the ribs, and at right angles to them, and which act as purlins, and great intermediate sash-bars. "Upon this simple and effective system," observes Mr. Saunders, "sixteen light and strong ribs have been made to span a width greater by 1 foot than the nave of Westminster Abbey, including its side aisles, and that at an elevation greater by 6 feet. The near approximation of figures is curious, and the contrast striking." Again, "a half-cylinder of glass, 73 feet in diameter, and 408 feet in length, with its summit at the elevation of 8 feet from the ground, would exactly represent it in curvature and situation; but to complete the architectural effect, would require the connexion of contiguous parts. Taken as a part of the building itself, one glance will suffice to convey an impression of its lightness and strength, and to speak a whole treatise on the consummate ability with which mechanical stability has, in this important part of the work, been united with architectural beauty."—(*The Palace of Industry*, &c. page 44.)

The Transept ribs were constructed in the great nave, somewhat east of the transept, under the superintendence of Mr. Fowler. They are marvels of carpentry, and are of the best Memel timber, the resistance of which to longitudinal compression is greater even than that of iron, weight for weight. The ribs "are made in three thicknesses of timber, cut into segments, 9 feet 6 inches long, of a circle 74 feet extreme diameter, the centre thickness being 4 inches by 13½ inches, and the outer, or flitches, breaking joint with the centre, being 2 inches by 13½ inches. The flitches are nailed to the centre thickness; and ⅝ths inch-bolts, about 4 feet apart, on the segment, traverse and bind together the three thicknesses. On the extrados, or outer circumference of the wooden arch thus formed, two planks, serving as a gutter-board, 11 inches by 1 inch, and a bar of iron 2 inches by ⅜ths of an inch, are bent to the curve; and on the intrados, or inner circumference, a piece of timber, 7 inches by 2 inches, moulded to correspond with the form of the columns, and a bar of iron, 3¼ inches by ⅜ths inch, are also bent to the curve. Bolts, at intervals of 2 feet from centre to centre, passed through the depth of the rib, unite these additions to each other, and to the main rib, which, thus increased in scantling, measures, complete, 1 foot 6 inches by 8 inches." (*Transactions of the Institution of Civil Engineers.*)

The planks being cut in 6 feet lengths, to the requisite thickness and width in the saw-mill, were converted into the segment of an annulus, or figure of the same form and dimension as the rib itself, in the following simple and economical manner, as described by Mr. Saunders: "a *templett*, or plate of metal, worked up to the exact pattern required, was laid upon the wood, and adjusted to the direction of the grain; the pencil was then carried round the edges of the templetts, and saw-cuts made along the mark perpendicularly to the face of the plank. By means of the templett, the curvature was accurately obtained at all points; and it is obvious that an elliptical or curvilinear roof of any species might be constructed in a similar manner; only, as the radius of the curvature is not constant, except in the circle, but varies continually from point to point of the curve, a set of different templetts would be necessary to make the different segments of the arch. The entire rib was built of two layers of two-inch thick segments, formed in the above manner, with a layer of four-inch thick segments interposed between them. All these being accurately portions of the circle, no great difficulty attended their union, because, when put together, they exactly made up a circular arc." The segments were placed in layers, so that the two-inch break-joints fall upon the centres of the four-inch, and *vice versâ*; each rib being an arch, its segments, voussoirs, or wedge-blocks, and having no horizontal thrust.

The raising of the Transept Ribs was the most difficult operation in the whole construction. The scene of two thousand men occupied in all parts of the works, aiding the accomplishment of the vast design, was, from time to time, an animating and exciting spectacle; but, the gangs of men raising the monster ribs presented, upon the whole, the most picturesque appearance; "the peculiar character and cut of the 'long-shoremen,' engaged in this particular service," says Mr. Whishaw, "from their capacity of handling and hauling ropes, and of managing hoisting tackle, added considerably to the general effect."

"The ribs of the transept," continues Mr. Whishaw, "may be compared to the ribs of the centering of a semicircular arch of 72 feet span. Every one engaged in engineering works knows the amount of skill required, and the great caution to be exercised, in putting together the temporary support of a stone arch, while under construction. Piles are driven into the bed of the river, to bear longitudinal and cross timbers; and on these, again, are framed various timbers, placed vertically, horizontally, and diagonally, and technically known as trusses, which support the ribs. But in the present case, no such support could be obtained; the whole strength must be chiefly in the ribs themselves, which were required to be suspended by ropes, and raised bodily in pairs from the ground to a height, in the first instance, of nearly 70 feet, without any scaffolding whatever. The weight of a pair of these ribs, when connected, ready to be raised, was 8 tons; and as there are altogether eight pairs of ribs, there is a load of 64 tons in this semicircular roof, independently of the intermediate timbers, and the glass."

The idea of *coupling* the ribs before hoisting originated with Mr. Willbee, to whom it occurred that, if two ribs were first braced together, with their purlins, intermediate bearers, and tension-rods, they would form, when fixed, a purchase in aid of the raising of the others; but, at the suggestion of Mr. Cochrane, all the ribs were thus coupled, and fitted with purlins, intermediate supporters, and diagonal iron-rod trussing, secured with screws and nuts, and protected by timber stays,—before each pair was raised.

The vertical supports for the roof consist of cast-iron columns, already described, placed one above another in three tiers—sixteen in each tier on either side. Above the top tier are fixed the trussed girders, 3 feet in depth, spanning from column to column, which are each 24 feet from centre to centre; and across the intersecting lines of the middle aisle are two double-trussed girders, 6 feet in depth, and corresponding in length with three spaces of 24 feet each; except under the columns of the south-east angle of the transept, the whole are placed on broad base-plates, already described, which rest on concrete foundations. In the exceptional case, the foundation consists of a solid brick pier, built in cement. At the top of each column which supports the roof is a cast-iron socket, 4 feet 4 inches in height, the use of which is to receive the vertical legs or supports of the rib, as framed together on the ground.

To resist the lateral thrust of the roof, there was formed on each side of the transept a gangway, 24 feet wide, constructed of strongly-framed and braced flooring, supported by trussed girders.

A pair of tie ribs was prepared for hoisting, as follows:—Two separate ribs were first raised in a convenient situation in the central aisle, by means of ropes and tackle in connexion with *crab* engines; and framed together with thirteen purlins, $4\frac{3}{8}$ inches by $13\frac{5}{8}$ inches, and two intermediate rafters; the whole being further strengthened by wrought-iron diagonal ties, two on each side; from side to side of each rib extended a horizontal tie, made of six pieces of scantling timber, each 7 inches by $2\frac{1}{4}$ inches, separated by blocks, and bolted together, and suspended from the crown by four flat iron rods, 3 inches wide by $\frac{1}{4}$ inch thick. The legs of two ribs, when connected together, rested on a temporary sill, 15 inches by 5 inches, the whole being firmly strutted and braced together.

The hoisting of the ribs was then performed in four stages.

The first stage was to move the pair of ribs, framed together, to the central space of the transept, ready to be elevated. This was accomplished by placing several friction rollers between stout planks laid longitudinally under two sills, the whole being moved forward by a force of about thirty men, supplied with crowbars and other appliances. This stage of the operations was readily performed, and without danger.

The second stage in the process was raising the pair of framed ribs to the level of the temporary wooden tram-way, on which the whole had to be moved to its destined position. This part of the process required the united labour of forty-eight men, twelve to each of four *crab* engines, placed near to the four intersecting angles of the centre aisle and the transept. The use of the *crab* engines was to wind up the ropes by which the ribs were suspended; four men worked the handle on one side and four on the other, while two men drew out the tail-rope, as required, and the other two attended to the front part of the engine. The rope from each engine passed to a leading pulley on the opposite side of the transept, and thence, in a diagonal line, to hoisting tackle on the top of the double girder over the central aisle at its intersection with the transept; from which tackle it passed down to one side of the frame of double ribs, where it was securely fastened.

When all the ropes and tackle were properly arranged and adjusted, Mr. Fox gave the word of command, and the four gangs of men at once commenced the task of raising the girders, by moving round the handles of the *crabs*, and thus winding the rope twice round the barrel, when the *tail*-rope was pulled out by the two men, as already mentioned: four guide-ropes, to steady the ribs in their upward movement, were connected therewith—two fore and two aft, the other ends of which were attended to by as many men. This part of the process was completed by lodging the ribs safely on the top of the large temporary beams or tram-plates.

The third stage was to move the pair of ribs along the top of the transept, opposite the situation which it was destined to occupy. This was effected by intercepting between the temporary sill of the ribs and the tram-plates five friction-rollers, on each side of the transept, at the springing level. These rollers were each 5 inches diameter, and, being formed with a sinking in the middle, were kept on the tram-plates while being moved forward. In each of the rollers were perforations, capstan-fashion, to receive the ends of the levers, by which the whole was moved forward; twenty-four men being required for this particular service.

We now come to the fourth and last stage. When the frame of double ribs was moved to its horizontal position above the sockets, each side of the frame was attached to pulley-tackle on the top of a derrick raised on either gangway, as already mentioned, by means of ropes attached to the crabs. Thus, the whole frame was once more suspended; and the rollers and temporary timbers having been removed, the legs were dropped into their respective sockets. The space on either side, 24 feet wide, is covered with lead, forming what is termed a "lead flat," to receive the water from the roof of the transept. On the side of the "flat," removed from the transept, is a wide gutter lined with lead, and laid with proper fall to the rain-water heads over the hollow columns.

Details of the Transept Roof.—The construction of the principals or main ribs has already been described. The preparation for the ends of the purlins, however, remains to be noticed. First, the two wide planks were cut across so as to form a cavity to admit the ends of the purlins, the parts of the planks thus separated being connected together by cast-iron plates. The openings thus made were filled in temporarily with wooden blocks, until the joiners were ready to fit in the ends of the purlins.

The strength of every purlin was duly calculated according to its relative position in the arch: thus, the three uppermost purlins, having the greatest strain on them, are each 13½ inches in depth by 4½ inches in width; while the four lower purlins on each side, having gradually less strain to bear, diminish regularly in depth to 9 inches, all having the same width as those at the crown; whereas, the lowest one on each side of the arch, being nearly horizontal, is increased to a scantling of 8 inches by 6¼ inches.

Between each pair of main ribs are two intermediate ribs, or, as called in ordinary roofing, *common rafters*, 4 inches deep by 3 inches wide. On the top of these are gutter-boards, in two thicknesses, as those described for the main ribs. The gutters, each 5 inches wide, are formed by two splayed fillets, let into and nailed securely to the upper side of the boards. These fillets also serve as abutments for the skylight bars, which are rather larger in section and size than those for the skylights in other parts of the building. Each bar is nailed at the lower end to the fillet, and at the upper end to the ridge piece, which is formed of three pieces of fir, one above another, the lower section being 4 inches wide by 1⅛ inches thick; the middle piece, 3 inches by 1 3-16ths inch; and the upper piece, 2 inches by 1⅜ths inch—the latter having a groove on each side to receive the glass. The three thicknesses are necessary in order to suit the curvature of the arch. The lower end of each ridge-piece is carried down to, and rests on, the lead flat.

Condensation gutters are formed in this roof, as in the roofs of the aisles and avenues, but by a different method. A sloping fillet is nailed on to each side of the gutter-board, and continued from the springing of the arch on one side to the corresponding point on the other. With a view to retain the ridges in their places, wrought-iron rods of $\frac{3}{8}$th-inch diameter extend from the purlins to the underside of the ridges.

In order thoroughly to carry off the rain water from every part of the roof, all the skylight bars are fixed diagonally from the ridge to the gutter; the water collected in each curved gutter is carried into a sloping trough at bottom, and thus discharged on to the lead flat, which is sloped towards the water-heads at tops of the hollow columns. Looking at the roof from the lead flats, the whole has a *herring-bone* appearance. The glass used for the skylights of the transept is the same as that described for other parts of the building; but every piece of glass required to be cut at each end to suit the angle formed by the sloping sash-bar, and the ridge-piece and gutter-board respectively.

To facilitate and expedite the glazing of this roof, travelling scaffolds were used, which were raised and lowered at pleasure by means of ropes and pulleys, and by the power of four men working a crab engine, placed on the lead flat contiguous. Each travelling scaffold ran on small friction-rollers, suited to the tops of the ridge-pieces which served as rails: without such a contrivance the glazing of the roof of the transept would have been almost an endless labour.

The Great Fanlights, which terminate the north and south portions of the transept are prominent ornamental features. Cast-iron would have been too heavy for windows of so large a size, and they are, accordingly, formed chiefly of wood. As these windows form the ends of the roof of the transept, which is 72 feet in width, from centre to centre of its supporting columns, on either side, so the radius of each fanlight is half of the above width, or 36 feet. The whole is formed of a bottom plate, four semi-rings, and eleven radial bars, all of wood, together with a central portion of open cast-iron work.

The outer ring is formed of deal sides, bottom and top, made up of two planks, the whole being nailed firmly to angle-fillets within. The cross section of this ring is 2 feet 5 inches by 12 inches. In its front is attached, by counter-sunk screws passing through blocks, a flat semi-elliptical hollow moulding of cast-iron, having a projection of 4 inches, which gives a finish to this part of the building, and corresponds with the general outline of the design. Stiffening pieces are fixed inside the rings throughout, forming so many chord lines. The next ring is framed in a similar manner to that already described, but is only 16¼ inches in width.

The third and fourth rings are of solid deal, 12 inches wide, with a hollow cast-iron splayed projecting piece screwed in front thereof, to correspond with the general design; chamfered fillets, each made up of three thicknesses, in order to obtain the proper curvature, are nailed to the several rings to form stops for the glass.

The radial bars are framed into the several rings, and secured at bottom to the cast-iron ornamental central portion of the window.

Each radial bar is solid, having a scantling of 12 inches by 4½ inches at its upper end, and tapering to 2½ inches in thickness at its lower end, at a distance of 4 feet from the centre of the window; chamfered fillets being fixed to each side of the radial bars. The semi-rings and radial bars are firmly secured together at their intersections by triangular blocks of elm, one being placed in each of the four angles, and bolted together by two ½-inch bolts running diagonally through the blocks; the whole being further strengthened by angle-irons corked into wooden segments, and screwed to the radial bars. The central semicircular division, 8 feet in diameter, is formed of open cast-iron work, in seven compartments, six placed radially around the seventh, which forms a curvilinear panel, whose projecting rim corresponds with the six radial divisions. The radial bars are all firmly fixed to the cast-iron central compartment; the twenty-four upper compartments are all splayed at their angles, and the lower twenty-four compartments are finished with hollow cast-iron semicircular heads; the horizontal plate forming the lower part of the frame of the fanlight, is of fir. The sash bars are of similar size and section to those of the vertical lights of the galleries, having a groove on either side, to receive the glass, which is connected at the meetings with leader junction-pieces. The whole is surmounted with an ornamental cast-iron frieze.

Upon the southern fan-light are fixed the hands of the Electric Clock, and the radiating bars serve as a semicircular dial for the figures. The clock we shall describe hereafter.

THE GLAZING STRENGTHENED.

To fortify the glazing against the force of the wind, the sash-bars and styles are pierced by three iron rods, fastened by nuts and screws, by tightening which the entire frame becomes bonded. Again, the glazing of the surface is further strengthened behind the centre rod by a piece of wood, the ends of which drop into castings near the rod ends. The front edge of the wood, next the sash-bars, is slightly cambered; whilst in a groove at the back is placed a tension-rod, which, being tightened by nuts at the ends, gives a slight convexity to the several sections of the glazing, and thus enables them the better to resist external pressure.

This ingenious provision for the 1500 sash-frames is thus more minutely described in the *Transactions of the Institution of Civil Engineers*:—"The sash-frames are 2½ inches thick, with seven bars in their width; the bars being 2⅝ inches deep, double-grooved for glass. Wrought-iron bolts, ⅜ inch diameter, pass completely through the sash-bars and sash-frames, at the points where they are attached to the columns; and thus a chain-tie is kept up all round the building, in order to prevent displacement of the sashes either bodily or in portions, by the pressure of the wind. To further guard against the same action, timber bridges, 3½ inches by 1½ inch in the centre, are fixed across the middle of the length of the sash; and at the internal angles, where the wind will exert its greatest force, iron rods, half an inch in diameter, are fastened from column to column, pressing against the wooden bridge, and converting it into a continuous strut, bearing up against any force applied to the exterior of the sash." We now proceed to detail

THE VENTILATION OF THE BUILDING.

This point was carefully considered by Mr. Paxton, in his original plan, it being evident that a building where so many individuals were to congregate, required constant admission of pure air; and a most copious supply was thus provided:—

"Four feet round the whole of the basement part of the building," says Mr. Paxton, "is made of *louvre-boarding;* and at the top of each tier a similar provision of 3 feet is made, with power to add an additional quantity if required. In the centre aisle, also, the air will be plentifully admitted. By simple machinery the whole of this ventilation can be regulated with the greatest ease. The advantages of this kind of ventilation are several. Louvre-boards are very simple in construction. They can be opened and closed instantaneously, with the greatest readiness. They nicely distribute the air, and yet admit a large volume of it; and, from the manner in which they are placed over each other, they effectually prevent the entrance of wet in rainy weather."

This part of the plan was altered in detail. For the spaces or panels formed by the wooden columns vertically, and by the sill and plate horizontally, are introduced the lower tiers of ventilators, originally intended to have been formed of louvre (vulgo, luffer,) boarding, similar to that extensively used in breweries; but these ventilators have been improved in their details, have a light appearance, and are more easily opened or shut, when required, than by the cumbrous louvre-board plan. Each frame of the lower tier of ventilators is constructed of $\frac{7}{8}$th deal, is 7 feet long, 4 feet 3 inches high, and $4\frac{1}{2}$ inches deep; being dovetailed at angles, and further strengthened behind by angle-ties. The blades or luffers are of galvanized sheet-iron, forming a flat S curve. Each blade is hung as a swing dressing-glass, with two $\frac{5}{8}$th inch pivots resting in proper bearings, fixed in the side of the frame. The blades, which are placed horizontally, are 6 inches from centre to centre; the whole being connected together by a vertical deal chamfered bar, by means of forked iron arms $3\frac{1}{2}$ inches long, and fixed to the sides of a sinking or groove in the vertical connecting-bar, which is 3 inches in width, and of sufficient length to embrace the eight blades. By the weight of a single pound, all the blades can be opened or shut at will, by a simple lever apparatus. The total surface of ventilation is nearly 50,000 superficial feet; the means of shifting is applied at about 90 different points; and each lever regulates 600 feet-superficial of ventilation. A wooden stop is introduced, both at top and bottom of the frame, to prevent the upper and lower blades from moving beyond their prescribed limits when closed. The construction of the upper tier of ventilators is similar to that of the lower, but, instead of eight blades, there are only five in each frame. The upper ventilators occupy the space above the close boarding, and are immediately behind the ornamental iron fanlights or panels.

The mode of opening and shutting the ventilating blades or louvres, however, merits further description. The contrivance is so simple that one man can move, at least, 24 sets of the lower ventilators at a time. For this purpose, at a height of about three feet from the floor, is a small iron frame projecting from the close boarding to which it is attached. In this frame is a spindle placed horizontally, which is turned by a winch; and, by means of a small beveled wheel, fixed on the spindle, and working into the second wheel placed horizontally, and on the top of a vertical shaft, with a worm near to the step fixed in the floor in which it turns, motion is given to cogged segments, fixed on the horizontal shafting, as above. The segments can be moved either in one direction for opening the ventilators; or in the other direction for shutting them. The apparatus is completed by double cranks, fixed at proper intervals, and by means of a $\frac{3}{8}$ inch iron roof, in connexion with slight vertical arms for each set of ventilators; these arms being furnished with pivots, one to each blade, so that the whole are moved together.

Messrs. Tupper and Carr supplied the 11,000 plates of their galvanized iron, of No. 18 Birmingham wire-gauze, which constitute the ventilating blades.

To modify the intensity of the light, and, at the same time, to aid in keeping the building cool, a canvas covering is attached to the ridges throughout the flat roof. The seams of the canvas occur immediately over the Paxton gutter, into which the rain-water falls, having been brought by capillary attraction to this point, and thus reducing the chances of leakage by broken panes or imperfect joints.

In a discussion which took place at the Institution of Civil Engineers, Jan. 28, 1851, it was maintained that the great amount of light, admitted through a roof entirely composed of glass, was objectionable for the display of works of art; and it was contended that a roof partially covered with slates would have been better for general purposes. It was also proposed to use Sir William Burnett's system of saturation by a metallic salt, to prevent the accidental burning of the canvas on the roof.

We now proceed to detail

THE DRAINAGE OF THE BUILDING.

We have already explained the employment of the hollow iron-columns of the building as down-drains or water-pipes to convey away the water from the roof-gutters. This is effected by the bases of the columns being fixed in the horizontal water-pipes, which are 6 inches internal diameter, and run underground in the direction of the length of the building. The columns are each placed in a socket, constructed with bars $\frac{5}{8}$ of an inch thick, 3 feet 1 inch long, and 18 inches wide, the whole being strengthened with vertical flanges: the internal diameter is 6 inches, and its surface is enlarged at its four angles for $1\frac{1}{4}$ inch bolt-holes, which correspond with perforated projections at the lower end of each column; so that, by screw-bolts and nuts, the two are firmly secured to each other.

Mr. Whishaw has well observed that "the drainage of a building having a horizontal area of roofing of something like 18 acres, requires not a little skill in arranging the various lines of the main drains, and in apportioning accurately the sectional areas of the gutters, pipes, and drains, so as effectually to carry off the largest amount of rain-water likely to fall at any period, causing temporary stoppages, or the drains blowing up." Moreover, the ridge and furrow plan of roofing requires that every length, both of longitudinal or transverse furrow or gutter, should be so formed as to carry off half the rain-water received into it from the skylights in one direction, and the remainder in the other direction. This is effected by *cambering* every length of gutter, as already described. The surface-water from the skylights is received into the longitudinal or three-way gutters, and these again empty themselves into the framed transverse gutters at either end; the sectional area of the former being about 5 square inches, whilst that of the latter is 27½ square inches.

The hollow cast-iron columns which support the various gutters, and act as so many rain-water pipes, in conveying the water from the roof into the cast-iron drain-pipes, run in parallel lines along the whole length of the building, and have each a sectional area of 24¼ square inches. Thus, it will be seen that, as the stream from its fountain-head increases and widens, so the system of drainage, following nature as its guide, presents a gradual increase of sectional area, until it reaches the capacious culvert, which finally discharges itself into the sewer of the metropolis.

The principal drain or culvert runs under the ground at the east end of the building. It is of egg-shape, or natural oval; its height being 2 feet 6 inches, its width 2 feet, and length 390 feet, to its junction with the metropolitan sewer, under the carriage-drive on the south side of the building. To the same outlet, a similar culvert, from the central transverse drain, runs beneath the above road, just outside the outer line of the footpath; it has a fall of 1 in 288 feet, and extending altogether 855 feet.

The main cross drain is placed 24 feet east of the central transverse line of the building: it is 18 inches in diameter, extends 294 feet southward, and has a fall of 1 in 240 feet. This cross-drain is continued by a 24-inch drain, with a similar inclination to the last, and running into the culvert in front of the building, at the distance of 190 feet.

Next is a 12-inch drain-tube, extending westward under the same road, inclined 1 in 288 feet; its whole length being 964 feet, to its junction with another sewer. At the west-end of the building, a 12-inch drain-pipe, 156 feet long, extends from the central line of the edifice, to join the 12-inch drain-tube beneath the road.

On the north side of the building, and running eastward, is a 9-inch tube in connexion with one of the lines 6-inch cast-iron pipes, 348 feet long, and falling 1 in 192. On the north side likewise is a 12-inch drain, 672 feet in length, and returning southward 78 feet; and further extended in the same direction 144 feet, to meet one of the lines of longitudinal 6-inch cast-iron drain-pipes.

Finally, there are 38 6-inch inlets from the bottoms of columns to the drain on the north side of the building, thus completing the entire system. Its details are of great interest, more especially as the importance of drainage, in a sanitary point of view, is now fully appreciated.

EXTERIOR RAILING.

The building is surrounded, at the distance of eight feet, by an ornamental iron railing, designed by Mr. Owen Jones, who has here very judiciously combined some of the leading features of the internal construction of the building, including especially the columns and trellis girders. The whole is painted to imitate bronze.

VIEWS OF THE EXTERIOR OF THE BUILDING.

The decoration of the building was entrusted to Mr. Owen Jones, whose artistic studies of colour, and whose systematic knowledge of the colouring adopted in Egypt, and in the East generally, in Spain, and other countries of Europe, eminently qualified him for this tasteful labour. In a paper read by him on the investigation, before the Royal Institute of British Architects, Dec. 16th, 1850, Mr. Jones observed: "The building, the painting of which we are now about to discuss, is well known by its marvellous dimensions, the simplicity of its construction, and the advantage which has been taken of the power which the repetition of simple forms will give in producing grandeur of effect; and I wish to show that this grandeur may be still farther enhanced by a system of colouring which, by marking distinctly every line in the building, shall tend to increase its height, its length, and its bulk." In the decoration of the interior, Mr. Jones has fully developed this system: externally, the building is coloured in its main lines a delicate blue, upon a white and stone ground, and the effect is gay and elegant, without any approach to tawdriness. The wood paneling, with which the lower story is filled in, is coloured in clever imitation of dark oak; but the beautiful form of the columns, (the suggestion of Mr. Barry,) is kept in blue and white. Flags of different countries are placed upon standards, which rise from the outer edge of the roof of the nave, and relieve its monotony; agreeing, as we do, with Mr. Jones, that "the defect of the building—for such it undoubtedly is—is its immense nave with a flat roof. Had a circular roof been adopted for the nave, similar to that of the transept, the building would, no doubt, have been one of the finest in the world."

The structure may be viewed with various effect from different points. At the principal entrance by Prince's Gate, the spectator is too near the edifice to appreciate the beauty of this the south front; and, if he recede, the intervening objects still mar the effect; although the altitude of the transept is well seen here, and is not diminished by the national flag which rises from the extreme end of the transept roof, here and at the northern point. From the south-west angle, the airy, pavilion-like character of the entire building, and especially of the end façades, is well seen; and the magnificent transept breaking the long-drawn avenue and aisles, and rising from tiers of terraces, is finely shown. Mr. Digby Wyatt considers the most picturesque view to be obtained from the north-west angle, assisted by the double foreground of trees.

The view from the south bank of the Serpentine, especially at mid-way, shows the transept roof in bold relief, which, when backed by a clear bright sky, gives the glass ridges the pellucid effect of *crystal*, suggesting the popular epithet for the entire edifice.

From a spot near the Royal Humane Society's Receiving-House, on the north bank of the Serpentine, the full extent* of the building, in its beautiful outline and details, and the graceful transept, are well seen.

From the high ground—"the Deer Park"—verging upon Kensington Gardens, a very interesting view of the building is obtained, backed by Ennismore Place, an ornate specimen of the latest style of house-building for persons of fortune. Here the "Crystal Palace" appears like a rich gem, set amidst an assemblage of objects, that alike indicate the industrial wealth and high civilization of this metropolitan suburb.

Still more prominently is seen the profile of the transept roof from the stone bridge in Kensington Gardens.

From whatever point the fairy-like edifice is viewed, the spectator cannot fail to appreciate its graceful character. But probably, under no influence are its long aisles and glittering roof seen to greater advantage than when illuminated by the moon's silver light, which, shining through the crystalline arches, is very striking; whilst the "tall ancestral trees" keep watch, as it were, around the stately shrine of the world's treasures; and the unruffled surface of the Serpentine, reflecting the moon's rays, lends enchantment to the whole scene.

It may be interesting to mention that, when the Exhibition was first projected, it was proposed to inclose the Serpentine, for the full display of specimens of naval architecture, models of floating bridges and breakwaters, of life-boats, and other humane contrivances; and the most improved modes of using the diving-bell, and of blasting by electricity under water, were proposed to form prominent features of the Exhibition itself. The only exhibition of this kind has, how-

* The Exhibition Building has been described as the longest building in the world; whereas, it is exceeded in length by the Middlesex Lunatic Asylum, just erected at Colney Hatch, which is 1881 feet 6 inches. Dr. Duff, at a late meeting of the Wesleyan Methodist Missionary Society, described Seringham, in the East Indies, as "the hugest heathen temple that can probably be found from the north to the south pole. It is a square, each side being a mile in length, so that it is four miles round. The walls are 25 feet high, and 4 or 5 feet thick, and in the centre of each wall rises a lofty tower. Entering the first square, you come to another with a wall as high, and with four more towers. Within that square there is another, and within that again another,—and you find seven squares, one within another, crowded by thousands of Brahmins. The great hall for pilgrims is supported by a thousand pillars, each cut out of a single block of stone."

ever, been a pretty model 20-gun frigate, named *The Prince of Wales*, which was brought from Greenwich Hospital Schools, fitted at Woolwich Dockyard, and launched on the Serpentine, on April 28.

The several objects outside the building presented interesting examples of Mining and Mineral Products, specimens of various Manufactures, &c. Thus, on the north side were two lofty obelisks of Cornish granite; three gigantic anchors; and some newly-constructed green-houses. The pavement of the south inclosure was laid by three Exhibitors; that of the east end is the prepared asphalte of the Seyssel Company; and the pavement of the south or transept entrance consists of slate-slabs from Festiniog, North Wales.

At the western end, south side, were various blocks and slabs of stone, some of gigantic size; artificial stone and cements; grindstones; vast blocks of coal, one of which, from the Stavely Mines, Derbyshire, weighing 24 tons, was raised from a shaft 459 feet deep; and another block, Steam Coal, the produce of a newly-opened colliery, is stated to be brought up in masses of 50 tons weight.

At some distance from the western extremity of the building was a colossal equestrian statue of Richard Cœur-de-Lion, in composition, coloured to imitate bronze, the work of the Baron Marochetti.

At the distance of 155 feet from the north-western angle of the building, on the south side of Rotten Row, was erected

THE BOILER-HOUSE,

for the purpose of supplying steam for the gratuitous use of Exhibitors of "Machinery in motion." The Commissioners originally designed to erect a Boiler-house within the building; but, on matured consideration, it was wisely determined to keep the furnaces apart from the building itself, and thus prevent what would have been a cause of alarm on the part not only of the Exhibitors, but also of the public generally.

The Boiler-house has been constructed on the same principle as the Crystal Palace itself; cast-iron columns at intervals of 8 feet and 24 feet respectively, and 24-feet trellis girders forming the framework of the structure; whilst, for close boarding as an inclosure, 9-inch brick walls are substituted. The whole length of the structure is 96 feet from centre to centre of columns, and the width 24 feet.

The Boiler-house is divided into three compartments by two cross brick walls, which support a capacious cold water tank. The largest compartment, at the east end, is for the boilers, being 50 feet in length; the middle compartment, for stores, 20 feet; and the western compartment, also for stores, 26 feet, respectively. From the level of the ground to the top of the trellis-work is 22 feet 2 inches. Over the boiler department, the roofing is of corrugated iron; whereas, the western division has the ridge-and-furrow roofing, as in the Great Building. The tank is formed of cast-iron plates, bolted together by means of internal flanges: it is 22 feet square, and 4 feet 6 inches in depth, and, consequently, will contain rather more than 55¼ tons of water.

There are five boilers, all set in brickwork: the largest is the middle one, from the works of Messrs. Galloway, of Manchester: it consists of two large horizontal tubes or cylinders, communicating with each other at 4 feet 2 inches from the front of the furnace ; and at the other end, 4 vertical tubes, 8 inches in diameter, passing from the lower to the upper part of the boiler, and ten conoidal tubes for the same purpose ; the whole length of the boiler being 13 feet, and the diameter 6 feet four inches. The smaller boilers, two on each side of that already described, are of the high-pressure, multitubular construction, as used for locomotive engines, being 3 feet 8 inches in diameter, and consisting of 41 horizontal tubes, each 2¾ inches diameter : a cast-iron bracket is riveted to each side of the boiler, to secure it to the brickwork, the flame first acting on the bottom and sides of the boiler, (supported intermediately by two cross walls,) and returning through the tubes towards the chimney, which is fixed at the furnace-end of the boiler. The chimney is constructed of iron plates riveted together, being circular, of 16 inches clear diameter, and 24 feet in height. These last-mentioned boilers are from the works of Mr. Armstrong, of Newcastle-upon-Tyne.

The pipes to convey the steam into the "Machinery in motion" department are of cast-iron, 8½ inches diameter internally, connected, as usual, by flanges, and coated externally with felt. The underground channel for these pipes is formed by a foundation of 3½-inch paving, on which are built dwarf 9-inch sides of brick in cement, 21 inches high; the whole being covered at top by two planks, the lower one of 4 inches, and the upper one of 3 inches in thickness, respectively. The details are given by Mr. Whishaw, in the *Illustrated London News*, No. 480.

We now proceed to—

INTERIOR OF THE BUILDING.—THE FLOORING

is laid upon the plan originally devised by Mr. Paxton, and thus described in his paper read to the Society of Arts, Nov. 13, 1850 :—

"I have tried, (says Mr. Paxton,) many experiments in order to find out the most suitable floors for the pathways of horticultural structures. Stone was objectionable on many accounts, but chiefly on account of the moisture and damp which it retained ; and was therefore uncomfortable, especially to those wearing thin shoes. The difficulty of getting rid of the waste from the watering of plants, was also an objection ; but perhaps the greatest is the amount of dust from sweeping, which always proves detrimental to plants. I likewise found that close boarding for pathways was open to many of the same objections as stone ; for although damp and moisture was in part got rid of, yet still there were no means of immediately getting rid of dust. These various objections led me to the adoption of trellised wooden pathways, with spaces between each board, through which, on sweeping, the dust at once disappears, and falls into the vacuity below.

"Whilst the accomplishment of this point was most important in plant-houses, I consider it doubly so with respect to the Industrial Building, where there will be such an accumulation of various articles of delicate texture and workmanship. Before sweeping the floors of the Great Building, the whole will be sprinkled with water from a moveable hand-engine, which will be immediately followed by a sweeping-machine, consisting of many brooms fixed to an apparatus with light wheels, and drawn by a shaft. By this means a large portion of ground will be passed over in a very short space of time.

"The boards for the floor will be 9 inches broad, and 1½ inch thick, laid half an inch apart on sleeper joists 9 inches deep and 3 inches thick, placed 4 feet apart.

"This method of flooring, then, possesses the following advantages:—It is very economical; dry, clean, pleasant to walk upon; admits of the dust falling through the spaces; and even when it requires to be thoroughly washed, the water at once disappears betwixt the openings, and the boards become almost immediately fit for visitors.

"The galleries will be laid with close boarding."

These details have been followed throughout. The joists are fir, 9 inches by 3 inches, and 2 feet 5 inches from centre to centre: they rest on transverse sleepers, 13 inches by 3 inches; and these are supported by vertical deal struts, which rest on the base-plates of the cast-iron columns. The extent of flooring for the central aisle alone amounts to upwards of 3½ acres.

THE OFFICES.

On either side of the grand entrance to the building, on the south side, nearly opposite Prince's Gate, are placed the Offices of the Royal Commissioners, the Contractors, the Executive Committee, and the Police; the whole occupying a frontage of 96 feet on each side of the transept. As in other parts of the vast structure, so in the offices, all the horizontal dimensions, from centre to centre of the frame partitions, are 8 feet or multiples of 8 feet. The whole extent of ground-floor space occupied by the officials is equal to sixty-nine squares. A staircase in each wing leads to the clerks' offices on the upper story. There is no lath and plaster employed in the offices; and the wood-work is painted to correspond with that in the other portion of the building.

The spaces occupied there by the lower tier of ventilators are filled in with close boarding. The offices throughout are lighted by large sashes occupying the spaces between each pair of the external iron and wooden columns, and reaching from the top plate of the lower tier of ventilators to the under side of the sill of the upper tier of ventilators, so that the rooms are well lighted. As the whole of the offices were to be used in inclement weather, they were warmed by means of gas-stoves, which were easily fixed, and were free from dust; cups of water being placed above the stoves, to moisten the otherwise dry atmosphere.

THE GALLERIES.

It will be recollected that Mr. Paxton, in his original design, dwelt upon the grand effect to be produced by the galleries, the stability of which, for bearing heavy weights, was much doubted at he time, and was not altogether established without repeated testing of the strength of these portions of the vast edifice. "From the side galleries, running the whole length of the building," said the designer, "there will be grand views of the goods and visitors below; whilst the transverse galleries, in the middle and at the ends, will afford ample means for general supervision, and will serve to communicate between the side galleries." These anticipations have been verified to the full, as we shall proceed to show.

First, of the extent. There are four main galleries running the whole length of the building—two on the north and two on the south side of the great central aisle, the whole being connected by two cross galleries, one at either end of the building; besides twenty intermediate transverse gangways, or crossings. The collective length of the galleries, restricted to the second tier, is 9456 feet, or more than one mile and three-quarters, and the width 24 feet; so that the whole area, or surface of gallery-flooring is equal to 210,240 superficial feet, or nearly five acres. In this calculation, the spaces for the staircases have been deducted. The whole weight of the galleries is supported by 730 cast-iron columns, a description of which we have already given. The whole length of cast-iron girders, 3 feet in depth, amounts to 26,576 lineal feet, or about five miles.

Besides obtaining fine views from various positions in the galleries, the exhibition space was thus increased by considerably more than one-fourth of the ground-floor area; making together an area of flooring equal to about 23 acres.

In reference to the galleries, Mr. Paxton says:—"This extra space is suited for the display of light manufactured goods, and will also give a complete view of the whole of the articles exhibited, with an extensive view of the interior of the building."

Over each of the galleries adjoining the central aisle there is an additional tier of girders; so that if, at the *eleventh hour*, additional space had been required, two galleries, the whole length of the Building, might have been added; but such extension was not found requisite.

The flooring of all the galleries consists of 1½-inch deal battens, grooved and iron-tongued: these battens are firmly nailed on to the joists, which have a scantling fixed at intervals from centre to centre of 2 feet 6½ inches; trusses are introduced transversely, at intervals of 8 feet: they are 7 inches square, consisting of two pieces, separated by a space of 2 inches, in which space are introduced 1⅜-inch tension rods, passing through eyes formed in cast-iron saddles, the ends of the tension rods being screwed up to cast-iron shoes. Longitudinal bearers, 9 inches in depth by 3½ inches in width, extend under the joists throughout, supported at either end by a bracket resting on the cross girder.

The external sides of the galleries are enclosed with vertical deal sashes, occupying the spaces between the deal-framed intermediate columns and the iron columns, respectively. In order to guard against the injurious effects of storms upon so large a surface of glass, exposed to wind and rain, the upright panes are tied together by three round iron rods and strengthening pieces of deal, which we have already described. The sashes are secured to the columns by three iron clamps to each column.

The water from the adjoining skylights is carried into the Paxton gutters, fixed between the lower parts of the columns; and, by the introduction of cast-iron rain-water heads fixed round each column, with opening from the gutters, the water finds its way into the transverse trough gutters, and these are furnished with false bottoms, and have a full inclination towards the tops of the hollow columns, which convey it to the iron pipes underground.

The exposed sides of all the galleries are protected by handsome cast-iron ornamental railing, placed between the iron columns, and secured to the floor by means of two intermediate open iron vertical standards, with plinths. The iron forming the panels is turned over both at the top and bottom, and is screwed, in the former case, to the hand-rail, and, in the latter, to the deal plinth: ornamental bosses on diamond-shaped grounds are fixed at the intersections of the diagonal iron bars. The hand-rail is of mahogany, of segmental form. The pattern of the railing gives a tasteful finish to the galleries. In the construction of the sides of the galleries, the operations of the workmen were much facilitated by traversing scaffolds, running each on four small rollers or wheels, planks being laid longitudinally on the top of the floor as tram-plates for the same. By the height of these travelling scaffolds, the men were enabled to fix the gutters and the ornamental frieze.

TESTING THE GALLERIES.

As the stability of the galleries was more questioned than the safety of any other part of the building, it became desirable to meet this maximum of doubt by the severest possible test. For this purpose, in illustration of the several discussions raised upon the subject, and to be detailed hereafter, an interesting set of experiments was performed in the Building.

The oft-asked question was—"Are the floors of the Crystal Palace sufficiently strong to sustain the moving masses that will daily pass over them?" This inquiry was most satisfactorily answered on Feb. 18, when, in the presence of the Queen, the Prince-President of the Exhibition, and the Royal Family, attended by Lord Granville and other Commissioners, and also by the officers of the Executive, severe tests were applied to a bay of gallery-floor measuring 24 feet by 24 feet, and containing 576 square feet. This square was formed complete, and rested upon four of the cast-iron trellis girders, which, during the experiment, were supported upon four points, corresponding with the condition in which they are fixed in the building itself. The approaches to the square of flooring to be tested were formed by inclined gangways, consisting of planks placed close together.

The first experiment was that of placing a *dead load* of about 42,000lbs., consisting of 300 workmen of the Contractors, on the floors and the adjoining approaches.

The second test was that of crowding the men together in the smallest possible space; but in neither case was any appreciable effect produced in the shape of deflexion. So much for dead weight.

The third experiment—which was that of a moving load of 42,000lbs. in different conditions—consisted in the same number of workmen walking first in regular step, then in irregular step, and afterwards running over and jumping upon the floor; the result of which was equally satisfactory.

The fourth experiment—considered to be the most severe test which could possibly be applied, in the use to be made of the gallery floors when the Exhibition was opened to the public—was that of packing together the above load, and causing the men to jump up and down for some time; when the greatest amount of deflection was found to be not more than a quarter of an inch at any interval.

The third experiment was then repeated; substituting, however, for the Contractors' workmen, a number of soldiers of the corps of Royal Sappers and Miners, who were ordered to march over it, to run over it, and, finally, to mark time upon it, in the most trying manner; when the result was alike satisfactory with the others. It should here be observed, that the elasticity or springiness of the floor, (which some persons, doubtless, mistook for insecurity,) served to protect the girders from the effect of sudden shocks, or the accumulating weight caused by the simultaneous movements of a crowd.

In addition to these experiments, a yet more severe series was applied. By means of an apparatus, devised by Mr. Field, (late President of the Institution of Civil Engineers,) there was drawn over the gallery-floor a number of 68-pounder shot, so placed as to present a load of 100lbs. per foot superficial. The flooring and the supporting girders still behaved as before; and thus the question of their stability was settled.

THE SCIENTIFIC CONSTRUCTION OF THE BUILDING ILLUSTRATED.

The last day of the year 1850, the one on which Messrs. Fox, Henderson, and Co., Contractors for the Building, were to have given up possession to the Royal Commissioners, was very appropriately chosen for the visit of the Members of the Society of Arts to the Great Building—thus gracefully acknowledging its importance in the great movement which produced the marvellous work. It was to the Society of Arts that Mr. Paxton first explained his original design; and to the same active Institution, was first illustrated its consummation. The members were privately invited to inspect the works,* on the noon of the 31st; and the occasion was properly inaugurated by an address from Professor Cowper, of King's College, on the scientific and mechanical character of the construction, and materials used in the building. Facing the inclement and rainy weather which incessantly prevailed during the day, a large and attentive audience was assembled in answer to this courtesy on the part of the Contractors. A space on the south side of the Building, towards the west end, was

* As important alterations and additions have been made in, and to, the original Contract, the Commissioners granted to the Contractors an additional month to complete the whole of their works.

enclosed as a lecture-room: there were present about twelve hundred persons, including many visitors, especially ladies, who were not members of the Society. Three sides of the lecture-room were enclosed by elegant carpets, suspended from the cast-iron girders and reaching to the floor; while the fourth side was formed by the permanent vertical matched boarding between the upper and lower tiers of ventilators. A temporary wooden platform, with table, had been erected especially for the use of the lecturer; and drawings and diagrams, illustrative of the subject, were pinned up behind the lecturer's table.

Mr. Cowper having paid the just tribute to Mr. Paxton, "who furnished the bold outline of the structure, to be constructed, as to its principal dimensions, of multiples of simple parts—a grand idea—and original as it was grand," the lecturer added: "Messrs. Fox and Henderson, seeing at a glance that the Paxton design was the one most suitable for the intended purpose, at once recommended it to the notice of the Royal Commissioners; at the same time undertaking to prepare detailed plans of such design, together with estimates, in the short space of one week; and this promise the Contractors not only made, but, by working day and night, actually fulfilled; and the consequence was that the general design was adopted; and we have now to see how this extraordinary and novel plan has been carried out.

"In the first place, this building is not what is usually termed an architectural structure. It is not built of wood, neither of stone nor brick, but of iron. The architect deals with materials, the strength of which is hardly ever the subject of calculation: brick is laid upon brick, and stone upon stone, without the slightest fear of their crushing from any weight they may be required to sustain, and without much thought of the *quantities* to be used. The engineer, on the contrary, has to deal with iron, a material whose strength is calculated in every situation in which it is used, and the economy in quantity reduced nearly to a *minimum*. Iron also differs altogether in appearance from brick and stone, which present large, broad surfaces; while iron, on the contrary, presents, as you will perceive throughout this building (except, indeed, the external boarding), such narrow surfaces, that it may be almost described as consisting of an assemblage of lines; and, in the building in which we are now collected, these lines are made up principally of columns and girders. Do not misunderstand me—I have no desire to depreciate architectural beauty; but it will be seen, on an inspection of this building, that the constructors have been guided by more cogent reasons than mere architectural beauty. I may mention that architects have no particular love for iron; and, as an example, I may allude to the roof of the hall of King's College, which is supported by iron columns; these columns are encased in wood, in order to give them a more substantial appearance.

"Let us begin with the columns, which are not solid, as if of brick or stone—but hollow—that is, tubular; and here science at once decides that this is the stiffest and strongest form for a given quantity of material. For instance, if we take two iron columns, each 30 feet high, the one being of 12 inches diameter, and hollow, with metal an inch thick, and the other being solid and 6·63 inches diameter, we find that the former will sustain about four times the weight of the latter. Perhaps, there are some critics present who, on looking at the columns of this building, may consider them weak; let me, however, respectfully request of such critics to test their own power of judging of these columns, by mentally estimating what these two quills—one inch in length, will bear." [Here Mr. Cowper placed the two pieces of quill in a vertical position between two boards, the upper one being adjustable by hinges; and then set weights on the upper board just above the quills, until they reached 224lbs., which was found to be the crushing weight. This beautiful and conclusive experiment drew forth loud applause.]

Mr. Cowper then detailed the foundation of the column bases, and the setting out of the ground; adding—"Perhaps there never was a ground-plan of similar character set out with such wonderful exactness—its beauty and accuracy meet you at every step you take. Column covers column with as much truth as if their places were set out on a sheet of paper, instead of on an area of 18 acres of ground."

The fixing of the columns was next described, and the chipping and filing, or *facing*, was shown, to ensure that if the base of the socket is placed perfectly level, the columns and connecting-pieces *must* stand upright. [The Professor now produced several pieces of wood, the ends of which were not properly faced: the consequence was, that, when placed one above the other, the whole fell together; but on immediately after substituting some properly-faced pieces of wood, and placing them one above another, the whole retained their vertical position.] By this precaution taken of facing the ends of the columns and connecting-pieces, not a crooked line throughout the building can be discovered.

The girders were next illustrated. "Let us see," said Mr. Cowper, "how the different parts of a girder 'behave,' to use an expression very familiar to engineers. In a common arch we have what is known as the pressure, or thrust; while, in a suspension-bridge, we have tension: in a girder there are both the thrust and tension."

In order to show that *form* has a great deal to do with the strength of materials, the Professor subjected a small sheet of tin to the pressure of his hand, and immediately doubled it up; but on putting the same piece of tin into a tubular form, and subjecting it to the like pressure, it retained its shape entire under 2 cwts. He then analysed a trellis-girder, (showing its weakness without the addition of the braces,) by means of wooden models, and by the aid of laths pinned at the angles, and representing one-half of the transverse section of the building. Mr. Cowper further explained the imaginary building of the critics, which might be blown down by a gust of wind; and then, adding the model braces throughout, exclaimed, "And here is the building of the Contractors.* Now see how stiff this slight model has become."

The almost entire absence of scaffolding, and the Paxton gutters, were next passed in review; and then the transept, with the formation of the wooden ribs of the arches or principals of the roof, which are so stiff, and have so little tendency to spread, that, when the ends (by way of trial) were put on planks, and the arch loaded with a weight equal to that which it was intended permanently to sustain, the friction was found to be sufficient to keep it from moving. "Arches, doubtless, have some thrust or tendency to open, but that it may be overcome is instanced by a cow's horn; and even this model, composed of layers of wood, will give you some idea of the strength which may be obtained." [The Professor then loaded the model with weights equal to 224lbs., but without producing any change in its form.]

Mr. Cowper added—"I look upon the original idea of Mr. Paxton as one of the most successful efforts of imagination and contrivance; and I consider the way in which Messrs. Fox and Henderson have made the bold conception *practicable,* one of the most successful and astonishing examples of contrivance, tact, science, industry, and perseverance, and engineering skill, the world ever saw; and, whatever wonders may hereafter be placed in this building, the structure itself will be the greatest wonder of all."

At the close of the lecture, Mr. Cowper, accompanied by a crowd of his new pupils, proceeded to the different parts of the building, and explained, in order, the testing machine; Henderson's patent "derrick" crane; the punching and cutting machines; the machinery for cutting off the ends of the sash-bars, and forming the semicircular ends to the gutters; the drilling machine; the mode of painting the sash-bars by machinery; the glazing wagons; the construction of the transept, and other parts of the edifice,—all which we have detailed.

Mr. Henderson, the Contractor, next undertook to read to the Society of Arts, on Jan. 15, a paper on the Statistics of the Material and Labour employed in the Building. Mr. Henderson was unavoidably absent; but Mr. Fox attended the meeting, and expressed his willingness to answer any questions as to the details of construction, &c. of the edifice.

The following conversation then ensued:—

Mr. Winkworth had heard fears expressed by persons intending to send goods liable to injury from damp, that sufficient security was not provided against damage which might arise from the dropping of the vapour condensed internally, or of water leaking through the glass roof.

Mr. Fox said that he believed the building would be one of the driest ever constructed, as it would always be acting on the principle of a still. Any exhalation that might arise from the soil would naturally rise till it came in contact with the glass at the top, where it would be condensed, and must trickle down by capillary attraction, and find its way to the small groove on each side of the Paxton gutters, and be eventually carried into the sewer; so that evaporation would never have the power of returning, because the moment it got condensed on the surface of the glass or sash-bars, it could only escape through the gutters. The groove not only took away the condensed water, but, supposing a pane not to be sufficiently tight in the roof, any small quantity of water that might escape through the edge of the glass and get underneath would find its way to the groove and then pass away. The transept roof and the skylight bars were what was commonly called "herring-boned;" in fact, they were *angular, both horizontally and vertically at the same time. So that in the transept roof, from top to bottom, the same principle of capillary action was at work and provided for; and every skylight was arranged on a slope of two and a half to one, which is the same as in the horizontal roof.*

Mr. Joseph Glynn wished to ask what means were taken to counteract the effects of the wind on such an extensive surface as that presented by the building?

Mr. Fox said the building rested on 1060 columns, and the most likely direction for the wind to have any injurious effect on the building must of course be that of its greatest width, which was 1800 feet, as compared with 400 in the opposite direction. These columns rested on cast-iron plates based upon concrete; and they could not rock about without the base-plates being broken. Above these plates were sleepers, to carry the floor. They were 13 inches in depth, fitted accurately between the columns, and running transversely from one side of the building to the other; so that not one of these columns could possibly be upset until it was actually broken in two. Again, at the top the columns are united by cast-iron girders, 3 feet deep, and four columns are framed together very much as a table is framed. Now, to break the column, they must exert a force equal to that of twice its transverse strength. From experiment, it was found that 12 tons was the breaking weight of the columns in the centre. Now 1060 columns multiplied by 6 tons (half the breaking weight) was equal to 6360 tons; so that it would be necessary to exert a force equal to 6360 tons, at a height of 24 feet from the ground, before the building could be blown down, without taking any bracing into account. Taking 28lbs. on the square foot, as the force of the wind, and assuming a gust of wind which would strike the whole side of the building at the same moment, the total force would be from 1400 to 1500 tons. Now they had got a power to resist it of 6360 tons, not taking into account the bracings, nor the offices and other constructions within the building, and which must of course add to its strength. The late gale, when Colonel Reid ascertained the force of the wind to be 19½lbs., did no harm whatever, at a time when the roof was not on, and the building was quite exposed.

Mr. Glynn wished to know if any provision had been made with respect to the effects of contraction or expansion, due to atmospheric changes?

Mr. Fox said that the length of the building, from centre to centre at each end, was 1840 feet, and the width of its general rectangle 408 feet. The total difference in length of a cast-iron bar 408 feet long between the extremes of summer and winter, would be about 1¼ inch. The building was divided into two by the nave, the only connexion between the two sides being the wrought-iron trusses and the roof. The greatest difference which could by any possibility take place in the perpendicularity of the columns, from the effects of a change in the atmosphere, would be about a quarter of an inch, while it would be perfectly safe to bend any of them to the extent of two inches. In order to provide for stiffness, they had determined that in the lengthway of the building the expansion and contraction should be entirely provided for by the elasticity of the columns themselves, which were all "keyed up" hard and fast together for distances of 200 feet at each end, and for a similar distance on each side of the transept. The girders would have the opportunity of sliding upon the brackets which supported them. The flooring of the galleries, running the whole length of the building, served, with the *Paxton gutters, as a continuous wooden tie, leaving the cast iron in a condition to move, as it was acted upon by the various changes of the atmosphere.*

A very erroneous opinion had been formed by many persons with respect to the strength of the girders, which, he believed, arose in a great measure from the circumstance of their not seeing a girder of the accustomed form, viz., a solid girder of a certain depth. The Contractors had taken the same quantity of iron as would have been required in a solid girder of, say 15 inches in depth, and made of it an open girder of 3 feet in depth, of greater strength, and capable of affording a greater amount of stiffness to the building than could be obtained by the solid 15-inch girder. It had been said that such light girders would not carry more than 4 tons, but, in fact, every one was tested to 15. Six of them had been broken, but not under 30 tons. They had assumed that a crowd of persons densely packed over the whole surface of the galleries (which could never take place), would press with a force equal to that of 112lbs. per superficial foot, which would bring upon each girder a load of about 5½ tons; they were proved to 15, and would not break with less than 30. Indeed, so little did he fear on the subject of strength, that he should be most happy to have a locomotive engine run along the gallery.

In answer to a question put by a member,

Mr. Fox said he thought the glass quite strong enough, or he would have made it stronger, as he had to keep it in repair for twelve months. The importance of considering the width with the thickness was then explained.

Mr. Glynn next put a question as to the security against fire, and as to the insulation of parts in case any of the articles contained in the building should be accidentally ignited. In reply to which,

Mr. Fox stated that before making any arrangement for the supply of water, he had consulted Mr. Braidwood, of the Metropolitan Fire Brigade, who said that in a building of such vast size and cubic contents as this, he should like the walls to be of slight material, as lath and plaster, and the roof of glass. The case was utterly different to that of an ordinary house or small structure. Here the object would be to discover at once in what part the fire was at work, and having lath and plaster sides, they would easily be broken through, and the fire at once reached. His reason for recommending a glass roof was, that it would soon crack and fall, and let the flames out at top, and then, unless there was much wind, the fire would be confined to that part of the building in which it began. He (Mr. Fox) said to Mr. Braidwood, "You recommend lath and plaster sides—what would you think of glass?" Mr. Braidwood said he would like it better—that then he could see where the fire was at once, and knowing what he was doing, could pour water upon it. Now it had been necessary to have wood all round the lower tier of the building; but on each side of the exit doors (of which there would be nineteen or twenty), there would be a glass window, so that in the event of fire, they could at once see where it existed and extinguish it.

For the supply of water, the Chelsea Water Works Company were laying a 9-inch main, with a column of 70 feet constantly on it, and a 6-inch pipe running across the building; a 6-inch pipe will run round the whole of the outside of the building, with sixteen branches into the interior, by which, with one length of hose, and without the aid of a fire-engine, they would be able to control the whole area. A special arrangement had been made with the Chelsea Water Works Company for the water to be always on; and the Company had been at the expense of an additional auxiliary engine, for the purpose of insuring a constant supply; whilst in ordinary cases they were bound to supply 300,000 gallons per day.

A vote of thanks was then passed to Mr. Fox, for the very kind manner in which he had attended there that evening, and afforded so much interesting information to the meeting; and also for his courtesy in allowing the Society of Arts to inspect the building under the guidance of Professor Cowper.

There remained, however, a still higher tribunal, before which the constructive details of the Building were to be discussed. This was the Institution of Civil Engineers; and as the structure is, strictly speaking, a vast *engineering* work, the Institution was the highest authority for its examination. Accordingly, on Jan. 14, a paper was read by Mr. M. D. Wyatt, Assoc. Inst. C. E., on the Construction of the Building; William Cubitt, Esq., President, in the chair. In this paper, Mr. Wyatt ably detailed the construction, as well as the various contrivances devised and employed for economizing labour; and, when listening to the details, it was universally felt that England possessed mechanical and physical energies, far exceeding those which gave form and being to the most celebrated monuments of antiquity.

At the two next meetings of the Institution, Mr. Wyatt's paper was most minutely debated; the discussion commencing on Jan. 21.

On the one side it was contended, that the present Building was not in accordance with the conditions published by the Royal Commissioners;—that from its form, the wind would have a most injurious effect on it, and therefore, that instead of testing each girder singly, as had been done, the whole roof should have been subjected to the same ordeal as Turner's roof over the Railway Station

Liverpool, which had been proved by suspending weights at intervals, on the presumed necessity for its bearing a strain of wind equal to fifty pounds per square foot. This test of proof had been suggested by Mr. Locke and Mr. Fox; therefore it could not be objected to now. The snugs, for receiving the ends of the girders, were considered as being too weak, and liable to fracture. The foundation of concrete under each column was considered insufficient, and not in accordance with the original design, as set forth in the *Illustrated London News*, of July 6th, 1850, where a proper kind of foundation was stated to be provided. The columns, of such slender dimensions as eight inches diameter, and varying from one inch and an eighth down to half an inch in thickness, and each composed of seven parts, must be unstable when carried to such heights as sixty-four feet.

The girders of the galleries, when under the action of the multitudes of persons all in one direction, would acquire an undulating motion, which would fracture them.

The glass of the roof being only of the weight of sixteen ounces per square foot, or about one-eighth of an inch in thickness, was quite inadequate to resist hail-storms, or even the weight of a fall of snow, and that great leakage must be expected from this and several other causes. The condensed vapour from the under side of the iron beams would also drop on the goods exhibited, to their serious injury.

The quantity of timber employed, and the system of open flooring, rendered the building peculiarly liable to catch fire; and on these grounds it was asserted to be wanting in the stability and the security requisite for a receptacle for the valuables which would be transmitted for exhibition. It had been stated by the Royal Commissioners that a building would be provided, free of rent and fire-proof: the latter condition was certainly not fulfilled, and if the building remained uninsured, each exhibitor would be under the necessity of providing for the safety of his own goods, and thus be subjected to a greater expense than the ordinary rent of a really fire-proof building.

On the other side, it was admitted that, up to the present time, the building was not insured against fire. It was, however, contended, that an examination in detail of all the parts of the structure demonstrated the fallacy of the objections which had been made. Every part had been attentively considered, and had been subjected to careful and minute experiment. The concrete foundation had been tested to the extent of seven tons per square foot, without crushing, whilst the greatest weight that could be brought upon each square foot of foundation was only two and a half tons; this was supposing the building to be crowded with visitors, and the roof covered with a depth of two feet of snow.

The columns had also been submitted to similar experiments; their thickness varied from half an inch to one inch and an eighth, according to the duty they had to perform, and the position they occupied in the building. It had been calculated, that the greatest weight which could possibly be brought upon the strongest column was sixty tons, whilst its breaking weight exceeded three hundred tons.

The glass was considered to be sufficiently strong, as its thickness and quality were similar to that used in the large conservatory at Chatsworth, of which not a pane had been broken by any hailstorm that had occurred since its erection, twelve years ago. The canvas employed outside would not only temper the rays of the sun, and aid in ventilation, but would also assist in preventing fracture of the glass; and in consequence of the canvas itself being fixed to each ridge in narrow strips, if any portion did catch fire, only that piece would be burned. It was further stated, that on the present design being accepted, an offer had been received for its construction from the person who now most violently attacked the original design and its actual construction.

On Jan. 28, the discussion on Mr. Wyatt's paper was renewed, and was continued throughout the meeting.

Arguments, based on calculation, were adduced to show, that though the building was amply sufficient for resisting any vertical pressure to which it might be subjected, it was not so well calculated to resist the horizontal force exerted by the wind, which might be taken as sometimes equalling 25lbs. per square foot.

The building in Hyde Park was the most extensive example in existence of the "pure rectangular construction;" but as it did not possess the strong gable end walls of the Lancashire Cotton Mills, which were also rectangular structures, composed of columns and girders,—the stability of the Glass Structure must depend entirely on the simple rectangular form, which could only be maintained by the perfect attachment of the girders to the columns. It was contended that the snugs by which this was effected were wanting in strength, and the columns not being attached to, or rooted into the ground, might be supposed to admit of lateral motion. The addition of strong diagonal bracing was therefore recommended, as being necessary to ensure that amount of stability requisite in a building intended for the circulation of such multitudes of persons as would attend the Exhibition.

The great amount of light, admitted through a roof entirely composed of glass, was considered objectionable for the display of works of art; and it was contended that a roof partially covered with slates would have been better for general purposes.

Explanations were entered into to show, that the snugs for supporting the girders were amply strong, not only for the general duties they had to perform, but also for resisting any tension, or accidental strains, which might be brought on them by the failure of any adjacent parts; and instances were adduced of the occurrence of accidents, during the course of construction, which had proved this position to be correct.

It was contended, that the glass was sufficiently thick, and that in an extent of roofing of almost forty acres, constructed by one firm during the last twelve years, wherein no glass exceeding the weight of 16 oz. per square foot had been employed, scarcely any breakage had occurred.

The construction provided for the effects of contraction and expansion, consequent on the changes of temperature.

In summing up the discussion, it was impressed on the Meeting, that the Institution was not in any way responsible for the expression of individual opinions, the object of the discussions being merely to elicit facts, from which each auditor might draw his own conclusions.

THE GREAT EXHIBITION BUILDING AND ARCHITECTURE.

Having thus viewed the constructive details of the building, and endeavoured to illustrate the *engineering* skill more or less developed in the execution of the entire building, it remains to be seen how far it has been with justice "prominently advanced as likely to effect a complete subversion of architectural practice." An acute writer in a periodical work, full of sterling promise for the true advancement of art,* says:

"The Building for the Exhibition is the greatest evidence that the Exhibition affords of the industrial resources of this country. It shows, perhaps, more than any single building that has ever been erected, the capabilities of labour, the resources of capital, and the energetic direction and working of the appliances of mechanical skill. But let it be distinctly understood by all who are carried away by its vastness, or by the splendours and general effect of its contents, that the building has no claim whatever to be considered as a work of ART, and is no evidence of what the ART of Architecture could accomplish, whether now or at any other time. Mere length, or height, or general size, or number of parts, may, no doubt, produce a certain effect, but may exist without contributing one quality to the effect of Beauty in Architecture. The interior of the transept of the Exhibition Building, with its arched roof—due to Mr. Barry—has, though deficient in length, a noble effect; but this stamps more completely the inferiority of ART in the general building. The original design, in the *Illustrated London News*, had about the same amount of this quality as might be discovered in a gigantic packing case. There was no transept, and no arched roof. Indeed, the trees were, it appears, not then to be roofed over; for the description represents Mr. Paxton's plan as either to transplant them, or fit the glass round the boles. It was, as every one knows, an ordinary conservatory; not better adapted to the object, except in the suggested application of certain mechanical inventions, and worse than any conservatory we ever saw as a work of Art. As to 'means of classification,' and 'internal arrangements,' which were to be provided for according to the 'Rules and Conditions of the Building Committee,' the difficulty was got over by omitting them.

"We admit the convenience of the Building for the temporary purposes of the Exhibition, but we entirely deny that it had the proper strength, as originally designed, or that it now has sufficient durability for a permanent structure. After the recent failures in structures where iron has been far less extensively employed, and far less severely tried—considering even the present state of our knowledge as to the strength of cast-iron, and the durability of wrought-iron, and considering the inefficiency and obvious want of durability in the roof and guttering, we cannot but regret that a building should have been erected, the price paid for which there seems to have been little chance of checking; and which, if retained, will, from the continual repairs and expenses which will be necessary, hang like a national debt upon the nation."

The writer then adverts to the mistakes of the Building Committee, in their original instructions, and their own design; and to their anxiety to provide a building appropriate to the objects, worthy of the occasion, and suitable for a permanent structure, if so required:

* The *Architecturaly Quarterl Review*, No. 1, June, 1851. Bell.

"They appear to have been right in this last point, if wrong as to what might be accomplished by their own proposal. They found themselves, however, in a difficulty which endangered the whole success of the Exhibition; and, fast sinking, grasped at the first straw which offered,—having previously rejected 'iron and glass' in the case of equally meritorious schemes, in accordance with the original instructions, which the last suggestion was not." "The injustice to the competitors which this act of the Committee involved," as well as to the competing builders, is then referred to; and the circumstances of the case are considered to throw great doubt upon the success of any scheme for an improved system in such competitions. The Reviewer concludes:

"We must, however, put this case upon higher ground than as an act injurious to architects. It has tended to serious misconception of the nature of ART. It is scarcely too extravagant to say, that the popular acceptation of Architecture now, is that of an art in which previous education is wholly valueless.

"The Building for the Great Exhibition was produced by the very omission of that *design* which made the works of Wren, and Jones, and Vignoles and Palladio; yet the designer of that building is now a greater man than all these. How far what was put forth as the great merit of the design, namely, the roof construction, was consistent with real ART, the building itself affords sufficient evidence; and how far the structural arrangement of this roof can be taken to be a novelty, may be doubted, since it has already been pointed out to be a direct plagiarism.* Its disadvantages and future costliness are, unfortunately, completely obvious."

These views, although somewhat stringently expressed, and of a more æsthetic character than may accord with the popular estimate of the merits of the building, it is important to place upon record; since the omission might induce the reader to believe the design to have met with unqualified approbation, and to be entitled to rank as a canon of construction; whereas the Reviewer's opinions show a fair and reasonable limit to commendation.

We now proceed to describe—

THE DECORATION OF THE INTERIOR.

The appointment of Mr. Owen Jones to this tasteful work has already been mentioned at page 74; with the artist's lucid explanation of his plan, as detailed by him to the Institute of British Architects. This paper affords so many nice illustrations of principles of art, comparatively but imperfectly understood, that we shall glance at its leading points.

Mr. Jones observes: "The very nature of the material of which this building is mainly constructed—namely, iron—requires that it should be painted. On what principle shall we do this? Should we be justified in adopting a simple tint of white or stone-colour, the usual method of painting iron? Now, it must be borne in mind that this building will be covered on the south side, and over the whole of the roof, with canvas, so that there can be but little light and shade. The myriads of similar lines, therefore, of which the building is composed, falling one before the other, would lose all distinctness,

* By a Correspondent of the *Builder*.

and would, in fact, form one dull cloud, overhanging the Exhibition; a line of columns, as even now may be seen at the building, would present the effect of a white wall; and it would be impossible, in the distance, to distinguish one column from another. This mode of painting would have the further disadvantage of rendering the building totally unconnected with the various objects it is destined to hold. May the building be painted of a dark colour, like the roofs of some of our railway stations? This, equally with the white method, would present one mass of indistinctness: the relief of the cast iron would disappear,—each column and girder would present to the eye but a flat *silouhette*.

"Let us now consider the building painted with some pale neutral tint—dull green or buff. In doing this we should be perfectly safe: provided the colours were not so pale as to be indistinct, or too dark, so as sensibly to affect the eye—one could hardly make a mistake; yet, how tame and monotonous would be the result. It would be necessary that this tint, whatever we might choose, should be of such a subdued neutral character, as to avoid a difficulty well known to mounters of drawings, and painters of picture-galleries, that, in proportion as you incline to any shade of colour, in that exact proportion you injure or destroy the objects it is intended to relieve, which may have similar colours. To this, then, should we be reduced,—a dull monotonous colour, without character. How unworthy would this be of the great occasion,—how little would it impress the public,—how little would it teach the artist: it would be to cut instead of patiently unravel the knot.

"We are now brought to the consideration of the only other well-defined system which presents itself—viz. parti-colouring. This, I conceive, if successfully carried out, would bring the building and its contents into one perfect harmony; it would fitly carry out one of the objects for which this Exhibition was formed—viz. to promote the union of fine arts with manufactures. It would everywhere bring out the construction of the building, which would appear higher, longer, and more solid. To produce this result it is essential not to make a mistake. Parti-colouring may become the most vulgar, as it may be the most beautiful, of objects. It is necessary, therefore, to proceed with great caution,—to calculate the effect of every step, not to be misled by the appearance of any one portion of the building, but bear in mind always the effect the building will have when complete and furnished."

Mr. Jones then refers to the remains of the architecture of the ancients, where we find that in the early periods the prevailing colours used in decoration were the primaries—blue, red, and yellow; the secondaries appearing very sparingly. We find this equally in the remains of Nineveh, Central America, of Egypt, and Greece; and throughout the eastern civilizations generally; we find also everywhere that as time wore on, the secondary colours invading the dominion of the primaries, blue and red were supplanted by green and purple.

"When the secondary colours were used, in the best periods, in conjunction with the primaries, they were generally confined to the lower parts of the building; following, in this, Nature, who uses for her flowers the primaries, and reserves the secondaries for her leaves and stalks. In the decoration of the Exhibition building, I therefore propose to use the colours blue, red, and yellow, in such relative proportions as to neutralize or destroy each other. Thus, no one colour will be dominant or fatigue the eye, and all the exhibited objects will assist and be assisted by the colours of the building itself. In house decoration we occasionally find a run upon one colour,—we have a green room, a pink room, and a red room, &c. It would obviously be unwise to adopt any one colour for this building, when the contents will be of all imaginable hues, from white to black. Discarding, on the other hand, the perfect neutral, white, as unfit for the occasion, we naturally adopt the red and yellow, in or near the neutral proportions of 8, 5, 3; but, to avoid any harsh antagonism of the primary colours when in contact, or any undesired complimentary secondaries arising from the immediate proximity of the primaries, I propose in all cases to interpose a line of white between them, which will soften them and give them their true value. It is well known that if blue and red come together without the interposition of white, they would each become tinged with the complimentary colour of the other; thus, the red would become slightly orange and the blue slightly green. As all coloured bodies reflect some white rays, the white in juxta-position, by its superior force, extinguishes these white rays, and we see the colours purer, at the same time that the white becomes tinged with the complimentary colour of that against which it is placed, thus further heightening the effect. As one of the objects in decorating a building is to increase the effect of light and shade, the best means of using blue, red, and yellow, is to place blue, which retires, on the concave surfaces; yellow, which advances, on the convex; and red, the colour of the middle distance, on the horizontal planes; the neutral white on the vertical planes.

"Following out this principle on the building before us, we have red for the under sides of the girders, yellow on the round portions of the columns, blue in the hollows of the capitals. Now, it is necessary not only to put the several colours in the right places, but they must also be used in their due proportions to each other. Mr. Field, in his admirable works on Colour, has shown by direct experiment that white light consists of blue, red, and yellow, neutralizing each other in the proportions of 8, 5, and 3. It will readily be seen that the nearer we can arrive at this state of neutrality, the more harmonious and light-giving will a building become; and an examination of the most perfect specimens of harmonious colouring of the ancients will show that this proportion has generally obtained—that is to say, that there has been as much blue as the yellow and red put together; thus the light and the shade balancing each other. Of course, we cannot, in decorating buildings, always command the exact proportions of coloured surface we require; but the balance of colours can always be obtained by a change in the colours themselves: thus, if the surface to be covered should give too much yellow, we should make the red more crimson and the blue more purple; that is, we should take the yellow out of them. So, if we have too much blue, *we should make the yellow more orange and the red more scarlet. A practised eye will as readily do this as a man may tune a musical instrument. It is here that science abandons the artist, who must* trust to his own perceptions, cultivated by repeated trials and failures.

The disadvantages of Mr. Jones's piecemeal illustration of his plan, (during the progress of the building,) were then pointed out; with an experiment before the Royal Commissioners, by suspending a series of carpets at a distance of 24 feet from the columns: the yellow and blue, No. 1, stood out clear and solid; while in the red column, No. 2, the red fell back to the level of the carpets' red and brown, and the column lost its brightness and solidity. This red colour never formed any part of Mr. Jones's plan. He painted it in obedience to the wishes of some critics, who thought it would be preferred to the yellow and blue colour; but as it was in direct violation of the principle Mr. Jones had laid down to start with, he knew that it would not do, and so the event proved. The column, No. 3, in front of the carpets, lost all form, and might as well have been a round one; and all advantage would have been lost of this very beautifully-formed column.

Mr. Jones then asked his hearers to banish from their minds the glare of light by which the experimental decoration was seen; and to forget the rough foreground of the works in progress, and to supply it in imagination with the gorgeous products of every clime; to picture in the foreground the brilliant primaries, blue, red, and yellow, the rich secondaries, purple, amber, and green, moulded in forms of every conceivable diversity, and, telling against them, darker tertiaries fading into neutral perspective.

The interior of the building has been coloured according to Mr. Jones's plan (somewhat modified), with all the success anticipated by its ingenious originator. The principal portions of the roof, of a delicate blue tint, harmonize most brilliantly with the light of the sky, beaming through the crystal roof. The transept is artistically splendid: the under side of each of the twenty-four ribs corresponds in colour with that decorating the square fillets of the columns supporting the ribs, viz. light blue; the part of the under side corresponding to the circular surface of the column is in deep chrome yellow; upon each side of this colour is a stripe of white, dividing it from the blue; upon the smaller ribs, the "returns" are coloured red, the edges chrome, and the sides blue; the diagonal tie-rods are painted bright yellow, with gilt centres; the sash-bars white, and the cross-bracings blue. It was originally intended to adorn the faces of the ribs and stouter supports of the building with texts, applicable to the noble and universal purposes of the Exhibition; but the sum set apart for decorations (£2,000) would not allow of this intellectual ornamentation.

It is worthy of mention that objection was taken by several artists to the choice of colours made by Mr. Jones. Mr. Sang suggested that the colour should be uniform, and in bronze, to convey the metallic character of the materials, and to perpetuate the uniformity of columns, girders, &c., which was generally pronounced objectionable. Mr. Jones himself originally asked the opinion of more than *twenty architects, house-decorators, &c., before he commenced his experiments. He found that no two of the persons whom he thus consulted agreed in their advice ; and, although he was anything but* indifferent to the suggestions poured upon him, he remained true to his own principles, and succeeded.

PROGRESS OF THE BUILDING, AND THE EXHIBITION ARRANGEMENTS.

The year 1851 opened with an auspicious incident. On the night of Jan. 1, a rough wintry gale swept over Hyde Park, but not a single sheet of glass was displaced, and the whole building was unaffected in any way by the violence of the wind.

Up to this period, the geometrical growth of the structure had been watched with unceasing curiosity by those who had the good fortune to obtain access to the works ; but now, the superstructure rose in its giant form, and excited the "special wonder" of the crowds who thronged the precincts of the building, more especially on Sundays, to witness the weekly instalment of the great work. On such a day, Jan. 5, a vast stream of visitors flowed through Hyde Park, and around the Palace itself; the weather was bright, and the view of the building, from the north bank of the Serpentine, was extremely imposing; the structure appearing in sharp outline against the clear sky—its long extent slightly broken, yet not obscured, by the bare-bough forms of the lofty trees. It was by periodical visits such as this, that the curiosity of all classes of the people accumulated to a greater height than had ever been reached upon any similar occasion; and it is gratifying to add, that never was realization of the popular expectation more complete than in the result, which our narrative is now fast approaching.

Meanwhile, the allotment of space for the Exhibitors, a labour of great difficulty, was proceeded with ; and the plans for the counters decided on.

After the 3rd of February, the admission of general visitors to the interior of the building ceased ; the receipts from the 5*s.* restricting fee exceeded on Feb. 1st, £300, added to the large accumulated fund set apart for the relief of the sick, and the reward of the industrious. At one time, it was calculated, some 3000 visitors were inspecting the several portions of the building; to these might be added some sixteen or eighteen hundred workmen; yet the eye rested upon small groups, and could nowhere detect an approximation to a large crowd.*

The building was now virtually transferred to the Commissioners by

* "We can, therefore, (says a journalist, writing Feb. 6,) readily believe that 20,000 spectators may, at any time, be safely admitted, when the marvels of the Exhibition are thrown open, without let or inconvenience." This proved a very safe belief; for the numbers at certain periods within the Building have considerably more than doubled the above conjecture.

Messrs. Fox and Henderson; though not before the water-tight security of the roof had been severely tested by a heavy fall of rain, which afforded the Contractors ample opportunity of investigating the causes of the leakage.

The reception of the goods was next commenced; the first arrival from the Continental Exhibitors being a specimen of German sculpture, on Feb. 12.

The attraction of the Building continued to increase: on Sunday, Feb. 16, between the hours of two and four, a competent statist declared that the number of persons passing and repassing the south transept window was at the rate of between 240 and 250 per minute, or about 14,000 to 15,000 per hour; and on Sunday, Feb. 23rd, between the hours of 2 and 5, there passed through Cumberland Gate and Apsley House Gate, 44,076 persons.

On Feb. 18, Her Majesty paid her first visit, accompanied by Prince Albert, the Prince of Wales, and other branches of the Royal Family.

On Feb. 25, the sale of season tickets commenced, at the house of the Society of Arts, Adelphi; and on that day realized £3500.

The arrivals of articles from foreign countries, and their reception at the Building in Hyde Park, afforded too many interesting points for us to record. Most of the goods were packed in wooden cases, or swathings of cloth or matting, giving the various divisions of the eastern or foreign half of the building the air of a vast repository of unpacked furniture, camp-baggage, &c. The arrivals from the Zollverein, for example, presented an infinite variety of size and shape of the parcels, and superscriptions, labels, brands, marks, and directions, running over them on every side.

A more notable arrival was that of the United States' frigate, *St. Lawrence*, with her freight of contributions from the mighty hemisphere of the West, "the giant son of the queen of the seas." This is an event of even historical importance, charged with high promise to the future destinies of the two great commercial empires of modern days; and proving the most marked advance towards the realization of that unity of the interest, purposes, and progresses of the human race, which first gave the Exhibition scheme its enlightened comprehensiveness: "not a unity," aptly enough said Prince Albert, at the City of London banquet, "which breaks down the limits and levels the peculiar characteristics of the different nations of the earth, but rather a unity, the result and product of those very national and antagonistic qualities."

The *St. Lawrence* left the navy-yard at Brooklyn, on Feb. 18; and, including officers, passengers, and 49 marines, had 303 souls on board. Her cargo of goods was very large: there were upwards of 500 Exhibitors, forwarding between 1000 and 2000 packages, weighing near 1000 tons; including a block of zinc ore, weighing 8 tons, probably the largest single block of that ore ever obtained. The frigate arrived at Southampton on March 14th, having run one-third of her passage across the Atlantic at steamer speed: she was most hospitably welcomed at the above port, her captain and officers being fêted by the Mayor and authorities; and the appearance of so large and fine a ship of war in the commercial docks of the town presented an interesting scene. As the last day of receiving goods (March 31st) arrived, the pressure was tremendous; and, on the night of the 31st, at the hour of closing, the heavily-laden conveyances were drawn into the Building, and there left to be unloaded next morning.

On April 15, Prince Albert presided at a full meeting of the Commissioners, after which it was officially announced that her Majesty would go in state to open the Exhibition on the 1st of May; those who had entirely contributed the Exhibition being excluded from witnessing the ceremony; together with the purchasers of season tickets. This brought a storm of disapprobation from every organ of the press; and the unpopular plan was speedily modified, by the Commissioners, on April 22, publishing the programme of the opening by her Majesty—the exhibitors and holders of season tickets to be admitted as spectators.

THE GREAT EXHIBITION OPENED.

" As I slept, me mette I was
Within a temple ymade of glas,
In which there were mo images
Of gold, standing in sundry stages,
Sette in mo rich tabernacles,
And with perrie mo pinnacles,
And mo curious portraitures,
And queint manner of figures
Of gold worke, than I saw ever.
* * * * *
" Then saw I stande on thother side
Streight downe to the doores wide,
From the deis many a pillere
Of metall, that shone not full clere.
* * * * *
" Then gan I loke about and see
That there came entring into the hall
A right great company withall,
And that of sondry regions
Of all kind of condicions
That dwelle in yearth under the Moone,
Poore and riche; and all so soone
As they were come into the hall
They gan on knees doune to fall
Before this ilke noble queene.
'*Madame*,' sayd they, '*we bee*
Folke that here besechen thee
That thou graunt us now good fame,
And let our workes have good name;
In full recompensacioun
Of good worke, give us good renoun.'"
House of Fame: CHAUCER.

So sang the Father of English Poetry, in the vernacular language of his own age and country, nearly five centuries since, but with a prefiguration identical with the ceremonial of the opening of our Great Exhibition, which seems to justify the olden association of the Poet and the Prophet.*

The Exhibition was inaugurated, according to announcement, on the 1st of May. Her Majesty and Prince Albert, the Royal Family, and the Court, proceeded in semi-state from Buckingham Palace to the Great Building in Hyde Park, where had assembled a company of some 25,000 persons. The only special preparation for the ceremony was a carpeted platform and a chair of state, placed beneath a canopy, suspended midway in the transept. As the Royal procession advanced, the mighty organ and the tuneful choir gave the national anthem. Prince Albert, at the head of the Royal Commissioners, next read to Her Majesty the Report of the Exhibition pro-

* The Temple y-made of Glas. A Prevision by Dan Chaucer, A.D. 1380. This parallel was first noticed in "Notes and Queries, May 10, 1851.

ceedings, to which the Queen graciously replied. The Archbishop of Canterbury then implored God's blessing upon the undertaking, and the choir sung the Hallelujah Chorus.

A Royal procession was then formed, headed by Mr. Paxton and Messrs. Fox and Henderson; followed by the Official personages of the Exhibition; the Foreign Acting Commissioners; the Secretaries; and Commissioners; Foreign Ambassadors; Her Majesty's Ministers; the Bishop of Winchester and the Archbishop of Canterbury; white wands; Prince Albert, leading the Princess Royal; THE QUEEN, leading the Prince of Wales; the Prince of Prussia and the Duchess of Kent; Prince Henry of the Netherlands and the Princess of Prussia; Prince Frederick William of Prussia and the Princess Mary of Cambridge; Prince Edward of Saxe Weimar and the Duke of Cambridge; the Court, attendants, &c. The procession made the circuit of the nave, the organs successively playing at the Queen's approach. On Her Majesty's return to the platform, the Queen declared "The Exhibition opened," which was announced by a flourish of trumpets, and the firing of a Royal salute on the north bank of the Serpentine; after which Her Majesty, the Prince, and their suites, left the Building, and returned to Buckingham Palace.

To the short notice and change of plan may, probably, be attributed the disregard of a fitting opportunity to invest the out-door ceremony with more of a pageant character than it was permitted to assume. What, for example, would have formed a more striking spectacle than a procession of the insignia which time has spared to modern Corporations of the merchant-guilds of our Saxon ancestors. What could have been more strictly emblematic of this great festival of Industry, than the blending of these memorials of the Past with the triumphs of the Present—these evidences alike of the glories of sovereign and subject; for, as eloquently remarked by one of our kindliest statesmen, (whose order binds him more closely with the sympathies of the people,) "from the throne of England downwards, there is not one whose comforts, whose luxuries, and whose life itself is not promoted, embellished, and sustained by the sweat of the brow, the strength of sinew, the skill of hand, and the resources of the brain, which go to constitute the wonder-working industry of Britain."

What could have been more splendidly accessory to the great event of the opening day than a national procession in which the several state carriages should have figured; for, cumbrous as they are in comparison with the vehicles of the present day, these "golden glisters" are curious specimens of carving and painting, and emblematic embellishment, recording the state of the arts of design a century or more since. The several guildhalls throughout the country would have contributed a goodly assemblage of something better than mere idle pomp in the banners and standards of the Corporations—curiosities of emblazonry—and the maces and state swords which have been borne in successive mayoralties for many generations, and which, in themselves, present notable examples of working in the precious metals. Such a display was not disdained at the York Corporation banquet: then, why should not these insignia have figured in the crowning glory of the regal inauguration of the Building. At the suggestion of the writer, the idea was thus shadowed forth in a popular journal; "Were the municipal authorities, or any of the great City guilds, by subsidiary processions, to add to the splendour and character, (both derived and bound up with our commercial enterprise,) of the festival, the attractions and solemnities of this auspicious and unprecedented event would be vastly increased, and the popular share of the out-door spectacle be greatly augmented." However, this was unheeded; and there were not wanting persons to maintain that what the pageant lost in glitter it gained in simplicity and substantial import.

THE GREAT EXHIBITION, GEOGRAPHICALLY DESCRIBED.

THE EARTH IS THE LORD'S, AND ALL THAT THEREIN IS;
THE COMPASS OF THE WORLD AND THEY THAT DWELL THEREIN.

NEXT, let us take a glance at the interior of the Great Storehouse of the World's display—the relative position of national industries—the extent which each occupies—the general nature of their respective products—and the more attractive features which they severally present.

At the outset, it is necessary to revert to the position and plan of the Building. It lies east and west, and in form resembles a cathedral; its long avenues stretching from east to west, being intersected nearly midway by a transept. Thus, an almost equal division of space resulted, which was turned to account in the most appropriate manner: the western portion being appropriated to the productions of the United Kingdom, India, and the Colonies; and the eastern portion to foreign countries.

The entrances to the Building are at the south end of the transept; on which side of the structure are six doors of exit. At the north end of the transept is an entrance reserved for Her Majesty; and on the same side of the building are three doors of exit. At the east end are another principal entrance, and three exits; and at the west end are a corresponding entrance, with four exits.

The vast extent of the entire area has been suggested by various comparisons. Thus, "the Alhambra and the Tuileries would not fill up the eastern and western naves,—and the National Gallery would stand very well beneath the transept. St. Paul's Cathedral does not cover half the ground. The Palace of Versailles, the largest in the world, would extend but a little way beyond the transept. A dozen metropolitan churches would stand erect under its roof of glass."—(*Athenæum*, No. 1227.)

The Building is divided into bays or areas, (spaces of 24 feet square between four columns,) which are marked by letters and numbers on the 77 columns; the letters commencing at the extreme northern wall, and terminating at the south; and the numbers proceeding from west to east.

The articles from the United Kingdom were divided into thirty classes, occupying the western side of the building; the British Colonial productions being arranged in areas adjoining the transept.

It was originally intended that the contents of the eastern section of the building, appropriated to Foreign States, should also have been classified; but this was found impracticable, and they were accordingly divided into Nations, in areas occupying the section, and ranging on the east side of the transept. The names of the several countries were inscribed in large characters above the bays or courts; and each was further distinguished by its emblematic banner, which we shall describe more at length hereafter.

The south side, west of the transept, bore several examples of wall decoration in cements, specimens of woods and ivory, and imitative wood and stone painting. The south side, east of the transept, was hung with examples of woollen and felted articles; sheets of metal, manufactures in metal, &c. The galleries, in their general arrangement, corresponded with that of the ground floor, that is, British and Colonial west; and Foreign Countries east; but they did not possess the precise gallery-space over their ground-floor allotments.

Illustrative of the Geographical Distribution, by a bold flight of fancy, and in open defiance of geometry, *the transept* was declared *the equator of the world in Hyde-park.* On one side, India and the Colonies, on the other, China, Tunis, the Brazils, Persia, Arabia, Turkey, and Egypt were grouped around it as the torrid zone. Behind the colonies, in the WESTERN DIVISION, were the products of our native industry; and after the foreign states mentioned, followed in the eastern division the contributions of the great European communities, and of our descendants across the Atlantic. Let us mark their order. Next to CHINA, TUNIS, and the BRAZILS, on the south side of the nave, was a strip of territory held by SWITZERLAND, and remarkable for a fine display of muslins, embroidery, clock-work, straw-plaiting, &c. Opposite to the space of the Helvetic Republic, on the north side of the nave, were located the different communities of the three Peninsulas that project into the Mediterranean. GREECE re-opened for this occasion the marble quarries from whence in brighter days her temples were adorned, and her sculptural reputation formed. SPAIN and PORTUGAL succeeded—no longer able to plume themselves on the riches of newly discovered countries—yet now relying upon the extent and value of their native resources—upon the variety of their vegetable and mineral products; and still upholding the ancient reputation of Toledo blades, and their manufacture of arms and artillery. Next to them came the ITALIAN STATES—Tuscan, Roman, and Sardinian—all striving amidst the pressure of more utilitarian industries to assert the pre-eminence of art, and to claim the palm of excellence in works which appeal to the imaginative and the tasteful. Travelling eastward, the second-rate Powers of Europe disappeared for a time; and we found before us the products of countries filling both sides of the nave, and occupying the entire breadth of the building, north and south. This was particularly the case with FRANCE, which held a considerably larger area than any other foreign state. She had about 60,000 superficial feet of exhibiting surface; and, at her northern and southern boundaries, her territories ran westward in two strips, so that her whole frontier line parallel with the transept assumed a hollow form, flanking Switzerland on the one hand, and Italy on the other. Great as was the space assigned to France, the amount of her industrial products was larger than could be accommodated therein; and, like England, she was obliged to seek a home for her surplus exhibitors in the less occupied area of the United States. At the extreme verge on the north-west, were the products of the great French manufactories in porcelain, tapestry, and carpets. From thence towards the nave were arranged the Algerine collection, fancy cabinet-work, machinery, and arms. In the southern half of the department of the French were their textile fabrics, their furniture, their bronzes, and their raw produce. In the nave itself they exhibited several trophies of industry and art—among which the organ, the group of St. Michael and Satan, and that of Cain and his Outcast Family, figured conspicuously.

From the French division, still moving eastward, we found the BELGIAN collection before us, disposed in a long strip across the breadth of the building. The Belgians came out boldly in machinery, which was placed on the extreme north of their division—in the manufacture of fire-arms, of which they had some splendid specimens—in fine arts, their chief contributions to which stood in the nave—in vegetable raw produce, which was arranged on the extreme south—and in lace, their finest examples of which were found in one of the north galleries. They showed only three or four carpets, but these were masterpieces in their way. HOLLAND occupied a narrow slip of space on the north side of the nave, between Belgium and Austria, which pressed it on either side, hardly allowing it room to ring the fine peal of bells which formed the chief feature of its collection.

You next entered the territory of the AUSTRIAN EMPIRE, stretching, like that of France and Belgium, right across the building, occupying an area commensurate with its political position as a leading Power of Europe, and presenting objects of attraction and interest inferior to no other country that sent its products to the Exhibition. The display of machinery and agricultural implements on the extreme north of this department was small, and rather curious than valuable. As you moved towards the nave, a variety of contributions placed the ingenuity and taste of the Viennese in a very high position. These were suites of rooms filled with carved furniture of extraordinary beauty, both in design and execution. There also were specimens of parqueterie and marqueterie, porcelain, lithographic printing, and a variety of other processes bespeaking great progress, and an elevated standard of national industry. In the nave, as trophies of art, were placed, among other objects, the group of Mazeppa bound to the Wild Horse; and in the centre, a huge pavilion of red cloth, the east side of which was occupied by a splendid stained glass window. The southern section of the Austrian department also had its attractions, the chief of which was the Milan Sculpture Court; at the entrance of which was the significant and characteristic statue of Radetzsky, and at his feet inscribed the now celebrated declaration to his troops, "Soldiers, the contest will be short." The public lingered long here in admiration of the Ishmael (by Strazza), and the various other charming works with which Monti, Galli, Cacciatori, and other artists adorned this apartment. The extreme south of the Austrian division was occupied chiefly by raw produce, of which there was a remarkable collection; and by meerschaum pipes and cigar-holders.

Next you entered the area devoted to the States of the ZOLLVEREIN. They occupied a large space on both sides of the nave; and their collection, while it was remarkably rich in works of art, approached more nearly a utilitarian standard than the majority of our foreign contributors. On the extreme north of this division was an excellent and well-arranged display of fixed machinery, hardware, and cutlery. Nearer the nave, was an octagonal hall, filled with the different kinds of German porcelain, from Dresden downwards. Outside that, on one side was a remarkable collection of sword blades and fire-arms; and on the other a very interesting and amusing assemblage of stuffed animals from Stuttgard, which, it was safely predicted, would become a popular feature of the Exhibition. The German objects placed in the nave incontestably proved the pre-eminence of Saxon genius in treating subjects on a grand and colossal scale: such are the Bavarian Lion, the Amazon Group by Kiss of Berlin, the Stuttgard Horses, and the fine bronzes by Schwanthaler. On the south side of their allotment the States of the Zollverein showed a vast mass of manufactured articles, textile fabrics of every description; and, farthest back, of all specimens of their raw produce. This part of their display most interested the mercantile community, and had the closest bearing upon the wants and necessities of the million. It wore, perhaps, a more commercial aspect than was suitable to the occasion; but there was a positive relief experienced in escaping from the crowd of attractions which everywhere else press upon the sight to those quiet nooks and corners filled with woollen and mixed stuffs, and with harmless unassuming cotton embroidery.

Next to the Zollverein, on the north side of the nave, came NORTH GERMANY; and, on the south side, DENMARK, SWEDEN, and NORWAY. These countries occupied comparatively small spaces, but were not unworthy of a rapid visit. Still moving eastward, you passed into RUSSIA, with its parqueterie, musical instruments, solid jasper and richly gilt vases, Cossack armour, and machinery. AMERICA occupied the remaining area of the Exhibition eastward, with the exception of a small slip at the south-east corner, which was in the hands of the French.

Thus far have we run over the entire eastern area of the Exhibition; and, though merely in outline, it may serve to fix in the reader's mind a distinct conception of the contributions of each country, and how they were placed.

It is not, however, so easy to give a definite and precise account of the disposition of spaces in the four galleries, two on each side of the nave, that run eastward from the transept. It must, therefore, suffice to say, that on the south side, the Swiss and French exhibited a variety of their lighter manufactures, such as silks, embroidery, lace, jewellery, ribands, and straw-plaiting. The Germans, on the same side, also had constructed a large organ. On the north side, the Belgians, the Germans, and the Americans, made the principal display. The first showed the different varieties of lace for which they are famous; the second, models of buildings and machinery; the third, chiefly perfumery and fancy soaps, in which last-mentioned material, busts of the Queen, Washington, and General Taylor were displayed.

Crossing the transept, and turning to the WESTWARD DIVISION, the first compartment was that which contained the EAST INDIAN COLLECTION. Our empire in the East, like the great European States, appropriated to itself an area stretching right across the building. Commencing on the extreme north, we found the ancient arts of an ingenious people illustrated by specimens little, if at all, inferior to the works in similar materials of modern civilized communities. Approaching nearer the nave, was formed a sort of divan, filled with carpeting, mats, elaborately-carved furniture, and the richest brocaded velvets. At the point of intersection of the nave and transept, on the north side, the East India Company had arranged a small model fleet of the different varieties of vessels peculiar to the Indian Seas. On the south side of the nave, the Lahore jewels were exhibited. Here were specimens of native arms arranged with great taste; and, among a variety of other objects, models of agricultural implements. The collection of raw produce was on the extreme south, and was of great variety and value.

You next came to the Colonial Department, comprising the industrial products of AUSTRALIA, of CANADA, and NOVA SCOTIA, NEW ZEALAND, several of the WEST INDIA ISLANDS, the CAPE OF GOOD HOPE, WESTERN AFRICA, MALTA, and the CHANNEL ISLANDS. The contributions from this vast extent of territory were chiefly confined to the south side of the nave. They yielded in interest and variety to no other department of the Exhibition, but they were chiefly raw produce. The visitor found there copper from the Burra Burra mines, seeds from Australia and Canada, flax, sponges, skins, furs, and corals,—the natural productions of tropical and almost polar regions brought into close proximity. Yet, manufactures were not altogether unrepresented; for Canada contributed a piano-forte, furniture, preserved meats, fire-engines, sleighs, and dressed leather. Western Africa sent a few specimens of textile fabrics; and Malta shone in the lightness and beauty of its filigree work, executed in silver and gold.

At an early period, the Commissioners determined that the collection of Raw Produce in the British half of the Exhibition should be disposed along the south side of the building; that Machinery should be ranged along the north; that our Manufacturing products should be collected, as much as possible, towards the centre, and should lend their brilliant colours and varied effects to decorate the portions of the interior adjacent to the nave; lastly, that the Fine Arts contributions should have a section of the building next in order to the Colonial

Department. This arrangement was strictly followed. The same general divisions that were laid down by the Commissioners with respect to our native products, and the same distribution in the building, they recommended Foreign Countries to adopt; and, in the eastern half of the interior, Machinery, where there was any, was generally found on the north side of the several departments; Manufactures being brought towards the central avenue; and Raw Produce thrown off to the extreme south. A further distribution of the objects included under the different heads of Raw Produce, Machinery, Manufactures, and Fine Arts, was also made; and they were divided into thirty sections: the first (raw produce), contained four; the second (machinery), six; the third (manufactures), nineteen; and the fourth (fine arts), one. Mining, quarrying, metallurgical operations, and mineral products, occupied a strip of space on the extreme south. Chemical and Pharmaceutical processes and products; Substances used as Food; and Vegetable and Animal Substances used in Manufactures; being generally light commodities, were placed in the south gallery. Manufacturing machines and tools, which required for their proper exhibition the application of the steam-engine, could not be conveniently displayed in any other position than that which was assigned to them, on the extreme north of the building, from the rest of which they were partitioned off. A Boiler-house* placed outside, north-west of the building, supplied them with steam. Machines for direct use, including Pleasure Carriages and Railway and Naval Mechanism, were arranged along the north side of the building, parallel to and within the space set apart for Machinery in Motion. The sections of Civil Engineering, of Naval Architecture, and Military Engineering, were placed on the western and northern galleries. Agricultural Implements, as already explained, occupied a space on the ground area parallel with, and next to, the department of Mining, Quarrying, Metallurgical operations, and Mineral products, on the south side of the building. Philosophical instruments, and processes depending upon their uses; Musical, Horological, and Surgical instruments, were situate chiefly in the western gallery and the north gallery of the nave. The display of Manufacturing products, comprising nineteen sections, was arranged on either side of the central avenue, above and below: Cotton woven fabrics, exhibited as specimens of printing and dyeing, woven fabrics of mixed materials, Leather, Furniture, Hardware, Cutlery, Furs, Mineral manufactures, and Paper, occupying the principal positions on the ground-floor; Silks, Velvets, Shawls, Carpets, Floorcloths, articles of Clothing, Jewellery, working in Precious Metals, Glass, Ceramic manufactures (china, porcelain, and earthenware), being placed in the galleries of the nave.

We have thus journeyed from the transept to the Colonial department, upon which impinged the SCULPTURE COURT, the MEDIÆVAL COURT, and the FINE ARTS COURT. The Mediæval Court proved attractive as a cabinet of curiosities, from its presenting to the latter

* Described at p. 76.

half of the nineteenth century the style of architecture and decoration, domestic and ecclesiastical, which existed in this country during the middle ages. The Fine Arts Court contained a variety of artistic objects, in its models of celebrated buildings, from the designs of Mr. Digby Wyatt, the active Secretary of the Executive Committee; specimens of printing in oils by Mr. Owen Jones, and a whole host of followers; a fine painting in silica colours by Armitage; a collection of lithographs, wood carvings, terra-cotta mouldings, and other decorative contributions.

The Hardware Department included every species of Birmingham products, and embraced a larger number of contributors than any other section of the Exhibition. On the north side of the nave was the display of Stationery and the ingenious Envelope-folding machine of Delarue and Co. The Furniture on each side of the nave comprised the best productions of our chief metropolitan and provincial makers. Beyond it appeared the department of Sheffield Cutlery; and thence to the western entrance, on both sides, was arranged the display of Textile Fabrics of all kinds—of leather, of furs, and of mineral manufactures. The last-mentioned section included the display of Cornish porphyry and serpentine by the Penzance Company. On the north side, at the western entrance, was a splendid collection of Carriages of all kinds, chiefly metropolitan; and a display of Railway Mechanism, including locomotives, railway carriages, and permanent way.

Adjoining was the department of Machinery in Motion, the long rows of iron frames producing a striking effect, and the vast mass of contributions leaving upon the mind a profound impression of the capital, the energy, and, above all, the mechanical genius, of the country. Cotton Machinery was placed farthest west; the contributions of Hibbert and Platt, of Dalton, of Parr and Co., and of Higgins and Co., being the most remarkable. Then came Flax Machinery, in which Lawson, Plumber, Parker, B. Brown, and Crawshall, were the principal contributors. In silk, Devonport, Reed, and Frost, were the most prominent. Then there were Lathes and Tools, the latter of which developed some remarkable peculiarities; the contributions of Whitworth, Sharp, Fairbairn, Garforth, and Hick were very striking; Appold's centrifugal pump was a very attractive feature of this department; and Applegath's vertical cylinder printing-press proved unceasingly interesting.

Between the end of the Railway Mechanism section, nearest the transept and the Furniture Court on the north side, was placed the Fixed Machinery, which included some beautiful marine engines upon different principles, exhibited by Watt and Co., Penn, Hatherton, and Slaughter; a gigantic crane, used by Fox and Henderson in the progress of the Great Building; the celebrated Britannia press; the Nasmyth hammer; the geometrical staircase; and a variety of other objects.

On the opposite or southern side of the nave, a little west of the Mediæval Court, were the Agricultural Implements Department; the necessity for selection and compression, which the limitation of oom imposed, compelling the agricultural implement maker to produce only the best examples of those articles upon which his reputation as a manufacturer rests. Here were Implements for tillage, drilling, sowing, and manuring machines, harvesting machines, barn machinery, field, fold, and yard machinery; wagons and carts; drainage implements, churn, dairy implements, and models of farm building.

The extreme south of the Building in the western division was occupied by MINERAL and METALLURGICAL PRODUCTS and their processes; which section was not examined with less attention and consideration than it deserved. Without our iron, our coal, our copper, our tin, and our lead, this country never could have achieved the position which it occupies. The extent of those materials still in reserve for the use of future ages was indicated with more or less distinctness in this section of the Exhibition; and the merest tyro in such matters might, amid the models produced, and the specimens exhibited, collect a fair notion of those simple yet ingenious and splendid processes by which materials, in the rough state useless to man, are fused and fashioned into shapes which fit them for the supply of his every-day necessities and comforts.*

Although the multiform character of the articles exhibited could not fail to impress the spectator from any point of the Building, with the variety as well as amount of interest, it must be admitted that something was wanted to complete the colouring of the picture. The attractions were too much concentrated upon the floor of the Building; and, as the eye rose to the aerial structure of the roof, there was felt to be a space between it and the articles, which might be so filled as to improve the effect of the whole. The Foreign Countries contributed somewhat to this end, by the mode in which they exhibited their carpets, but more by the display of their national flags above their respective locations. Thus far the eastern nave. Our carpets in the western nave were suspended from the girders which run across the Building; and Mr. Owen Jones cannot be too highly complimented on the effect which they produced upon the general aspect of the interior, which was subsequently considerably enriched by the municipal and other banners suspended immediately over the displays of our manufacturing towns, which were at once significant and pleasing decorations. The names of the several countries, &c., inscribed upon coloured cloth, hanging in front of the girders above each court, were another utilitarian enrichment.

Each of the sections may likewise be said to have been represented by an array of trophies, which occupied the main centres of the nave and transept, and were most prominently placed for inspection. The chief decorations of the transept floor were statues, gateways, and fountains. At either end were highly-enriched park entrances, fine specimens of iron casting: those at the northern end were by the

* This Geographical Outline has been adapted from the *Times*, May 1.

Coalbrook Dale Company, each of the four gates being cast in one piece and bronzed. The groups of sculpture in marble, bronze, and plaster, were effectively placed; those at the sides backed by crimson drapery. Entering from the south, first appeared Mrs. Thornycroft's statue of her Majesty on her favourite charger, Hammon; and at the commencement of the north transept, equestrian statues of the Queen and Prince Albert, full size, designed for bronze by James Wyatt.

At the intersection of the main avenue and transept was Osler's gigantic fountain, 27 feet high, of the purest flint glass, and therefore peculiarly appropriate for the centre of the "Crystal Palace." In the north transept was a collection of majestic palms and tropical plants from Loddige's nursery at Hackney; with Ward's closed cases of exotic ferns, cacti, and other plants; flowers in pots of embellished design; from amongst which rose the fine old elms that had been spared, altogether presenting a delightful mingling of the noblest productions of nature and art. In the transept gallery, north and south, was placed a powerful organ, the former with an enriched front; and, at the south-west angle of the galleries, was the Queen's carpet, designed by Papworth, and worked in Berlin wool by 150 ladies; with near it a splendid chandelier; both exhibited by Her Majesty.

Returning to the central fountain, and looking westward, the Spitalfields trophy of superb silk, and a vast specimen of British plate-glass, and a colossal rustic dome of cast-iron, rose high above the range of statues in bronze, stone, and plaster; fountains, sculptural and architectural; light-house apparatus; a group of telescopes (one 20 feet long); models, and monumental crosses; a group of Canadian timber; whilst a collection of marbles and chemical specimens lent the rich aid of colour. Here, too, was a clock on a large scale by Dent, purchased by the Great Northern Railway Company.

Looking eastward, life-size portraits on Sèvres china of the Queen and Prince Albert, and the baptismal shield presented by the King of Prussia to the Prince of Wales—first met the eye. Next was the gilt cage of the Koh-i-noor Diamond: a stupendous earthen wine-jar from Spain, an olive-jar from Portugal; the Vieille Montagne statue of Queen Victoria upon a lofty pedestal; howitzers and mortars from Spain; a colossal plaster group of St. Michael and the Dragon; a large equestrian statue of Godfrey of Bouillon; a draped pavilion inclosing a large painted window of Dante and his "fine frenzies," by Bertini, of Milan; the colossal bronze statue of Radetzsky, from Vienna; bronzed zinc of an Amazon on horseback attacked by a tiger, modelled by Kiss, of Berlin; a colossal lion, 15 feet long and 9 feet high, by Müller, of Munich; two bronze statues, 7 feet high, by Schwanthaler; a group of Berlin castings, vases, and figures; a huge brass bell, by Gruhl; a mass of New Jersey zinc ore, 16,400 lbs.; American statues of the Greek Slave and Wounded Indian; and a large Glass-house model; were the objects that rose in the centre avenue. At each end of the nave gallery was a gigantic organ; and throughout the line, the carpets, table-covers, tapestries, oil-clothes, &c., suspended from the gallery girders, and against the walls, had a magnificent effect.

Rich, varied, and showy as was the great central display, viewed from either of the points we have designated, a far wider range, illustrative of the world's industry, extended beneath the galleries, and in the side aisles, north and south. In the north-west was an assemblage of gigantic locomotives and railway apparatus, beside which the ordinary wheel-carriages appeared as merely luxurious contrivances. Opposite was a large group of Cotton Machinery, presenting a most complete illustration of how are spun

"The fleecy forests in a slender twine."

Still further north was a vast assemblage of Machines in Motion, showing cotton, woollen, power looms, &c.; flax, silk, lace, and rope making; lathes and tool machines; building contrivances; railway and steam machinery in motion—a plurality of living interests; naval models, indicative of man's ingenuity in all ages; and printing machinery—the leverage which Archimedes sighed for—to move the world. Of interest akin was the paper machinery, where rags passed in at one end were delivered at the other as a sheet of paper, a process almost as rapid as thought itself. Sometimes, the juxta-position of objects was strangely suggestive of contrasts; as in the great lathes for turning locomotive wheels and shafts; the gigantic hydraulic press, and the centrifugal pump throwing 2000 gallons of water a minute—located beside the delicate nick-nacks of the Fine Arts Court.

South of the western nave were deposited British specimens of printing and dyeing; flax, woollen, and mixed fabrics; hardware, brass and iron work, locks, and grates, and furniture; a long space filled with agricultural and horticultural machines and implements; and beyond them specimens of the earth's treasures—gems, clays, stones, coal, iron, copper, and lead. And, as you approached the transept, on either side were assembled a variety of productions, illustrative of the productive wealth of the British Colonies.

Ceylon contributed some very interesting minerals, including iron, tin, manganese, and plumbago; the ruby, with the beautiful earthy substances, zivern, chryso-beryl, and tourmaline. Among vegetable productions were coffee, cinnamon, tobacco, &c., accompanied by a model of a coffee-store and drying plantation. Of other natural products exhibited, were numerous gums and oils, specimens of ivory, buffalo and deer horns, tortoiseshell, and a great variety of woods. In manufactured products and agricultural tools, there were gold and silver ornaments, lace, cotton fabrics, and cordage. There were also some models of carriages, palanquins, and temples; but the chief art in which the Cingalese appear to excel is that of inlaying in wood, of which there were several samples: one, an ebony table inlaid with fifty different Cingalese woods, &c.

The East Indian Courts were rich and varied in their contents. There was a fine display of weapons of war, suits of armour, &c., of native make, tastefully arranged; amongst which a brass gun, with a tiger's mouth, was a formidable object. There were likewise models of European guns, &c., at present in use, so that every stage of progress in the arts of war was faithfully represented. Next were muslins richly embroidered, a very old branch of manufacture with the nations of the East, and in which, in many respects, they are still unrivalled. Next was a show of musical instruments, both stringed and wind, from Bengal, singular and picturesque in appearance. Facing these were models of the mills, gins, and other works, used in the preparation and manufacture of the cotton-plant,—primitive contrivances of the rudest class, to which few or no additions or improvements have been made for centuries; with models of equally primitive and clumsy machinery for the grinding of sugar, the distilling of spirits, and other like purposes. A curious contrivance for casting coin, and used in the Madras mint, attracted much attention: it consists of a battery of ten feeding-tubes, or hoppers, which are acted upon by handles.

There were several curious utensils in brass, copper, and pottery, especially some used by the Hindoos in their idol-worship; including the self-feeding peacock lamp, in brass, used in the Deorah, or temple of the iron dealers of the Surragee persuasion, by whom it is held sacred, but who readily contributed it for exhibition in the Crystal Palace. The principle of this lamp is simple enough, the oil being supplied from the breasts of the peacocks into the lamp-burners whenever it is required.

The Indian furniture included some elaborate carving and inlaid work; white marble chairs and couches from Rajpootama; and a royal state bedstead from Benares, with purple muslin curtains richly embroidered.

One of the most striking features in the Indian collection was a room furnished in the gorgeous style of an Indian palace. Around it, externally, were a large collection of figures, in clay, illustrating the various trades and castes of the Hindoos. Within was a display of rich shawls, carpets, matting, and mixed fabrics. Nor must the various objects of natural produce, vegetable, animal, and mineral, be overlooked; for they are of the highest interest to the future destinies of our vast Eastern empire. Gutta percha and vegetable tallow were exhibited here, with some new vegetable dyes; with carpets of beautiful colours and patterns, Cashmere shawls, Dacca muslins, and other riches of the Indian looms. Cutlery, with specimens of the famed Wootz, or Indian steel, was also picturesquely arranged. The models were very numerous, and included several varieties of Indian vessels, including the pirate prahu of Mindanao, and the sampan of Singapore, with sails and oars; and, in a supplementary collection "forwarded by the mail steamer," were some of the famed edible birds' nests of Java.

We must here say a few words of the superb assemblage of royal dresses of state, and jewels, which were exhibited in the Indian collection, inclosed with plate-glass. First in the group was the kinkhob (cloth of gold) coat of a Sikh chief, laid with pearls, rubies, and emeralds, from old Delhi. Next, on a crimson velvet saddle-cloth, stood a set of chessmen in bloodstone and carnelian; then, in filigree gold, with a bird-of-paradise feather fan, a pair of moorchals, the insignia of the highest rank in India; next, a girdle of nineteen large emeralds, bordered with diamonds; and a pair of armlets, with three large rubies. In the centre of the group lay, set round with ten other diamonds, the celebrated "Durra-Durra," or "Sea of Light;" and near it a necklace of 240 large Oriental pearls, valued at £7000. Near it were a white carnelian cannon, wheels, and mountings; rock crystal vases and cups, worth from £50 to £200 each; jade caskets, set with emeralds, rubies, and topazes; and wonderful specimens of filigree silver and gold work from Agra, Cutch, Delhi, and Trichinopoly; besides pith figures and models; grand gold and silver embroidered and silver-handled umbrellas; and chattahs, which are only carried on state occasions in royal processions.

There were subsequently added some magnificent presents from the young Newab Nazim to Queen Victoria: consisting of a howdah, with all the trappings complete, belonging to an elephant; the sides of ivory, inlaid, and painted in gold, and covered with a canopy of gold and silver brocade, an awning in front supported by two ivory poles, and acting as a protection from the sun. The position of this awning designates the standing of his Highness, and is only to be seen in the establishment of the Nizamut. The "jhool," or covering on which the howdah rests, is of splendid workmanship, the body velvet, with a richly-embroidered gold border, and corners of raised gold needle-work. These gorgeous trappings were placed upon a preserved elephant, borrowed from the Saffron Walden Museum.

Next was a throne, or native reception-seat, with its splendidly-worked "shamiana," or velvet and gold and silver canopy, supported by four silver pillars, about 7 feet high.

Another costly item was a state palanquin, with a long pole attached to each side, and carried by eight pole-bearers; and near it was a "palkee," such as is borne on the shoulders of servants.

The velvet and silk materials with which these conveyances were lined, were all of Indian manufacture; and the taste and elegance displayed in the mixture of colours, gold and silver, and embroidery, was admirable. These presents are interesting as so many elaborate specimens of the cost and skill lavished in the East upon articles of personal state and adornment.

We should not omit to notice the Sculpture and Mediæval Courts, eastward of the General Manufactures, and in their Marbles, and the older forms of the Ecclesiastical Furniture of the Middle Ages, breathing the spirit of antique art, contrasting with the crude products of nascent civilization, as developed in our Australian colonies; and the barbaric pomp of the Indian collections.

Such associations of objects illustrating the condition of the human family in opposite phases of society, must, to well-regulated minds, have presented many striking studies of ethnological character; and, in results of this class, the Exhibition may be expected to prove more lastingly beneficial than by any extrinsic attractions, or even by the vastness of the assemblage.

The Canada Court illustrated this view. A hundred years ago, Canada would have furnished a very different display from that which she here presented. Then we should have had a rude and miscellaneous lot of native contrivances and aboriginal finery; as a wigwam, some wooden or horn spoons, rough earthen pots, a few embroidered mocassins, a few tomahawks, scalps, and other military trophies; but nothing indicative of the natural resources of this vast and almost virgin territory, nothing that spoke of the honest industry or intelligent enterprise of its inhabitants. Very different from this, however, was the case. Civilization has begun its useful work in the far west, tutored by European industry, and some of the results were exhibited. They were not showy, but were more valuable as evidences of social advancement,—they were the fruits of peace, not the spoils of war—the industrial beginnings of a junior branch of the great human family, not the gaudy remains of an effete barbarism, demolished, but not replaced by anything better. Thus, the Canadians sent us specimens of iron, copper, and silver ore; a case of native gold obtained from the gravel on the south-east side of the prolongation of the Green Mountains; specimens of stones for lithography, of agates, soap-stones, gypsum, slates, and serpentines. Of timber (in the trophy in the main western avenue), there were oak, curled ash, bass-wood, black walnut, pine, curled maple, birds'-eye maple, hemlock, elm, spruce, &c.; the maples and black walnut being well adapted for decorative furniture. Of agricultural products, there were barrels of corn, Indian meal, barley, oats, peas, beans, flax, potatoes preserved for sea voyages, also Siberian oil-seed, hemp, hops, and maple-sugar; all showing the varied richness of a land, which, put to good account, might relieve the short-comings of the older communities of the world.

In unmanufactured or but partially manufactured products, there were specimens of moose hide and leather; moose deer's head and horns; calf-skin, porpoise-skin, &c. In addition to these resources of natural wealth, there were promising specimens of Canadian handicraft in furniture and articles for household use. Among the former were half-a-dozen chairs, the seats and backs worked in worsted and silk by the ladies of Montreal, "for England's Queen." There were also a handsome piano-forte and some other musical instruments; some stylish sleighs, with sleigh robes and harness complete; a fire-engine of elegant design, capable of throwing water 210 feet high; several models, including one of a wooden bridge, with an arch 250 feet span; a Canadian trading canoe, of bark—a fine specimen; ship-building crooks and futtocks; specimens of cordage, tools, and cutlery; samples of carpeting, blankets, and grey cloth; fine cloths and satinettes, leather trunks, brass-bound; cooking and parlour stoves; a church-bell made from the copper of Lake Huron; some excellent printing types; a new copying-press; snow-shoes and mocassins; articles of jewellery, and specimens of artificial teeth.*

The arrangement of the eastern or Foreign portion of the building in countries, instead of classes of objects as in the British department, was a disadvantage as respected practical application and instructive purposes; but this national grouping materially contributed to picturesque variety and effect; each Court presenting so many *tableaux* of the humanizing influence of industry, and its progressive contributions to social refinement. Occasionally, a department presented a curious picture of manners and customs with extraordinary fidelity: we may instance the Tunis court or bay, in which a good-natured Turk sat as *custodian,* amidst a motley assemblage of shoes, boots, and slippers, of red, green, and yellow morocco, as well as saddle-bags of the same materials; thus presenting a picture of a Tunisian shop, or bazaar stall.

The model of a Tunisian tent was also curiously illustrative of the nomadic habits of the people; and some superbly embroidered dresses and horse caparisoning showed the inhabitants of North Africa to excel in works of ornament to the neglect of the useful arts, as seen in some ill-manufactured iron and earthenware.

China was represented by several specimens of ingenuity, among which the model of a Joss-house was prominent; and, as a methodical illustration of Chinese manufacture, we had "a complete collection of the various materials employed at the Great Porcelain Works in the vicinity of the Poyang Lake, in making porcelain." Still, amidst a host of common-place specimens, glittering and showy, but of comparatively little interest, it was impossible to forget the "Chinese Collection" first exhibited in England in 1842, and altogether, a most complete illustration of the industrial skill of a nation famed beyond all others in all the arts that minister to human subsistence. In vain we looked for a barrow with sails, such as have been seen in China in fleets, and which Milton refers to at

> "Sericana, where Chineses drive
> With sails and wind their cany wagons light."

Spain contributed, in its collection, three characteristic specimens of her ingenuity: sumptuous *custodia,* (altar-furniture) of gold and precious stones, valued at £28,000, and made for the cathedral of Lima; some genuine Toledo swords, one in the form of a serpent; and a piece of the Moorish palace of the Alhambra. Among the ingenuities was an octagonal table, from Barcelona, of inlaid wood,

* This excellent display was insured by a preliminary or "Provincial Exhibition," held at Montreal, in October, 1850, with a view to the selection of articles (Canadian produce) for transmission to the mother-country. The sum of £2000 was granted by the Legislature, which, aided by local subscriptions, enabled the Commissioners to award prizes to the amount of £1500 to the best articles in the specified classes. The articles were exhibited in the Bonsecours Market hall at Montreal; and the Governor, in order that such benefits shall be commemorated, has resolved upon publishing a catalogue of the articles, with engravings of the more striking productions. Thus, Canada, as well as many other countries, may continue to have their own Exhibitions, benefiting by the happy thought of the parent country.

containing 3,000,000 pieces; the arms of England alone, in a space of three inches by two, consisting of 53,000.

Italy displayed a fine collection of minerals and chemical products; silk in all its stages, and the sumptuous work of the Italian looms; inlaid and carved furniture; and some specimens of mosaic work, including a table bearing some views of buildings, resembling highly-finished paintings; and a mosaic copy of Guercino's John the Baptist, from the famed school of the Vatican.

Among the more striking features of the Foreign Division was the large space occupied by France, well merited by the excellence of her productions of ornamental design, or *art-manufactures;* as displayed in the Gobelins tapestry and carpet-work; in the national china of Sèvres, and the rich silks of Lyons, and other looms; clocks in or-molu; and gold and silver work, and bronzes, of exquisite taste and workmanship. Nor must we forget the plate-glass conservatory of Artificial Flowers in the main avenue, between two of the bays of France: these exquisite productions of M. Constantin, of Paris, for truth and delicacy have never been equalled; being in beauty, and everything but smell, identical with nature: roses, lilies, hot-house plants, ivy, were here realized in trailing luxuriance, and *vraisemblance* of colour, and this, too, in one material—cambric—by an art which M. Constantin may fairly be said, if not to have created, at least to have brought to a point of excellence which it had never before attained.

Belgium occupied, with its produce, the bays next France, on both sides of the avenue, and included specimens of almost every branch of industrial occupation—agriculture, commerce, manufactures, mining, and fine arts. After its separation from Holland, it will be recollected, Belgium was thrown upon its own resources, as a manufacturing country, with only 40 miles of coast, and two indifferent ports. Great was the struggle of this tiny kingdom to open up foreign trade; but its wisest and most successful step was the construction of a network of railways, long before any other Continental state ventured upon such a novelty. These railways made Belgium the high road to the Rhine and Germany, and raised its manufacturing interests by greatly cheapening the cost of raw and manufactured produce. Among the specimens exhibited were the cheap mixed fabrics of woollen and cotton; the fine kerseymeres, in which the Belgians under-sell our Gloucestershire and West of England men; also, capital stout canvas and damask linen from Flanders; coloured flannels; carpets from the Royal Belgian manufactory of Tournai; saddlery and harness, somewhat clumsy; and patent leather boots. Liege sent the bright-barrelled musket and bayonet of the pattern made for Schleswig-Holstein; and the muskets, with sword-bayonets affixed, which are used in almost every corps of the Belgian army, and in our Engineer corps; a pair of rifles, one of which is stated when "fired from a rest at a mark 4 inches in diameter, from a distance of 110 yards, to have made 95 hits out of 100." Behind these arms were specimens of flour, millstones, bristles, bricks, tobacco, flax, and hemp, and the dried plants in seed, with all sorts of cereal grain, hops and malt, coal, iron, cannon and agricultural implements; the fleeces of merinoes and cocoons of silkworms—giving a good idea of Belgian industry and versatility. There were two beautifully-made carriages, from Brussels; and furniture in walnut, oak, and spa-wood. There were some fine castings from the great establishment at Seraing, for the manufacture of steam-engines and all kinds of machinery. In the gallery were three life-size figures, with embroidered robes, which the Brussels maker warrants to wear 100 years, and then clean. Here, too, was a case of medals, cameos, bronzes, a shield, dagger, and other ornaments richly chased in iron; all displaying very considerable taste and executive skill, and maintaining the character in the fine arts which Belgium has deserved by the statuary exhibited. But more attractive for the ladies were the specimens of lace from Brussels, Mechlin, &c., in robes, flounces, veils, collars, parasols, and every conceivable article of dress fashioned in thread lace of the most elegant patterns, and hung upon wax figures.

Austria exhibited some fine porcelain and glass; and sculpture in marble and plaster. A suite of five rooms, floored with parqueterie, and filled with the choicest furniture of carved and inlaid woods, was very attractive. An oak bookcase, presented to Queen Victoria, is very beautifully carved. A state bed, by Leister, of Vienna, was attractive: it is 11 feet long by 9 feet wide, and 13 feet high, made of zebra-wood; but, though the figures are beautifully carved, the mixture of Gothic, Italian, and modern Rénaissance decoration, is in questionable taste.

The Zollverein, (Prussia, Saxony, Würtemburg, Bavaria, Baden, Nassau, the two Hesses, and all the minor states of the centre of Germany,) contributed many tasteful as well as useful articles; including stained glass, looking-glasses, curious toys, furniture, including a set of stag's-horn inlaid with ivory, inlaid tables, (mother-o'-pearl and or-molu); crochet woollen-work, and spun coat and waistcoat buttons; Darmstadt ivory carvings; metal manufactures from Hamburg; woven fabrics from Prussia; paper patterns for Berlin wool-work; and Berlin iron castings and bronzes of great beauty.* Of course, porcelain was not unrepresented; and the cutlery, (made after English patterns,) was very good. A model field-piece, polished as a jewel by Herr H. Krupp, is beautifully finished; and some bright cuirasses are excellent specimens of steel cast by a new process. Among the *curiosities* of this department was a large display of walking-sticks, (in the form of a sun,) by C. A. Mayer, of Hamburg, who employs above 300 persons, and exports walking-sticks to all parts of the world. A collection of stuffed animals from

* Critics differ in their estimates of "the art of many-climed Austria." Kiss' Amazon and the Bavarian Lion are, undoubtedly, works of genius; "but," says a judicious critic, "we may remark generally of the Zollverein States, with Prussia at their head, that in art they exhibit the crudeness almost inseparable from new efforts, when there are no old examples, no traditional principles, to guide the hand. The subjects chosen are too often of a base order, unworthy of high art, and are sometimes treated with an extravagance intolerable to an educated taste."

Wurtemburg, (frogs, dogs, and cats,) were very ludicrous; more especially the frog who is shaving his companion; another, who is walking with an umbrella; and a party of cats who are drinking tea, while another cat plays the pianoforte.*

The Russian Court, on the north side of the nave, contained several articles of great value, from their rarity and workmanship, and of real beauty of material and design. Among these were two richly-gilt bronze candelabra, each 10 feet in height, and for fifteen lights, made by Krumbigel, of Moscow, and entered for duty at £500 a-piece. Next was a pair of folding doors of malachite, 13 feet high, panelled and ornamented with gilt bronze, and valued at £6000: there were also a pair of malachite cases, with pedestals, valued at from £1500 to £3000 a-piece; and malachite tables, £400 each, and chairs £150· there were besides vases of cast iron, inlaid with malachite; and three real jasper vases, one of them 3 feet 6 inches in height, which excited the admiration of those most skilled in such matters by the exquisite cutting of its border of leaves, which, as the process is not explained, it is concluded must have been done by mounting the diamond, the only mineral of sufficient hardness to cut agate, in some specially-contrived machine: the cost of the workmanship alone exceeded £700, and the vase can certainly not be valued at less than £2000. These vases are the property of the Emperor, and were made at his own manufactory at Katrinburg. There was also a large vase in porcelain, from the imperial manufactory at St. Petersburg, and valued at £2500. Jewels, estimated at £40,000, were exhibited by M. Bolin and M. Kammerer, both crown jewellers at St. Petersburg. The plate comprised, from the workshop of M. Sizikoff, of Moscow, one candelabrum containing 2 cwt. of silver, and illustrating an incident memorable in Russian history. Near this candelabrum was an ebony cabinet, designed by Baron Clott, one of the first artists in the Russian empire: on the top is a bunch of grapes in amethysts, (the light seeming to show the very juice of the real fruit,) and which are set off by a sprig of mountain ash in coral. Next is a bunch of currants, in white carnelian: the very seed of the fruit are so true to nature, that the Prince of Wales said when he saw them, "He should really like to eat them." On the opposite end are bunches of cherries in red carnelian; and, on the other sides, pears and plums in agate and onyx. Here, too, was a Warwick vase, in hammered iron, from Warsaw; a curious carpet, made in squares of squirrel-skin, surrounded each by a border of needlework; and a cabinet in light wood, with porcelain medallions, from the Imperial manufactory, valued at £500. Malachite (carbonate of copper) was also exhibited in the rough lumps in which it comes from the mine, and in every stage of preparation. It is found in the copper-mines of Siberia and the Ural Mountains, and has lately been met with in the Burra Burra mines, in Australia; that in the Exhibition was

* These animals were stuffed by Ploucquet, of Stuttgard. They have been engraved and published in an amusing little work, entitled "Comical Creatures from Wurtemburg; including the Story of Reynard the Fox."

from the mines of Prince Demidoff. The manufacture of articles of malachite is in itself a work of art; and, smooth as the surface seems, it is made up of a multitude of variously-shaped little pieces, carefully selected to produce particular patterns. In the doors exhibited, there may be some 20,000 or 30,000 pieces embedded in cement, made of the malachite itself. The doors are of wood covered with copper, the malachite veneer being about a quarter of an inch thick. The United States' contributions, occupying the east end of the Building, included some interesting machinery; India-rubber preparations; Daguerreotypes and Hyalotypes; and a variety of manufactures. Among the *curiosities* was a display of fancy soaps, as a coloured glass window.

Of the Galleries we need here say but little. A twin staircase approaching one of them merits description. This was erected by Mr. Banks, the inventor, in one of the north-west avenues of the Nave, and communicated with the gallery above. It was placed here as a specimen of what may be done in a small space, there being two staircases,— one for parties ascending, the other for those descending,—in the area or space which would be devoted to one flight under the ordinary method of construction. This contrivance is considered particularly adapted for cabins of ships, picture galleries, show-rooms, and temporary erections, where a great influx of visitors is likely to attend; being capable of being put up at short notice, and at comparatively small expense. The principle of construction is very simple, being merely an adaptation in extreme limits of the well-known properties of the spiral curve, or springing arch. The ascent is necessarily steep, there being no less than thirty-eight steps in each semicircular flight, the diameter of the plane of which probably does not exceed 12 or 15 feet, whilst the height is 23 feet. The length of the step is four feet, and the length of the outer string-board, 37 feet. Each flight lands on a circular corridor, which intersects two of the galleries of the building at right angles with each other. The rails are continuous ones, so that a person ascending and placing either hand on the rail may continue with the same on the rail during the ascent, all the way across the corridor, and all the way down by the opposite flight.

The contents of the northern galleries in the western or United Kingdom and Colonial departments were models, cutlery, animal and vegetable manufactures; philosophical and musical instruments; and in the transept galleries, china and pottery. The southern galleries contained clocks, jewellery, plate, &c.; lace and embroidery; arms, models, &c.; raw materials; substances used as food; and chemicals: and in the transept galleries, silk, shawls, &c. In the galleries at the west end were clocks and globes; naval models, arms and maps.

The galleries of the eastern or Foreign department mostly corresponded with the allotment of the ground-floor; except that the transept galleries were occupied by perfumery and toys; fishing tackle, and wax flowers; and the southern transept galleries by hosiery and other clothing.

Our sketch of the Geographical Distribution of the Building may not inappropriately be closed with a descriptive enumeration of the various flags and banners suspended over the respective countries of the eastern division, and cities and towns of the western; altogether presenting an interesting heraldic record.

The banners that hung on the Foreign side of the Building displayed, in general, merely the national colours of the different exhibiting countries: in some instances, armorial ensigns were placed upon the flags, as will be noticed in the following detail of them. The banners, seriatim, were these:—

Switzerland.—A flag, white with a red cross.

France.—A tricolor flag, blue, white, and red. This is the celebrated standard which was established during the first terrible French Revolution, the standard which waved over the victories of the Republic and the Empire, and which was displaced during the temporary restoration of the Royal House of Bourbon, the old white flag, "la banniére sans tache," being then restored. At the Revolution of 1830 the tricolor was brought back again, and it has ever since continued the national standard of France.

Belgium.—A tricolor, black, yellow, and red, the national standard adopted by the Belgians at the formation of their new and happy monarchy in Sept. 1830.

Austria.—Black and yellow banner.

Zollverein.—Banner, white and green: another, blue and red.

America.—The celebrated star-spangled banner and arms of the Republic of the United States, which may be blazoned thus: Paly, ar. and gu., a chief az., semé of stars, or. *Crest*—An eagle. *Motto*—"E pluribus unum."

Spain.—A flag, per pale, red, yellow, and red, bearing the arms of Spain upon it: quarterly 1st and 4th gu., a castle tripled-towered, or, for Castille, 2nd and 3rd az., a lion rampant crowned, gu., for Leon, over all, on an escutcheon of pretence, az., three fleurs-de-lis, or, for France.

Italy, Rome.—A white flag bearing the Tiara, and Keys crossed in saltier, emblematic of the Papal dominion.

Italy, Sardinia.—Banner, green, white, red; charged in the centre with the arms, az., a cross, gu.

Greece.—A flag bearing the arms of the Greek monarchy, az., a cross, ar., over which an escutcheon bendy-fusilly of twenty-one pieces, ar. and az., for Bavaria.

Turkey.—Az., a crescent and star of eight points, or.

Denmark.—Banner, red, charged with a white cross.

Russia.—Banner, blue, charged with a yellow cross; first quarter a cross, blue and yellow, quarterly saltire-wise, blue, and red.

Portugal.—Banner, blue and white, charged with the arms, ar., five shields, crosswise, az., on each five plates saltire-wise; on a bordure, gu., seven castles, or.

The arms of the states and principal towns of the Zollverein were placed against the wall in front of the Zollverein balconies.

On the English side, the flags were different in this, that they invariably had arms upon them. They were the municipal banners of the various contributing cities, boroughs, and towns, suspended over their respective compartments. Entering the West Avenue from the transept, and taking from left to right, was *India,* which had no banner; next was Canada, which displayed, first, the municipal flag of Montreal, and next the colonial flag of Canada itself. Then followed the municipal banners of *Quebec* and *Toronto.* Next were the banners of the English towns, in the following order:—*Coventry, Wakefield, Portsmouth, Birmingham, Durham, Preston, Yarmouth, Canterbury, Lynn, Warrington, Sheffield, Cambridge, London, Leeds, Huddersfield, York, Bradford.* Then came one Scottish flag, for

Glasgow; next that of *Halifax;* and then an Irish banner, that of the Royal Dublin Society, which was a large contributor. Beyond the most westerly stairs to the galleries, on this side the avenue, were the flags of *Ramsgate, Lincoln, Liverpool* (opposite the model of that port, in the centre of the avenue); and at the extreme west end of this south side, the corporate arms of *Manchester.* Crossing to the north side of the avenue to return to the transept, overhead were the following flags, in the order enumerated:—*Carlisle, Leicester, Bolton, Derby,* and *Belper.* Then came the north-west stairs to the north gallery of the west avenue; and beyond these was hung the flag of the Mercers' Company. Then followed the municipal banners of *Aberdeen, Hereford, Swansea, Tamworth, South Shields, Worcester, Oxford, Basingstoke, Wisbeach;* and, lastly, over the compartments assigned to the contributions of the Channel Islands, the flags of *Jersey* and *Guernsey;* these terminating the west avenue, at the corner of the transept. These flags had the municipal or corporate arms of the towns they represented, properly blazoned on silk. Each town chose its own colours, and thus the banners were more varied than those of the foreign avenue; for some were of white silk, others of crimson, or sky-blue, or deep purple, and various other colours, which served to contrast with those of their armorial blazoning, and form a striking relief.

The arms on the west nave flags may be blazoned as follows:

Coventry.—Per pale, gu. and vert, an elephant, on his back a tower triple-towered, all or. *Crest.*—A Leopard passant, ppr.

Wakefield.—Az., a fleur-de-lis, or.

Portsmouth.—Az., a crescent, or, surmounted by an estoile of eight points, of the last.

Durham.—Az., a cross, or.

Preston—Az., a paschal lamb, couchant, with the Banner, all arg., round the head a nimbus, or, in base the letters P. P. of the last.

Canterbury.—Arg., three Cornish choughs, ppr., two and one: on a chief, gu., a lion passant guardant, or.

Lynn.—Az., three Conger eels' heads erased and erect, or., in the mouth of each a cross crosslet fitchée of the last.

Dover.—Sa., a cross, arg., between four leopards' heads, or.

Ripon.—Gu., a bugle horn stringed and garnished, or; the word Rippon, of the last, the letters forming an orle; viz. in pale the letters I and N, in chief the letters R and P, and the letters P O in fesse.

Oxford.—Arg., a Bull, gu., armed and unguled, or, passing a ford of water in base, ppr. *Crest*—A demi-lion rampant guardant, or, regally crowned of the first, holding between his paws a rose, arg., charged with another, gu. *Supporters*—Dexter, an elephant, ermines, eared, collared and lined, arg., armed, or. Sinister, a beaver, ppr., ducally collared and lined, or. *Motto*—"Fortis est veritas."

Worcester.—Quarterly, gu. and sa., over all a castle triple-towered, arg., on a canton of the last, a fesse between three pears, sa.

Hereford,—Gu., three lions passant guardant, in pale arg., on a border, az., ten saltires of the second. *Crest*—A lion passant guardant, arg., holding in his dexter paw a sword erect, ppr., hilt and pommel, or. *Supporters*—Two lions rampant guardant, arg., each gorged, with a collar, az., charged with three buckles, or. *Motto*—"Invictæ fidelitatis præmium."

Hertford.—Arg., on a mount vert, a stag couchant, gu.

Aberdeen.—Gu., three castles triple-towered, within a royal tressure, arg. *Supporters*—Two leopards, ppr. *Motto*—"Bon accord."

York.—Arg., on a cross, gu., five lions passant guardant, or.

Glasgow.—Arg., a tree growing out of a mount, in base, surmounted by a salmon in fesse, all ppr.; in his mouth an annulet, or; on the dexter side a Bell pendent to the tree, of the second.

Lincoln.—Arg., on a cross, gu., a fleur-de-lis, or.

N.B.—The City *Seal* is a castle with five towers, with these arms placed over the port.

Liverpool.—Arg., a cormorant, sa., beaked and legged, gu., holding in the beak a branch of sea-weed called laver, inverted, vert. *Crest*—A cormorant with wings endorsed, sa., beaked and legged, gu , in his beak a sprig of laver, vert. *Motto*—" Deus nobis hæc otia fecit." With respect to the bird (in the blazon called a cormorant) which, like that of the Ark, bears the emblem of peace in its bill, it has unquestionably caused the creation of the heraldic " Liver." The bird is from the first name of the town, not the town from the bird.—*See* Baines' Hist. of Lancashire, vol. iv. p. 35.

Manchester.—Gu., three bendlets, or., on a chief, arg., a ship, in full sail, on waves, ppr. *Crest*—A globe, semée of bees. *Supporters*—Dexter, an antelope, collared and lined. *Sinister*—a lion guardant, each charged on the shoulder with a cinquefoil. *Motto*—" Concilio et labore."

Cambridge.—Gu., on a fesse arched three towers, or, all masoned, sa., in chief, a fleur-de-lis between two roses of the second; in base, a river, ppr.; thereon three vessels, each with one mast and yard arm, of the third. *Crest*—On a mount, vert., a quadrangular castle, with four towers domed, in front two ports, all or, masoned, sa. *Supporters*—Two sea-horses, finned and maned, or.

London.—Arg., a cross, gu., in the dexter chief quarter a sword erect of the second. *Crest*—On a wreath a dragon's sinister wing expanded, arg., charged with a cross, gu. *Supporters*—Two dragons with wings expanded, arg., charged on the wings with a cross, gu. *Motto*—" Domine dirige nos."

Leeds.—Az., a fleece, or, on a chief, sa., three mullets, arg. *Crest*—An owl. *Supporters*—Two owls.

Exeter.—Per pale, gu. and sa., a triangular castle with three towers, or. *Crest*—a demi-lion rampant, gu., crowned, or, holding between his paws a mound of the last. *Supporters*—two Pegasi, arg., wings endorsed, the inside of the wings charged with three bars, wavy. *Motto*—Semper fidelis.

Derby.—Arg., on a mount, vert, a stag lodged within park pales and gate, all ppr.

Leicester.—Gu., a cinquefoil ermine, pierced of the field. *Crest*—a wyvern with wings expanded, sans legs, arg., strewed with wounds, gu.

Carlisle.—Vert, the base wavy of six, arg. and az., thereon a castle between two roses, or, on a chief, gu., a lion passant guardant of the 4th.

Warrington.—Ar., five lions, three, two, and one, gu.

Sheffield.—Az., eight arrows in fret, or, feathered and united by a band, ar.; *also*, gu. six swords, arg., hilted or, two and two in chief, and two in base, crossed saltirewise.

Wolverhampton.—Sa., on a chevron between a pillar in base, ar., and two maces crowned in chief, or, an escutcheon, az., charged with a saltire of the second. On a canton, ar., a cross gu., thereon a key, or, in foot of the shield two keys addorsed, gold. Crest out of a mural crown, a mace and sword, saltirewise, and above, the Staffordshire knot, or. *Motto*—" E tenebris oritur lux."

Huddersfield.—Ar., on a chevron between three fleurs-de-lis, sa., three rams' heads of the first.

Halifax.—Ar., the Redeemer's Head, ppr., above the word HALES, below the word FAX.

Bradford.—Per pale, gu. and az., a chevron between three bugles stringed, or.

Dublin.—Az., three castles, ar., flames issuing therefrom, gu.

Dublin Royal Society.—Or, the figure of Erin with harp and cornucopia of flowers, ppr. *Motto*—" Nostri plena laboris."

Belfast.—Per fesse, in the lower half, waves, a ship in sail, and clouds, ppr. the upper half, ar., a pile vair; on a canton, az., a bell, or. *Supporters*—Dexter, an heraldic wolf, ppr.; Sinister, a white sea-horse, ppr. *Crest*—A white sea-horse, ppr. *Motto*—" Pro tanto quid tributum."

Cork.—A British ship in full sail entering a port between two watch-towers, all ppr. *Motto*—" Statio bene fida carinis."

Godalming.—A banner: gu., a woolpack, ar., the word Godalming in bend below; on a chief, ar., the letters E. R. with a crown above, and the figures 1575 below, or.

Bolton.—A banner, red and yellow, charged with an elephant and castle, ppr., and above a bend sinister, or, the British colours in chief.

Wisbeach.—Az , two keys crossed, saltire-wise, or.

Basingstoke.—Gu., St. Michael in gold armour, piercing a dragon, ppr.

South Shields.—Waves of the sea, clouds, a ford, ppr., over it the words "Always Ready." *Supporters*—Dexter, a sailor; Sinister, a female figure, ppr., white-robed, murally crowned and holding in her left hand a caduceus, or. *Crest*—An anchor, or. *Motto*—"Courage, Humanity, Commerce."

Tamworth.—Ar., a fleur-de-lis, or., semée of cinquefoils, gu., az., and vert. *Supporters*—Two mermaids, ppr., holding each in their dexter hands a green leek.

Swansea.—Gu., a castle, with two towers and banners, ar., above in the middle chief point an escutcheon, or, charged with a raven, ppr,

Ramsgate.—Per pale, gu. and az., on the dexter side three demi-lions passant guardant, or, issuant from the sinister; and on the sinister side three demi-antique galleys issuant from the dexter, ar.

Isle of Wight.—Waves, a galley with golden sails unfurled, clouds, all ppr., round the shield the inscription "Insigne Newporti."

Birmingham.—Quarterly, first and fourth, az., four lozenges in bend sinister, or; second and third, party per pale indented, or and sa.

Canada.—Gu., two female figures in white robes, ppr., the dexter one holding a shield, with a view of three ships sailing on water, the sinister holding a shield, ar., charged with a sword, arrow, anchor, in saltire, and above, a crown, or. Over all the Royal Arms of Great Britain and Ireland. The words "Provincia Canada" below.

Montreal.—Ar., between a cross in saltire, gu., in chief a rose, on the dexter side a thistle, on the sinister a shamrock, and in base a badger with a leaf in its mouth, all ppr. *Motto*—"Concordia salus."

Quebec.—A female figure robed, sitting by waves, holding a cornucopia, her arm resting on a shield, gu., charged with a lion passant, or. *Motto*—"Natura fortis industria crescit."

Toronto.—Quarterly, first, gu., three lions passant guardant, or; second, ar., a badger, ppr.; third, ar., a garb, ppr.; fourth, gu. a steamboat, ppr. *Motto*—"Industry, Integrity, Intelligence."

Jersey and Guernsey.—Gu. three leopards passant guardant, in pale, gu.

Abingdon.—Vert, a cross patonce, or, between four crosses pattée, arg.

Yarmouth.—Per pale, gu. and az., three demi-lions, passant guardant, conjoined in pale with as many demi-herrings, arg.

Fishmongers' Company.—Az., three dolphins naiant in pale, arg., finned and ducally crowned, or, between two pair of lucies in saltire (the sinister surmounting the dexter,) ppr.; over the nose of each lucy, a ducal crown of the third on a chief, gu., three pairs of keys indorsed in saltire, or. *Crest*—Two cubit arms erect, the dexter vested, or, the sinister, az., both cuffed, arg., holding in the hands, ppr, a regal crown of the last. *Supporters*—Dexter, a merman, ppr., on his head a helmet, the body only covered in armour, in his dexter hand a sabre, all of the first; sinister, a mermaid, ppr., crowned, or, in her sinister hand a mirror of the last. *Motto*—"All worship be to God only."

Merchant Taylors' Arms.—Arg., a Royal tent between two parliament robes, gu., lined erm., the tent garnished, or, tent staff and pennon of the last; on a chief, az., a lion passant guardant, or. *Crest*—A mount vert, thereon a lamb passant, arg., holding a banner of the last, staff, ppr. On the banner, a cross pattée, gu., all within a glory of the third. *Supporters*—Two camels, or. *Motto*—"Concordia parvæ res crescunt."

Mercers' Company.—Gu., a demi virgin, couped below the shoulders, issuing from clouds, all ppr., vested, or, crowned with an Eastern crown of the last, her hair dishevelled, and wreathed round the temples with roses of the second, all within an orle of clouds, ppr. *Motto*—"Honor Deo."

THE ELECTRIC CLOCKS IN THE BUILDING.

The application of electricity to the measurement of time for the purposes of the Great Exhibition was an appropriation in every way accordant with the spirit of the grand scheme of enlightenment, as well as with the genius and skill evinced in the Great Building itself. Besides the great electrical clock for the transept, which we shall attempt to describe, two dials of smaller size, one at the east, and the other at the west end of the Building, were set to work in connexion with it; the electrical current to each of the two auxiliary clocks being transmitted through copper wires, coated with gutta percha.

It appears that Mr. C. Shepherd, Jun., the inventor of certain improvements in the application of electricity to horological purposes, having received from the Royal Commissioners permission to fix one of his clocks in the transept of the Building, it was proposed by Mr. Owen Jones that the figures should be arranged in a semicircle, because a circular dial would greatly interfere with the design of the façade. This proposal was accordingly adopted; the figures being placed on spaces left at the intersection of the second semicircular rib from the centre with the radial bars of the southern fanlight of the transept.

In the arrangement of the hands and figures, the semicircular dial has, as in the circular dial, twelve divisions, and the figure 12 is also, as usual, at the top of the semicircle; the numbers corresponding with one o'clock, &c. likewise follow in the usual order: but, as with one hand only, the semicircular dial would be left by the hour hand for intervals of each alternate twelve hours, a second number 6 was added on the west side of the dial, and also a second hour-hand, which pointed to the number 6 on the west side, as the first hour-hand left the number six on the east side. Or, as Mr. Shepherd more briefly describes it: "in order to indicate the time on a semicircular dial throughout the twenty-four hours, it was necessary that the hands should be double, projecting equally on both sides of the centre. The minute-hand revolves once in two hours; and as one end leaves the right side of the dial at six o'clock, the opposite end commences at six on the left." The hour circle is 24 feet in diameter; the hands are of copper gilt; the minute-hand is 16 feet long, purposely shortened, so as not to descend below the fanlight frame; the hour-hand is 12 feet long.

The leading feature in Mr. Shepherd's clock is the application of electricity to the winding up of the impulse-spring, or weight, in order to render the *escapement*, or impulse given, certain in its action; besides improvements in effecting the movement of the train, in order to denote the hours, minutes, and other subdivisions of time.

The mechanism of the clock was fixed in the south gallery of the transept, at about 48 feet below the centre of the dial. It is thus described by Mr. Shepherd, in a paper read by him to the Society of Arts: "The framing of the clock for moving the hands of this large dial is of cast-iron, gun-metal bushes being let in to receive the pivots. There are two wheels between the frames, one large wheel, 18 inches in diameter, with 240 teeth; and the escape-wheel, with 120 ratchet-teeth. This wheel is in two parts, the teeth of each part being arranged in contrary directions; a click falls into each of these sets of teeth, one preventing the wheel from running back when moving forward, the other preventing it from moving forward by the action of the wind upon the hands. When the escape-wheel is to be moved forward, which in this clock is every two seconds, this click must first be raised, which is effected by a pin projecting from the motive-click, actuated by the electro-magnet. The stopping click being raised, the motive-click, as it advances, carries the wheel forward; before it has advanced the wheel to the full extent, the pin in the motive-click is disengaged from the stopping-click; the latter, being dropped into its wheel, stops all further motion until again raised by the motive-click at the next action.

"The arbor of the large wheel projects through the frame, and carries a vertical bevelled wheel 12 inches in diameter. This wheel takes into the teeth of a horizontal bevelled wheel of the same size; from the arbor of this wheel the motion is to be carried up to the hands by a rod composed of lengths of brass tubing screwed together. There will be eight electro-magnets, composed of charcoal-iron, three-quarters of an inch square; on each leg of the magnets is placed a brass reel, carrying more than 1500 feet of copper-wire, or 25,000 feet in all, the weight of which is about 1½ cwt.

"This clock, although quite equal to that at St. Paul's Cathedral, occupies far less space, the heavy weights, with the room necessary for their descent, being of course dispensed with."

This large dial, and the two smaller ones, (five feet in diameter each,) are governed by one pendulum, kept in motion by electro-magnetism, on a plan entirely differing from any method previously invented, and thus described by Mr. Whishaw:

"The magnet is employed merely to bend a spring at each vibration to a certain fixed extent; the re-action of the spring giving the necessary impulse to the pendulum, by which means the variations which are continually taking place in the batteries have no effect on the time measured by the pendulum. At the end of each vibration of the pendulum, it comes in contact with a small spring tipped with platinum, which completes the necessary circuit for giving motion to the several clocks. One of the great advantages of Shepherd's clock is, that the largest hands may be moved with all the accuracy of those of an astronomical clock. The impulse-spring is screwed on to a brass stud fixed on the bed-plate, through a slot in which the pendulum vibrates. It has a small arm extending nearly at right angles, and a second arm which projects from the armature, and which, being attracted down by the action of the magnet, the poles of which pass through the bed-plate, the other end of the armature comes in contact with the arm projecting from the impulse-spring, and raises it so as to lock the upper end in a detent, which is screwed on to the same stud as the impulse-spring.

"The pendulum, in the course of its vibration, comes in contact with the upper part of the detent, which it lifts up; thereby leaving the impulse-spring free to drop on the side of the pendulum, and follow it for a short space of its vibration, so as to give it the necessary impetus, forming what it is technically called among clock-makers, the *remontoir* escapement, and which, in the present instance, is in its most perfect form. The pendulum had been in action, for some weeks previously, at the house of the Society of Arts, in the Adelphi."

One of the most obvious advantages in electro-magnetic clocks is, (says Mr. Shepherd,) that precisely similar time will be kept by any number of dials situated in the different parts of a large establishment, and connected with one pendulum. Such a series has been going for some time at the extensive warehouses of Messrs. Pawson in St. Paul's Churchyard, where their accuracy has given every satisfaction. The whole of the dials are regulated by one pendulum, situated in the counting-house. The wire required to communicate between the pendulum and the dials in the different departments of the warehouse is upwards of a quarter of a mile long.

Mr. Shepherd employs six small batteries in connexion with the electro-magnets. He prefers Smee's battery to any other, on account of its simplicity, and the ease with which it is re-charged when required. At his establishment in Leadenhall-street, Mr. Shepherd has had one of his electrical clocks, in connexion with a Smee's battery, at work for upwards of two years.

This form of battery was devised by Mr. Smee for the above clock. The negative plate consists of a strip of platinised silver, the platinum being used in the finely divided state, in which Mr. Smee first discovered that most metals had the singular power of facilitating the evolution of the hydrogen; and the visitor may observe a constant stream of infinitely fine bubbles of gas continually rising to the surface of the fluid. The positive pole consists of pieces of the thinnest rolled zinc immersed in mercury. The reason for using this zinc is, that, in the process of manufacture, the purest zinc is used for that purpose, whilst the baser portion is used for the thicker plates. The use of the mercury is to prevent local action by the adhesion of the hydrogen to its smooth surface. It is of very great consequence to place the porous pot in the right place. If it were placed at the bottom of the solution, during the action of the battery it would become incrusted with crystals of sulphate of zinc, which would effectually prevent any further action. By suspending it, however, at the upper part of the solution, the salt falls eventually to the lower part of the solution, and becomes uniformly diffused through the whole fluid. A platinum wire, coated with gutta percha, except at its end, passes into the mercury, and is connected to a binding screw to form connexion. The battery is charged with dilute sulphuric acid, in the proportion of one to eight; and the size of the outer vessel depending upon the time which the battery is required to keep in action, and the amount of the work which it is called upon to perform. In obtaining force for an arrangement of this character, nothing can exceed the economy of material, for almost every particle of zinc dissolved contributes its effective power, and thus the cost solely depends upon the value of the zinc. There can be no question that there is nothing to be compared to this form of battery for clock purposes. The great clock, notwithstanding the large surface exposed to the wind, sometimes in high gales, marked the time in a satisfactory manner.

The *Geographical Arrangement* of the Exhibition, which we have here attempted to sketch, must have materially contributed to the success of its ulterior object—to present to the spectator, or rather to the student of the subject, a methodical display of the world's industry; the economic resources of each country; its advantages of location and relative position, so as to furnish a chart of the course of industrial wealth and the impulse of trade all over the world; of the developments of which it is capable, and of the direction in which these may be most safely pointed; the limits of profitable competition; the latent wealth of the earth, and fresh fields for commercial enterprise; views of the utmost importance at the present moment, when the gigantic power of steam, by ocean, river, and rail, enables man to explore every region of the earth, and thither, with the same mastery, extend the peaceful triumphs of civilization and science.

Hence, the Exhibition became an intellectual study for the reflective mind; whilst the larger portion of the visitors, accustomed to trace great effects to little causes, could appreciate the homely lesson of philosophy, in placing the raw materials and produce at the sides of the Building, and articles of superior manufacture in its centre; and the productions of the tropics nearest to the transept—the imaginary equator of this industrial sphere.

The social results of this gathering of the works of Art and Industry—the applied and real science of the world—are thus contemplated by a powerful writer:

"The collection of the materials is as nothing compared with the collection of men. A powerful monarch might at any time collect such specimens of industry and skill as are now on view in Hyde Park,—the Emperor of China, or the United States' Congress may, either of them, buy up a duplicate of the whole Exhibition,—a Pericles, a Ptolemy, or a Cæsar, with great cost and difficulty, might have formed a museum of the industry of their times: but in no age except the present—in no country, perhaps, save England—could the industry and the industrials, the conceiving mind and the executive hand, of the world have been brought together under the same conditions of free emulation. What has antiquity to show in comparison with the scene in Hyde Park? The noblest congresses of the ancient world look narrow, insular, and local by its side. The glory of the Olympian Games pales in contrast with the Festival of Industry. Pericles could not have called the producers of the world together, because Greeks could not associate on equal terms with foreigners. At the Olympian Games, the stranger had no place. It was thought enough to allow him to be present as a spectator. In their exclusive pride of race, the Greeks recognised only the man of their own blood. Kings and princes begged in vain to exhibit at their games, and contend for their oaken crowns. That this old and formidable barrier between nations is thrown down for the future, the Crystal Palace is a pledge. It is the work of nations, performed in their individual, as well as in their corporate capacities. While looking down the Eastern Nave, along the line of American and Continental art, the memory reverts to the Southampton Water, where the non-armed ships of Turkey and of the United States ride at anchor, after having poured out of their holds, instead of missiles of war, the trophies and ministers of peace. On this common ground are united nearly all the princes of the world,—the energies of governments and of people; and nothing less than this combination could have achieved the object in view. In this co-operation on equal terms for a common end, and in the success which has attended it so far in its progress, the future historian will remark the first settled sign of the coming Fraternity of Nations. The Crystal Palace knows no difference between Jew and Greek, Frank and Saxon. In that arena, for the first time in the annals of mankind, the Negro, the Malay, the Sclave, and the American, will stand together on equal terms; and merit, of its kind, will carry away the honours of genius and industry, without reference to questions of blood, type, or colour. This is a starting-point for the true theory of the equality of nations,—a new era in the history of progress."—*Athenæum*, No. 1227.

WE now proceed to select and describe the more important and interesting objects from the Exhibition.

LOCOMOTIVE ENGINES.

Most conspicuous among the Railway plant were three stupendous Locomotive Engines, two of which were exhibited by the North-Western, and the third by the Great Western Railway Company.

The North-Western Company contributed a locomotive engine on a gigantic scale, called "The Liverpool," constructed by Messrs. Bury and Co., on the principle of the Crampton patent; the peculiarity of which is, that the driving-wheels are placed at the rear of the engine immediately under the firebox. This immense machine is supported on eight wheels, the driving wheels being 8 feet, and the supporting wheels 4 feet in diameter. The cylinders are 18 inches diameter and 24 inches stroke. The heating surface exposed to the direct action of the fire is 156 square feet, and the total surface of the tubes which traverse longitudinally the boiler, and by which the gaseous products of combustion are conducted from the firebox to the chimney, and strained of their heat *en route*, have a total surface of not less than 2090 square feet. Thus, there is a total heating surface of 2400 square feet. The weight of the machine, when supplied with its full complement of coke and water, is 37 tons.

The second engine exhibited by the North-Western Company was "The Cornwall," designed by M. F. Trevithick, and constructed at Crewe, 1846, for running express trains at a high rate of speed. The cylinders in this machine are 17½ inches in diameter, and 2 feet stroke. The driving wheels are 8 feet 6 inches in diameter. This increase of diameter is given to the driving wheels with a view to obtain an increased speed with a diminished wear, arising from too rapid reciprocation of the pistons. The cylinders in this engine are placed outside the wheels. The centre of gravity is lowered by suspending the boiler under the driving axle. The driving-wheels are placed about midway in the length of the engine, while the others, bearing a lesser weight, are placed at the foremost and hinder ends; this disposition of the wheels being found to be favourable to the motion on curves. The boiler has 1046 feet of heating surface, with certain peculiarities of construction and arrangement of the working gear, which render it easily examined when running. The gross weight of the engine in working trim is 27 tons. It is supported on eight wheels, and has taken trains at speeds varying from 60 to 70 miles an hour.

The Great Western Company exhibited a stupendous engine, constructed at their works at Swindon, called "The Lord of the Isles," one of the ordinary class of engines which have been worked for passenger traffic since 1847. It is affirmed that it is capable of driving a train of 120 tons gross at an average speed of 60 miles an hour (the flight of the pigeon) upon such gradients as those which prevail on the Great Western Railway, which is nearly level. The evaporating power of the boiler, when in full operation, is stated at 1000-horse power; and the effective power of the engine, measured by a dynamometer is equal to 743 horses. Its weight, including coke and water, is 35 tons. The tender attached to this machine weighs 9 tons, the tank contains 1600 gallons of water, and there is space for a ton and a half of coke, giving a total weight, fuel and water included, of 17 tons 13 cwt. The surface in the firebox exposed to radiant heat measures 156 square feet, and the heating surface of the tubes measures 1759 square feet. The diameter of the cylinder is 18 inches, the stroke 2 feet, and the diameter of the driving wheels 8 feet. It is estimated that the boiler is able to bear a pressure of 120lbs. per square inch; and that its actual consumption of fuel in practical work, drawing an average load of 90 tons at an average speed of 29 miles an hour, including stoppages (which represents a mail train), is under 21 lbs. of coke per mile.

Messrs. Hawthorn exhibited a locomotive engine of rather less dimensions, for which they claim a capability of running with safety at a speed of 80 miles an hour with a large express train. The cylinders are 16 inches diameter, and 22 inches stroke; the driving wheels 6½ feet in diameter, and the bearing wheels 39 inches; the heating surface of the firebox is 98½ square feet; the boiler is traversed by 158 brass tubes, giving a heating surface of 865 square feet. The principal improvements claimed by Messrs. Hawthorn for this locomotive are the following:—Instead of the six ordinary springs on each axle, the engine is fitted with double compensating beams and four springs acting simultaneously on all the journals, so that the weight assigned to the respective axles is not affected by any irregularities or imperfections on the line of railway, but is uniformly maintained throughout, securing thereby a constant weight upon the driving wheels, and consequently a constant amount of adhesion. By this direct, simultaneous connexion between the axles, great stability is given to the engine; greater safety, particularly at high speed; and a smoother and easier motion. The engine has outside framing, with outside bearings to all the axles, the cylinders being placed inside; it is supported on six wheels, the driving wheels being in the centre. The second advantage claimed is the application of expansive link motion and slide valves, which admit of the boiler being brought down nearly as low as in engines with straight axles; and by the introduction of the slide valves the pressure on the valves, and consequently the friction, is considerably diminished. An arrangement is likewise introduced into the engine of the patent steam pipe of Messrs. Hawthorn, which removes the domes and other projections on the top of the boiler. This steam-pipe is fixed into the tube plate of the smokebox by a ferule, like an ordinary tube, and extends nearly the entire length of the boiler. Being carried under the top, it is perforated with a series of small apertures or slits along its entire length, and it is arranged so as to receive the steam directly above the place at which it is generated, instead of compelling it to rush from all parts of the boiler to one or two orifices. By this arrangement, the steam is conducted to the cylinder, nearly, if not altogether, free from *priming*.

In the following table are shown in juxtaposition the principal dimensions of four of the engines just described:—

	Liverpool	orn wall.	Lord of the Isles.	Hawthorn.
Diameter of cylinder.................... (inches)	18	17½	18	16
Stroke of cylinder...................... (inches)	24	24	24	22
Diameter of driving wheels .... (ft. in.)	8 0	8 6	8 0	6 6
Diameter of bearing wheels .... (ft. in.)	4 0	..	..	3 3
Number of wheels	8	8		
Surface of firebox exposed to radiant heat (sq. ft.)	154	..	156	98½
Heating surface of tube .... (sq. ft.)	2136	..	1759	865
Weight of engine, including fuel and water (tons)	37	27	35	
Weight of tender, including fuel and water (tons, cwts.)	..	..	17 13	
Quantity of water carried by tender.... (gallons)	..	..	1600	
Quantity of fuel ditto .... (tons)	..	..	1½	

Abridged from the Times.

Among the locomotive engines on a smaller scale, were one called "Ariel's Girdle," exhibited by Mr. W. B. Adams, and constructed by Kitson and Co., Leeds; one called "The England," exhibited by the Messrs. Fairbairn; and a locomotive tank engine, exhibited by the same engineers. "Ariel's Girdle" is a four-wheeled engine coupled to a four-wheeled carriage, constituting thus a complete eight-wheeled machine, adapted to run with great speed and safety for a distance of 50 or 60 miles without stopping. The carriage has accommodation for eight first-class, twelve second-class, and twenty third-class passengers. This engine, with its attendant carriage, thus forming a train to accommodate thirty passengers, may also be advantageously worked as a mail or express train, or a train for branch lines. The inventor claims also that it is well adapted for highway purposes, with rails laid on the level of a macadamised road, which would not interfere with the ordinary traffic; thus facilitating the construction of branch lines at a very cheap rate, by which railway communication might be carried into agricultural districts, and even into farmyards. It is well known that in the United States such effects have been realised, the railways being, in many cases, carried through the streets of the principal towns.

Mr. Adams claims that one of these engines, drawing one of the long eight-wheeled carriages, carrying forty passengers, will travel with perfect smoothness and steadiness from forty to fifty miles an hour; and, by reason of its lightness, will do this without any damage to the rails or roadway. It may be employed, also, as a simple four-wheeled tank engine, to draw 100 tons gross of waggons for a distance of twenty-five miles. A pair of ordinary breaks are applied to the driving wheels, and powerful sledge breaks are applied to the other wheels, the whole of which are at the command of the driver and stoker on the platform of the engine. Engines of this form and construction have been for some time in operation on the Eastern Counties, the Cork and Bandon, the St. Helen's, the Londonderry and Enniskillen, the Bristol and Exeter, and some other railways.

The second locomotive engine, of much smaller dimensions, called "the England," has for its peculiarity great lightness in proportion to its power, and the combination of the engine and tender upon the same wheels. The purpose of this engine is to work trains of light weight, and its constructors affirm that it has sufficient power to impel a train of six first-class carriages at a speed of sixty miles an hour, at half the working expense of the engines now used for such trains. Although it has no tender, it is stated to be capable of carrying a stock of fuel and water sufficient for a stage of fifty miles.

The South-Eastern Company exhibited an express locomotive engine called "Folkestone," constructed upon Mr. Crampton's patent, which claims advantages from having the engine suspended from three points at the ends of the machine; the object being to insure the weights on the wheels at all times the same, and thus produce the greatest amount of steadiness. The whole of the machinery is independent of the road, and is thus similar in its action to a fixed engine; the risk of breaking the cranked axle, which frequently occurs in inside cylinder engines, being avoided.

Messrs. Fairbairn and Co. exhibited a tank-engine, in which the boiler is 8 feet in length, and 3 feet in diameter, having 88 brass tubes, each of 2 inches diameter. The effective heating surface is equal to 480 square feet; the fire-box, of copper, 2 feet 5 inches long, 3 feet broad, and 3 feet 5 inches deep. The cylinders are of 10 inches diameter, with a stroke of 15 inches. The driving wheels, in middle, are of 5 feet diameter, and the leading and trailing wheels of 3 feet 6 inches diameter respectively. The tank is placed underneath the foot-plate, and contains 400 gallons of water. The ascertained consumption of coke by this engine is 10 lb. per mile; and in working condition the weight is 13 tons: useful load, six composite carriages, with 250 passengers.

A double boiler-tank engine was exhibited by Messrs. E. B. Wilson and Company; its principal novelty consisting of two multitubular boilers, side by side, instead of one, as in all other locomotives of the present day. It has six wheels, four of which are coupled, including the driving-wheels, of 5 feet diameter; while the leading wheels are 3 feet 6 inches. The outside cylinders, placed horizontally, are 12½ inches diameter, with a stroke of 18 inches. The whole length of engine is 24 feet 3 in.; breadth, 8 feet 3 in.; and height, from surface to top of chimney, 13 feet 6 in.; the whole weight of engine, exclusive of fuel and water, is 16 tons; and the additional weight, with complement of coke and water, 3 tons 17 cwt.; making together 19 tons 17 cwt. The tubes, of 1¾ inches diameter, are altogether 136 in number, giving a radiating surface of 694 feet superficial, in addition to which the heating surface of fire-box is 61 feet; together, 755 superficial feet. The tanks will hold 520 gallons of water, which is found sufficient for a journey of 25 miles. The coke space is equal to 42 cubic feet, or 15 cwt., equal to 26 bushels of coke.

From Belgium were sent two Locomotives:—the first, from the Société de Couillet Belgique, was a six-wheel engine, constructed after the plan adopted for some time by R. Stephenson and Co., of Newcastle. The six wheels, of 5 feet diameter each, are all coupled; the boiler is multitubular, and contains 185 tubes of 1¾ inches diameter. The workmanship and finish are altogether inferior to the manner in which all the British locomotives are turned out. A six-wheel tender is attached. The second Belgian Locomotive Engine, was the "Vallée de la Vesdre," from the celebrated house of Cockerill and Co., of Seraing, near Liege; where the coal and iron are raised on the spot, and the latter converted, by powerful machinery, into the various parts of locomotive and fixed engines, which are turned out in considerable numbers. This engine is mounted on eight wheels, four of which, including the drivers, of 4 feet diameter, are placed behind, and four bearing-wheels, of 2 feet 8 inches in diameter, in front; the cylinders are placed outside, and in a sloping position. The novelty in this locomotive appears to be a "donkey," or auxiliary pump, with, however, a good deal of work about it.

The solitary Locomotive Engine from France is named "Lahore," and was from Messrs. J. F. Call and Co.; being somewhat similar to that of the Belgian company, Couillet, having six coupled wheels, of five feet diameter. It stood above an *engine race*, or pit, constructed for the purpose of allowing the machinery to be examined; which, however, did not bear comparison with the exquisite workmanship of the British locomotive engine-builders.—*Abridged from the Illustrated London News.*

RAILWAY CARRIAGES.

The North Western Railway Company exhibited a Passenger Carriage, built at Wolverton, which, besides economizing the dead weight, is also so constructed as to have greater durability and safety, in consequence of introducing the use of iron instead of wood into the framing and body of the carriage. The sheet iron which is used for the panelling is corrugated; which, while it increases the strength, gives greater external beauty to the outline and appearance of the vehicle. This carriage is supported by six wheels of peculiar construction, each wheel being formed of wrought iron in one solid piece, tire included, an arrangement which obviously gives greater security against fracture than the common mode of constructing the wheels in parts. The length of the carriage is 40 feet by 8 feet in width, and it is divided into two first class bodies, each capable of accommodating eight passengers, and so lofty that a person of ordinary stature can stand erect with his hat on. There are five compartments, each of which accommodates 12 second-class passengers, besides compartments for luggage, and accommodation of the guard. Thus this carriage may be regarded as a train in itself, capable of conveying 76 passengers, with their luggage and guard; the total weight of the carriage, without its load, being only 8½ tons. To convey the same number of passengers with the carriages at present used on railways, would require a dead weight of from 17 to 18 tons.

The South-Eastern Company exhibited a still larger Passenger Carriage. This vehicle is 44 feet in length, and has a floor of 374 square feet distributed over eight supporting wheels. It is built upon the principle of Adams's patent, and is arranged so as to be separable into two four-wheeled carriages, which, however, are so coupled that the combined bodies form a perfectly rigid frame. Notwithstanding its great length, provision is made to enable it to pass freely over curves of the smallest radius known on the English railways. This is accomplished by an arrangement which gives a lateral play of some inches to the wheels in their bearing, so that they can move right or left, independently of the body of the carriage. By this plan, each pair of wheels beneath the carriage is at liberty to follow the path of least friction by incessant lateral divergence; while the body of the carriage maintains perfect steadiness, whatever be the speed, by reason of its great length and width, precisely as a large steamer at sea is steady, while a short one pitches. The load, also, being distributed uniformly over eight springs, and not subject to oscillation, the springs are not liable to be broken by sudden shocks, and may be made more light and flexible. The advantages claimed for this species of passenger vehicle are, first, economy in tractive power by diminished friction; secondly, economy in structure by a diminution of the ratio of the dead to the profitable weight; thirdly, freedom from oscillation; fourthly, greater safety in case of collision. The woodwork, as well as the wheels, is of varnished teak timber, similar to that used in Dutch shipping. The body of the vehicle consists of four first-class and four second-class compartments, with a compartment for the guard and luggage. There is thus accommodation for 80 passengers.

The North-Western Company exhibited two specimens of Goods-Waggons on improved principles, constructed under a patent obtained by Mr. Henson. One of these waggons is made of hard mahogany, with sliding doors on one side, and a sliding roof for about half the breadth of the waggon, and about one-third of its length, corresponding to the opening of the doors on the side, for the purpose of facilitating the loading and unloading. The sliding doors and roof are secured by a fastening, which locks the doors and roof at the same time, without a key; but the doors cannot be opened without the proper key. This waggon weighs about four tons and a half, and is capable of holding six tons of goods, forming, when closed, a kind of fire-and-water-proof warehouse; and, at the same time, preserving the goods from thieves.

The other Waggon differs from this in construction to some extent; being made wider, but with similar framework: instead of having wooden panels, corrugated sheet iron is used for that purpose, which is fitted exactly in the rounds and hollows to the framework inside, and secured thereto by screws, thus forming a comparatively light and very strong body. This waggon weighs about 4 tons 2 cwt., and is capable of conveying 10 tons of goods; thus saving a considerable amount of dead weight.

There was also exhibited a model of Henson's improved Goods-Waggon, made to a scale of 2 inches to the foot. The framework is lined or panelled with corrugated sheet-iron of superior quality, which is covered on both sides with a thin coating of glass, which completely protects the surface of the iron from the weather, and adheres so closely to it that severe blows will not break or remove it. This process of glazing the surface of iron appears to be a valuable discovery, not only for this purpose, but for many others; particularly as the expense is said not to be greater than galvanizing, while it is believed to be much more durable, and never likely to require painting. The roof of this model is covered with glazed corrugated iron, of the same description as that forming the panels on the sides and ends of the waggon.

These waggons may be described as so many moveable warehouses. —*Abridged from the Times.*

RAILWAY BUFFERS.

India-rubber, spiral springs, and compressed air, have been tried with various effect in Railway Buffers, and were exhibited; but the most recent, and apparently the best, is the Volute Spring. It consists of a flat broad plate of steel, coiled, and partially drawn out. In shape it resembles a strip of paper that has been rolled up conically. The resistance is applied on the edge of the metal, and tends to force the projecting coils parallel. The effect of application of force in that direction is to enlarge the diameter of the coils, and thus add to the resistance, which increases in a rapid ratio, so as to prevent the shock that would be given if the coil were forced in so far as to be level with the edge of the solid bearing of the outer whirl of the volute. A highly-finished model of the frame of a railway carriage represented this form of spring applied to support the carriage, and as a drawing spring, as well as to the buffers. As the play of the volute is perpendicular, it seems well calculated for this purpose, especially for locomotive engines, as there would be less of the swinging motion.

RAILWAY PROPULSION.

Among the models exhibited of new plans of Propulsion, was an entirely new plan of supporting a railway carriage and engine on the rails—to remove the danger of breaking the axles, by causing the weight of the carriages and engines to rest on the rims of the wheels, without bearing on the axles at all. These wheels are not fixed to the carriage, but are attached to an endless chain that passes round the carriage-frame, each pair of wheels being connected by a light axle. Wheels of larger diameter, armed with spikes, that take into the links of the chain and carry it round, are placed at each end of the carriage-frame. The frame itself is of iron in those parts where the peripheries of the wheels run; and it seems as a second railway, always moving along with the wheels.

The Atmospheric System of Railway Propulsion, by means of a continuous slide valve, through which connexion is made with the carriages, is not yet extinct. Messrs. Harlow and Young exhibited a model of their patent mode of keeping the valve air-tight, the object being accomplished by a lateral piece of metal, to be pushed over the shot by a spring. Mr. Carter also exhibited an atmospheric railway, with improved vacuum; and a model of a railroad with stationary engines, for propelling carriages by compressed air, was contributed by Mr. J. Jackson.

Mr. Parsey's system of Propulsion by Compressed Air was represented by a large-sized model. He purposes to supersede steam power on railways by employing compressed air, to be contained in strong reservoirs, and applied in nearly the same manner as high-pressure steam. The proposed advantage of this plan consists in dispensing with the weight of the engine and the annoyance of the steam. The ingenious part of the system is the mode by which the inventor regulates the force of the compressed air, so as to equalize it within certain limits, and counteract the varying pressure in the reservoir. Mr. Parsey had a plan, which, it is stated, he could not bring to bear, of economically compressing the air.

In the French department of the Exhibition, a curious system of Locomotion was represented, which is, however, only the modification of a plan exhibited in London many years since. It is a railroad without rails. In the English invention there were pairs of wheels fixed on the road at stated distances, which were to be kept in motion by stationary engines; the power being communicated by a band passing from the engine, and connected with a great number of wheels. The rails were fixed to the bottom of the carriages, and were made long enough to have always a bearing on two of the wheels at least. When the system of the wheels was put in action, the carriages were propelled by the bearing which the rails beneath had on the peripheries. One of the advantages of this plan was, that single carriages instead of trains could be started, and at very short intervals, without danger of collision. In the French modification of the invention, the principal difference consists in the means of giving motion to the wheels. Instead of connecting the series with one long endless driving band, there are numerous short endless chains connected with the axles of only two pairs of wheels, so that the motion of one pulls the chain that propels the next. The model road exhibited was on a steep incline, for the purpose of showing that this mode of propulsion is applicable to the ascent of hills.

STEAM-ENGINE SERVICE FOR THE EXHIBITION.

The department of Machinery in Motion, as was expected, proved an object of paramount attention in the Exhibition. There were thirty-one Steam-engines exhibited, all of which, however, were not employed in communicating motion to other machinery. The aggregate power of all the steam-engines exhibited in motion amounted not quite to that of 150 horses; while a single locomotive engine is of four or five times the power. The steam to work these several machines was generated in the Boiler-house, considerably removed from the Building, and already described at page 76.

Only five boilers are there mentioned; but, owing to several engines being added to the collection subsequently to the opening, on the 1st of May, it was found necessary to increase the supply of steam to eight boilers, the three new ones being furnished by Mr. Armstrong, of Newcastle. The distance from the boiler-house to the Great Exhibition Building is rather more than 150 feet, and the extreme length of the main line of steam-pipes, which were placed in a channel constructed under the flooring of the north passage of the Machinery in Motion department, was 1000 feet, so that the extent of main supply pipes within the Building was equal to 850 feet. Leaving the boiler-house, the internal diameter of the pipes was 8 inches for a length of 189 feet, then 6 inches for 383 feet, and, lastly, 4 inches for 428 feet; the branch pipes, amounting altogether in length to 3600 feet, varying from half an inch to two inches in diameter. All the steam-pipes throughout were clothed with a thick coating of felt, to economize steam, and keep down the temperature of the atmosphere. The exhaust pipe from each engine ran into a tunnel carried under ground. The fuel used for the production of steam was the stone coal, or anthracite, from the South Wales field; of which, in the eight furnaces daily the consumption was about 9960 lbs., and cost £30 a week. It is a curious fact, that, from the boilers to the extreme end of the main steam-pipe, a distance of 1000 feet, there was only a diminution in the value of the steam of four lbs.; the same difference being observed when the steam was either at a higher or lower pressure at the boilers.

It was interesting to observe with what beautiful simplicity, in every part of the Exhibition, the motion of each steam-engine was conveyed in every direction, upwards, downwards, and obliquely, from shaft to shaft, by straps. In the department of Cotton Machinery, instances of this on a considerable scale were seen: in some cases, the shaft which received revolution immediately from the engine, passing under the flooring. It was connected by an endless strap with another, which passes under the ceiling and over the machines, and this with various others parallel and at right angles to it. With equal facility and promptitude each machine could be put in motion or stopped at the pleasure of the attendant, either by throwing the band on or off the driving wheel, or by coupling or uncoupling one shaft with another.

MARINE STEAM-ENGINES.

Maudslay's Double Cylinder Direct-acting Engine drove their improved coining press: its cylinders are of 5 inches diameter, with a stroke of 16 inches, the power being calculated at six horses. It also gave motion to the following beautifully-executed models:—1st. A pair of direct-acting double cylinder marine steam-engines, patented by Maudslay and Field, fitted with paddle-wheels and improved feathering floats: on this plan has been constructed machinery for marine purposes, of an aggregate power of 19,130 horses, and some of them of 800-horse collective power. 2nd. A pair of direct-acting marine steam-engines, with oscillating cylinders, patented by Joseph Maudslay. 3rd. A pair of direct-acting double piston-rod marine steam-engines, peculiarly adapted for the shallow rivers of India and other parts of the world; patented by Maudslay and Field for the Indus and Sutlej, and for the Rhone. 4th. A pair of marine side lever beam-engines, on which plan have been constructed 103 pairs, of the aggregate power of 11,358 horses. 5th. A pair of direct-acting annular cylinder marine steam-engines, patented by Joseph Maudslay, fitted with paddle-wheels and improved feathering floats. Engines on this principle have been fitted to several of the fleetest packets in the Channel. 6th. A pair of direct-acting marine steam-engines, for driving a screw propeller, so constructed as to occupy but little space; and, when fixed in the vessel, to be entirely below the water line. Thus, this celebrated firm have constructed marine engines on their various plans, amounting in the aggregate to a power of 35,183 horses.

Messrs. Penn, of Greenwich, exhibited a beautiful collection of engines and models, among which was a pair of small Oscillating Marine Engines, 24 horse-power. This machine is simple and light in structure, the parts being few, and the action of the pistons on the crank most direct. Their gross weight, including the supply of water for the boiler, does not exceed 9 cwt. per nominal horse power. Messrs. Penn have placed two of these engines on board her Majesty's steam-yacht *Fairy*, the admiralty yacht *Black Eagle*, and many of the post-office and war-steamers. A pair of engines of this construction, of 500 horse-power, are now in process of construction for the *Great Britain* steam-ship.

Messrs. Penn also exhibited a pair of patent Trunk-engines for driving the screw-propeller by direct action, without the intervention of cogged-wheels. In this arrangement, the connecting-rod is directly jointed on to the piston itself; and the angular strain is taken by trunks or pipes, passing out of each end of the cylinder, crossheads and all other complicated apparatus being dispensed with. The air-pumps are double-acting, and worked by a straight rod from the piston to the plunger, the feed-pumps being similarly worked. Engines on this principle have been fitted on board her Majesty's screw-frigates, *Arrogant* and *Encounter;* the former making sixty, and the latter eighty, revolutions per minute. The power of each of these machines is 360 horse. Messrs. Penn also exhibited a model of their oscillating engines of 500 horse power, placed on board her Majesty's steam-frigate *Sphinx.*

Mr. Atherton, chief engineer of the Royal Dockyard, Devonport, exhibited a new form of Marine Steam-engine, applicable either to the paddle-wheel or the screw-propeller; the object being to simplify the construction of the marine sway-beam engine; and, as compared with the ordinary construction of side lever-engines, the inventor claims:—1. That it occupies less width. 2. That, being in a central position, and connected directly with the piston and cranks, various cross strains are avoided, and it is not so liable to breakage. 3. The crosshead, crosstail, and various parts, are entirely suppressed, and consequently all the parts of the engine are more accessible, and more easily cleaned when in operation; in fine, the engine is nearly balanced by means of two air-pumps, one on each side of the main centre, and is therefore less liable than marine engines generally to be brought up in a heavy sea. The expansive gear operates with precision, whatever be the speed of the engine, and supplies self-acting means of regulating the expansive working of the machine. Mr. Atherton exhibited this machine to illustrate the practicability of steam fleets being fitted with engines; whereby it is calculated that ten different sizes only would meet all the requirements of steam-marine service, now employing in Great Britain upwards of 1000 different sizes and constructions.

Mr. Smith exhibited a most interesting collection of models and drawings illustrative of the history of Screw-steam Navigation, showing the progressive changes which have been made in the Screw Propeller from the date of its first application to the present time.

Messrs. Stothert, Slaughter, and Co., exhibited a Direct-action Marine Engine, adapted to a Screw Propeller; in which, instead of accelerating the motion of the piston and transmitting it to the screw by mechanical means, the engine is made to propel the screw directly; but has its motion retarded in being transmitted to the vacuum, supply, and bilge pumps, which are moved directly by the engine, and we have a universally retarded motion. The exhibitors claim that, by this system, there is no reasonable limit to the high speed required for the screw propeller shaft.

Messrs. Rennie exhibited some good models of their Direct-acting class of Engines. The cylinders are vertical, with the cranks overhead; the headstock is made of wrought iron; and the upright rods which form the supports for it, serve also to connect it with the cylinders, so as to make the framing independent, and entirely of wrought iron. One of the pairs of engines is on the plan of the *Gorgon* engines, but the other pair has some novel arrangements. There are two piston-rods connected by one crosshead, on the under side of which a boss projects downwards, to which the lower end of the connecting rod is attached. In the cylinder-cover, between the two-piston rods, is a recess to receive this boss, when at the lowest part of the stroke. The two air-pumps are worked from one crank by levers: starting gear is not there, yet quite enough is shown of the engines to found a good claim to simplicity and effectiveness. There was also a model of a pair of large engines, with four inclined cylinders, working on to two cranks; and with the air-pumps vertical, and worked by levers moved from a crank in the intermediate shaft.

The Foreign Exhibitors sent scarcely any specimens of Marine Engines; neither France nor America having contributed. The deficiency of the latter country is the more remarkable when we reflect on the immense value to the United States of their steam-boat engines. The only article exhibited under this head was a drawing of a pair of engines, such as are fitted into the transatlantic steam-ship *Pacific*. They are of the usual American pattern, with the trussed beam, working above deck, and the framings almost wholly of timber. The rapid passages made by this vessel are well known.

The only specimen of Foreign Marine Engines was a pair of boat engines, on the oscillating principle, from the firm of Cockerell and Co., at Liege. The cylinders are fore and aft, and are inclined towards each other, and are both coupled on to a pair of crank-pins—which last are again coupled by a drag link—the one cylinder being a little on one side the keel line, and the other as much on the opposite side, so as to allow the caps of the piston-rods to clear the drag link and each other. There is, of course, no intermediate shaft. The air-pumps are vertical, are placed just outside each frame, and they are worked by a crank formed in each paddle shaft. The paddle-wheel ends of the shaft are meant to overhang the side of the boat, and to carry the wheels without any outside bearings. The long inboard shaft helps to balance the overhanging wheels.

Messrs. Watt and Co. exhibited a pair of Marine Engines, 700 horse power, for driving a screw propeller by direct action, without the intervention of gearing; the propeller 16 feet diameter, making sixty-five revolutions per minute. The general arrangement consists of four horizontal cylinders, between which are placed the condensers, with two double-acting air-pumps. These engines occupy but little space, and, their extreme height being but small, they can be entirely protected from the effects of shot, by being placed in the vessel far below the level of the water-line. Side-by-side with the above were exhibited models of Messrs. Watt's Locomotive Engine of 1785; and an Oscillating Engine, patented by James Watt, in 1784. The locomotive (made to run on the common roads in Cornwall in 1785-6), on three wheels, and, with its cylinder crank action, strangely contrasted with the Crampton leviathan engines of 1851.

LAND STEAM-ENGINES.

Messrs. Joyce exhibited their High-pressure Pendulous Engine, in which the cylinder is suspended by trunnions from the top, and the piston gives motion to a crank, on the shaft of which are the fly-wheel and pulley. The introduction of steam of high pressure into a small cylinder, and afterwards allowing it to act expansively in a larger one, adding to its effective force by condensation, is in this engine applied in an extremely ingenious and simple manner. The cylinders are not placed before each other, as is generally done in the beam-engine, but firmly bedded and jointed side by side, forming what might be termed a double cylinder; which cylinders the inventors, upon a principle entirely new in this country, invert from their usual position, and suspend them between the framing; the trunnion pipes or steam ways being placed at the end, or what in the ordinary engine would be termed the bottom of the cylinders. By this means, a direct motion is applied to the crank without the intervention of cross-heads, side-rods, or parallel motion; the piston-rod being attached to the crank pin, the cylinders vibrating with a pendulous movement on their bearings or trunnions, whilst the oscillation of the cylinders works the slides by means of a bar.

Messrs. Donkin and Co. exhibited a Disc Engine, calculated at six-horse power on their improved construction, which gave motion to their disc water-mill, and also to their disc pump: the engine is of large size, having a disc of 17 inches diameter, and the continued leakage of steam, which was one of the great objections to this class of engines when first brought out, appears to have been entirely remedied. It also actuated the circular planing machine, drilling machine, and slide lathe of Messrs. Smith and Co., of Leeds; and likewise the centrifugal sugar-drying machine of Messrs. Rotch and Co.

Mr. Bishop has paid great attention to the improvement of the Disc Engine; and has erected one at the *Times* office, in Printing-house-square, which still actuates the vertical printing-machine of Mr. Applegath, by which eight copies of one side of the paper are thrown off at each revolution of the vertical cylinder. Altogether, these disc engines come nearest to the obtaining of direct circular motion.

Middleton's Vertical Cylinder Direct-acting Engine, with cross-head and double crank, gave motion to Applegath's vertical printing-machine, by which the Exhibition Supplements of the *Illustrated London News* were printed weekly in the Building. The same gave motion, when required, to a new Folding-machine; and likewise to Maclure's Lithographic Press; contiguous to which Messrs. Hopkinson and Cope's 2½-horse engine (5-inch cylinder, 14-inch stroke), with cross-head on the old plan, worked the Scandinavian horizontal printing-press exhibited by Mr. Hopkinson; and also the perfecting machine of Mr. Napier.

Messrs. W. Fairbairn and Sons supplied power to several machines by means of their Vertical Direct-acting Steam-engine, having a 19-inch stroke, the cylinder being chiefly inclosed within the iron pedestal. Whether for its design, simplicity, or ease of action, this may be taken as one of the best samples of steam-engines sent to the Exhibition.

Messrs. Hodge and Co. exhibited an Oscillating Direct-action Engine; the cylinder hung in the middle, of 6 inches diameter, with a 20-inch stroke. This engine drove Brick, Tile, and Pipe machinery.

The clay being properly pugged, by two screws working together, is made to pass through a die at one end of a cylinder, through which it is forced by considerable pressure, of uniform texture and size, and the continuous band of clay is accurately cut into the required lengths. With one-horse power, and the labour of two men and a boy, one thousand bricks are made by this machine in one hour.

The Butterley Iron Company exhibited an Oscillating Engine; the cylinder being suspended in the middle by hollow trunnions, through which the steam is admitted on one side and carried off on the other; cylinder, 9 inches in diameter; stroke, 18 inches in length; power, 8 horses.

Evans's High-pressure Oscillating Engine—the cylinder hung at bottom, on transverse hollow trunnions—is calculated at six-horse power. It drove Crawhall's vertical rope-making machine, by which the whole process of rope-making is entirely completed; and this is believed to be the only machine of the kind in the kingdom, Hudart's exquisite rope-making machinery having lately been taken to pieces, and sold to different purchasers.

Bradley and Co. exhibited an interesting model of a colliery in action, which is worked by a pair of small cylinders placed horizontally.

Robinson and Russell exhibited the largest and most powerful of the steam-engines in motion; being an Oscillating Engine, with the cylinder hung by trunnions in the middle, having a diameter of 18 inches, and stroke of 42 inches in length, calculated at 24 horses, which drives their large sugar-cane crushing machinery by means of motion communicated thereto by a series of cog-wheels. The cane is first placed in a proper inclined receptacle, and passes under and between large rollers of iron, by which the juice is expressed, falling into a proper reservoir, from which it is conveyed in suitable conducting pipes, to be collected for use; the residue of the cane is carried away by laths and endless chains, also worked by the machinery attached to the engine.

Crosskill, of Beverley, exhibited his Oscillating Engine, the cylinder hung in the middle: it is of 7 inches diameter, with a stroke of 11½ inches. This engine not only gave motion to various mills contributed by Mr. Crosskill, but also the tenoning, planing, and mortising machines of Mr. Furness, which were partly brought into requisition in the construction of the Crystal Palace. It also gave motion to Mr. Dakin's Coffee-roasting Apparatus; in which, instead of exposing the cylinders in which the coffee is placed to the direct action of the fire, an outer cylinder is provided, the whole being placed within an oven. The cylinder is made of an alloy of silver, to prevent the injurious effects produced on the flavour of the berry by the use of iron. The coffee is introduced through a slide in grooves, which, when closed, render the cylinder nearly air-tight; great importance being attached to the particular temperature at which the hot air is admitted to the cylinder.

Manlove and Co. exhibited their Centrifugal Hydro-extracting or Drying Machines, which are driven by a two-horse vertical cylinder engine in connexion with bevelled cog-wheels, working into smaller wheels placed horizontally: these give motion to two vertical spindles, on the bottom of each of which is a rigger, whence motion is communicated to the pair of revolving copper vessels, in which clothes, sugar, and other articles are rapidly dried by the centrifugal action of the machine. The process of drying sugar by this machine is merely to place the raw material in segmental cases of gauze wire into copper vessels, and subject the whole to centrifugal action, when the treacle is rapidly extracted, and beautiful crystalized sugar is left behind.

Bunnett and Co. exhibited their patent Concentric Reciprocating Engine (4 horse power,) with double action, suited either for high or low pressure steam, which is worked expansively. This engine is without the ordinary gearing or tappets, having a fly-wheel on one side and large pulley on the other: the piston (6½ inches by 3 inches) works in a semicircular passage, having a 12-inch stroke.

Of the numerous Oscillating Engines, one of the lightest and most elegant was that by Messrs. Pope and Son, which works free from noise. The whole machine stands on an iron foot-plate 27¼ inches long by 25¼ inches wide, embedded into a pedestal of stone 9 inches thick. The diameter of the cylinder is 6½ inches, and the length of stroke 14 inches, the fly-wheel being 78 inches in diameter. The engine makes 70 revolutions per minute. The several parts, including the feed-pump, throttle-valve, and governor, are all contained within a neat Gothic frame; and the power of the engine is calculated at four horses.

Hodge and Battley exhibited the novelty of an Oscillating Engine without hollow trunnions, as the steam is admitted and discharged by arcs cast on the cylinder, and rubbing against corresponding arcs on the frame.

Portable Engines are remarkable for their simplicity and small number of parts. In the 4-horse engine exhibited by Dodds and Son, the boiler, which is of a cylindrical form, extends from end to end of the engine, and the strengthening stays are dispensed with, notwithstanding which an additional area of 16 superficial feet is obtained. This engine works expansively, and is direct in its action; the valve-rod is worked by a return crank; and all the steam-pipes being enclosed within the boiler, surface condensation is prevented, except as regards the cylinder and boiler, both of which, however, may be clothed to obtain the full advantage of the steam.

Barrett, Exhall, and Co. exhibited their Portable Engine, in which the cylinder and the whole of the engine part are placed upon a metal frame, complete in itself, independent of its attachment to the boiler, and easily removed, without affecting the other part; and a much steadier action is also produced while working. This engine is well adapted for agricultural work, sawing, pumping, &c.; and its consumption of coal is not more than 7lb. per horse-power per hour.

A Rotatory Engine, (patent elliptic revolving,) 6 horse-power, an ingenious specimen of its class, was exhibited by Messrs. Davies. It has two cylinders, side by side, and coupled together into a long one. Each piston is an elliptical disc, fitted on to a spherical part of the one axis at a considerable angle, and revolves continuously forward, its edge moving in a groove in the cylinder. Instead of the two governor balls ordinarily used at the ends of arms, there is here but one ball revolving on its own axis. On this ball is fixed a ring or zone of metal, heavier on one side than the other; so that when the engine is going slowly, the centrifugal force is not sufficient to overcome the gravity of the heavy side, and the ring is at a considerable angle with the horizon; but when the speed is increased, this same force acquires so much more power that the heavy side flies out towards the horizon, and, in so doing, rises at the same time, so that the ring is nearly horizontal. The connexion with the throttle-valve is made inside the ball, and passes down the hollow spindle on which the ball is supported, and by which it is driven. By this engine was worked the cotton and long-line flax machinery of Messrs. Higgins, including a patent roving frame and double self-acting mule; and also their flax, drawing a roving and spinning frame.

Mackintosh exhibited a peculiar Rotatory Engine, in which the steam is admitted within a flexible tube of canvas or india-rubber, pressed against by a roller, and caused to revolve at a rapid rate; but this arrangement is only adapted for engines of the smallest size.

Simpson and Shipton exhibited their Patent Short-stroke Reciprocating Engine, uniting in the advantages of the reciprocating and rotatory engine; and thus obtaining power equally applicable to engines required either for stationary, locomotive, or marine purposes. Thus, the piston and crank are combined, the piston being moved from top to bottom and from bottom to top of the steam-chamber alternately, as in the cylinder engines, while the crank still possesses all the properties of that in ordinary use. The principle of this engine is that of "an eccentric revolving in its own diameter." It has to overcome centres, as in the ordinary engine; the revolving motion, however, is obtained direct, instead of through the intervention of a crank. The eccentric, or piston, being keyed on to the shaft, a back plate is fitted into a recess in the steam-chamber, and is pressed against the piston, either by springs or by the admission of steam behind it. Thus, if any wear takes place in the periphery of the piston, the plate is intended to compensate for it. The piston is made steam-tight at both ends with rings of metal fitted with conical seatings cut open on one side so as to leave a lap-joint. The shaft is carried on vibrating rods, so as to vibrate the distance of the eccentricity of the piston. The power from the piston to the lower cranks is conveyed by means of connecting-rods, which are always parallel, working in direct lines. Although the steam is admitted above and below the piston, as in ordinary engines, the valve is different, as it exhausts through the back, and is packed similarly to the ends of the piston, being worked by an eccentric lever. The first motion may be attached direct to the main shaft; thus unnecessary gearing being dispensed with.—*Mr. Whishaw; Illustrated London News.*

Hick and Son exhibited their Six-horse Engine, of direct action, having a vertical cylinder of 9 inches diameter, with a stroke of 18 inches; and employed to drive the Cotton Machinery of Messrs. Hibbert, Platt, and Co., of Oldham. The cylinder is chiefly placed below the pedestal, the crank above the cylinder, the crank-shaft working by cog-wheels on two parallel shafts which gave motion to six carding-machines, a single scutcher and lap-machine, an opening and cotton-cleansing machine, a slubbing-machine of twenty-eight spindles, a second slubbing or intermediate machine of fifty-four spindles, a drawing-machine, and a grinding-machine; while by other shafts at right angles, and accessories, were driven a roving-machine of 120 spindles, a weft self-acting mule of 402 spindles, a twist self-acting mule of 348 spindles, a doubling-machine, a winding-machine, a throstle of 160 spindles, besides four power-looms; all which machines are described at pages 163 and 164. There were altogether six drivers and thirty-two pulleys in this machine.

Hick and Son's engine also actuated Crabtree's card-setting machine, one of the most interesting contributions in the Building. The fine wire of which the card is partly made, is drawn out from the reel, cut off to the exact lengths required, removed by two artificial fingers placed in punctures already made by another elegant contrivance; and lastly, the ends of the wires passed through the tape are turned down at the proper angle; thus completing the operation, and placing the wires on the tape with astonishing precision.

Messrs. Fairbairn exhibited a plain solid engine, of the pattern often made by them, in which the cylinder is placed at the bottom of a hollow column, the top of which carries one end of the crank shaft. It has the advantage of requiring little or no foundation, and consequently it can be put up in a very short time. It was used for driving the wool, carding, and spinning machines of Mr. Mason.

HYDRAULIC MACHINERY.

Centrifugal Pumps.—Mr. Appold exhibited two Pumps:—The one of 3 inches diameter, driven by hand; the other, 12 inches diameter, driven by Clayton's oscillating engine. The latter is thus described by Mr. Whishaw. "A gutta percha band, from the 8-feet flywheel of the steam-engine, passes to the pump driving wheel, of 30 inches diameter. On its shaft is a larger wheel of 48 inches diameter, from which a second band passes to a 12-inch pulley, on the spindle of the 12-inch pump or fan, which is contained in an iron case, and placed within a wooden vertical pipe, 7 feet 6 inches long, and 12 inches wide in the clear, and reaching from the floor to the underside of the cast-iron trusses of the roof. In the front of this pipe are two wooden valves at different heights, to show different effects; the lower one has a sectional area of 576, and the upper one of 1008 superficial inches respectively. The water is drawn into the fan (which has six blades angularly placed), by two apertures, each of 6 inches diameter, in the circular sides or discs. In the iron case which encloses the fan, is an opening at top, of 63 superficial inches, for the eduction of the water. With the large pump, of 12 inches in diameter and 3 inches in width, which contains a gallon of water, a duty equal to 70 per cent. is effected when the gallons of water pumped up are equal to 1400." In front of the wooden pipe was a large basin or tank, to receive the overflowing water, which, falling in a broad sheet from an elevation of 17 feet, breaking into drops before it reached the bottom, and throwing up spray like a mountain waterfall, had a most striking effect.

The water, it must be borne in mind, does not flow over with any previously acquired impulse, but has the slow movement of a stream impelled by a fall of only 3 inches: there is little or no commotion of the water on the surface, and, on looking into the tank before the water has reached the top, the fluid mass seems to be lifted up, as if elevated steadily from the bottom. From the tabulated results of many experiments. as stated by Mr. Appold, the maximum effect of the pump is attained when it is raising water 5 feet 6 inches high, when it will discharge 1400 gallons per minute, whilst making 535 revolutions; and the amount of duty at that rate is 72 per cent., being a loss of power of only 28 per cent. for friction and resistance. The main use of the invention is for draining fen or marshy land.

The principle is thus more popularly illustrated in the *Builder*:—By means of a little wheel, 12 inches in diameter, with twisted apertures, radiating from an open central space, there is made to rise to the roof of the department a mass of water, which produces a broad and heavy, noisy, and continuous waterfall, that might turn a powerful water-wheel. Of course, however, to produce this striking result, sufficient power is requisite to produce that rapid revolution in the little wheel which does the work. The wheel itself contains only a single gallon of water when its apertures are full; yet, by being made to revolve at the rate of 607 revolutions in a minute, it lifts no less than 1800 gallons in course of that time; so that it must be filled and emptied about three times in the course of every revolution. In fact, the disc, once under water, where it works, may be said to carry the water through its apertures in continual streams, or threads, or cables rather, of water, forced out at several interspaces by the centrifugal power of its rapid rotation.

Bessemer's Centrifugal Pump was exhibited close to Mr. Appold's, from which it differs chiefly in the radial connecting and partitioning arms of the discs being straight instead of curved, as in Appold's; and the width of the ejecting orifice being smaller than the distance apart near the centre. The size and mode of action are also different from the pumps shown by Mr. Appold; and it illustrates the effect of such a pump made on a large scale, rotating with comparatively low degree of velocity, and raising water from a low level. The diameter of the disc is 6 feet; the height to which the valve is raised does not exceed 3 feet; the water ejected resembles a torrent, and shows how efficaciously the machine may be employed for the draining of marshes.

Gwynne's American Centrifugal Pump was likewise exhibited; in which the discs of the piston are of concave form, the hollow parts being placed immediately opposite to each other. An impeller, radiating from a boss or hollow axis, is fixed between the two discs, and mounted on a shaft, which may be placed at any required angle: the narrowest part of the impeller is at the outer edge of the piston, increasing gradually in width, until its edge intersects the inner surface of the opening in the suction side of the piston; from which line to its extremity at the boss, its edges are parallel to each other, and at right angles to the axis of the shaft. An annular opening is left all round the circumference of the discs, the area of which is equal to that of the opening for the admission of water to the piston through a circular aperture in one of its sides. The piston is enclosed in a case of circular form, in one side of which is a circular opening, through which passes the suction-pipe, its end tightly secured by a collar to a corresponding projection in the side of the piston. The discharge-pipe, in the specimen exhibited, was placed vertically, on one side of the receiver; and in an opening opposite the suction-pipe, was fixed a hollow nut to equalize the lateral pressure on the piston. The main journal of the shaft was attached to the hollow balancing-nut, passing through a proper stuffing-box and gland, to render the whole properly water-tight. In cases of fire, a pump on Mr. Gwynne's plan, with a discharge-pipe of 9 inches diameter, will throw 4000 gallons per minute; and with a piston of 48 inches diameter (the pump making 400 revolutions per minute), the water would be raised from mines to a height of 120 feet.

Greatorex's Hoisting Machine was exhibited, supposed to be fixed in a section of warehouse, to be worked either by hand or steam-power from any storey. It contains several improvements on the machines ordinarily in use, as in the arrangement of the breaks, the motion for shifting the gear, &c. The application is as follows:— The floor of the ascending box is brought to the level of the floor of the warehouse, and secured by the break. The goods are placed on to the floor of the machine, the break released, and the endless rope on one side of the machine being pulled, causes the box to ascend or descend to the particular floor, as required, when the whole is instantly stopped by turning the break-handles, on the right-hand side of the apparatus. One such break-handle is applied for each storey. There are both fast and slow motions, according to the nature of the loads required to be moved; and these are available on any floor, by simply turning to the right or left the handles, under each of which is an index-plate, with the words "fast," slow," or "out" (of gear), respectively marked thereon. The model, constructed to one-eighth of the full size, represents a machine capable of raising to a height of 50 feet about half a ton, by the labour of two men, in about two minutes. This is with a slow motion. It is perfectly manageable with half the weight by one man; an additional balance-weight being provided in the centre, gives additional power, and can be applied at any moment. A break motion—a simple arrangement—is fixed inside the box, to enable any person to descend without additional assistance from any other floor of the building, and to stop at any floor to which he may desire to go.*

Armstrong's Hoisting Machinery.—W. G. Armstrong exhibited models of some of his hydraulic machinery, as applied to cranes, corn lifts, and a machine for unshipping coals. Here the pressure of the water is obtained by a small steam-engine forcing water into the accumulator, where the water acquires a certain pressure. When the crane is required to act, the water is allowed to press on a piston in a cylinder; and as the piston moves from one end of the cylinder to the other, a chain being attached to the end of the piston rod passes over a series of pullies, by which the stroke of the piston is multiplied; the chain then passes over the jib of the crane, and being secured to the object required to be raised, the hoisting is thus performed. By causing the chain to pass through a system of pulleys, the stroke of the piston can be multiplied to any length, and the pressure of water is also made subservient to swinging the crane.

Tebay's Water Meter was exhibited. It consists of three main parts: first, a registering apparatus for ascertaining the quantity of water flowing through the machine; second, a self-acting regulator, to enable the instrument to suit itself to any pressure; and, third, a check-valve to prevent surreptitious use. The measuring or registering apparatus stands on a truncated column, and is furnished with a dial, to indicate the number of gallons and pints drawn from the cistern in a given time: the inlet pipe passes through a horizontal flange, by which the machine is secured either to a table or shelf; the outlet pipe is connected to the back part of the registering apparatus, which cannot be tampered with without detection. The meter may be placed at any part of the water-pipe, and at any altitude in the building.

Hydraulic Rams.—Easton and Amos contributed a self-acting Hydraulic Ram, which is of very simple construction; being composed chiefly of an air-vessel and three valves, two of which are for the water, and one for keeping up the supply of air. Upon the valve situated in the conducting tube being pressed down, the water escapes from it until its momentum is sufficient to overcome the weight, when the valve immediately rises, and closes the aperture. The water, having no other way of escaping, is forced through the

* These hoisting machines are used in the Reform, Conservative, Army and Navy, and other Club-houses, chiefly for elevating and lowering to the different floors, dinners, breakfasts, &c., so that hot closets are required to be appended to them. Not only was such a contrivance designed for the present Fishmongers' Hall, but also a "hot plate dining table." The principle, however, of the "lift" is of far more extensive application to public buildings for ascending rooms, as at the Colosseum. Lifting-rooms were proposed for the stations of the intended City and West-end Railway, designed to be carried by a spacious tunnel under the New-road and City-road respectively.—*F. Whishaw.*

inner valve, and compresses the air in the air-vessel until the latter is in equilibrium with it, when it re-acts by its expansive force, closing the inner valve, which retains the water above it, and draws it up the ascending tube. By this reaction, the water is forced back along the conducting-pipe, producing a partial vacuum beneath the outlet-valve, which immediately falls by its own weight. The water then escapes until it has acquired sufficient force again to close it, when the action is repeated as before.

Messrs. Freeman Roe and Hanson exhibited an improved Hydraulic Ram, with a fall of 30 inches, and throwing up water to the height of about 16 feet—the action of the ram being visible to spectators. In mountain districts especially, these rams may be advantageously introduced for raising water for the supply of houses, for the irrigation of lands inconveniently situated as regards water, and for many other purposes where it is desirable to dispense with additional labour. This ram was driven by the waste water of a fountain by the same inventors: it is of iron, as is also the rim of the basin, 18 feet in diameter. Three other basins rise one above another, the whole being surmounted by the stand pipe, furnished with several jets, as the dome, the convolvulus, wheatsheaf, &c. Of the central basins, the lower one is 4 feet 10 inches in diameter, and the upper one 12 inches. In the large basin is the model of a *Victoria regia* lily, made to the scale of 1½ inch to the foot, having the leaves, flowers, and buds complete: on one of the leaves stands the model of a boy holding a flag in his right hand, with "God save the Queen" inscribed thereon. In the full-blown flowers, water gushes out to form the petals; and around the large ground basin are seventeen variable jets.

The Britannia Press, part of the great hydraulic apparatus employed in raising the Britannia Bridge tubes, was exhibited; it was executed by the Bank Quay Foundry Company, Warrington, and is the most powerful machine ever constructed. Its application in raising the tube may be thus explained. The press was placed at the top of one of the towers or piers of the bridge: there is one cylinder, in which works the plunger, and at the top of which is fixed a cross-head, from each extremity of which hang the chains, connected with the tube below, as well as to the cross-head working through two guides secured to a girder above, when the plunger, being forced up, raises the tube; as soon as one lift was accomplished, the tube was packed up underneath, the chains secured above, the fastenings which connected the chains to the cross-head were loosened, and the plunger, with the cross-head, was then allowed to descend to prepare for another stroke; the chains were again made fast to the cross-head, and the press was then ready for another lift.

The following are the details. The internal diameter of the cylinder is 22 inches, the diameter of the ram is 20 inches; the external diameter of the cylinder is 42 inches, external length, 9 feet 1½ inches; thickness of metal, 10 inches. The water being forced into the cylinder through a pipe and valve, the press is placed in the jacket, and rests upon the cast-iron beams, strengthened by wrought-iron beams; and the cast-iron cross-head has wrought-iron links let in at the top, for strengthening the part subject to tensile strain; the sides of the jacket also being strengthened with wrought-iron slabs, weighing 30 cwt. each, expanded first by heat, and then fitted on hot, and allowed to contract.

To cast the cylinder it required 22 tons of fluid metal, the additional quantity beyond its finished weight being requisite for the head, or git, which weighs 2½ tons. This head was kept fluid for six hours after the run, by replacing the material after it became stiff, with metal fresh from the furnace, and of the highest attainable temperature, for the purpose of supplying the space in the immense body of metal below, consequent upon the contraction. In three days afterwards, the cylinder was partly denuded of its outer coat of sand, when it was found red-hot: in seven days it was lifted from the pit in which it was cast; and in ten days, or 240 hours, it was sufficiently cool to be approached by men well inured to heat, for the purpose of dressing the remaining sand off it.

The beams for supporting the press consisted of six vertical ribs of boiler-plates, $\frac{3}{16}$ths thick, united by vertical straps, the spaces between the ribs being filled with American elm, so that the vertical rib was a sandwich of elm and iron. The top and bottom flanges were each formed by twelve wrought iron-bars, rivetted together, and extending the whole length of beam. The weight of each girder was 12 tons.

The weight actually supported by one pair of beams was 1177 tons, but they are capable of sustaining 2000 tons. The length between the bearing is 17 feet 4 inches. The ram is cast hollow, and turned to bed truly, beneath the cross-head, which is bored to receive it. The cross-head is guarded by two wrought-iron rods, 6 inches diameter, fitted in sockets on the top of the press, and keyed to a cast-iron girder built in the masonry.

There are two sets of clamps: the one placed on the cross-head and rising with it, was immediately used for lifting the chain and tube; the under set was fixed on the cast-iron girders which support the press, and was used for securing the chain at the end of each lift, while the press was lowered, and the upper set of links removed. The wrought-iron clamping cheeks are slotted to fit closely beneath the slotted shoulder in the head of the links; they are withdrawn or closed by right and left handed screws, on turning which the cheeks recede from each other, or are drawn into close contact with the chain. To insure a parallel action, the screws are moved simultaneously by a winch and gearing; they are thus easily worked by one man; and at each stroke of the press the tube was raised 6 feet, the time occupied in one lift being usually from 30 to 45 minutes.

The lifting chains were manufactured by Messrs. Howard and Ravenhill; the clamps and valves by Messrs. Easton and Amos. The superintendence of the designs and construction of this machinery was entrusted by Mr. Robert Stephenson, the engineer, to Mr. Edwin Clark.

The greatest weight lifted by the press at the Britannia bridge was 1144 tons; the quantity of water used for each 6-feet lift 81½ gallons.

"The pressure at 3 tons per circular inch equals 3·819 tons per square inch, which would raise a column of water 5·41 miles in height; this pressure would, therefore, be sufficient to throw water over the highest mountains on the globe." Mr Edwin Clark states this in his able work on the Britannia and Conway bridges, as well as the following striking illustration of the stupendous power of this machine:—

"If it were required that 1 lb. should raise the tube, or 2000 tons, then one arm of the lever must be 448,000 times as long as the other; but if the 1 lb. move through a space of 1 inch, the tube will be only lifted $\frac{1}{448000}$ th part of an inch; and in order to raise the tube 100 feet the pressure of 1 lb. must be continued through a space of 83,522 miles; and, conversely, a pressure of 2,000 tons through a space of 100 feet, would raise 1 lb. 83,522 miles; thus the descent of a clock-weight through a space of 6 feet overcomes the friction of the machine, and moves the extremity of an ordinary seconds-hand through a space of two miles in a week, and the descent of the tube to the water would maintain the going of an ordinary clock for 240,000 years," or the power expended by the press in lifting the tube 100 feet, if applied to an ordinary clock, would work it for a period of 240,000 years.*

Allan's Hydrostatic or Floating Turn-Table was exhibited in model, (¾ inch to a foot,) the Table being 40 feet in diameter, and 4 feet 4 inches in depth, capable of turning the largest and heaviest locomotive engine and tender in use. Its principle is perfectly hydrostatic, the turning part being completely borne over the whole surface—"a condition highly favourable to the carrying of great weight with perfect safety, either in a state of rest, or when passing over it, at any velocity hitherto attained in railway practice." The patentee, Mr. Allan, adds: "in the full-sized Table, (built either of *wood* or of *iron,*) if fixed in a reservoir 40 feet 3 inches in diameter, and adjusted so as not to have any upward pressure at all, but merely so as to float at the level of the railway, a weight of 35 tons could with safety be placed upon it, and the deflection, or sinking below the level of the rails, would be almost inappreciable, not exceeding the *fifteen one hundredth part of an inch.*"

FILTERS.

High-pressure Filter.—Among the Filters exhibited was this apparatus, consisting of a hollow sphere of iron, into which there is fixed a smaller hollow ball of sandstone, between which and the iron, the water to be filtered may freely circulate; it being admitted into the space from a considerable height, so as to obtain the requisite pressure for forcing it through the pores of the sandstone in sufficient quantities. A tube fixed into the hollow sandstone globe is connected with the pipe for drawing off the filtered water, so that none of the

* See the Official Descriptive and Illustrated Catalogue for Engravings of the front and end elevations of the Press; and the Press shown in operation—a tube partly lifted.

liquid admitted into the iron sphere can escape without passing through the stone globe. There is, however, another pipe, which is connected with the unfiltered water, and is supplied with a stop-cock, by turning which the water in contact with the exterior surface of the sand-globe rushes out. By this means the solid matter that is strained from the water, in passing through the stone, is washed away, and the apparatus is cleansed. This apparatus is, however, but a modification of the old sandstone filters, in common use before the introduction of filtering machines. The water, instead of being poured into a sandstone basin, and allowed to pass through the pores by its own pressure, is now introduced on the outside of two sandstone basins, joined together; and additional pressure is applied by enclosing the united hemispheres within a strong iron sphere, the water being forced from the outside to the inside of the basin, instead of percolating from the inside to the out. The new plan has in principle many advantages over the old filter. First, the pressure is equal over the whole surface, consequently, every portion of the water is equally purified; and, as the whole exterior of the ball operates at the same time, a much greater filtering surface is exposed than when the pressure is from within, and acts only partially. A small sand-ball of 4 inches diameter filters as much water in a minute as would percolate through the old sandstone filters in a day.

The Syphon Filter is, perhaps, the most convenient kind for general purposes, as it may be readily carried about and used by any ordinarily available pressure. The shape of the filter is that of an elongated bell. It is made of white metal; and, at the top of the well-shaped vase, there is inserted an inflexible metal tube, furnished with a stop-cock near the end. The vase is filled with powdered quartz of various degrees of fineness, and the mouth of it is closed with a perforated cover. When required to be used, the vase is inverted in the water to be filtered, and the tube is allowed to hang below it. When the air is withdrawn, the water rises through the powdered quartz, and fills the tube; and by syphonic action, the water is drawn down by its superior gravity. The lower the tube the greater the pressure, for the weight of water flowing down operates on the filtering surface as directly as if the same column of fluid were placed above it. The amount of pressure is, however, limited to that of the pressure of the atmosphere; for were the tube lengthened beyond 30 feet, the column of water would separate and leave a vacuum. This filter renders the muddiest water beautifully clear when acting with a pressure of not more than 2 feet at the rate of 4 gallons an hour.

Gravel Filter.—In this apparatus, water is purified by passing through layers of sand and gravel: and it may be fixed to the pipe from a cistern, so that filtration is always going on. The water is admitted at the bottom, and rises through the gravel thoroughly filtered, into the reservoir. The same pipe that supplies the filter is connected with the stop-cock from which water is drawn, and the flow of the current through the bottom of the gravel keeps the filter clean. Whether fine gravel, sandstone, or powdered charcoal be employed, is quite immaterial; provided the interstices be sufficiently fine to prevent the particles, mechanically suspended in water, from passing through.

Centrifugal Filter.—A model of this apparatus was exhibited. It professes to purify two million gallons of water per diem. The filtering materials are felt and canvas, enclosing a layer of sand, placed round the circumference of two discs, kept apart by partitions, in the same manner as in the centrifugal pump; the pressure being similarly obtained by "centrifugal force." Rapid rotatory motion is given to the apparatus, by which means the water admitted in the centre is forced through the felt and sand at the circumference. This filter would require a great amount of power to work it, to produce the discharge promised; and, if mechanical power be employed, it would be better to apply it directly to force the water through the strainers.

ERICSSON'S INSTRUMENTS.

In the United States department were exhibited the following ingenious inventions, by Captain Ericsson:—

1. *A Distance Instrument,* consisting of a reflector, like that of a quadrant, which is firmly attached to a spindle, an object-glass, and a sight, by which the necessary angles are measured. By this instrument, from an eminence on shore (the height previously ascertained), the distances of various objects at sea may be taken with great precision. 2. *The Hydrostatic Gauge,* consisting of a thin copper sphere, filled with water, and a vessel of mercury suspended in it; which, having been submitted to hydrostatic pressure, and the mercury weighed, furnishes the exact amount of compression of the water in the sphere. 3. *The Reciprocating Fluid Meter,* which has been fully tested by the directors of the Croton Aqueduct, New York, as a check on the quantity of water used by the large manufacturers and others supplied from that celebrated conduit. The meter being placed in the water itself, the measurement is effected by two double-acting plungers connected to cranks working at right angles. In the piston-rods are oval slots, made so much wider than the diameter of the crank-pins, as to allow the latter to move through an arc of 20 degrees, whilst the piston remains stationary. A register of the usual construction is applied to the meter, which is set once a year; and the quantity of water which has passed through the meter is at any time ascertained by inspection. 4. *The Alarm Barometer,* in which, so soon as the mercury sinks below any given altitude, the falling of the mercury causes a gong to be sounded, by means of a hammer impelled by a spring: the mercury, in its fall, descending into the cup, and disturbing the equilibrium of a lever, which disengages a catch connected with the hammer. Thus, the helmsman in a vessel at sea, has only to watch the decreased movements of the mercury of the barometer, to be warned of the approaching storm, and enabled to take in the sails and observe other precautions. 5. *The Pyrometer,* invented by Captain Ericsson, discovering that the Wedgewood scale was not to be relied on in experiments requiring an accurate knowledge of the expansion of permanent gases under

high degrees of temperature. In this instrument, by comparing the elevation caused by boiling water with that of molten silver, it is easy to determine the degree expressing the melting point of silver above that of freezing, according to Fahrenheit's scale.

COINING-PRESSES.

Maudslay's Coining-Press.—This beautiful machine is worked by a double-cylinder direct-acting high-pressure engine, on the shaft of which is a metallic pulley of 36 inches, and a fly-wheel of 72 inches diameter, respectively. The cylinders are each of 5 inches diameter, and the length of the stroke 16 inches. From the pulley of the engine, a strong double leather strap passes to a drum of 56 inches diameter on the main shaft of the press, by which motion is given to the cross-head and other parts of the machine; this drum being attached to the engine fly-wheel, of 64 inches diameter. In coining-presses, as ordinarily used, either a screw or lever is employed to give motion to that part of the machine by which the necessary impressions are given to the metallic *blank;* but in the present instance, this motion is obtained by means of an eccentric, by which a pressure is brought into action of 140 tons: the cross-head, worked by the eccentric, which is concealed from view, having an alternate vertical motion of three-quarters of an inch. Underneath, and attached to the cross-head, are two collars, the lower one of which contains the upper die; while the lower die is contained in a collar, which is kept up by three radially-placed springs pressing thereon, and forms the temporary resting-place for the blank undergoing the process of stamping. At proper intervals, the collar is pressed down by two small levers or arms, having an alternate motion. The blanks, twenty-eight in number, each of nearly one-eighth of an inch in thickness, are placed in a circular brass hopper, from an opening in the bottom of which they are successively transferred to the lower die by means of a split curved arm, or tongs of ingenious construction, having two fingers at the end, by which the blank is held during its transference from the hopper to the lower die, when the curved arm is opened so as to release the die: the distance between the centre of the hopper and the centre of the die is 5 inches. The opening and shutting of the split-arm, or tongs, is effected by a vertical pin moving in a short slot formed in the stem of the curved delivery arm; this pin is attached to the end of a second horizontal arm or lever, which is worked by a vertical spindle in connexion with an elliptical cam towards the top and front of the press. In case of a blank being larger than that of the required gauge, a safety spring is attached to the second horizontal arm already mentioned, having its centre of motion on the vertical spindle, by which the error is detected. By this press, 60 double impressions are thrown off in a minute.—*F. Whishaw.*

German Coining-Press.—Among the contributions to the Exhibition from Cologne was a Coining-Press, on the principle of the knuckle-joint, which, coining at the rate of from thirty to forty a minute, completes the coin and *mills the edge in letters at one motion.* By Maudslay's coining-press above described, the coins are silently and successively stamped, pushed off, and replaced by another blank disc, in a manner that seemed, until we examined the German press, the perfection of art. But the milling the edge with letters by the motion which forms the die, has not hitherto been effected by English machine-makers.

PAPER-MILL.

In the French department was exhibited Middleton and Elwell's Paper-Mill. At one extremity is an endless band of wire gauze of the required width, which passes round rollers; on this the pulp is allowed to flow; the thickness of the paper being regulated according to the flow of the pulp, or to the speed at which the wire gauze is driven. As the pulp is carried along by the gauze, the water percolates; sometimes a jogging motion is given to the gauze more effectually to set the pulp, which, having acquired a certain degree of consistency, just sufficient to bear being removed, it passes on to a long jack-towel, if we may so term it, which absorbs the moisture more effectually; the pulp thus travels on, gradually acquiring a greater degree of consistency, till it passes over three cylinders heated by steam, each cylinder increasing in temperature; the paper is then made, and is cut longitudinally and transversely into any sized sheets. All this is done by the same machine.

BISCUIT-MAKING.

Barrett and Co.'s Biscuit-making Machines were exhibited, chiefly kept in motion by a very small Brunel steam-engine, having two inclined cylinders, the pistons of which are connected with one crank. The small engine stood on a table, and by a gut-line from a wooden drum attached to the fly-wheel, motion was communicated to a metallic pulley placed below the table. From this pulley a band passed to another pulley, on the axle of which was a small bevelled wheel rotating in a vertical plane, the teeth of which worked into the teeth of a horizontal wheel placed centrally below the kneading-trough; the vertical shaft of the propelled wheel was attached to the trough, and caused it to rotate with it. The flour, water, and other materials having been placed in the trough, the mixing is performed by the whole mass passing under a grooved roller of great power, which is attached to a beam running above the trough. When sufficiently mixed, the lump is transferred to a hand-break roller, or crushing machine, which consists of a flat table with an enclosed back-board, having rollers, between which the dough is passed until the kneading process is entirely completed. By adjusting rollers, it is reduced to the required width and thickness, and is then pressed by an endless canvas into a continuous sheet, to be cut out by a hand-press into biscuits, and stamped "Reading made biscuits."

CEYLONESE COFFEE-ROASTER.

In the Ceylon department were exhibited three models of works employed on coffee estates. First, there was the *pulping-house*, with its *pulpers, cisterns, &c.*, for removing the outer red husk of the coffee berry, and afterwards washing the mucilage from it. Next were the stove, and moveable trays running on wheeled platforms, whereon the washed coffee is exposed to the sun in its inner covering of parchment-skin. When thoroughly dried to a flinty hardness, the berries are removed to the adjoining building, the peeling-house, where a pair of copper-covered wheels are revolving in a circular trough, under which the parchment rapidly breaks, and becomes detached from the coffee beans. There was also another model of a stove for curing coffee, patented by the inventor, Mr. Clershew, of the Rathongodde estate. It is formed on the principle of curing the coffee whilst in the *parchment*, by means of a current of hot air, to be used during weather when out-of-door drying would be impossible.

AERATED WATER MACHINES.

Cox's Aerated Water Apparatus was exhibited; its chief features being the absence of mechanical contrivances usually forming part of aerated water apparatus; and the entire exclusion of atmospheric air. The water is impregnated with the gas in excess, by connecting the vessel which contains the sulphuric or other acid employed to generate the carbonic acid gas, with a second vessel, called a "generator," in which the gas is made, by means of a supply-pipe, in such a manner as to cause an equal pressure of gas both above and below the acid. By means of a tap, any desired quantity is admitted into the generator, and the pressure of the gas increased so as to force an excess of the carbonic acid gas into the liquid.

The *modus operandi* may be thus described. When the generator is charged with its complement of water and lime, the acid vessel with the sulphuric acid, and the purifier with the water, all the taps and openings being closed, the acid is admitted into the vessel containing the lime, which is kept in a state of agitation during the time of impregnation. The atmospheric air is forced, by the action of the acid on the lime, to the top of the vessel, whence it escapes by the tap-hole. On this tap being closed, the whole of the generator is occupied with the gas; the gas is then admitted into the purifier, and, passing through the water therein, occupies the upper part of the vessel. From the purifier the gas is next admitted to the interior of the cylinder containing the water to be impregnated; the water being kept in agitation, to facilitate the amalgamation.

There were several Soda-water Machines exhibited; the principle of all being the same—that of forcing a certain amount of carbonic acid gas, in combination with water, into strong glass bottles, which are then corked and securely wired. Sometimes, the water is additionally medicated by the introduction of a certain quantity of alkaline matter previous to the impregnation with carbonic acid gas. Tyler and Co.'s Machine is adapted for two bottlers, and, acting on the continuous principle, is capable of making 300 dozen bottles a day. The condenser, in the centre of the upper frame, is of gun-metal, tinned or silvered inside; and, being separated by a partition in the middle, acts as two condensers.

NASMYTH'S STEAM HAMMER.

This very successful machine was patented in 1842; and not fewer than 380 Nasmyth Hammers have been constructed for all quarters of the globe. At Messrs. Mare's ship-building works at Blackwall, is a hammer of six tons, with a stroke of six feet; but that exhibited in the Crystal Palace weighs only 30 cwt. The anvil, chiefly buried below the floor, weighs eight tons; the hammer itself is suspended from the piston rod: the piston, which works in the cylinder, placed at the top of the machine, is of 16 inches diameter; and the extreme fall of the hammer, or what in steam-engines is usually called the stroke, is equal to 42 inches. The ingress steam-pipe is of two inches diameter, the pressure of steam usually employed being equal to 40lbs. on the square inch. The hammer being on the self-acting principle, every degree of blow, from that of merely cracking an egg-shell to that of a dead pressure of 500 tons, is attainable. The whole width of the frame at the level of the floor is 11 feet; and the space between the legs in which the top of the anvil is placed is 7 feet; the height of the machine being about 15 feet. By admitting the steam under the piston, the hammer is elevated to the desired height; and by its own gravity the hammer falls: but the fall may be instantly eased, if desirable, by the admission of steam, according to the particular kind of blow required. In ordinary work, seventy blows are given in a minute; but, at the Exhibition, the hammer was not shown in operation.

Mr. Ryder exhibited his patent Forge for light work, and further illustrated the progress of machinery in the art of smithing. This machine, worked by an oscillating engine, is used for forging, drawing down, and swaying, by steam-power without the use of hammer or anvil, up to two inches round or square; it acts rapidly, by small degrees, giving about 700 blows per minute.

In the French department, Derosne and Cail exhibited some excellent specimens of Forgings: one, a locomotive wheel; the other, the end of a locomotive fire-box; said to be by pressure.

RIVETING MACHINES.

Messrs. Fairbairn exhibited their machine for Riveting Boiler-plates by Steam power, noiselessly, with increase in work at the rate of twelve to one. The riveting dies are of various descriptions, adapted to every description of flat or circular work; even the corners are riveted with the same care as other parts, so that vessels of any shape may be completed without recourse to the old process of hammering.

Mr. Garforth exhibited his direct-action Steam Riveting Machine. In Fairbairn's machine the riveting is produced by levers acting like a knee-joint; when the joint becomes straight it gives a deadly squeeze to the rivet, and brings the plates together, only that the dies have to be set to suit the thickness of the two plates which are being riveted. In Garforth's direct-action machine, this adjustment is rendered unnecessary: it simply consists of a cylinder with its piston and piston-rod; when steam is admitted at the back of the piston, the piston-rod being forced forward the end of it comes into contact with the red-hot rivet, which has been inserted through a hole previously made in the plates; the rivet is kept in its place at the back; and the die fixed to the end of the piston rod never stops till the plates are effectually riveted together. By common riveting three men and one boy can only rivet twenty three-quarter inch rivets per hour; with Garforth's machine, one man and three boys can rivet with perfect ease at the rate of six per minute, or 360 per hour.

LATHES AND TOOLS.

Sharp Brothers and Co., of Manchester, contributed some good examples of lathes for turning the wheels of Locomotive engines and other purposes. The first of these is called a Railway Wheel-turning Lathe, having two face-plates each of 7 feet diameter, adapted for turning a pair either of locomotive or railway carriage wheels of that size, when fixed upon their axle or otherwise, without torsion. Two tires may be bored at the same time, or a wheel may be turned on one plate whilst the boring or bossing of a second wheel is going on, being attached to the other face plate. The extreme distance between the centres of this lathe is 9 feet 6 inches, so that axles and wheels of the broadest gauge may be turned in it. The advantages of this machine are, that the two tools employed have self-acting motions, whereby one man is enabled to accomplish more than twice the amount of work by lathes of the ordinary description.

The second Machine was that used for cutting the key-grooves in the bosses of railway and other wheels, up to any diameter not exceeding 7 feet; having also longitudinal, transverse, and circular self-acting motions.

The third was a machine for Planing articles of metal; the article being moved along by a traversing table, while the cutting tool is attached to a cross slide, and so arranged that the machine itself, having been once put in motion, causes the tool to cut either horizontally, vertically, or at any required angle, without the assistance of an attendant.

Next was a Horizontal Shaping and Planing Machine, differing from the previous one, in the tool moving while the article operated on is stationary. Horizontal and circular work is effected by self-acting movements of the machine; while irregular curves are planed by a motion requiring the attention and direction of the workman.

Holtzapffel and Co. exhibited some of their Machines and Tools adapted to ornamental turning, specimens of which were also displayed. There was a lathe with a new and rather complicated rest; its chief peculiarity being, that it enables spheres to be turned with greater precision than hitherto. There were also the geometrical, eccentric, and oval chucks. In this class of instruments the tools, made of every variety of form, revolve, while the work under operation remains stationary; being the opposite conditions to those usually observed in ordinary and rose-engine turning. In some instances a still larger amount of elaborate work is produced by putting both the work and the tool in motion at the same time. There was also a valuable rose-engine, very completely fitted with a variety of apparatus, such as a compound sliding rest, segment engine, oblique motion, eccentric, oval, straight-line, spherical, geometric, and many other chucks; which are employed either independently or in combination with each other, with or without the rose-engine movement, which in itself is a prolific source of elegant embellishment.

Whitworth and Co. contributed a complete series of their beautifully-finished self-acting Lathes; as also their planing, slotting, drilling, boring, screwing, cutting, dividing, punching, and shearing machines, respectively. Most of these machines were seen daily in action in connexion with a steam-engine.

Parr and Co. exhibited a general Shaping Machine, used for cutting out and forming hollows in metals to half an inch in radius. Its novelty consists in the introduction of a pair of eccentric wheels, which give motion to the crank, thus effecting a more uniform motion.

Next was Parr and Co.'s Machine for Drilling holes in metal, up to 1½ inch diameter. It is supplied with a self-acting feed motion; the pressure being regulated either by a friction-brake, or by the operator. Parr and Co. also exhibited their Slide and Screw-cutting Lathe—fitted with geared head-stocks, having a conical mandril, and case-hardened steel bearings and collar. The guide-screw extends the whole length of the machine, and the compound slide-rest is self-acting, both longitudinally and transversely: motion being given to the machine by steam. By the same inventor's Planing Machine, metals are as easily planed as wood is by the carpenter's plane. By a multiplying pulley, in connexion with a band or strap from a steam-engine, the motion of the machine is accelerated or retarded.

Shepherd and Co contributed a self-acting Lathe and Screw-cutting Apparatus, self-acting surface motion, and improved disengaging motion, remarkable for superior finish.

It has been well observed of this department, that "if we find but little novelty, there is much to excite admiration for the perfection of its execution and the magnificent scale of its operation. Thus, we have a lathe which turns a shaft nearly forty feet in length, and another which turns the tire of a wheel eight feet in diameter, both being driven by steam. Planing and boring machinery will be found in operation upon the same vast scale. The effects of a colossal punching machine (Hick and Son's Hydraulic Press,) are exhibited, by which a steel punch eight inches in diameter is passed through a plate of iron four inches thick, with as little apparent effort as though it passed through the same thickness of cheese, although to effect this a force of 2500 tons is required."

PRINTING MACHINES.

The Printing Machines exhibited, differed from the Printing Press, in producing the impression by a cylinder instead of by a platten; except in one instance, the Scandinavian Printing Machine, where the same power runs the form under the platten, and back again; and the tympan and frisket of the press are retained.

In the several machines, whether printing one or both sides of the sheet before it leaves, the forms are laid flat upon the bed of the machine, which moves alternately backward and forward; the inking rollers pass over the type, above which revolve in opposite directions two heavy cylinders, around which are blankets, and the sheets confined by tapes, to be printed, and further kept in position by guiding-rollers. The inking apparatus consists of a roller at each end, revolving in a trough of ink; and which roller touches the inking-table at each of its motions, and leaves upon it a line of ink, which is distributed upon the surface of the table by its passing under other rollers revolving upon fixed axes; and thence to another set of rollers.

Among the models exhibited was that of a printing-machine, with a horizontal cylinder, upon which stereotype plates are fixed. This is described as new; but such a machine was constructed by Mr. Applegath, nearly twenty years since. The machine exhibited, however, printed the paper "in the web," which was then cut into sheets by an attached apparatus. There was also shown a machine for printing from cylinders of gutta-percha.

The great attraction of this department was, however, the *Vertical Cylinder Machine*, constructed by Mr. Applegath, for printing the *Illustrated London News*, which might be seen working daily in the Exhibition, at the rate of 5000 copies per hour. A similar machine had been previously produced by Mr. Applegath, to print *The Times*, at 10,000 sheets per hour. In both these vertical machines, the type is fixed around the cylinder, instead of being laid flat, and the cylinders passing horizontally over the type. Again, the cylinders being entirely covered with type, as long as they continue to revolve and touch inking-rollers, and other cylinders covered with paper, the printing must be continuous; whereas, in the horizontal machines, it is but alternate.

In the above new Vertical Machine, there are the type cylinders, and four printing cylinders; and between the latter, four sets of inking-rollers. The type cylinder, the great feature of the invention, consists of three strong circular rings of cast-iron, securely keyed to an upright spindle; and attached to the rings by screws are segmental chases, (iron frames,) which contain the type and woodcuts. During the revolution of the type-cylinder, it comes in contact with the four printing cylinders, each of which is exactly one-fourth of its diameter; and they work into the type-cylinder by means of toothed wheels placed beneath them.

The surface of the impressing cylinders is made partly of fine woollen cloth, and partly of paper, or from card-board. The ink is carefully spread over a circular invert opposite to the type, and connected to the vertical spindle of the type-cylinder by hinged arms resting on an upright bar, which is terminated by a pulley. This pulley acts upon a circular undulating railway, fixed below the type-cylinder, and from which the distributing surface receives a slight up-and-down motion as it revolves. The distributing surface is fed with ink by vibratory rollers, which continue in action between it, and the upright ink-boxes under the copper reservoirs. The contact of the inking rollers with the type is regulated by long coiled springs connected with the bearings, so that they merely touch the surface of the letters, which is one of the great advantages of the vertical principle of the machine. Again, the dust or small particles adhering to the paper are shaken from it, and fall to the floor, instead of being often deposited upon the form, or the distributing-table, as in the horizontal machine.

As the Vertical Machine throws off four impressions for each revolution of the cylinder, so many sheets of blank paper are introduced at the same time. This is done by the "layer on," drawing a sheet towards the upper rollers, when a small iron spindle furnished with brass pulleys, revolving at considerable velocity, descends upon it, causing it to pass between sets of vertical tapes, which carry it down to a point where its course is altered by narrow upright pieces of wood, called "stoppers;" and these advance, and compress the sheet of paper between them, the vertical tapes at the same time receding. The stoppers next recede, and the paper is momentarily suspended between small pulleys, mounted on delicate springs, called "finger rollers." The sheet is now impelled towards the impressing cylinder by means of vertical rollers in rapid motion on either side of the paper, which is secured by the ordinary marginal tapes; and, passing round the impressing cylinder, receives an impression from the type-cylinder. The sheet, thus printed, passes toward the "taking-off" table, being supported in its progress by the upper pair of tapes, which are stopped at the proper time; leaving the sheet suspended between small spring pulleys above it, until the "taker off" removes it to the table.

In the *Times* machine, each column has a flat surface; but, in the machine just described, the wood-cuts and rules are curved to the cylinder; but its contour is so slight as to allow the usual types to be used, when properly adjusted.

Waterlow's Autographic Press was exhibited. By this apparatus, any person may with facility print any number of letters, circulars, pen-and-ink sketches, musical notations, &c.; the whole machinery being compassed in a neat box not larger than a lady's writing-case. The process is as follows:—A letter is written on prepared paper, and then transferred to a polished metallic plate by hand-power, assisted by a "scraper." The paper is then washed off with water, when the writing remains on the plate, and is charged with ink from a roller. Paper is now laid on the plate, and upon the application of pressure, the impression is derived, and the process may be repeated sixty or seventy times in the hour, the plate being subjected to the ink roller for each impression. When sufficient copies are cast off, the plate is cleaned, and ready for a fresh operation. The specimens worked are equal to lithography.

Printers' Composing Machine.—In the Denmark department was exhibited a new Machine for composing and distributing types at the same time—the composing part being supplied with types by the distribution of those previously used; and the distributing part of the machine being placed over the composing part. It rests with its hollow axis on the projected central axis of the latter, and distributes the types by revolving on that axis, and conducting each type to that place in the lower part of the machine to which it belongs. Here the types are piled on and between brass rods, of which there are as many as there are letters, characters, or signs wanted for printing. These rods are perpendicularly fixed between two plates of metal, in circular order, so that they form an open cylinder. The distributing part of the machine has a similar construction, consisting of vertical rods of the same size, of a similar number, between similar circular plates. The essential difference between them is, that the one is fixed, while the other is moveable. All the rods have a longitudinal projection, by means of which the types, having a corresponding incision, can be fixed, and slide up and down; the triangular form of the projection and the incision keeping them in the horizontal position in which they are piled on the rods. In the composing cylinder, the triangular projection on each rod ceases at the lower extremity, so that the undermost type upon it can be pushed from its place by the action of a spring, which is moved by a string, in connexion with a scale of keys corresponding to the letters or characters. By touching the key, a type is moved forward and falls, in the same position which it had on the rod, into a funnel; and on the inclined plane of this it slides down into a spiral tube, which brings of necessity all the types to a narrow opening connected with a receiver, in which the line, by type after type, is formed. By a common pedal, the composed line is continually moved forward, and afterwards divided to the width of the page. If the compositor finds in the MS. words requiring peculiar types, he indicates the place by a particular sign, and they are supplied afterwards. The types must be cast expressly for the machine, every letter or character having an incision of a different kind, corresponding with openings in the distributing plate. The expense of the machine is upwards of £100, and a skilful compositor, it is stated, can learn to use it in a few days.

The Imperial Printing Establishment, at Vienna, exhibited in the Austrian department a collection of objects of graphic art. The machinery department of the Imperial Printing-office is supplied with an engine of twenty-horse power, moving forty-eight printing, and twenty-four copper-plate presses, and ten glazing machines. There are, moreover, thirty-six large and twelve small iron hand-presses, twelve numbering and embossing machines, and thirty lithographic presses. A fresh supply of types is constantly supplied by twelve casting machines and nine ovens, and 3000 cwt. of type is kept on the premises. According to a moderate computation, each cwt. contains about 40,000 types, and the 3000 cwt. we mentioned make a total of 120,000,000 of types of various sizes and characters: 500,000 sheets, or 1000 reams, of paper *per diem* are required for the consumption of the establishment: the report of the Austrian Commissioners states, that ten years ago but fifty persons were employed in the Imperial Printing-office. Among the objects sent to the Exhibition, was a collection of 11,000 Steel Punches, including 104 different alphabets, from the hieroglyphic, hieratic, and Demotic, down to the Kionsa, Laos, Shyan, Mandshah, and Formosan.

There was a collection of gutta-percha and galvanized copper matrixes and patrixes of woodcuts, *fac-similes* of antique relievos; and, as a specimen of the typographic strength of the Imperial Printing-office, there was a copy of *The Hall of Languages*, consisting of seventeen sheets in elephant folio, containing the Lord's Prayer in 608 languages, printed with Roman letters, and in 200 languages, in the characters peculiar to each language; a work of vast design and exquisite execution. Next was a collection of MS. writing in the early ages—from the sixth century to the days of Guttenberg and the invention of the art of printing. There were, besides, ornamental letters of the Middle Ages, reproduced from the documents of the time, *fac-similes* of curious old woodcuts, chiefly taken from an old and very rare book, entitled, *Kaiser Maximilian's Ehrenpforte*. There was also a Japanese novel, the first work of this kind ever printed with moveable type; oil-colour prints; photography on paper, in its various applications to objects of nature and art; and a selection of ornamental tools for bookbinding.

ENVELOPE-MAKING MACHINES.

Messrs. Delarue's Envelope Machine was shown in motion, on the north side of the western nave. In the contrivances for folding, gumming, forwarding, and delivering the envelopes, which were formerly done by hand, the inventor has closely followed several natural movements of the human frame; the cams, especially, exhibiting his thorough knowledge of animal mechanics. First, the lozenge shapes of paper are cut out by a powerful lever machine, with a steel cutter, worked by hand, thus forming at one stroke 480 blanks at once; and a single cutting-machine, worked by one man, cuts a sufficient number of blanks to feed ten folding-machines. In that exhibited, two boys were employed; one placing the lozenge-shaped blank on the flat bed of the machine, between four vertical register guiders, at the rate of sixty per minute; the other boy removing the envelopes as finished. In front were seen the *fast* and *loose* pulleys, with a band passing half round the working pulley, and thence below the floor to other pulleys in connexion with one of the steam-engines at work in the Machinery in Motion department. All the chief movements are obtained by means of cams on the principal shaft, which derives its motion from the pulley fixed on one end of it. The cams are five in number, viz., two double, two single, and a large central double cam, which works the double plunger levers, provided with counterpoise balls. The curved plunger, in two parts attached to the levers, is brought down on to the paper at regular intervals; the lower part of the plunger remaining down, while the upper part is drawn upwards. The folders, which turn down the flaps in proper rotation, are worked by the two side cams of the main shaft; and the other double cam of the main shaft gives motion to the taking-off apparatus, or "artificial hand," by which the paper is removed when folded. The two fingers of the hand are small cylinders, fitted at their lower ends with India rubber, which is pressed on to the paper by a spiral spring within, similar to that used in Palmer's candle-lamps; when, the air being excluded by the closeness of the two surfaces, the paper is readily removed.

The envelopes, being transferred by the artificial fingers, are deposited on an incline metallic table, each envelope, as it is finished, being placed in turn at bottom of the pack, by means of two small springs projecting above the table. An endless blanket now conveys the finished envelopes into a metallic case or shield, from which they are taken by the carrier boy.

To the gumming apparatus, motion is given by means of a small shaft, worked by a pulley from the main shaft, in connexion with a segment lever and wheel at one end of the frame. The effect produced by this contrivance is, first, to move an artificial hand on to an endless moving blanket covered with gum, and afterwards to transfer the gum to the proper flaps of the envelope.

Another motion at the top of the frame consists of a segment lever, the teeth of which work into the circular rack or screw, which again works into a small toothed wheel, by which each of the four flaps is made to perform a half revolution, the horizontal circular rack moving first in one direction and then in the other. Eleven of these machines are constantly employed at the manufactory of Messrs. Delarue, in Bunhill-row, by which 396,000 envelopes are completed in a single day of ten hours, averaging 25,000 each machine; more hands are employed by this machine than were formerly occupied in hand-folding at 3000 per day; and only twelve envelopes are spoiled on an average day's work.

Remond's Machine, also exhibited, differs essentially from that of Delarue; atmospheric pressure being employed for raising singly each sheet of paper, and placing it on the top of the folding apparatus; and, again, in giving the necessary inclination to the flaps of the envelopes previously to their being folded down by the action of the plunger. Several hundred blanks being placed on the feeding table of the machine, by a very simple operation it is started by the girl in attendance. The top sheet is raised from the rest by a "finger," the underside of which is perforated; when, a partial vacuum being formed, each sheet is sucked up against its under surface, and transferred to the folding apparatus, on reaching which, the exhaustion being no longer maintained, the sheet drops into its place. The folding apparatus consists of an open box or frame, the size of the required envelope, over which is fixed a creaser or plunger, fitting the inside of the frame. The blank piece of paper having been placed on the top of the box by the feeding finger, the plunger descends just within the box, and the flaps of the envelope are thus bent to a right angle. The bottom of the creasing-frame or box is perforated, to prevent any atmospheric resistance on the entrance of the paper, and the passing back of the plunger leaves the paper within the frame, with its four flaps standing upright. At this point, the second atmospheric action gives the flaps of the envelope a preliminary inclination inwards, and fits them for receiving the flat folding pressure of the return stroke of the plunger: to this end, the four sides of the folding-box are perforated, so as to allow streams of air to be forced against the outsides of the flaps of the envelopes, in order that, on the second descent of the plunger, they may all be folded down at once. There are also certain contrivances for embossing the outer flap of the envelope; and for gumming the lowest flap, as a fastening. To compensate for the continual decrease in the height of the pile of blank papers, and to provide for the upper one always coming in close contact with the lifting finger when the platform rises, the addition of a spring has been found amply effective. By this machine, forty envelopes are produced in a minute, which gives as many as 24,000 per day, gummed, embossed, and entirely completed for use; if needed, the velocity might be increased.—*Abridged from the Illustrated London News.*

Black's Patent Folding Machine was also exhibited, and was much admired for its simplicity and efficiency. It consists of a box or case, with a main shaft, which being caused to rotate by manual or by any other power, gives motion to folding blades and rollers. The newspaper or printed sheet to be folded, is laid upon the table of the machine, with a slit, through which a blade descends upon the sheet, and forces the same at the requisite line of fold. This operation is repeated, accordingly as the blades are set for the sizes, within the machine, which is said to insure perfect register, and to fold 2,000 quires of paper, or 48,000 sheets in an hour. (For the Patentee's details of this invention, see *Mechanic's Mag.* No. 1461.)

Alarm Bedstead.—Mr. Savage, of Birmingham, exhibited a machine, in which, by means of a common alarum clock hung at the head of the bed, and adjusted to go off at the desired hour, the front legs of the bedstead, immediately the alarum ceases ringing, are made to fold underneath; and the sleeper, without any jerk or the slightest personal danger, is placed in the middle of the room; where, at the option of the possessor, a cold bath can be placed. The expense of this bedstead is little, if any, more than that of an ordinary one.

Adorno's Cigarette Machine.—This machine consists of two travelling chains, each link composed of twelve pieces, which are cut out of iron by machinery. One portion of the link is fixed on the chain, and the other portion is moveable. It is necessary that the machine be so adjusted as to provide for the proper quantity of tobacco and paper, and which must be regulated to the thickness of very thin paper. The machine performs 14 operations:—1. It developes the paper. 2. It moulds the paper. 3. It inserts and presses the tobacco. 4. It regulates the amount of tobacco. 5. It brushes away the tobacco in excess. 6. It cuts the paper and divides the cigarettes. 7. It prepares the cigarettes to be folded. 8. It folds the cigarettes. 9. It transfers and finishes the cigarettes. 10. It prepares the ends of the cigarettes. 11. It finishes their ends. 12. It sends the cigarettes arranged to be packed. 13. It registers the number of cigarettes. And lastly, it cleans itself. The machine makes and finishes the cigarettes (more than eighty in a minute,) with greater neatness and perfection than by manual labour. Paper of the proper width and thickness passes over one of the travelling chains, consisting of links corresponding with the scantling of the cigarette. When the paper has a sufficient number of indents, fine tobacco is put into them, and the waste falls into a trough beneath the machine. As the chain moves forward, a knife, by a reciprocating motion across the machine, separates the paper to form the cigarettes, which are finally folded entire, by passing to the other travelling chain; and, by pressure from above, the cigarettes are completed. In the English market there is scarcely any demand for cigarettes; but in Spain and the American republics, the importance of this machine is great.

Expanding Model of a Man.—This mechanical curiosity, exhibited at the west end of the Building, is the invention of Count Dunin, who, in early life, becoming involved in the cause of the insurrection of the Poles, was banished the country; and, in his exile, betook himself to mechanical pursuits, that he might expiate his offence, real or imaginary, against the Emperor of Russia, by showing that he might be useful to the country if he were restored. The figure represents a man 5 feet high, in the proportions of the Apollo Belvedere: from that size the figure can be proportionally increased to 6 feet 8 inches; and, as it is intended to measure the clothing of an army, it is so constructed as to be capable of adjustment in every part to the particular proportions of each individual. This is obtained by mechanism composed of 875 framing pieces, 48 grooved steel plates, 163 wheels, 202 slides, 476 metal washers, 482 spiral springs, 704 sliding plates, 497 nuts, 8500 fixing and adjusting screws, with numerous steadying pins; so that the number of pieces is upwards of 7000.

Flying Car (Char Volant).—A model of this well-known kite-carriage was exhibited, and erroneously described as "a new invention:" whereas it was shown many years ago on Durdham Downs, near Bristol.* The vehicle is impelled by the air acting upon large kites, at the rate of 20 to 25 miles an hour; and two kites, one 15 feet and the other 12 feet in length, will draw a carriage with four or five persons in it, when the wind is brisk. The kite is made to fold up, the standard is divided into two equal lengths, the wings also have hinges or joints at the top, and the frame is covered with strong linen. Two lines are used for the belly-band, the upper one stationary or fixed; the under one, the lower brace line, reeves through an eye in the upper line, at about the distance where the usual bow is tied in the belly-band of the common kite. Both these lines are continued down to the hand of the controller, but enclosed in a casing of canvas or webbing. By straining on the lower brace, the kite is brought up against the wind in full action; by slackening the same, the kite is laid inactively upon the wind; thus its power is instantly increased or lessened. By the same means, the kite is elevated or lowered, in proportion as the angle is formed on the kite's surface. There are also two side lines, one attached to the right hand extremity of the kite, and the other to the left, by which move-

* See also Viney and Pocock's Patent Char Volant, *Arcana of Science*, 1828, p. 28.

ments, trees and other obstacles are avoided. The power of a kite 12 feet high, with a wind blowing at the rate of 20 miles in an hour, is as much as a man of moderate strength can stand against. With a boisterous wind, such a kite has been known to break a line capable of suspending a weight of 200lbs. This kite spreads a surface of 49 square feet.

The Chiragon of Mr. Stiddolph, for assisting and teaching the Blind to write, was exhibited, with testimonials to its success. It consists of a frame with a raised margin, having a groove on the left, in which the paper is placed, and is fixed on the right by a narrow slip of wood; across the frame, another piece of wood, or wrist-rest, is laid; projecting therefrom is another narrow slip, as a rest for the little finger; and connected therewith is the piece against which the pencil works in the manner of a parallel ruler, having a spring in the centre to carry the pencil back to the original line, after having been pressed down to form the tails of the long letters below the line. One line being finished, the wrist-rest is brought down by a gentle pressure of the finger from notch to notch in the racks on each side of the frame, forming the distance between the lines, the straightness being obtained by the parallel ruler; the noise made by moving from line to line serves as a warning of the number of notches passed over. Thus far it is intended for those who are blind from casualty: to assist those who are blind from infancy, an extra parallel ruler is attached to regulate the equality in the size of the writing. There are several other minor points of equal importance to the blind, which must be seen to be understood.

A Machine for Teaching the Blind to Write was exhibited in the Austrian department. It is of metal, of a circular form, and has round the disc the letters of the alphabet and the ten simple numerals. Within are rows of points or keys in connexion with the characters, which, on being pressed down, make an impression on the paper underneath. The person writing, soon makes himself acquainted with the position of each, by the touch; and there is some machinery on the top to guide the hand and keep it in position.

TEXTILE MACHINES.

Cotton Machinery.—Messrs. Hibbert, Platt, and Sons, exhibited, from the Hartford Works, Oldham, a complete set of machinery for cleaning, carding, spinning, and weaving cotton, all finished in the highest style of workmanship; and the invention and manufacture of the exhibitors. The clever details and illustrations of this beautiful machinery occupy upwards of ten columns of the *Official Illustrated Catalogue*, Part II., pp. 258—263; but our limits will allow little more than an enumeration of the several machines. 1. An Improved patent Opening and Cotton-cleaning Machine, differing from all others used for the same purpose, all fibre being cleaned in it by passing between cylinders making about 500 revolutions per minute, and throwing down all motes, seeds, &c.; the power for cleaning 3000lbs. per day varying from 1 to 1½ horse. 2. Single Scutcher and Lap-Machine, for further cleaning the cotton from sand, and forming it into laps, to feed the breaker carding-engine; the novelty being chiefly the patent consolidating calender rollers, by which the cotton is better felted, and so compressed as to admit an increase of 40 per cent. on the lap-roller, and save much labour at the carding-engines. 3. Breaker Carding-Engines, for further cleansing, combing, and laying the cotton, received in laps from the scutcher, reduced by these machines into continuous webs, and thus delivered into cans. Their novelty consists in the method of feeding the card by a dish, straight-edge, and large roller; in the cylinders, doffers, rollers, and strippers, being of iron; and in the adjustment of the bearers or carriers for the rollers and strippers; while the method of applying the bearings, &c., for carrying the rollers, is capable of the finest adjustment. 4. Lap-Machine, fed by the cans from the breakers, and which again forms the cotton into laps; the patent consolidating calenders being applied here, as in the scutcher. 5. Finishing Carding-Engines, in which the laps are taken in, and the fibres are again drawn, combed, and straightened into perfectly even web, to be delivered and coiled into cans; these machines having the same improvements as the breaker carding-engines. 6. Grinding-Machine, for sharpening the teeth of the roller cards, and the flats of the carding-engines. 7. Drawing-Machine, for doubling or drawing the web or sliver, and delivering it and coiling it into cans, which revolve; this machine being furnished with self-acting guides, which stop it whenever the sliver breaks in its passage. 8. Slubbing-Machine of twenty-eight spindles, for drawing the slivers, and winding them and twisting them on bobbins. 9. Second Slubbing or Intermediate Machine, of fifty-four spindles, used for doubling and drawing the slubbings, and twisting them, and winding them on bobbins, for the creels of the roving-machines. 10. Roving-Machine of 120 spindles, for transferring the slubbings to still smaller bobbins, for the creels of the spinning-machines: the improvements in these roving machines consist of the self-acting motion for stopping when the sliver breaks; patent bearings, or collars for the spindles, and fitting their flyers so as greatly to increase their speed; and the application of double patent pressure to the flyers, to maintain the equilibrium of the spindles, whether the bobbin be full or otherwise. 11. A Throstle of 160 spindles. 12. Weft Self-acting Mule, of 402 spindles, for drawing the fibres, and winding the yarn on cops for the shuttles of the looms. 13. Twist Self-acting Mule, of 348 spindles, for spininng yarn for the warp. These mules have improved drawing-out motion for the carriage; squaring and steadying the carriage by a back-shaft; and a new mode of winding on the yarn by a catch-box, in place of the springs and levers previously used. 14. A Doubling-Machine, for twisting spun yarn into a thread. 15. A Winding-Machine, winding on one side the yarn from cops spun in the mule, and the other from bobbins on the throstle. 16. Power-looms, with new patent uniform winding or taking-up motion, by surface rollers; and with a mode of holding the edges of the cloth in weaving by an improved temple.

Macindoe's Patent Self-acting Mule was exhibited—for spinning cotton wool into yarn, with oscillating or vibrating lever, for taking in or putting up the carriage; and a mode of putting down the faller from any of the twist pulleys by centrifugal disengaging catches. The great features of the improvement are :—1. The mode of regulating the movements of the spindles, and the twisting action, so that they work in concert. 2. The oscillating lever, which causes the carriage to start at a slow, yet steady pace, to be gradually increased, when its rate diminishes in a similar ratio up to the roller-beam. 3. A counter part to the radial arm and screw, for winding on the yarn. 4. The extension of the main driving-shaft over the whole length of headstock, thus distributing the movements, and dispensing with additional connexions. 5. The extension of the cam-shaft from the drawing roller, forward to the front end of the headstock. 6. The power of applying the headstock in the centre of the carriage, without cranks, or connecting-rods and joints. 7. The backing-off motion, worked by wheels, to the nicest regulation. 8. The second draw, necessary for fine yarn. 9. Disengaging pulleys or friction-pulleys for steadily starting and stopping the movements in connexion with the cam-shaft. In the *Official Illustrated Catalogue* is a large steel engraving of this machinery.

Hornby and Kenworthy's Patent Sizing and Dressing Machine was exhibited : it is used for preparing the warp threads with flour-paste, so as to make them more tough and smooth for wearing. In cotton manufacture, before the yarn is taken to the warping machine, it is wound from the cop on to bobbins, then taken to the warping machine for the threads being laid parallel to each other so as to make them into a beamed warp, and to facilitate their arrangement after being sized and placed in the healds or "heddles" of the loom. By the connexion of Mr. Kenworthy's warping-machine with the sizeing-machine of Messrs. Hornby and Kenworthy, the process is much simplified. In the warping-machine itself, also in the Exhibition, the bobbins containing yarn are so placed in a wooden frame, called a creel, that they will revolve ; the threads are then passed through a wraithe on to a roller-beam, the wraithe being required for the purpose of keeping the threads separate and uniformly in the order in which they are intended to be wound off (after having passed through the size,) on to the weaver's yarn-beam. In this machine is a beautiful adaptation of mechanism, by which the yarn may be backed off the beam, if any thread chance to get upon the same. The sizeing is effected by the continuous threads being passed over a conducting roller, and immersed into a trough containing the sizeing material, which is kept heated by a pipe of steam; and is thus boiled into the warp threads as they are passed through it, and under an adjustable tension-roller. Thence the threads are passed through squeezing rollers, and again immersed in the trough of size, to finish the yarn; whence they are passed round the drying cylinder, also heated by steam ; in passing over which, a circular revolving brush dresses or lays the fibres, now resembling tapes or bands. Thus dried, sized, and finished, they are conducted by two rollers through a similar wraithe, or comb-bar, by passing through which edgewise they are again similarly divided by the oscillating or vibratory action of the comb-bar, and laid over the tension-roller, to be received and wound upon the warp-beam ready for drawing in, after which it is taken to the loom and woven. Connected with the machine is an improved self-acting apparatus, which marks with colour the desired lengths of warp to be woven.

The Sizeing Machine is equally well adapted for sizeing flax : it stands in about the same space as the old dressing-frame, takes less power, does nearly six times the quantity of work, and is calculated for coarse or fine mule or throstle yarn : with the assistance of a good workman, it will run off fully 1000 cuts per week of 5½ days, of nine-eighths wide, 66 reed, and 25 yards long.

This machine is more fully described by Mr. Whishaw, in the *Illustrated London News*, No. 518.

Flax Machinery.—Mr. Plummer exhibited his Patented Machinery for the whole process of Flax-dressing : 1. The Brushing Machine of five indented rollers, rotating horizontally. 2. The Scutching Machine, with a disc of yellow pine, 6 feet in diameter, made to rotate at sufficient speed to *scutch* the flax effectually. The disc is attached to metal arms, and is divided on either side into six compartments, each containing two brushes, thereby working double : the first brush of wire $\frac{7}{8}$ of an inch long, (No. 22, Birmingham wire gauge.) The second brush is of strong whalebone ; the third of whalebone and bristles alternately ; and the fourth brush of three parts of bristles and one part of whalebone. Thus, there are altogether 24 brushes. Four boys are employed in this part of the process—the one handing the material to the other in turn, the wire-brush being first used. Next, —*Heckling* is performed by placing the material into the double oscillating cylinder machine, in which it is suspended to be heckled by ten rows of heckles and brushes. The holders have cheeks of gutta percha, which are found to last out six of those ordinarily used. In front of the machine are three receptacles for three descriptions of tow, which passes down from the cylinders by means of an endless chain or series of round wooden bars. The whole of this machinery was kept in motion by one of Hodge's four-horse engines.

Harrison's Improved Power-Looms were placed, side by side, with an old loom, made about half a century since, at Abbey Mill, Paisley, which was then a wonder, although only capable of running *sixty picks* or throws of the shuttle per minute, with advantage ; besides requiring the constant attendance of one person : whereas, the new looms may be driven at the rate of 220 picks per minute ; and, by the application of several improved motions, one person attends to two or three looms at once. These motions are the "weft protector," a small fork which acts in connexion with the setting or handle of the loom ; and whenever the weft thread breaks, or is absent from its place, the machine is immediately stopped by a break.

Next is "the temple," a long, semi-cylindrical box, into which is fitted a roller, cut or fluted to nearly one-third of its length at each end : the use of this roller, which rotates, is to keep the fabric at one uniform width throughout the piece, and the sides free from perforations and rents. In the old loom, also, is a temple, but it requires an operator to move it, and it often tears the cloth. Next is the "taking-up" motion for insuring uniform thickness throughout the piece; and regulating the number of threads of weft in a given space, by a small toothed wheel acting in connexion with three other small wheels and the cloth beam; which latter, at one and the same time, folds up the cloth, and moves it, so as to insure the desired thickness throughout. Lastly, are "the loose reed and break," for light fabrics, and "the fast reed and break" for heavy goods. Whenever the shuttle fails in traversing the sley from one end to the other, a great destruction of the reeds takes place in ordinary looms; but, in the new loom, the loose reed falls out at its place, and gives way to the shuttle, so as to prevent derangement or breakage of the warp. There are many other motions to perfect the working. By the old loom, not more than one-third of the amount of cloth can be produced as compared with the workings of the new looms, and this with twice the amount of labour. The weaving of each piece costs 5⅛*d.*: a workman at one of the old looms, could only produce four similar pieces, each of which would cost 2*s.* 9*d.* for weaving alone.

Weaving Machines.—The collection exhibited, both in the British and Foreign departments, fairly illustrated the progress of this branch of mechanical art, and of the interchange of inventions between this country and continental Europe. First, was the *English Stocking-frame,* worked by hand-power, which, with all the advantages of modern improvements, is still worked on the same principle as that invented, at the close of the sixteenth century, by William Lee, of St. John's College, Cambridge. In another part of the same department might be seen the *Circular Rotatory Stocking-frame,* driven by steam-power, which weaves stockings, webbing of all kinds, night-caps, and elastic shirts. The French also showed an ingenious improvement of the same principle. Still, William Lee's stocking-frame may be considered the parent of all lace and net machines, however complicated, now in use in the Nottingham trade. A Nottingham mechanic or weaver will trace you down the successive improvements which have at last produced Burkin's lace machinery, with Jacquard adaptation, composed of 110,000 pieces, of which not less than 70,000 are in motion at once, capable of weaving the most complicated lace patterns; or we may turn to Sewell's bobbin-lace machine, in which, a few years ago, it was considered good work to make four racks a day of 140 holes each of net, 36 inches wide; but which, by improvements and addition of steam-power, will now make five racks an hour of 112 inches wide: it was here shown making beautiful Brussels lace. But one of the greatest triumphs of mechanical ingenuity was exhibited in Ball's *Rotatory Warp Lace Machine,* worked by steam power, which, since 1816 (in the recollection of a Nottingham man at work near it,) had been thrown by, or sold for the price of old iron, twenty times; and has been again and again rendered valuable by new improvements, until it is now available, not only for weaving two kinds of lace, (one, fine blond,) but a variety of other goods, including stocking net, afterwards cut and sewed;

velvet; light worsted cloth for waistcoats; or, "anything, from a spider's web to a blanket."

Bobbin Net-Machine.—Mr. Sewell, of Carrington, near Nottingham, exhibited a "Double-tier Machine," in which two tiers of bobbins and carriages are worked simultaneously. This machine contains 2460 bobbins and carriages, each bobbin containing about 100 yards of thread; an equal number of threads proceeding from the warp-beam are brought into operation, round which the bobbin threads are twisted by means of the forward and backward motion of the bobbins and carriages, which have also another motion to the right and left, so that the bobbin threads are made to cross each other. A set of steel points then descends, takes up the twisted and crossed threads, and puts them into the form of meshes; and thus a piece of net is produced equal to 150 yards superficial, the quantity of twisted thread consumed amounting to 246,000 yards.

Judkin's Heald Machine was exhibited; by which the yarn is doubled and twisted from single of itself, and at certain intervals is braided or plaited, so that the eye or loop of the heddle is formed without knots of any description, the whole forming one continuous line or cord; the eye being coated with a metallic substance, which forms also a novelty in the invention. Between the ends of the light iron frame is placed horizontally the bed-plate, on each side of which, and let in flush with its upper surface, are ten revolving tables, each having six slots—the use of these being to receive the spindles carrying the flyers and bobbins. The tables work together in pairs, and each carries three spindles, which are so set in relation to each other, that each spindle, at proper intervals, comes opposite to the vacant slot in the other table. After being twisted, the yarn is taken up from the bobbins, twisted so as to be converted into a heddle, by two cylinders, one on either side of the machine. The working shaft of the machine is connected with the revolving tables by means of bevelled wheels underneath the bed-plate. The machine acts both as a doubling and twisting machine, except at the time when the eye or loop of the heddle is formed, when at the top and bottom of each loop it becomes a braiding machine. The bobbins, during the operation, pass from one table to another throughout the whole series in a most ingenious manner.

Judkin's Sewing Machine was also exhibited: it sews in a circle, curve, or straight line, 500 stitches per minute; the rack in which the cloth is placed being moved forward by a spring, at a given distance for every stitch. There are two threads—one is carried in the shuttle, the other taken from a reel at the top of the machine, and passed through the cloth by the needle; and, when withdrawn, both threads are locked in a lasting stitch.

Jacquard Reading Frame.—By means of this machine, a boy may learn to "read," "cut," or "repeat" the design in a few hours; and one boy can thus accomplish more in the same space of time than is now performed by a man and a boy. The operation is similar to that of playing the pianoforte, or any other keyed instrument; the machine consists of an upright frame, with perforated plates at the upper part of the front, which contain the punches for perforating the cards. A number of bell-crank levers, working upon axes, are fitted at one end to keys placed in the lower parts of the machine, like those of a piano. These keys are numbered to correspond with a graduated scale or "sight plate," immediately above them, representing the squares or "cords" to be read in from the design or pattern. The other end of the levers acts upon needles at the back of the plates in the upper part of the machine, which force the "punches" from the stock plate into the "receiving" or centre plate, in the exact position required for forming the patterns. All, therefore, that is required, in order to read in any pattern, is for the person working the machine to press down such keys as will force out the punches corresponding to the squares or cords indicated on the pattern by the graduated scale before him. When the whole of the punches corresponding to the squares have been placed in the receiving plate—which may be 480, or 600, or any other number—the perforation of the "lash cards" is performed by means of an eccentric shaft or rod, by which the punches in the receiving plate are forced back, and produce the required perforation. The machine is also provided with knives for cutting the cards to any required size.

Spinning Machine.—Messrs. Sharp Brothers and Co. exhibited an improved Throstle or Spinning Machine, furnished with 96 spindles, which are arranged for cotton, and driven by friction, instead of by bands. Thus, greater certainty is attained, and less power required; the flyer is dispensed with, and the spindles are driven at a much greater velocity, without injury to the machine; one-fifth of the space usually occupied is saved; and the machine is more uniformly worked.

Lace-gassing Machine.—Messrs. Barton and Eames exhibited their machinery, consisting of a series of gas-burners, placed in a straight line, and regulated in length by the width of lace to be "gassed." The lace is made to pass through the various jets of gas at such a velocity as will just remove the fibres by which the whole surface is covered, and yet not destroy the fabric itself. During the process of gassing, the lace is carefully watched by four persons, two in front, and two behind the machine; in order to see that the lace is duly gassed, and also to prevent the fabric itself taking fire.

Cotton thread which has been subjected to a process nearly similar to that above directed, by means of a machine somewhat modified from that in the Exhibition, is sold in the market as "gassed thread," and in consequence, commands a higher price. The cost of burning off the fibres from muslin and other delicate fabrics, some thirty-five years ago, was at the rate of 6d. per square yard; whereas, 600 square yards of lace may now be gassed for the

CALICO PRINTING MACHINERY.

Figured patterns were formerly printed on white cotton cloth by means of wooden blocks cut after a fashion similar to those used at present for wood engravings. These blocks being smeared with a colouring matter, were pressed upon the cotton cloth by hand; and when patterns of more than one colour were produced, different blocks, carrying the figures corresponding with the different colours, were successively applied to the same cloth. This hand-labour gave way to the invention of a system of Calico Printing Machinery, by means of engraved copper rollers, of which numerous specimens were shown in the Exhibition. By one machine constructed upon this principle, calico can be printed in eight colours at once, and dried and finished for consumption; and another claims a still greater power in reference to the combination and variety of colours. Although these machines are very complicated, even with a machine under our eyes, their general principle may be rendered intelligible. The patterns on printed calicoes and similar figured cloths are formed by a continual repetition of the same figure, which, so far as it consists of a single colour, is engraved upon a copper roller, the length of which corresponds with the breadth of the calico, and the circumference of which corresponds with the length of the pattern. Generally, the breadth of the pattern is repeated many times in the width: it is, therefore, engraved upon the surface of the roller, the length extending completely round it, and being repeated throughout the length of the roller in the same manner as it is intended to appear on the cloth. This roller receives the colouring matter by a certain apparatus which first smears, and then wipes it, so as to remove all dye except what fills the incisions of the engraving. The cloth is then passed between this roller and another which has a soft surface; when the two being pressed severely together, the colour deposited in the lines of the engraved roller is transferred to the cloth, and the printing is completed. For printing patterns in two colours, a second engraved roller is provided, carrying upon it the pattern corresponding to the second colour; and the cloth, after having been printed with the first colour, is made to pass in contact with this second roller, so that the pattern of the second colour is transferred to the cloth from the roller in the same manner as that of the first; whilst, the movement of the cloth is so nicely regulated that the pattern of the second colour falls precisely into its place. Where patterns of three colours are to be printed, a third roller is in like manner provided and worked.

Until lately, calico has not been printed by these means in more than four colours; a fifth colour, however, has been added, but by a different, slower, and more expensive expedient. In a machine, however, sent to the Exhibition by Messrs. Mather, the means of printing in eight colours by a single operation, and afterwards drying the cloth, are provided.

But the most admirable part of this machinery is the method by which the copper rollers on which the patterns are delineated are engraved. This, by ordinary tool-engraving, would be very expensive; and the engraved copper rollers would be rapidly worn by the printing. The cost has, accordingly, been evaded by the following beautiful and ingenious mode of producing these engraved rollers at a trifling expense:—

Suppose that the length of the pattern, and consequently the circumference of the roller on which it is to be engraved, is six inches. A small soft steel roller is taken, whose circumference is six inches, and whose length is equal to the width of the pattern. Upon the surface of this roller, the proposed pattern is engraved, and the surface is hardened by a certain process: it is next placed by a powerful press, in contact with another roller of soft steel, and the one roller being rolled upon the other, the surface of the soft roller takes *in relief* an exact impression of the *intaglio* pattern engraved upon the original roller. The second roller, with the pattern in relief, is then hardened, and is rolled by a powerful press, upon the copper cylinder to be engraved, and leaves upon it the engraved characters. These rollers being repeatedly applied to the copper cylinder throughout its entire length, the engraved pattern is reproduced in the same manner as it is intended to be printed upon the cloth.

It is evident that when a pattern has been once engraved in the manner above described upon a soft steel roller, afterwards hardened, the engraving may be multiplied indefinitely; for the first roller may transfer it in relief to a second; and that being hardened may again transfer it in *intaglio* to a third, which may produce another in relief, and so on. A pattern, therefore, however complicated, elaborate, and costly, being once engraved, may thus be literally perpetuated; and the expense of the first artistic labour applied to the original roller, being spread over the unlimited multitude of rollers which may be made from it, becomes insignificant.

A single calico-printing machine worked by engraved rollers, as above described, driven by steam or water power, and attended by a man to superintend them, and a boy to feed the colour troughs, is capable of producing as much calico per hour printed in four colours as would require the labour of 200 men to produce by the old method of block-printing. And the economy of labour is, of course, still more surprising, when a machine for printing in a greater number of colours is used.—*Abridged from the Times.*

BRICKS, AND BUILDING CONTRIVANCES.

Brick-making Machines.—Messrs. Randell and Saunders exhibited a Brick Machine, with double screw-press and perpetual cutter, for making patent draining sewerage bricks. The machine occupies a space 12 feet by 4, and can be placed under the pug-mill, or the clay may be otherwise thrown into it, to fall on two screws working into one another, driving the clay out at the further end of the cylinder, and giving it in its transit great compression, so that the bricks are delivered through the dies firm and solid. They then pass under a perpetual cutter, which works without checking the progress of the clay, severing the bricks or tiles at any required lengths, giving the ware joints either square, angular, circular, or any segment of a circle, plain joints, or tongues and grooves. Two men and one lad, with the machine working at little over one-horse power, produce 1000 bricks per hour.

The curious and interesting machinery, invented by Messrs. Bovie, and applied by them to a similar manufacture in France, deserves notice also, as producing an amount of strength, with a small consumption of material and greatly-diminished weight, which, if in any sense economical in the first cost, must have an extraordinary value. These bricks of Messrs. Bovie's manufacture are much larger than those at present used, or those just described, and can be made of considerable length if required. They are extremely strong, and must be very compact and readily dried. They contain several small hollows, and in this respect, and the mode of manufacture, are entirely new.

The Hollow Bricks sent by the Society for Improving the Condition of the Labouring Classes are considerably larger than the common size, and have one large open hollow in the centre of a recess in the top and bottom for mortar. Bricks thus made, dry very quickly and thoroughly; and are admirably adapted, by their comparative lightness, for various purposes in fireproof buildings, and for party-walls. They are also much cheaper, bulk for bulk, than ordinary bricks.

Other new kinds of Bricks were exhibited by Mr. Workman, who has invented and patented a new process for rendering them waterproof at small cost; and by Mr. Haddon, who has manufactured them of a rhomboidal form, ensuring their bonding. There were also a number of Ornamental Bricks, of which some sent by Lord Lovelace were interesting and ingenious; and others, by Mr. Ambrose, also indicated taste and good material.

Amongst the foreign goods of this kind, were the Austrian Bricks and Tiles exhibited by the establishment of M. Miesbach. The raw material was not sent with the manufactured article; but, from an authentic account, it appears that one brick and tile factory (the largest of several), belonging to M. Miesbach, and situated close to the city of Vienna, occupies upwards of 250 English acres, on which are drying-sheds 25,000 feet in length, adapted for common bricks; forty-three kilns, capable of burning three millions and a half bricks at a time; and more than 8300 feet of shed for moulding tiles and ornamental work. The annual make from this single establishment is 65,500,000 of bricks, employing nearly 3000 persons in the manufacture. This is only one of seven large establishments belonging to and worked by the same manufacturer, who employs in all nearly 5000 persons, and sells upwards of 107,000,000 of bricks per annum. The colour and texture of the bricks and tiles are admirable; and the selling price is almost inconceivably low, considering the cost of fuel and the price of labour. M. Miesbach obtained the gold medal—both at the Industrial Exhibition at Vienna, in the year 1845, and at that in Pesth, in 1846—in consideration of the magnitude of these establishments, and the excellent manufacture of all descriptions of bricks.

The light yellow and red ornamental bricks are said to be the most excellent productions of the kind since the first manufacture of bricks in Vienna under Drusus and Tiberius (13 years before the birth of Christ).

Slates were admirably exhibited, not only in their rough state, but as split by the hand or machine, and as sawn into slabs, and afterwards prepared for various uses. The series by Mr. J. Stirling, jun., was as complete as can be made, so far as the slates sold in the London market are concerned. The process of enamelling slate, or covering it with varnish capable of receiving colour, and either forming slabs of imitation marble, or tables resembling those now manufactured in *papier-mâché*, is comparatively modern, and very important. The works of Mr. Magnus were extremely remarkable in this respect. Among the specimens was a large Slate Bath, of good architectural design, with columns of lapis-lazuli, and other portions in imitation of different marbles. Many chimney-pieces of imitative black marble in enamelled slate are now in common use in this country.

The uses of slate are now very numerous; and from 30,000 to 40,000 tons are annually brought into London only. One-third of this large quantity is received in slabs, and may be considered to represent the proportion available for miscellaneous and ornamental purposes. The rest is in split slates for roofing. Some good series of slates were exhibited by France, chiefly from the neighbourhood of Angers, but also from the eastern districts, near the Meuse. A fine slab of polished slate was sent from Sardinia.

Model Paving.—The Patent Union Road Paving was exhibited. It consists of broken stone, inserted between blocks of wood; driven hard on to the wood at the bottom of a groove, which is first to have placed therein a composition of gravel and ground lime, and a portion of the same brushed over the surface to fill up the vacancies that may be left, after which a thin layer of gravel is laid over the surface.

Model Houses for the Working Classes.—Opposite the Crystal Palace (west of the Cavalry Barracks, Hyde Park), a block of Model Houses was erected at the expense of his Royal Highness Prince Albert,—a contribution to the Exhibition,—with the view of conveying practical information calculated to promote an improvement in the dwellings of the working classes, and of stimulating visitors to the Exhibition, whose position and circumstances may fit them for the task, to imitate his example. The houses were designed for the accommodation of four families. The most prominent peculiarity of the design is that of the receding and protected central open staircase, with the connecting gallery on the first floor, formed of slate, and sheltered from the weather by the continuation of the main roof, which also screens the entrances to the dwellings. The four tenements are arranged on precisely the same plan, two on each floor. The peculiarities of the building in constructive arrangement are, the exclusive use of hollow bricks for the walls and partitions (except the foundations, which are of ordinary brickwork); and the entire absence of timber in the floors and roof, which are formed with flat arches of hollow brickwork, rising from 8 to 9 inches, set in cement, and tied in by wrought-iron rods connected with cast-iron springers, which rest on the external walls, and bind the whole structure together; the building being thus rendered fire-proof, and much less liable to decay than those of ordinary construction. The roof arching, which is levelled with concrete, and covered with patent metallic lava, secures the upper rooms from the liability to changes of temperature, to which apartments next the roof are generally subject; and the transmission of sound, as well as the percolation of moisture, so common through ordinary floors, is effectually impeded by the hollow brick arched floors.

The external and main internal walls are of patent bonded brickwork, which has the important advantage of securing dryness and warmth, with economy of construction. Another important benefit arising from the use of hollow bricks is, that where they are laid double, in parallel courses, without headers, as in the patent bonded brickwork, the internal face of the wall is sufficiently smooth to render plastering unnecessary. In the present instance, where plastering has been resorted to, it is confined to one side of a thin partition, or to partitions formed with bricks not intended for the situation in which they are used.

The glazed surface of the bricks used in the two upper-floor living-rooms, and at the foot of the staircase, is a specimen of what can be accomplished by the skilful adaptation of fitting materials, and is highly creditable to their maker, Mr. Ridgeway, of the Staffordshire Potteries. Specimens of glazed bricks of clay from the north of Devon were also exhibited.

Internally, French plaster has been used, as drying quicker and having a harder surface than ordinary plaster. The floors, where not of Portland cement, are laid with Staffordshire tiles; except to the right-hand room, first-floor, which is of lava, by Orsi and Armanie. The coping is in Portland cement. The external string courses, and internal cornices, are the patent bonded bricks set in Portland cement, with the splayed side outwards.

The advantages of the hollow brickwork, and its various applications, especially when formed with a longitudinal bond, as adopted in the construction of these houses, are stated to be dryness and warmth, as well as economy of construction; considerations which recommend them as a preventive of the evils which result from the absorption of moisture by common bricks and other porous materials.

For agricultural buildings, and for inclosure, park, or fence walls, they are particularly adapted; as well as for the ordinary dwellings of the labouring classes, for schools, and for houses generally of moderate height; and, with the usual weight of roofs and floors, rendering internal battening unnecessary. Their strength may be adapted to circumstances, and, where necessary, be rendered equal to that of solid bricks.

When used for partitions, or for roof and floor arches, they are fire-proof, deaden sound more effectually, and are considerably lighter than solid brickwork. As a lining to stone or flint walls, they supersede the necessity for battening, and the consequent risk of fire and dry-rot is avoided. For cottage floors they are also well adapted.

The various forms of hollow bricks proposed, prior to that which has been patented by their inventor (Mr. Henry Roberts, F.S.A., Honorary Architect to the Society for improving the Condition of the Labouring Classes), are all, particularly in reference to external walls, more or less liable to the objection, that they either will not properly bond together, and form a substantial wall; or else that the headers and the vertical joints afford a medium for the transmission of damp from the exterior to the interior.

By the form adopted in the patent hollow brickwork, a perfect bond, running longitudinally through the centre of the wall, is secured; all headers and vertical joints passing through it are avoided; internal, as well as external strength, is obtained; and every facility is given for the fixing of floor-plates and other timbers; whilst, by the parallel longitudinal cavities, ample security for dryness is afforded, and great facility presented for ventilation, as well as for the conveyance of artificial heat, and for the transmission of bell-wires, pipes, &c.

Improved Roofing.—A coarse kind of felted cloth has been successfully applied to the roofing of buildings; to illustrate which a cottage roofed with asphalted felt was erected in the north-west gallery of the Crystal Palace, by Messrs. Croggon and Co. Messrs. M'Neill and Co. also exhibited specimens of asphalted and dry felt, the latter being intended to nail on to the rafters underneath slates or metal. For this purpose it is found a better protection against both heat and cold than a lining of wood, and considerably cheaper. For economical roofs, especially over temporary buildings, the thick asphalted felt, which costs only one penny per square foot, is extremely convenient. Another useful purpose connected with buildings, to which the bituminous felt is applied, is the lining of damp walls.

Under-ground Chimneys.—Mr. Devey exhibited the model of a new plan of constructing the flues of chimneys; in which all the flues of the fireplaces are connected with a downcast shaft, which forms a junction with a horizontal flue from the chimney in the kitchen leading to the sewer. The smoke, which is prevented from issuing from the chimney tops by valves, would be, as the inventor states, drawn down by the current produced by exhaustion in the sewer, the action being assisted by heat from the kitchen fire. This system of underground smoke drainage is applied to existing buildings, among others to Her Majesty's Theatre.

Expanding and Contracting Rooms.—The model of a plan for accomplishing this desideratum effectually was exhibited among building contrivances by Mr. Hurst. On each side of the room are two ornamented pillars, slightly in relief, placed so closely together that the space between them serves as a groove for a partition, which rises through the floor when wanted. The space beneath may be a room, also arranged for temporary division; or the rising and falling partition may, when not in use, drop into a receptacle in a wall.

Fire-extinguishing Ceiling.—This automatic contrivance was exhibited by Mr. Bergin, for extinguishing fires in laundries and other parts of a building specially liable to such accidents. The inventor proposes to have a large tank, containing water, fixed at the top of the room; this tank to be perforated with holes, and to be fitted with a valve plug, like a shower bath; the plug to be held down by a string, to be fixed near the most combustible materials; in case of fire, the string would be burnt, the plug would rise, and a deluge of water would be showered down on the incipient fire.

Bellhouse's Fire-proof Door for Warehouse Hoists was exhibited among the Machinery. It consists of iron doors sliding vertically in grooved frames of the same material, so that the communication between the different floors of the building and the well-hole may be entirely shut off in cases of fire. Hollow iron bricks are built into the brick walls of the well-hole as the building progresses; the side jambs are of cast iron, having slides for the doors, the jambs being bolted to the hollow bricks; stationary plates of cast iron bolted to the side jambs, form the lintel in the case of one doorway and the sill of the next; and there are two sliding doors, the former opening upwards, and the latter downwards. These doors are moved either upwards or downwards by means of chains attached to the upper angles of the door; the chains pass downwards, in grooves formed in the sides of the upper door, and over pulleys, and are fastened to the upper side of the door. Hence, in whatever direction one door is moved, the other door must necessarily have the reverse movement. The weight of the doors is so adjusted, that the excess of weight in one door causes them both to close when left to themselves. The slides or grooves in which the doors move are so arranged as to prevent them coming into contact with each other. To keep the doors open while the cradle is being loaded or unloaded, an apparatus of simple construction is provided; and by the same arrangement, none of the apertures communicating between the apartments and well-hole need be left open.

CIVIL ENGINEERING MODELS.

Bridges.—The three following interesting Models of Bridges were exhibited, and thus described in the *Daily News*:—

1. *Stephenson's Britannia Bridge;* the model executed by James, of Broadwall, is to a scale; all the parts bear an exact proportion to things as they are and as they were. The bridge consists of two tubes, forming the up and down lines; and each tube was made of four different parts, namely, two land tubes of 230 feet span each, and two centre tubes of 460 feet span; when these had been raised to their proper position on the piers (at a height of 103 feet above high water mark,) they were joined together to form one. The total weight of the two tubes is about 11,000 tons. In the model, one tube is shown complete, stretching across the Straits; and the land

tubes having been built on scaffolding in the position they now occupy, the scaffolding is shown. The two central portions of the second tube, illustrate the transits of the tubes from the platforms on which they were built to their ultimate destination on the piers; one tube is shown being floated to the basement of the piers, and the other is shown in the act of being raised by the hydraulic presses, already described at pages 145 and 146 of the present volume.

2. *The Railway Bridge* over the Wye, at Chepstow, by Brunel, is a novelty in engineering. It is composed entirely of wrought iron. One span is 300 feet, and others 100. The principle of construction adopted in spanning the 300 feet seems to be that of an extravagant trellis; the principle of the trellis is of the same character as the Britannia tubes, or any other beams or girders,—that is, the top is subject to compression, and the bottom to extension. This bridge has two lines for the up-and-down trains. The span of 300 feet consists of two huge trussed girders, the bottom of each composed of two simple wrought-iron beams, which resist extension, and between which one of the lines runs; these beams being formed of boiler plate, riveted together. These two girders are supported at two points, 100 feet apart from each end, from a wrought iron tube above, which stretches across the whole span, and this tube resists the compression. This tube also has been raised at a considerable elevation above the bottom girders, so that the weights, such as trains, &c., passing along the line, may be properly resolved or distributed over the tube by means of the tie-rods and stays; the 100 feet spans being crossed simply by wrought-iron beams.

3. *The Wrought-iron Bar-chain Suspension Bridge*, at Kieff, in Russia, across the Dnieper, by Vignoles, is the most extensive work of the kind ever attempted, being half a mile in length. This Bridge has four principal openings, of 440 feet each, and two side openings of 225 feet. On the right bank of the river is a Swivel Bridge, which gives a free opening of 50 feet for the passage of boats, &c. There is a disadvantage in the suspension principle when the chains cannot be moved from shore to shore, as in this case, an island of masonry having to be formed in the river as a mooring abutment, to allow of the free passage for boats at the other side; there are, therefore, three abutments—two for the chains, and one for the swivel bridge, and five piers; all these required coffer-dams of unusual size, particularly for the abutments. The chains are composed of broad flat links, 12 feet long, and weigh about 4 cwt. each. The tie-rods, which hang from the chains on each side, are 2 inches in diameter, and are immediately connected to the girders which support the platform. The platform is the chief novelty; and consists in a judicious combination of iron and wood, light and stiff. The trussed girders are mostly of wood, and are deeper than the tension girders, which latter are rendered rigid by tension bars. One set of chains supports the trussed girders, and the other set supports the tension girders, and these occur alternately; the additional depth of the trussed girders being for the double purpose of stiffening the platform, and supporting the footpaths outside the chains. The trussed girders

are connected underneath at each end by longitudinal ties, which run the whole length; the balustrades separate the carriage way from the footpaths; and they act conjointly with the ties underneath in checking any tendencies to undulation; the girders are also braced diagonally to prevent side-play. The model is executed by Mr. James. The whole of the machinery and iron used in the construction of the Kieff bridge was made in England, and weighs about 3300 tons; nine steam-engines are employed, varying from eight to fifty horses power, in pumping, driving piles, grinding mortar, hoisting timber, &c. The cost of the bridge, when finished, is estimated at £400,000. (See a more detailed account of this Bridge in the *Year-Book of Facts*, 1851, page 31.)

Stephenson's High-level Bridge, at Newcastle-upon-Tyne, was also exhibited in model, by Hawks and Co., who were contractors for the iron-work. The banks of the Tyne, both at Newcastle and Gateshead, are exceedingly steep, and are connected by a viaduct, 1375 feet in length, running at a height of 112 feet above high-water mark. There are six principal openings, each of 126 feet span. The principle of construction is the bow and string; the arches, which form the bow, are of cast-iron, and the rods, which form the strings, are of wrought-iron, to resist tension; there are four arches to each span, two on each side, which bear properly on the piers, through the medium of bed plates, on which the arches rest; and the strings of each arch consist of two wrought-iron rods, keyed to the arches at the abutments. Cast-iron columns connected to the arches support a platform above, on which three sets of rails are laid, and they also support another platform below for a carriage-road, the footpaths running between the two arches on each side; this road, in fact, runs along the strings, but has no connexion with them; the arches take the whole weight of both platforms above and below, leaving the strings independent, to resist only the tension. The iron-work required the adjustment of an immense number of parts; yet no joints, and hardly any fastenings, are to be seen; in fact, it is difficult to make out how it has been put together.

Ouse-burn Viaduct.—Amongst other objects of interest exhibited by B. Green, of Newcastle-on-Tyne, was a model of the central arch of the Ouse-burn viaduct, on the Newcastle and North Shields railway; the arches are of timber, built up of layers or planks sufficiently thin to allow being bent to the required sweep. The arch having thus been built up to the required size, is bound together by iron straps, bolts, &c. It is then scientifically strutted, to resist and distribute the thrust properly.

Salter's Model of the Great Opening Bridge at Selby, on the Hull and Selby Railway, was exhibited, and is of novel character, on account of its large span. The River Ouse is at all times rapid, and particularly so during the frequent freshes; it required, therefore, that a peculiar construction should be resorted to; and, by the Act of Parliament, it was stipulated that the Bridge at Selby should have an opening arch of 44 feet span for the sea-borne vessels trading to York. Messrs. Walker and Burges, were engineers for the Railway;

the Bridge was likewise executed under their direction; the contract for the iron-work being undertaken by the Butterly Iron Company. The river, at the point of crossing, is about 200 feet in width, and at low water 14 feet in depth; the tide rising 9 feet at springs, and 4 feet at neaps. The bed of the river consists of silt, resting on a thin bed of sand, beneath which is clay of a hard quality. The land abutments are constructed of brickwork and masonry, resting on piles. The intermediate piers for the support of the superstructure are formed of open pile-work, the piles being driven 15 feet into the solid clay, and their tops surmounted with cap sills, of large scantling, upon which the iron-work is bedded. To give additional stiffness to the two centre piers, a novel plan was resorted to in the bracing, by rounding the centre piles for a portion of their length, so as to allow the cast-iron sockets to descend and take a solid bearing on the square shoulders of the piles, to which were connected the long timber braces; so that when the sockets, with the braces attached, were let down to their bearings, the tops of these braces were brought to their places at once, and secured to the cap-sills. The superstructure is of cast iron, consisting of six ribs in the width of the bridge. The opening arch is formed of two leaves each, worked upon a centre carriage, with tail-pieces acting as counter-balances for assisting the opening and shutting when necessary. This is accomplished by an iron segment of nine-feet radius firmly fixed upon the main shaft, and worked by a system of wheels, so arranged that one man can raise or lower either leaf of the bridge in fifty or sixty seconds. A double line of railway is laid along the bridge on continuous timber bearers. To provide for the effects caused by changes of temperature on the iron-work of the bridge, wedge-shaped iron keys, fitting into proper grooves at the junction of the two leaves of the opening part of the bridge, are inserted to such a depth as to give the necessary bearing. The extreme variation of the width of the opening from the above cause is found to be about three-quarters of an inch. The entire weight of cast and wrought-iron is equal to about 600 tons, and the weight of each leaf of the opening span rather more than 90 tons.

Static Bridge.—This Model was exhibited by the inventor, Mr. Sankey, who, to add increased strength to all Bridges on the principle of the arch, whether of stone, brick, or other material, proposes to cut the voussoirs in such a manner as to add them a wedge-shape *both* in their *vertical* and *horizontal* planes, so that each voussoir shall become the integral or component part of two arches, viz.: the vertical, or that which spans the road, river, &c. intended to be crossed, and a *horizontal* arch bounding one side of the roadway. Now, if the voussoirs on both faces of the bridge be so cut, it follows that there may be two horizontal arches, each having the direction of its thrust opposed to the other; in fact, substituting portions of a cone, or portions of a cone and cylinder, for the common cylindrical arch; and if the spaces between these two horizontal arches are well keyed in by headers, running continuously through the entire width of the bridge, or, where hollow spandrils are deemed requisite, by means of cross walls, &c., any force, such as a mountain torrent, a very strong wind, or a heavy body striking against the side of the bridge, would be resisted by the convex arch on the other side; and the concave arch, against which such force must first impinge, would retain its position unaltered, provided the abutments be solidly and judiciously constructed. Were a bridge built on this principle, with abutments so formed as to counteract the thrust of these side arches, any lateral pressure that might be exerted against it would only tend to wedge the convex arch on the opposite side more closely together; or rather, these arches, having been well keyed in the first instance, would undergo no change whatever; a very valuable condition for bridges thrown over rivers subject to floods, or other sudden causes of side pressure, which so often carry away bridges built in the ordinary manner.

Shields's Models of Bridges, &c., from New South Wales, were exhibited in the Colonial department. These engineering contrivances are especially suitable for New South Wales, where, the cost of iron-work being very considerable, the engineer has to economize to the utmost extent the use of this valuable material, and in cases where practicable to dispense with it altogether. Mr. Shields's model of a "Lattice Bridge," and also that of a "Railway Trestle Frame," are of the latter character; and are, therefore, suitable for many other parts of the world—New Zealand, for instance, which abounds with valuable timber, suitable for bridges and similar works. The American engineers have long paid considerable attention to the best disposition of timbers in the construction of their bridges and extensive railway viaducts; and these have been followed, to some extent, both in the railways of England and Ireland.

Mr. Shields's lattice bridge is of round timber, thus getting rid of much expense in the shape of labour, and also in the entire absence of iron fastenings. The model consists of three lines of vertical round timbers, properly notched, and having two perforations to receive the horizontal timbers. Between each pair of vertical timbers are two diagonal pieces, resting at bottom on cross-timbers, and framed into the vertical timbers at top. There are three double sets of horizontal timbers, the upper ones supporting the joists placed transversely, and to which the floor-boards are secured. These joists project on either side of the bridge, in order to gain additional width of roadway; a wooden railing, properly strutted, completing the whole. The "Railway Trestle Frame" is intended specially as a substitute for embankments, in countries where labour is dear and timber plentiful. The framing is similar to that of the lattice bridge.

A third model shows Mr. Shields's economical method of laying the rails in New South Wales, which is the same as that adopted in the north of England, and to a great extent in America; but the peculiar mode of placing the rails, and securing them to the timbers, are the novel parts of the design.

Captain Moorsom was the first engineer in our country to introduce the railway lattice bridge from America: this he first effected on the railway between Birmingham and Gloucester; and he has since erected, over the Norr, in Ireland, a handsome bridge on this plan, a model of which was exhibited; as also, a model of his design for the proposed bridge over the Rhine, which gained for him the second prize.

Leather's Suspension Aqueduct over the Calder was exhibited in model. This fine work carries over the river Calder the canal, which is navigable for sea-going vessels of 7 feet draught of water, and 120 tons burthen. The tank or trough is 9 feet deep, and 24 feet wide within, and contains, between the points resting upon the abutments, 940 tons of water, being more than is held in the 19 arches of the Pont-y-Csyllte Aqueduct in Wales. On each side of the Calder Aqueduct is a towing-path; a Grecian-Doric colonnade masks the sides of the tank, with a portico and pediment at each end, the suspending-rods passing through the columns to the ends of the transverse bars, concealed by steps. The span of the suspending arc is 155 feet; weight of each, 101 tons; width between the suspending-rods, 30½ feet; diameter, 2¼ inches; total weight supported by arcs, including their own weight, 1700 tons. There was also exhibited a model of *Leather's Cast-iron Bridge over the Aire*, (arch, 120 feet span,) remarkable for its architectural beauty, though strictly an engineering work.

Suspension Piers.—Captain Sir Samuel Brown, the inventor of the Chain Bridge, exhibited a model of the Brighton Suspension Pier, one of the first of the kind executed, and which has led to the adoption of this pleasing form of pier and bridge by many of the first engineers of Europe, in cases where the traffic is not of a ponderous character. The fairy-like structure of the great Telford over the Menai Straits serves as an illustration; for, so soon as the heavy traffic of the Holyhead Railway was anticipated, a new Bridge of great strength was designed and carried into execution by Mr. R. Stephenson; while the lighter traffic of the Holyhead Road, is still carried over the original structure.

Thames Tunnel.—A model of the Shield of the Thames Tunnel, the great work of Sir M. I. Brunel, was exhibited by Donkin and Co., who constructed this ingenious and extraordinary piece of mechanical contrivance, and assisted the engineer in the invention. In the model, the Shield is shown in position; one outside frame being removed, the brickwork following immediately behind. The screw was the mechanism employed in shifting the paling-boards, and securing them one by one, as the earth was dug out, from 9 to 6 inches at a time; by the screw also were moved the legs of the frames, and the frames themselves by pressure against the newly-formed brickwork. The "Ground-line," "Low-water" and "High-water" marks are in the model set, relatively, to scale, as in the actual shield and brickwork.

Plymouth Breakwater.—By order of the Lords of the Admiralty, a model of the Plymouth Breakwater was exhibited. The lighthouse, designed by Messrs. Walker and Burges, is executed in silver; the whole being further illustrated by sectional and other models.

Street-cleansing Machine.—Models of London Bridge and other localities were exhibited, to illustrate a method of washing and watering the streets of the metropolis. The inventor purposes to effect this object, in streets, lanes, and large thoroughfares, by substituting, for the usual *stone* curb, one of cast iron, perforated at the sides; and charged with water at convenient distances from the present mains, which, by means of a stop-valve, can always be applied for washing, or rendering the streets sufficiently wet to enable the scavenger to thoroughly sweep and clear away the mud: this a great portion of the year he is unable to do, from its adhesive properties; it merely then gets smoothed over, to become dust in hot weather, or soft fœtid mud in wet, producing dirty foot and carriage ways, and consequently dirty houses in each case. The application for watering purposes is the same, the supply being regulated by local requirements, state of the streets, roads, &c.

ARCHITECTURAL MODELS.

Turner's Models.—Mr. Turner, Hammersmith, Dublin, exhibited a sectional model of the Iron and Glass Palm-Houses in the Royal Botanic Gardens at Kew, which has nearly an acre of glass; extreme height, 69 feet. Next was the portion of the Botanic Society's Curvilinear Iron and Glass Winter Garden in the Regent's Park; and the Segmental Curved Patent Iron Roof of the Terminus of the London and North Western Railway, at Lime-street, Liverpool. Mr. Turner has already been mentioned, at page 29, as the designer of one of the earliest, if not the first, model proposed for the Great Exhibition Building, which was also exhibited in the above collection: "It is the only model out of the 243 submitted in competition, that had the transept, which, with the nave, was to be semicircular, and was, all throughout, 110 feet high in the centre. (See *Official Illustrated Catalogue,* Part ii., page 303.)

Cattle and Meat Market.—A model of a proposed Suburban Live Cattle and Dead Meat Markets, Abattoirs, &c., for the supply of the Metropolis, occupying 65 acres (exclusive of layerage), to be established at Copenhagen Fields, was exhibited by Thomas Dunhill, C.E., to promote the total removal of Smithfield Market. The plan provides official residences in a principal terrace entrance, supported at either end with buildings of considerable magnitude, whose interior areas are appropriated as carcase markets, or as a hide market, and for the sale of the manufactured offal, &c., of the animals slaughtered in the proximate abattoirs. In these buildings is office accommodation for salesmen and bankers, as well as spacious public halls, &c., open to all comers. In the market-place, the stands for the oxen, and pens for the sheep, are arranged in parallel lines, divided by ample roadways, thereby affording the means of classification and separation of the foreign from the native stock; similar roadways bound the market place on all sides, which is further intersected transversely by two principal roadways, and numerous minor ways, affording free and immediate access to every pen and stall in the cattle market, which occupies an area of 23 acres, and will accommodate 6000 head of oxen and 40,000 sheep. Midway, on each side of this area, are four ranges of covered layers. Next are the Calf Market and the Pig Market (with its attendant and exclusive abattoir), on one side; and the Horse Market and Cattle Hospital, or quarantine ground, on the opposite side of the market. Lastly, is a commodious abattoir of 13 acres, including slaughter-houses and ample stallage; also, melting-houses, triperies, stables, cart-sheds, manure depôts, and manufactories for converting and procuring from the refuse matters, those valuable products to be developed by chemical agency. Live cattle will pass directly out of the market into the abattoir, their carcases being conveyed away by entirely distinct routes; so that the two leading features of the design—the cattle market and the abattoir—although in immediate connexion, are so arranged that their respective business may be carried on independently of each other. Four ranges of private slaughter-houses, with railed layers, conclude the chief details of the project the model illustrates.

Falls of Niagara.—Mr. Catlin transferred from his American-Indian Collection the Model, faithfully representing the "Horse-shoe" and American falls (the former descending 150 feet, and the latter 163 feet); the various mills, hotels, residences, roads, and Goat Island, extending to 75 acres, embracing an extent of country equal to nearly a square mile; and, being constructed to a scale of 90 *feet to an inch*, every object is very distinctly shown. The amount of water descending over the two falls is said to be equal to 1,715,000 tons per minute, which is chiefly derived from the drainage of Lake Superior, Lake of the Woods, Lake Michigan, Lake Huron, Lake St. Clair, and Lake Erie.

Appenzell, Switzerland.—C. A. Scholl exhibited a Relief of the Canton, according to the trigonometrical survey made by him by order of the government, whose certificate is attached. This Relief was made by hand. It includes a surface of about 130 square miles, on the scale of 1-6000, and represents Mount Santis, with its dependencies, the most beautiful and interesting mountains of Eastern Switzerland, forming, from their partially-isolated situation, with their celebrated views and geological riches, a most remarkable part of the Swiss Alps.

Victoria Grand Necropolis.—A model of this project, by Mr. Wilson, was exhibited. It is a pyramid, 900 feet high, or 100 feet higher than the Great Pyramid of Egypt; and is to contain catacombs (brickwork, granite-faced), for 5,000,000 bodies, within an area of 18 acres: the catacombs to be numerically arranged, and approached through a lofty Egyptian portal, containing chapels and offices; also, four central entrances or avenues—east, west, north, and south—intersecting each other in the middle of the edifice. From the base to the summit is to be a central ventilating shaft, for carrying off any gas that may escape through tubular drains, under the avenue floors, and communicating with every catacomb. Round the exterior of this shaft is to be an ascent to the lantern or obelisk at top, to be used as an observatory. The pyramid is to contain, vertically, 94 stages of catacombs, each stage distinct, and altogether

215,296 vaults; the interior to be lighted and ventilated, and a mural slab placed at the mouth of each vault; the base of the pyramid, a square of 900 feet, to be surrounded with 100 or 200 acres, to be laid out and planted as a cemetery. The ventilation is the most ingenious portion of this design, which it is proposed to erect on Woking Common, Surrey.

Liverpool.—This fine model was executed and exhibited by John Grantham. It is 40 feet in length, 10 feet wide, and on the scale of 8 feet to a mile, and represents a surface of 5 miles. The docks are filled with 1600 tiny vessels, rigged. The model is chiefly cut out of wood, the finer portions being of paper; and the water represented by glass, stained of a greenish tint, and silvered, to reflect the ships which float on its surface. Its cost is stated to be £750. It is supported on a base, formed of elephants, cast in iron, from the backs of which rise the columnar supports of the roof; pediments, filled with appropriate decorations, in imitation of bas-reliefs, being at the ends and centre.

London.—This model is on a scale of 8 inches to the mile, and containing in all 96 square feet. It represents the exact situation of all the public buildings, churches, bridges, railways, &c., with the Thames, from Battersea to Rotherhithe; and shows the different elevations of the streets.

Interiors of Her Majesty's Theatre, and Exeter Hall, were also cleverly represented in two large models.

A large Model of a Gothic Church in terra-cotta, from the Ladyshore Works, was attractive by the novelty of its material, in which the original church is built, as well as by its architectural beauty.

Cork Landscape.—An ingenious piece of Cork-cutting in bas-relief, was exhibited by Mr. Byrn: the subject, a sylvan landscape, with figures engaged in the sports of the period of Charles II. Its form is circular, and calculated for a frame. On either side, meeting at the top, is a tree. Above, in the centre, a hawk is about to strike a heron; and in the lower ground, on the right, stands a falconer, with a hawk on his right thumb, and his left arm leaning on a gate. In the central foreground are two dead boars, watched by one of the dogs used in boar-hunting. On the left lies a stag, and near, reclines a peasant youth.

NAVAL ENGINEERING.

Jeffery's Marine Glue.—A collection of pieces of timber, masts, &c., joined by the Marine Glue, was exhibited. It is asserted that by means of this material upwards of 25,000 tons *additional* strength is dispersed over the hull of a first-rate, and 6,384 tons over the internal surfaces of the masts. A Commission, recently appointed by the Admiralty, collected evidence to this effect, viz.—that out of the 130 vessels which have been glued in the Royal Navy, one caulking and paying with glue has been found equal to three times with pitch; besides other valuable evidence as to its cleanliness, security, and comfort to crews. At an examination in Sheerness Yard, of the masts and bowsprits of five line-of-battle ships, all made since

1841-42, of yellow pine timber, *without marine glue*, sixteen out of twenty were found rotten and condemned, although the masts of three of the ships had never been in commission; while all the masts and yards made *with marine glue* in 1842-3, were found, on their return from foreign service, inseparable even by the wedge, as testified to in official reports. Among the specimens exhibited was a piece of mast put together with the marine glue, and subjected to a pressure of twenty-two tons, by means of the hydraulic press, before the splinter could be effected. To show the great additional strength of the main-mast, the fore-mast, and the mizen, by the use of the marine glue,—the number of feet of surface joined in the three masts is equal to 2128; so that, only taking three tons to the foot, we have an additional strength put into these masts of not less than 6384 tons, a thing unprecedented. Another specimen showed the method of converting rectangular into circular timber, by dividing the rectangular piece by a segmental cut at the radius required, and then placing the under piece above the upper piece, and connecting the two pieces together with marine glue. The ribs of the roof of the Transept of the Crystal Palace were thus formed; not, however, with marine glue at the joints. This composition is simply three ingredients, viz., caoutchouc, coal naphtha, and shellac, in proper proportions; several days being required to dissolve the caoutchouc previously to the addition of the shellac.

Ships' Capstans.—There were exhibited two specimens of Ships' Capstans, worked like fire-engines, with a pump-handle motion, instead of the old capstan worked by handspikes, which the men pushed against while they ran round to a lively tune of the ship's fifer, with great exertion, tremendous stamping noise, and occasionally serious accidents, from the weight of the cable overpowering the men, and flinging the handspikes in all directions. This old-fashioned capstan has been superseded in the Navy by some one or other of several patent machines. The full-sized one exhibited by a London house seemed very good; the turning power, obtained, by simple friction-bands, making no noise on the return stroke, worked by two arms that require no shipping and unshipping, which is always so dangerous on a dark night: it has the great advantage of simplicity—there is nothing to clog.

MODELS OF SAILING SHIPS.

Foremost among the numerous specimens exhibited, was a Model of H.M.S. *Queen*, of 116 guns, on a scale of half an inch to a foot: the ship is fully rigged, and on the stand of the model, a piece of canvas shows the effect of a tropical storm on the sails of a ship. There were also models of H.M. ships *Vanguard* (80), *Vernon* (50), *Pique* (40), designed by Sir William Symonds, late Surveyor of the Navy; and which were placed beside a model of an old 46-gun frigate, to show the contrast between the old and new systems of ship-building. There were, likewise, sectional models of the bow, stern, and midship sections of most of these vessels, showing the interior arrangements of the fittings, armaments, &c.; and two models of the sterns of first-class frigates illustrated the advantage of the new plan over the old one for fighting the stern-guns.

As historical *curiosities*, there were placed near the above a model of the *Royal Sovereign* (100), built at Woolwich in 1637, stated to be the first ship ever constructed on scientific principles; and a model of the *Great Harry*, built in the reign of Henry VIII., her cost is stated at nearly £11,000; burthen 500 tons. A model, in oak, of a Roman war-galley carried the observer back some nineteen centuries, when Cæsar first approached our coast in their cumbrous craft. This model was, however, constructed to illustrate Mr. Howell's theory, according to which, the banks were reckoned in the direction of the galley's length, and not from the number of tiers, as generally supposed.

Mr. Joseph White, of East Cowes, exhibited, among several models, those of a Schooner and a Cutter Yacht, and *Victoria* Yacht, built for the Emperor of Russia. To this division of the subject belongs a model of a heavy-armed 12-gun Cutter, made from pieces of the celebrated men-of-war, *Victory*, *Teméraire*, *Alexander*, *Namur*, &c. Messrs. T. J. and R. White exhibited their designs for the first transatlantic steam-ship to New York, 1838; and for an ocean steam-ship of 3,000 tons; with numerous models, including the *Samuel Enderby*, South-seaman, now employed in the Auckland Islands whale-fishery. Here, too, was a sectional model of the lengthened bow of the Fox Frigate, showing the advantage of the "long-bow" over the older one. Messrs. White's brig, *Daring*, it will be recollected, gained the superiority in the trials of the Experimental Gun Brigs in 1843, of which models were exhibited.

Mr. T. White, jun., of Portsmouth, exhibited four models for building the vessels of the entire Navy from one design; besides a 50-gun Frigate and Corvette upon parabolic sections; and a heaving-up slip, with recent improvements in doubling the power with the same machinery. The same exhibitor also showed models of Noah's Ark, and a Transatlantic Steam-vessel on a like scale; and in a work illustrative of the whole, Mr. White attempts to prove that, in the lapse of 4000 years, nothing has been done "to improve the proportions given by the Great Architect of the Universe, for a floating body that was to endure the greatest convulsions of the elements the world ever experienced."—(*Hunt's Hand-Book*, vol. i. p. 229.)

The *Royal Albert* First Class Ship-of-war, designed by Lang, and now building in Woolwich dock-yard, was exhibited in a model on a scale of one quarter of an inch to a foot—although only rated as a 120-gun ship, being 700 tons larger than any other vessel in the royal navy; number of guns, 130; those on the lower deck, 34 in number, being 68-pounders. She will mount twelve guns right aft on her stern, which is made to have the appearance and pleasing outline of the round stern, with all the advantages of a flat one. She will also mount twelve guns on her bows in the line of her keel, and twelve on her quarters, at an angle of 45 degrees. The other 94 guns will be mounted on her broadsides. The model has all the guns mounted, and the masts put in, but broken off a short distance above the upper deck. The figure-head is a well-executed bust of Prince Albert, supported by Neptune and Britannia. The following are the dimensions of the *Royal Albert*:—Length, extreme, 262 feet; length between perpendiculars, 220 feet; breadth, extreme, 60 feet 10 inches; depth in hold, 25 feet; burden, in tons, 3,462.

The Admiralty Models, exhibited from Somerset House, included a series of Half-models of Ships of-War fitted with Screw Propeller, six of which are now building; also, Half-models of Sailing Ships of the Royal Navy, five now building; besides Experimental Frigates, Ships, Boats, &c.

Among the models of ships was also shown a piece of Iron bolt of the *Cornwallis*, which was in the vessel twelve years, and under water eight years; also, a piece of timber from the same vessel, and subjected to the same trial, proving the superior durability of teak-wood.

The models of British Merchant-ships showed the latest improvements in this class of vessels, including some fine Indiamen; and among the novelties was a ship's hull, of parabolical form, the uniformity of the lines greatly facilitating the laying down of the ship. The models of celebrated Yachts, of wood and iron, were also shown in great numbers.

There was also exhibited a rigged model of a class of vessels, which is making rapid innovations upon our old-fashioned mercantile marine—an Aberdeen Clipper Schooner. "The 'Clipper' is constructed upon the general theory, that a small amount of stowage-room may be advantageously given up to secure a great amount of speed; and with that speed, a preference for cargo, and a greater degree of safety from the accidental risks of the sea. The fast-increasing class of screw-propeller boats—principally devoted to traffic in cattle between the Thames and Ireland and Holland—are built and rigged on clipper principles; and Aberdeen has recently built clipper ships of large tonnage, one of which, in a voyage from China lately, beat an American ship, loudly trumpeted as the fastest vessel which ever bore the stars and stripes. The model in the Exhibition showed that the Aberdeen clipper schooners, while they are formed abaft much upon the ordinary moulding of a yacht—that is, with a long and fine run, and very high from the bottom of the sternpost to the taffrail—are modelled forward upon the principle of the bows of a Clyde steamer, involving great sharpness, rising into a concave shoulder of exaggerated hollowness, compared with that mere tendency to concavity which we have described as characterising many new vessels, both men-of-war and merchantmen. The effect of this construction is not to prevent the vessel pitching, but to cause her to pitch without being wet; the overlapping portion of the bows flinging the water downward and backward from the obstacle, while the sharpness beneath enables the ship to slide quickly and steadily through the water. As yet, with few exceptions, the clipper build is confined to coasting craft; but the initiative has been taken in the construction of large full-rigged ships upon the same principle."—*Abridged from the Illustrated London News.*

MODELS OF STEAMERS.

Mr. Ditchburn, of Blackwall, exhibited several Models of Iron and Wood Steamers, and of the earliest experiments in steam navigation. Mr. Gibson exhibited in model a Steam-ship with improved Paddle-Wheels, with paddles attached to endless chains, to run over two extra wheels; a dragon to drive a gutta-percha tail-propeller, and a railway gunwale for four guns.

Mr. Scott Russell exhibited models of Ships, Yachts, and Steamers, constructed upon his wave principle; including a war-steamer, with paddle-wheels, and the new patent system of armament, which enables a ship to carry double the usual armament; capable of being fixed parallel to the keel.

Among the models of Screw Steam-ships were certain vessels so constructed, that their engines, &c., do not interfere with their armament; which have proved perfect men-of-war, without steam-power, and have worked well with steam and sails combined.

Here, too, was a model of H.M. Steam-frigate *Terrible,* of 600 horse-power, designed by Lang, and acknowledged to be one of the most efficient paddle-wheel steamers.

A model of the *Great Britain* Steam-ship, as she lay stranded in Dundrum Bay, with the apparatus and lever-power by which she was removed and sent afloat, is a tangible record of that vast engineering labour. The vessel, boats, &c., are made of tin, painted, and equipped with the chains, &c., used on the memorable occasion.

STEAM-BOAT PROPULSION.

Illustrations were shown in the Exhibition, in full size and in models, of almost every kind of Steam-boat Propeller, from the ordinary paddle-wheel to the submerged feathering screw. Some of the plans exhibited were liable to the objection of not being able to bear the strains and shocks of a rough sea. There were others, however, which appeared so simple in their construction as to invite adoption. The Feathering Float of Penn and Son, of Greenwich, has stood the test of practice on large steam-vessels; but is somewhat complicated in its action. The direction of the floats is altered as they rise out of the water, by means of arms radiating from an excentric wheel; and one advantage of the arrangement consists in the continued action of the floats as an ordinary paddle-wheel, should any accident interfere with the feathering mechanism.

A Self-acting Feathering Paddle-wheel, exhibited by Jones, deserves attention, from the simplicity of the arrangement, and the effective way in which it prevents retarding resistance. The floats turn on pivots, and have stays at the back, to prevent them from turning round when they are required to act against the water; but as soon as they have passed that point, and their further resistance would be detrimental, they turn and meet the water edgewise. In principle, this seems very good; it is questionable, however, whether the turning floats would stand in a rough sea.

A very peculiar arrangement of a Feathering Paddle-wheel, exhibited by the inventor, Mr. Edward Rhone, places the wheels at the bottom of the vessel. They are, of course, entirely submerged, and the floats are made to turn edgewise when their resistance would be prejudicial.

Among the Submerged Direct-Action Propellers, was one provisionally registered by Mr. Pym. It was illustrated by a large working model, that fully exemplified the mode of action. The paddle-wheel consists of a number of double blades, each resembling a flat oar, radiating from the centre, the upper and lower parts being placed at right angles to each other. A screw in the axle of the wheel takes into threads in the centres of the blades, by which they have a rotary motion imparted to them, independently of the revolution of the wheel. When resistance is required, the flat sides of the oars are turned to strike against the water ; and when resistance would check propulsion, the blades are turned edgewise.

In Terrett's paddle-wheel, also exhibited, the floats are placed vertically, and feather in the same direction.

The model of a Submerged Paddle-wheel, contributed by Wilding, deserves notice, from the ingenious manner of turning the floats. He also exhibited, in the same model, a new method of converting reciprocal into rotatory motion, which is cleverly contrived.

Other plans, not involving any mechanical movement in the floats, but resting their claims to superiority in their shape and inclination, were also exhibited, and perhaps offered practical advantages greater than the more complicated contrivances. There were likewise shown models of Mr G. Rennie's triangular Paddle-wheel Floats, designed to diminish the back-water, by allowing the water to flow off at the points.

A Reciprocating Propeller, provisionally registered by Eccleshale, deserves notice. It is an attempt to apply the reciprocating action of the piston of the steam-engine directly to propulsion. The propeller moves backwards and forwards in the line of the ship's course, the floats falling back in the return stroke to avoid resistance.

The system of propulsion by the "Screw" was amply represented. Mr. Smith, the originator of the plan, exhibited several specimens of the propellers originally employed, when the form of the screw was in reality adopted. At first, two threads of a double screw were used ; but the back-water of one thread being found to re-act on the other, the parts of the screw have been gradually cut away, until now only two blades, each of the sixth part of the entire thread, are generally employed, and found most effective. Propellers reduced to one-eighth of a circumference were exhibited by Captain Smith, but the limit of available reduction seems to be one-sixth. The first screw employed for propelling boats was among this collection; as was also the model of the screw of the *Archimedes*, in which steam-vessel this principle of propulsion was originally adopted, in 1838.

Maudslay and Field exhibited a model of their patent Feathering Screw-propeller, the peculiarity of which consists in the arrangement that fixes the screw edgewise, when it is not required to be in action, so that it may not impede the course of the ship under sails.

Among the retrospective *curiosities* was the model of a Sailing

Vessel, with auxiliary Screw-propeller, to be worked by the men on board instead of by steam-power.

The Parabolic Submarine Propeller, invented by Hodgson, exhibited the only remarkable difference in the form of the propelling blades. The parabolic shape is more curved towards the reacting water than the oblique screw-shaped propellers, and gives a more direct impulse.

Mr. Mare exhibited a half-model of a 2000-tons Steam Screw-propeller Yacht, on the stocks for the Viceroy of Egypt. A large model of a new paddle-wheel steamer, fully rigged and complete, down to the minutest details of finish, was a peculiarly perfect first-class craft of her species. She is flush-decked, and carries swivel signal guns upon her paddle platform. The floats of the wheels are disposed, not after the too common fashion, in a plane with the spokes, but perpendicularly, so as to strike the water edgewise; and to expend the whole force of the paddle upon a productive lateral, and not an unproductive downward, movement.—*Morning Post; abridged.*

Capt. Carpenter's Patent Duplex Rudder and Screw-Propeller, applicable to paddle-wheel as well as screw steamers, were exhibited in model, fitted in new positions for improved steering and propelling. Abaft the midship section of the vessel, the keel, with the dead-wood, sternpost, and rudder, are removed; parallel with the former keel are placed two additional keels, to which framework is carried down, leaving a free channel for the water to run between them, in the direction of the midship keel. A sternpost is placed at the end of the additional keels, and upon each of them hangs a rudder. A screw-propeller works in an orifice in each framework, one of these propellers being a little more aft than the other. By this new arrangement, the rudders and propellers are stated to act with double effect in each case.*

Among the novel propelling arrangements should be mentioned a Steam-vessel, in which the engine-shaft is attached to a wheel working in a water-tight case, supplied with water by a jointed pipe, by the raising or depressing of which, and its direction, the speed of the ship is regulated.

There was likewise shown a Patent Steam-tug, for hauling vessels on canals, without paddle-wheels or screw-propeller; being worked with a double keel, with an intervening hollow chamber, in which are two wheels driven by the steam-engine; between these wheels is drawn rapidly a flexible iron band or rail, laid at the bottom of the canal, and then let sink again.

The latest contribution to this class of inventions was the model of a novel and effective system of surface-propulsion, named "the Fan Paddle-wheel," by Mr. Lee Stevens. It consists of a series of blades or segments, connected together from their common centre (the boss which attaches them to the shaft) to their common periphery, in such a manner as to constitute a complete rotatory fan. Each blade is an isosceles triangle, every two blades forming, at their outer extremities, two sides of an equilateral triangle, occupying the full width of the paddle-box; the united action of the whole being necessarily conti-

* See Marine Engines, pp. 134-135.

nuous, although the blades alternately compress or divide the water right and left; yet, entering and leaving it so obliquely as to avoid unpropulsive disturbance, or any lifting of back-water: of course the propulsive effect is precisely the same forward or backward. The constructive principle of the system is that of a rotatory fan, the entrance and egress of each segment being obliquely instead of horizontally. In action, it assimilates to the motion of a fish's fin, or to that of a scull or oar, and the entire action very closely approximates to that of a screw, applied to surface propulsion.—*Mining Journal; abridged.*

MODELS OF BOATS.

Several interesting specimens of River Boats were exhibited, including the following:—

A Boat, by Biffin and Sons, to change into a four or eight-oar at pleasure, by merely removing some of the parts, thereby making one boat as good as two; and, when not in use, to be packed so as to occupy less space than a single boat on the old principle.

A Pair-oared Gig; and an Eight-oared Racing-boat, 64 feet long, but beautifully light; both by Searle and Son, who also exhibited a superb Model State-barge of the Lord Mayor of London.

An Outrigger Sculling-boat for racing, by Noulton and Wyld; the body of the boat composed of one single plank from head to stern, without a joint or reel.

A Rowing-skiff, built by Searle and Son, and presented to the Prince of Wales, in 1849, by Light's Patent Marine Buoyancy Company: her length over all is 20 feet; she is constructed of bird's-eye maple; the linings, saxboards, and thwarts, being of Spanish mahogany; her keel-bend, stem-bend, and rudder-hangings are of bronze; the rudder of maple, with a carved yoke, gilt, and silk lines and tassels of crimson and gold colour. She is also fitted with an elegantly-carved chair, the seat covered with crimson satin damask and velvet; the back supported by the Prince of Wales's feathers, carved in maple and heightened with gold. The rowing mat is of the same material as the cushion of the chair, and there is a small foot-ottoman of Utrecht velvet. The sculls are of mahogany, and are very light. The boat, which is a "single sculling skiff," is lined throughout between the timbers with Captain Light's patent materi- which is said to give her all the buoyancy of a life-boat. al,

The other models included the Admiralty Barge; a 3 Galley, from Richard Treginza, of Falmouth; a Gunning Pu 0-feet water-tight bulkheads, for wildfowl shooting; Foster's Boat it, with wood, and coated with a compound of gutta-percha a, built of rubber; the new Megavissey Drift and Fishing-boats; a nd India-Fishing-boats used on different parts of our coast. nd specimen

There was also exhibited (by Matthews, late Mac lection of India-rubber Portable Boats, of two kin kintosh), a col-for lake-fishing, duck-shooting, and general purp ds: a larger one, a smaller kind, which can be worn as a cl oses; and the other cloak-boat) when uninflated, and of essentia oak (hence called the service to travellers.

The larger boat is constructed of sail-canvas, made air proof by India-rubber, which, when inflated, is capable of carrying four persons; is steady on the water, and is propelled by a paddle, as a canoe, or by oars, sculls, &c. This boat weighs not much more than 56lbs., with bellows and paddles, and the small compass into which it is capable of being packed renders it readily conveyed to places where it would be impossible to transport any other boat. Its extreme buoyancy is owing to the large size of the cylinder running round it, which, when filled with air, gives it its shape, and makes it capable of sustaining a very great weight, thus rendering it valuable on board ship as a life-boat. It can be inflated by bellows in less than four minutes; and persons may be landed, by means of these boats, through a heavier surf than by any wooden-built boat. The cloak-boat is made of the ordinary waterproof material, fitted with an air-proof cylinder, and is intended to carry one person; it is extremely serviceable for crossing rivers or streams, and, in cases of necessity, may be converted into an excellent bed. The weight of this boat, with bellows and paddles, is about 10lbs.

Models of Native Boats were exhibited in several of the Colonial and Foreign departments: in "the Indian Archipelago," for example, there was shown an interesting Native Collection, including a Lanun Pirate Prahu of Mindanao, 1st and 2nd class; a Padewahkan, or Bugis Trading Prahu; and the Sampans, or Passage-boats peculiar to Singapore, and remarkable for their swiftness, both with sails and oars.

The most remarkable of the Indian boats is, however, the Snake-boat of Cochin, a canoe from 30 to 60 feet long, and worked from the solid tree: some of them are carved, and richly gilt. There were also the Ferry-boat of Cochin, and the Cotton-boat of Bombay; and the Ceylon Dow, 70 feet long, 20 feet broad, and 12 feet deep.

LIFE-BOAT MODELS.

The general characteristics of the Life-boats exhibited take for their common principle of buoyancy the construction of an air-tight lining in the interior of the boat—the space between the outward and the inward sides of the vessel gradually widening until a very broad gunwale is formed. In other specimens, the air-tight cell is placed lower, running in the form of a square or circular box round the boat, but beneath the thafts or seats. A few specimens are fitted with those cork belts and furnishings, which keep the boat nearly as buoyant as air-tight tanks would do, and certainly, from the additional advantage of not being rendered useless by an accidental blow from a sea against the wreck. This danger, however, is sought to be guarded against by the construction of several air-tight compartments—any of which, we are generally assured, would suffice to keep the boat, with her crew, above water.

There were several adaptations of Surf-boats, built open beneath, the buoyant agency being placed entirely in the sides, thus letting the seas break in and out—the level in the water of the boat being never altered: the bottoms of some of the life-boats consist merely of cross-bars on which to rest the men's feet; while in others there is a flat flooring, only connected, however, by pins and bars with the closed sides of the boat.

The United States showed several Surf-boats, or oblong spherical cases of metal to contain air, for passengers to be conveyed in them, for a short transit through the breakers. A number of the Life-boats were on wheels; and were built for port and ship, as well as for coast service; and for hanging in davits, as well as for being hurried across the country.

The long shallow shape of the boats was universal; and they were constructed alike at stem and stern, so as to avoid the dangerous necessity of going about. A few had rudders fitted on, but oar-steering appears to be more generally practised; the rowing-oars being generally attached to pins on the gunwales, so as to allow them to swing. An ingenious attempt to get rid of part of the difficulty of rowing in a sea-way from the motion of the craft, was in the model of a Boat within a Boat—the former swinging freely in the latter, and always preserving its equilibrium, in spite of the rolling of the outward vessel.

In a Life-boat from the Isle of Wight, the planks, instead of running fore and aft, were laid diagonally across, from the gunwale to the keel. A Whitby Boat was furnished with outriggers supporting nets, into which people might leap from a ship, while the boat was kept at such a distance as to diminish the risk of her being swamped against the wreck.

The Lowestoft and Yarmouth Life-boats have their buoyant apparatus in the sides beneath the thafts; the oars double-banked, and beside every man is a pump for getting rid of a sea when it fills the boat. A label attached to these boats, states that they are in use over a range of coast of about 20 miles; that not one of them has ever been upset, and that they have saved from 500 to 600 lives. The "Infallible Life-boat" is a whimsical construction, entirely open at the bottom; and made, indeed, exactly after the same fashion bottom and top. A Land's-end Life-boat is remarkable for the horizontal cuts or longitudinal openings, like loop-holes, piercing her sides in continuous lines; beneath she is open to the water.

Holbrook's Iron Bottomless Life-boat, 26 feet long, was exhibited in model: it is made entirely of wrought and sheet iron, lined and covered with strong netting; it has six floaters made of sheet-iron, filled with tubing formed into air and waterproof barrels, with tanks for 222 gallons of fresh water; provisions, warm clothing, compass, alarm apparatus, fuel, fireworks, rockets, and 1000 feet of line; and in the figurehead, a kettle that will boil in ten minutes. The boat is secured together with 400 screws and bolts, and 10,000 rivets: total weight, 20 cwt. Having no bottom, this boat can scarcely capsize; should its floaters let in water, the barrels inside will remain buoyant; and it will carry nearly 150 persons, and food for many days.

Bonney's Life-boat, which has been experimented on in the Serpentine and the Thames with unvaried success, was also exhibited:

it is clinker-built; the sides are doubled from the bilge to the spar-deck, and filled with gutta-percha water-tight cells; and the fore and aft parts are divided into water-tight compartments. This boat has sailed full of water without impediment; and being hauled over and then half filled with water, and released, righted itself immediately. It rows or sails equally well both ways, and the plan is applicable to boats already in use.

Among the novelties were two Life-boats, by Erskine: one propelled by new pinion-wheels and self-acting syphon pump; the other fitted with revolving air-tight cylinders, life-protecting rings, &c.

Hely's Catamaran, or Life-float, was exhibited: it is composed of water-proof canvas cylindrical cases, filled with bedding, clothing, provisions, stores, &c. The same inventor contributed a Salvage Boat, wholly formed of metal tubes, serving as atmospheric and hydraulic chambers, with loaded keel, and self-shifting wheels.

Here, too, were found South Shields Life-boats, completely fitted with sails, &c.; a Whitby Life-boat, capable of emptying itself of water in four seconds, by two apertures in the bottom; and a Life-boat of wood and cork, with gutta-percha air-tight compartments, and scuppers in the keel for letting out water. Skinner's Aberdeen "Momentary-motion Life-boat," was exhibited: it is stated to possess the self-righting power under all interruptions. Allowing 65½lbs. as the weight per cubic foot sustained by this or other air-tight vessel, a boat of 247 cubic feet will float a greater number than such boat can contain; and the same buoyancy is maintained, however placed. When inverted, the boat will float on her fore and after air-cases, thus preventing the contact of midship gunwale with water, whereby little water is left to displace.

Dyne's Life-boat is built with diagonal battens, laid lattice-wise; its outer sheathing formed of gutta-percha: its buoyancy is 350 cubic feet of air, capable of sustaining upwards of 9½ tons, and letting off shipped water by 3600 holes; in the convexed bottom are three perforated steadying-fins, and between them 2 tons of water, not one ounce weight to the boat when upright: there are also galvanized springs placed at the stern, to act like railway-buffers in collisions; besides fusees, rockets, and other lights. The same inventor exhibited a Portable and Folding Emigration Life-boat, to be put in requisition in a few minutes; and, in wreck, to carry provisions for 100 persons seven days.

The Patent Collapsible Life-boat was exhibited by the Rev. E. L. Berthon, and is stated to enable passenger vessels to take to sea enough boats for any emergency, without crowding the decks: they are always ready for use, "frapped to under the davits;" and, on casting off the gasketts, the boat flies open, and takes into fore and aft cells a large supply of air.

Of the 280 models and plans of Life-boats sent in to compete for the premium of 100 guineas, nobly offered by the Duke of Northumberland for the best boat, fifty-four models were exhibited. The Report of the Northumberland Life-boat Committee (one of the most interesting documents of its class), states there were several models in the form of Pontoons; Catamarans, or Rafts, formed a second group; a third group had for its type a Troop-boat, or Steamer's Paddle-box Boat; a fourth, partaking chiefly of the North-country Coble; and, lastly, a group of ordinary boats, with modifications. The *Prize Boat*, modelled by James Beeching, Great Yarmouth, Norfolk, is of whale-boat body: "she would, from her form, both pull and sail well in all weathers; she would have great stability, and be a good sea-boat; she has moderately small internal capacity for holding water under the level of the thwarts, and ample means for freeing herself readily of any water that might be shipped; she is ballasted by means of water admitted into a well or tank at the bottom, after she is afloat; and, by means of raised air-cases at the extremities, a light iron keel, and the absence of midship side air-cases, she would right herself in the event of being upset; thus combining most of the qualities required in a life-boat."—*Report.*

LIFE-PRESERVING CONTRIVANCES.

A variety of buoyant Articles of Clothing were exhibited: they may be worn as every-day clothes, and include "Yachting jackets," and ladies' paletots, described as capable of supporting the wearer in the water. Many other means of support in the water were shown; such as belts, to be inflated by the mouth, and lumps of cork, threaded like beads, to be put round the body. Waterproof trunks, made so as to serve as supporting media in the case of shipwreck, were exhibited, with models illustrating their easy adaptation to the purposes of rafts. Air-tight mattresses were shown, suitable for hammocks and berths, and which, of course, are exceedingly buoyant; together with "floating buoyant settees," (with air-tight gutta-percha cases,) for the decks of passenger steamers; and a marine floating-chair for three persons.

There were likewise exhibited Carte's Life-Buoy, (circular belt;) Swimming-Gloves, web-fingered; and Swimming-Boots, the soles fastened to flat pieces of wood, to which are attached flaps or leaves working by hinges; India-rubber cloaks, capable of being inflated, when they become small buoys or boats; and Caulcher's Cork-ribbed Jacket, to be worn, without inconvenience, whilst rowing a boat.

In the American department were several buoyant contrivances, made of vulcanized India-rubber, for saving life under peculiar circumstances.

The Apparatus of the Royal Humane Society was exhibited: including their Ice-boat, constructed of wicker-work, covered with raw hides, and from its lightness easily propelled on the ice to the broken spot; the Breaker Ladder, with air-tight barrels, on wheels; the Ice-sledge—two canoes united by thwarts into a floating platform; Rope drag, and Pole drag, the latter by an air-tight cylinder rendered a floating-drag. Here, too, were exhibited the Life-boat and models of the National Institution, for the preservation of life from shipwreck. There was also shown Light's invention for rendering ships' boats so buoyant that they become life-boats; by filling the spaces between the timbers and beneath the thwarts with a very light material, and covering it with thin boards; and should the bottom be stove in, the frame, held together by the fibrous material, would float as a raft. The process can also be applied to any part of a ship, or boat, its mattresses, or other furniture, so that each may become a life-buoy.

Grapnel Shots, with mortars for their projection, to aid wrecks, were exhibited. The shot has attached to it a strong but light line; and consists of loose curved arms, which fly out on being disengaged from the gun: when the line being pulled from the shore, the implement fixes in the bottom, anchor-like, and the boat's crew have the means of warping themselves off. Of the same class is the Rocket-gun, for carrying a 600-yard line from the shore to a wreck, or *vice versâ.* Another model proposes to project a small anchor to the wreck; another to propel a line without the use of gunpowder; and next were shown the life-boat and mortar apparatus of Captain Manby, the venerable patriarch of this family of humanities.

SIR W. S. HARRIS'S LIGHTNING CONDUCTORS FOR SHIPS.

Among the nautical inventions were exhibited practical models to illustrate the system of Conductors, invented by Sir W. Snow Harris, and now employed to protect the ships of Her Majesty's Navy from Lightning. In the principal model, is shown the line of conduction on the masts from the vane-spindle to the step; to the keel at the sides, and at stem and stern; and in the other models are seen the plan and construction of the conducting-plates, showing the alternate jointing of the plates, &c. Copper is selected as the best conducting metal, and is in rods three quarters of an inch in diameter; each mast having its conductor, "permanently fixed and connected with bands of copper passing through the sides of the ship, under the deck-beams, and with large bolts leading through the keels and keelson, and including, by other connexions, all the principal metallic masses employed in the construction of the hull. Under such a system, a discharge of lightning falling on a house or a ship, finds its way to the earth or the sea, without the possibility of danger. The great principle in applying such conductor, is to place the ship or building in the same electrical condition it would assume supposing the whole were a solid mass of metal, or as nearly as may be; and the conductor should be applied so that a discharge of lightning falling on the general mass cannot enter upon any circuit of which the conductor does not form a part."—*Sir W. S. Harris.**

Since these conductors have been employed in our Navy, no damage from lightning has been recorded.

SHIP-BUILDING CONTRIVANCES.

Morton's Patent Slip, an economical substitute for a dry dock, was exhibited. By the old system it cost £170 to haul up a 500-ton ship

* See Year-Book of Facts, 1848, page 121.

for repairs: by this new slip, it can be done for £3. Capt. Sir S. Brown's plan for hauling up on dry land the navy ships in ordinary, (said to be a preservative from dry-rot,) was also exhibited in model. There was similarly illustrated, by W. Scamp, Admiralty, Somerset House, "a Preservative Dry Dock for the reserve of the Royal Navy," for laying up ships without dismantling or removal of machinery; for inspecting, repairing, or refitting vessels; and for building ships, seasoned and dry, &c.

Parker's Brass Valve, worked by a screw, to supersede the present plugs in ships' boats, and not liable to be lost, as plugs are, was exhibited in a boat model. There was likewise shown a Brass Safety Plate, to cover the aperture of a ship's scuttle; and, among other provisions, to make the windows, in case of storm, safe in one minute.

Captain Denham's "Jury Tiller," for steering a ship when the helm-fittings are disabled, was exhibited in model: it consists of an appendage to the rudder at the water-line, and can instantly be thrown into gear.

Sir Robert Seppings's Truss-work for the interiors of ships was shown in model: its principle corresponds with that of the girders of the Great Exhibition Building.

Mr. Grantham, of Liverpool, exhibited in model his improved method of sheathing (without bolts) iron ships' plates with wood, to be coppered, to prevent fouling, as well as preserve the iron. Specimens of Muntz's Patent Ships' Sheathing Metal were also shown.

West's Marine Compass was exhibited: in this instrument the magnetic needle is always steady, and in the heaviest weather only vibrates four or five degrees.

Mr. Soulby, 126, High-street, Wapping, lent, as an historical contribution, the identical Quadrant and Compass used by Captain Cook in his Voyage round the World.

Spenceley's Patent Pillars and Screw Apparatus, for the prevention of "hogging" in Ships, and for straightening hogged ships without going into dock, were exhibited.

Chapman's Patent Shroud Blocks (to be substituted for the wooden dead-eye), were shown in brass model: by a pair, one man can raise three tons weight.

Bothway's Twenty-inch Cat and General-purpose Block, was shown: its weight is only 2 cwt. 1 qr., yet it has withstood 50½ tons' strain. The same inventor's Internal-strapped Blocks were shown in contrast with the old Rope-strapped blocks; his Cat-heads, of reduced size; and his Slings and Portable Gear Blocks, long used in the largest ships in the Royal Navy.

Shuldham's Patent Revolving Masts, for saving manual labour in tacking, were exhibited.

Messrs. Ferguson, of the Mast-house, Poplar, contributed models of economical Masts; Improved Fids; and Blocks, with improved sheaves and pins.

Trail's Patent Storm Sails were exhibited; their novelty consisting in narrow corded bands being sewn diamondwise on the fore and aft part of the sail, so that the destroying effect of the wind is restricted within the diamond, and the strain is equalized throughout.

Hughes's Steering Apparatus was shown in model; consisting of two cast-iron standards supporting two traverse boxes, on a toothed rack, with a pinion on the upright shaft to which is affixed the steering-wheel; the turning of which moves the rack, and next the rudder, by two connecting-rods leading to the tiller. The same inventor also showed his Masting-shears for lifting a boiler of 20 tons weight, as well as for putting masts into ships.

A new Launching Apparatus, by Etrick, was shown in model; by which contrivance one man may launch a Long Boat, without the masts, or remove it to the side of the vessel, clear of the hatchway; the boat may also be shipped on transverse wheels, and thus run to any part of the vessel.

Williams's Self-acting Machinery for pumping ships by the movement of the vessel, was shown.

There were likewise exhibited in this section, models of a Windlass and Capstan, fitted with Johnstone's patent double-action iron lever purchase; another of a Ship's Capstan and Rein, or cableholder, and Gryll's patent Whelps; a safety Steering-wheel, which stops when left by the man; and Lanyard-plates, to set up the standard rigging of ships, instead of rope lanyards and dead-eyes.

ANCHORS AND IRON CABLES.

Among the Anchors exhibited was one by Smale, which can be taken to pieces, and stowed in one-third less than an ordinary anchor.

Porter's Patent Anchor was shown: its superior strength and holding power preventing fouling, at single anchor or otherwise; insuring quick bite, in all ground, and with short cable bringing up the ship instantly; the arms can be disconnected from the shank, so as to be more conveniently stowed; and less weight of metal is required.

Inglefield's Anchor without a stock, both flukes to take the ground, was exhibited: it takes into two pieces, is not to be fouled, and is stated to have double the hold of an ordinary anchor.

The largest and the smallest Anchors used in the British Navy, manufactured by the Bedlington Iron Company, Northumberland, were exhibited; with Rodgers's improved patent Small Palmed Anchor, and Kedge Anchor.

Capt. Sir Samuel Brown exhibited several patterns of the Iron Cables, invented and introduced by him into the Royal Navy in 1810, as a substitute for hempen cables; the system of biting by stay-pins being more important than the original invention. The specimens illustrated the principal stages of this important invention.

Messrs. Gladstone's Ship's Windlass Purchase, for raising anchors, chain-cables, &c., with less than half the usual number of hands, was exhibited in model.

MODELS OF LIGHTHOUSES.

A variety of excellent Models of Sea Towers and Lanterns, with two large specimens of Lighthouse Optical Apparatus, were exhibited.

First was Capt. Sir Samuel Brown's Model of a *Brass Columnar-bearing and Distance Revolving Lighthouse*, designed for the great Hanois Rock, on the south-west coast of the island of Guernsey. The centre of the light would be 130 feet above high-water mark, and visible, in clear weather, at 12 miles' distance; the second altitude, at 10 miles; and the third, 8 miles. The metal dome, 10 feet diameter, was to be tempered into a bell, to be struck as an alarm in fogs or thick weather. The cost of this column would have been £10,000; time of erection, six months; and its stability would have been guaranteed for seven years.

Next was Mr. Gandell's Design for erecting a Lighthouse on the Goodwin Sands, which are constantly shifting.

The Commissioners of Northern Lights exhibited a set of beautifully-executed Models of Lighthouse Apparatus and Towers; Alan Stevenson, engineer. First, was a *Revolving Dioptric Apparatus*, of the largest dimensions employed in lighthouses; and consisting of an octagonal hollow prism, eight pyramidal lenses, eight smaller mirrors, and five tiers of reflecting prisms, which are so arranged as to project the light in the shape of a flat ring to the horizon. Next was a *Fixed Dioptric Apparatus*, consisting of a cylindric belt of glass, surrounding the flame in the centre, and filled with a series of catadioptric zones, acting by total reflection, and causing the light to emerge horizontally. This light, with improvements, has been introduced into the lighthouses of Scotland.

Next was a Model of the *Bell Rock Lighthouse*, executed according to the design and under the superintendence of the late Robert Stevenson, F.R.S.E., and first lighted in 1811. The model shows the progress of the work, commenced in 1807; the temporary timber barrack-house; the railways, stone-lighters, and cranes employed; and the courses of masonry, dovetailed and joggled. This lighthouse is 100 feet high; the door is 30 feet from the base; and the ascent to it is by a massive bronze ladder: the light is alternately red and white, produced by a revolving frame, with sixteen Argand lamps, placed in the foci of large mirrors; and the machinery which moves the whole in a circle, is also applied to the tolling of two large bells. Cost, £61,331 9*s*. 2*d*.

Model of the *Skerryvore Lighthouse*, in Argyleshire, designed and built by Alan Stevenson, F.R.S.E., the present engineer; the light first exhibited in 1844. The perils of this work have been elaborately described by Mr. Stevenson: the tower contains more than double the quantity of stone in the Bell Rock, and five times that of the Eddystone; the light is revolving, and of the first order of dioptric:

cost, £86,977, 17*s.* 7*d.* Mr. Stevenson gives the following tabular comparison of the three largest sea lighthouses erected in Britain:*—

Lighthouses.	Height of Tower above first entire course.	Contents of Tower.	Diameter.		Distance of centre of groins from base.
			Case.	Top.	
	Feet.	Cubic feet.			
Eddystone....	68	13,343	26	15	15·92
Bell Rock....	100	28,530	42	15	23·59
Skerryvore ..	138·5	58,580	42	16	34·95

Model of a *Balance Crane,* designed and used by Robert Stevenson, in building the Bell Rock Lighthouse; and by which the stones were raised, and set at any distance from the centre of the tower.

Model of the *Apparatus of the Intermittent Light,* at Tarbertness, Barrahead, and Mull of Galloway, on the coast of Scotland; designed by Robert Stevenson.

Model of a Lighthouse Lantern on the Diagonal Arrangement; by Alan Stevenson. Here were, also, Models of a Mechanical Lamp of four Wicks, in which the oil is raised by pumps from the cistern, and unceasingly passes and repasses over the wicks; and a Holophotal Arrangement of Lighthouse Apparatus, by Thomas Stevenson, C.E.; in which the whole sphere of light is employed.

There were also exhibited the following instruments, belonging to the Northern Board of Lights, and invented by Thomas Stevenson, namely:—a *Reversing Light,* in which only half the usual number of reflectors, and quantity of oil, are required; a *Parabolic Reflector made Holophotal,* by a portion of a catadioptric annular lens; and a combination of a hemispherical mirror and a lens with totally-reflecting zones.

Next was a model of Wells's *Universal Telegraphic Lighthouse,* in which apertures are cut just below the lantern, and filled with ground plate glass, whereon the initial of the particular lighthouse is clear and bright.

The Improved Patent Catadioptric Apparatus, for a first class lighthouse, by W. C. Wilkins and C. Letourneau, was also exhibited. It produces the light called "short eclipses," by these arrangements: first, is provided a fixed light, consisting of a cupola, and lower part of catadioptric rings; and a central cylinder, around which is arranged a series of lenses (vertical prisms), upon an exterior revolving frame. The radius of their curves is in opposite directions to those of the cylinder, so that, at passing, they converge into a parallel pencil of light; all the horizontally-divergent rays from the cylinder producing a brilliant effect, like that obtained from annular lenses in revolving lighthouses. The improvements are, a considerable

* From the abridgment of Mr. Stevenson's large work, published by Weale.

increase of light, and simplicity of the optical arrangements; in substituting for the moveable cylindrical lenses a single revolving cylinder, composed of four annular lenses, alternating with as many lenses of a fixed light; or, according to the succession of flashes to be produced in the revolution. Next, is an improvement in the arrangement of the revolving part, so that the friction rollers, when they have worn a deep groove in one place, can be adjusted to another, and the regularity of the rotatory movement be thus secured. Thirdly, the power of the flashes is increased to double what has hitherto been obtained in revolving lighthouses. The prisms, lenses, and zones are of glass of the clearest crystal colour, accurately ground and polished to the correct curves, according to their respective positions. The lamp for lighting the apparatus, consists of a concentric burner, with four circular wicks, to which the oil is forced up by atmospheric pressure.

Next was the *Improved Lantern and Revolving Apparatus for a Light-vessel*, by the same patentees. It consists principally in the machinery working beneath the deck, instead of in the lantern, as formerly; and is, therefore, more under control, and better protected.

Rettie's Inventions for Use at Sea were likewise shown:—viz. Lamps, Lights, Lighthouse Apparatus, Reflectors, Signals, Life-boats, Fire-extinguisher, Breakwater, &c.

STRENGTH OF HOLLOW BRICKS AND PORTLAND CEMENTS.

On September 20th, 22nd, and 23rd, some interesting and important experiments were made at the Great Exhibition, under the supervision of the jury of Class XXVII., when a large Beam of Hollow Bricks and Portland Cement, erected in the area at the west end of the Building by Messrs J. B. White and Sons, of Millbank, was broken down. The experiments were watched with great interest by a large number of scientific men and others:—

The first experiment was on a block of neat Portland cement, 4 inches square, suspended at each end, and 16 inches long between the bearings. The weight was applied exactly in the centre. This was broken down by 1580lbs., including the weight of the scale: the fracture was perpendicular. The block was four months old.

2. A block of neat Roman cement (Harwich stone), exactly the same size as the last, seven months old, broke down with 380lbs.

3. A block of neat Sheppey cement, the same size as the last, broke with 980lbs. in the scale.

4. A block of neat Portland cement, six months old, 2 inches thick and 2¼ inches wide, required 2280lbs. to pull it asunder.

5. Two pieces of Portland stone, 6 inches square, (each 6 inches high too,) cemented together by a thin joint of neat Portland cement (four months old), were suspended. When 3700lbs. were in the scale attached to the lower stone, the top stone yielded where the iron clippers held it. Afterwards, the square holds for the ends of the clippers were made deeper in another part of the stone, and 4500lbs. were put in the scale, when the iron hook broke, the joint remaining sound.

6. Two pieces of Portland stone, the same size as the last, joined together with Roman cement five months ago, (a thicker joint, by the way, than in the previous case,) required 2780lbs. (including scale) to separate them,—a much greater weight than was anticipated. The cement left the stone; so that its adhesive power yielded, not its cohesive.

A few days before the opening of the Exhibition, was erected a *Beam of Hollow or Tubular Bricks, with Portland Cement and Sand (in equal portions,)* with iron hooping in the lower courses; and generally following, in all respects, the dimensions and form of a beam built in 1837, with Roman cement, at Nine Elms, as far as the use of the hollow bricks would permit. The weight was applied in the central part of a clear bearing of 21 feet 4 inches, in the same manner as to the Roman cement beam. The use of the hollow bricks occasioned some difference in the sectional area, which we have to take into account; but we shall disregard, in the present comparison, the disadvantages arising from having merely the narrow edges of the tubes to connect with the cement, instead of the broad surfaces of ordinary bricks.

The Portland cement-beam consisted of ten courses, the upper part having three courses on edge, and four flatwise, and the lower part two courses on edge, and one flatwise. The bricks were all laid as stretchers, and the beam consequently consisted of a series of forty tubes (the number of bricks in section throughout), which were open from end to end of the beam. The average size of the bricks was $5\frac{5}{8}$ inches by $4\frac{1}{8}$ inches, and, the rims or sides being about $\frac{7}{8}$ of an inch in thickness, the tubular or hollow parts were each equal to 9 inches super. But with the joints and beds, the whole measured in the six upper courses an average of 36 inches $\times$ 17·25 inches, = 621 inches; and in the three lower courses an average of 16·5 $\times$ 26·6 inches, = 439 inches; making a total area of 1060 inches: from this, deducting the forty vacuities, or hollow parts, of 9 inches each, = 360 inches, we have, as the net sectional area, 700 inches. As the vacuities were distributed throughout the whole depth of the beam, they occasioned a loss of strength nearly proportionate to their whole extent, varying, of course, as their distances from the neutral axis.

On Sept. 20, the beam was loaded in the central part with 15,000lbs. weight of pig-iron, and in this state it was left until one o'clock on Sept. 22nd, when it was carefully examined, and found quite free from any indication of failure. The loading was then resumed until it was weighted with 40,000 lbs., at which time a deflection of nearly one-eighth of an inch was observed: with 41,600lbs. two cracks exhibited themselves in the four lower courses, at a short distance right and left of the centre of the beam, and then a crack in the centre of the beam. With 51,600lbs. the cracks extended through the six lower courses, and the deflection increased to five-sixteenths of an inch: with 62,800lbs., which it bore for a short time, the beam gradually separated into two parts, as nearly equal as possible, the line of fracture being vertical, and indiscriminately through bricks and joints as they occurred. In falling, the beam thrust the piers considerably out of an upright.

On the part of Messrs. White, it was argued that the depth of the Roman cement-beam being 57 inches, and the sectional area 1107 inches; and the depth of the Portland beam being $52\frac{1}{2}$ inches, and its net area 700 inches, we shall have 1107 $\times$ 57 = 63,099; and 700 $\times$ $52\frac{1}{2}$ = 36,750, as expressions of the relative strength of the two beams, supposing they had been built of the same materials. In the present experiments, however, it should be stated that the *Roman* cement-beam was built *seventeen months* before the breaking-weight was applied; whereas the *Portland* cement-beam had only been erected *five* months.

The *Roman* cement-beam was broken down with 50,652lbs., and since, 63,099: 36,750 : 50,652 : 29,500, it follows that if the *Portland* cement-beam had broken down with 29,500lbs., the two cements would have exhibited equal strength; but, inasmuch as it took 62,800lbs. to break down the *Portland* cement-beam, the experiment exhibited a superiority of *Portland* cement over *Roman* cement in the ratio of 2·128 to 1, or, in round numbers, $2\frac{1}{8}$ to 1. This reasoning, however, is scarcely correct, since it does not take sufficiently into consideration the strength dependent on *disposition* of the material.

The important part played by the iron-bond in this experiment must not be overlooked. "The mutual adhesion of cement and iron," says Sir Charles Pasley, "is so perfect, that no force can separate them without producing the complete fracture of the brickwork, which is thus resisted by all the tenacity of the iron."

In the Hollow-brick beam there were fifteen pieces of hoop-iron bond, one-and-a-half inch by one-sixteenth of an inch nearly; namely, four in the first course, four in the second, three in the third, and two in each of the next. The pieces of iron were all broken, except one in the bottom course, one in the second, and one in the top course.

We now pass on to the experiments, also on Portland Cement, which were exhibited on the same occasion by Messrs. Robins and Aspdin, of Scotland-yard.

1. A suspended block of cement, $3\frac{7}{8}$ inches wide, and $2\frac{1}{8}$ inches thick, (one month old,) was pulled asunder by 3240lbs., including the weight of the scale.

2. Sixteen stock-bricks, attached to each other with neat cement, supported at one end, and projecting from the bearing point 3 feet $2\frac{1}{2}$ inches, broke in the eleventh brick with 256lbs., exclusive of scale, suspended on the extreme end.

3. A solid step, 6 feet 5 inches long, and $7\frac{1}{2}$ inches deep at the back, formed of two parts Portland cement and one part broken bricks, held up at one end, carried itself, and broke off close to the bearing-point when the third 56lbs. weight (168lbs.) was placed on the extreme end. The weight of the step was called $4\frac{1}{2}$ cwt.

4. Two blocks of neat cement, 1 foot $5\frac{1}{2}$ inches long, 9 inches wide, $4\frac{1}{2}$ thick, cemented together with neat cement, bore 6000lbs., when the lower part of the lower block gave way.

5. Twenty stock-bricks, united side by side with cement, composed of one of cement and one of sand, 3 feet $6\frac{3}{4}$ inches in bearing, were supported at each end by iron clamps: the weights being applied to the centre, the bricks broke with 1200lbs.

6. Six fire-bricks, in courses, cemented together with pure cement, were suspended, and weights were applied to pull them apart: the upper brick broke with 2836lbs in the scale.

7. The five fire-bricks from the last trial were again tested, iron being inserted in the second brick from each end: the upper brick broke, carrying away also part of the lower, with weight of 4600lbs.

8. Two pieces of Portland stone, 2 feet by $11\frac{1}{2}$ inches, $7\frac{3}{4}$ inches thick, cemented together with neat cement, took a weight of 7272lbs., when the lower stone yielded, carrying away a small portion of the cement-joint.

We have abridged these important results from No. 451 of the

Builder, whose well-informed editor, Mr. G. Godwin, F.R.S., was one of the most efficient of the jurors present at the experiments.

CARRIAGES FOR COMMON ROADS.

The contributions of our Carriage-builders to the Exhibition maintained the superiority which they have long held in this department of manufacture.

Amongst the Carriages exhibited, there were none absolutely new; but the special requirements of almost every one were here provided for. Approaching the style of a state carriage, was the "Semicircular Clarence," built by Offord for the Exhibition: in which the axletree is so constructed, that if it should break, the wheels would continue to run without coming off; the springs are made on a plan to procure the ease of a long spring without its unshapely form; and a new self-acting door-lock fastens itself, and prevents the door from rattling. The hammercloth of blue silk velvet, decorated with gold and silver, is stated to be unique in design; but seems better adapted to be the carriage of an ambassador, or other important official personage, than of a private individual.

A remarkably elegant park phaeton, by Hallemarke and Co., of Long-acre, was conspicuous from the novelty and beauty of its design. The lower part is of the cockle-shell pattern, painted white, which is relieved by a bright blue above. The lamps resemble richly-cut glass vases, with handsomely-chased silver covers, and are quite new in design.

Among the carriages of more utility, in which ease and convenience are especially attended to, was a Patent Brougham, with inverted double C springs, from the manufactory of Cook and Co. The old-fashioned C springs, from which carriages were generally hung, give a much more easy motion than the elliptical springs that have in a great measure superseded them. The suspension of a carriage from curved springs is a very effectual means of preventing jolting, though it is liable to produce a swinging motion; but the principal objection to them is their appearance. In the carriages fitted with the double C springs, this objection has been removed; for the double curve affords sufficient elasticity within a much shorter space, and they are arranged underneath the carriage in the same position as, and looking scarcely more prominent than, elliptical springs. In the patent carriage of Cooke and Co., fitted with these springs, there is also a convenient arrangement inside to serve as a substitute for the carriage baskets, which occupy so much room in front. Without impairing the external appearance, there is a cupboard made inside the coachman's seat, which opens inside the carriage.

An improved "Sociable," made so as to form an open or close carriage at pleasure, exhibited by E. Booker and Sons, of Mount-street, is worth notice, from the compactness of the design, and its generally applicable use. This vehicle, we believe, attracted more attention from foreign coach-builders than any other in the

Exhibition, and the care with which they measured its proportions, was considered to be indicative of their intention to introduce this class of carriage on the Continent.

A Carriage with Patent Automatic Invisible Steps, invented and exhibited by D. Davies, of Wigmore-street, dispenses with the attendance of a footman to open and shut the door. The steps act on the principle of the "lazy tongs:" they open with the door, and, as the door closes, they fold up underneath very compactly. There was also shown a Simultaneous Double Step; by a small connecting-rod, both treads opening and shutting at once, and more conveniently than in the ordinary double step; it can be opened or shut by a person inside the carriage, and can be made to work with the door.

Middleton and Co., of Long-acre, exhibited a new plan of turning the axle and front wheels of a carriage on its bearings, so as to diminish the distance between the wheels. The carriage turns upon what is termed by the inventor a "Centripetal plate;" by which means, the hind and fore wheels may be brought almost 18 inches nearer than can be done in the usual mode of construction. The same object is effected in a carriage exhibited by Mr. C. Saunders, of New-yard, Great Queen-street.

An economical arrangement for those who desire to have different kinds of carriages combined in one, was shown by Rock and Son, of Hastings, the inventors of the Patent Diorompha, which may be used either as a Clarence, as a barouche, or as an entirely open carriage; if a covered one be wanted, either entirely closed or not, the appropriate head is fixed on. The folding-steps are likewise on a new principle.

Kesterton's Amempton Carriage is also of this class; which, by a simple contrivance, can be converted into a light, open, step-piece Barouche. The framework is secured to the head with a new kind of fastening; and the back, instead of being flat, is of a curved form.

A Four-wheeled Model Carriage was exhibited by the designer, G. H. Baskcomb, of Chislehurst. It indicates the distance of the ground travelled over, and marks the same upon a dial; it has spiral springs beneath the driving-box seat; an elastic bar to relieve the feet from vibration; four preventive wheels, in case of accident; two arms with roller wheels, to protect the vehicle from collision; and a screw-break, by which the driver acts upon the wheels, so as to ease the vehicle down hill, or stop it.

In Horne's Patent Segmental Brougham and Chariot, the distance between the wheels is greatly shortened by the application of the eccentric double perch bolt-lock in the turning of the fore-carriage.

A New Four-wheeled Carriage, or Improved Brougham, by H. Mulliner, of Leamington, has two distinct curves instead of one in the front part, and trimming inside at the back. In the communication with the coachman, the voice-conductor is entirely concealed; and the mouth-piece is at each side, instead of at the middle of the back, as usual, and suspended from the roof.

By Willoughby's Carriage invalids with fractured limbs, or severely afflicted, may be removed from their beds without change of position or fatigue. Inside is a kind of platform, supported from the top by springs, which passes under the front of the carriage, and is long enough to hold a person in a recumbent position. A portable couch which fits on to this platform may be carried into the bed-room, and the invalid having lain down upon it may, without the slightest change of position, be introduced completely into the carriage through an opening at the back. Room is left on the side of the couch for two seats to hold attendants.

Of invalid or Bath chairs, to be drawn by hand, there were many kinds. One manufactured by Jordan, had a self-adjusting reclining apparatus, an addition to the usual construction; and another, called a Park Wheel-chair, invented by Heath, of Bath, was decorated with paintings and glass panels.

There was also exhibited a Four-wheeled Pleasure-ground Victoria Chair, by Ward, of Leicester-square, upon C elliptic and body springs, with patent vulcanized India-rubber tires.

There were among the carriages several varieties of Jaunting-cars, Dog-carts, and other light Vehicles: some of which were constructed with remarkable paucity of materials, and were elevated by high wheels, so as to run over the ground with scarcely any perceptible draught.

Among the models of public carriages was a Cabriolet, to carry five persons in separate compartments; and an Omnibus divided into compartments; both patented by J. A. Franklinski: the omnibus has an outside gallery, with a separate door to each compartment, and an improved method of reaching the roof by end steps; and the entire carriage is 2 cwt. lighter than those in general use. A large omnibus, manufactured by Kinross, of Stirling, was also shown: it will carry 19 passengers inside, has a large ventilating well in the roof; the passengers, when going out and in, can walk upright; and the well forms a comfortable seat for outside passengers. It has double hind-springs, so that when lightly loaded, the motion is easy; and, when heavily loaded, both springs come into action, and cause it to retain the same motion: it is adapted for two or three horses abreast, with equalizing bars, or levers; as is also the Omnibus exhibited by Menzies, of Glasgow. Rock and Gowar, of Hastings, exhibited their Patent Omnibus, in which each passenger has apportioned his proper share of space on the seat, namely, 16 inches: the front and hind are circular, and the door opens both ways, so that passengers may get upon the step from either side of the road with safety.

There was also shown an Improved "Hansom" Cab, in which the driver is brought down from his elevated perch behind the hood, and the wheels are of lighter make. The body, too, is brought nearer to the ground and rendered more accessible, but the main features of the old style are preserved; and no attempt is made to secure a registration of distances. Shillibeer exhibited two of his Patent Funeral Carriages, in which were combined the hearse and mourning-coach in one vehicle.

D. Mitchell, of Whitburn, Linlithgowshire, exhibited his model of a Safety Carriage, which, in peril, can be stopped from the inside with facility and safety: this invention was described in 50 different languages.

Rock and Sons' Patent Improved Pony Carriage was shown: it has seven single-leaf springs, weighing only 12½lbs., but which have been proved with 4 cwt., without taking any "set."

Of improved Carriage Construction, several specimens were exhibited: including working models of Collinge's Patent Axle-trees, besides their Spherical Hinges and Fastenings; Crosskill's Improved Patent Wheel, in which the spoke is turned with strong double-shouldered ends, the rims are turned, and double-shouldered sockets bored in the felloes—the hoop-tire being made and affixed by patent steam-machinery.

Aitken's Patent Iron Wheels are stated to have nearly one-third less draught than any now in use, and from their suspending construction, to obviate all jar; and, in case of accident, a spoke of the wheel can be replaced in ten minutes without removing the tire.

In Lee's Patent, when the Axle breaks, the wheels bear up, and continue the work of the carriage, without the axle; and they do not take fire, as the boxes carry oil to last twelve months.

There was also shown a model of Grisdale's Spring Carriage-wheels, in which the springs are inclosed in the nave of each wheel, and revolve with them; and any shock, from the uneven road, is received on the springs alternately.

Mr. Gibson, of Birmingham, exhibited his Elliptic Springs, between which is placed a block of India-rubber, the three thicknesses being bolted together, (with sufficient play,) and covered with a brass-box.

Among the Coach-furniture, that of Worcester china was generally admired; and much of the coach-lace was in excellent taste.*

FIRE-ENGINES AND FIRE-ESCAPES.

The inventions for the Protection of Life against Fire, which were shown in the Exhibition, may be divided into the general classes—Fire-engines and Annihilators, intended to quench actual flame: Fire-escapes, intended to convey people away from its ravages; and systems of Fire-proof Construction, intended to set flames at defiance.

The Fire-engines exhibited, presented no definite principle of novelty. They were of all sizes—from the small parish engine, to the huge machine which takes 40 men to work it. A number of small house-engines—of neat and handy construction, and working on the simplest principles,—were exhibited, chiefly by Mr. Merryweather, in whose department forcing-pumps of all sizes, and suitable to all purposes of spouting water, were to be found. Here, too, were firemen's tools—helmets, and light crow-bars, and narrow-bladed tomahawk-like axes, furnished with a spike behind.

One of Mr. Merryweather's specimens was a Carriage Fire-engine,

* The well-known Model of the Char Volant (Kite Carriage) was exhibited and has already been described at page 162 of the present volume.

to be drawn by two or four horses, of the pattern employed by the London Fire Brigade (Simpkin's patent;) fully equipped with 7-inch gun-metal cylinders, and spherical copper air-vessel; gun-metal pistons and valves in separate valve-chambers; handles for thirty men, which fold up fore and aft; improved wrought-iron fire-carriage, patent axles and springs; and double delivery screws, for attaching two lines of hose.

The same inventor showed a Cabinet Fire-engine, resembling, in appearance, an article of furniture, presenting all the requisite apparatus of a small fire-extinguisher. An improved Spreading Jet, connected with the branch pipe, makes the engine applicable to garden purposes. By a very simple contrivance, a fan-shaped flat surface is brought to bear obliquely on the jet, which is thus spread out in a sheet of water: in this form the engine was used for watering the large trees in the Exhibition; and its power was sufficient to throw a stream of water to the top of the highest tree.

The most prominent object, however, was a Fire-engine from Montreal, which carried off the first prize at the Canadian Exhibition of Industry, and was sent to the Crystal Palace, by subscription among a few patriotic Canadians: it was built by Mr. Berry, of Montreal. As a carriage, it is extremely handsome. The panels are adorned with paintings of Canadian scenery, far above ordinary coach-painting. The body is of copper, from the rich copper mines on Lake Superior, lined with wood. The tool-box is of mahogany. Although the engine is 24 feet long, it will turn within 7 feet, thus allowing it to move rapidly round the corners of streets. It is also fitted with lamps, and a signal bell to be heard at a considerable distance. It is followed by a hose-box on two wheels, to carry 30 feet of hose, and weighs altogether 35 cwt. It is stated to propel a larger quantity of water with an equal number of men working, than any other engine: it is self-supplying, and will pump up water from a depth of 27 feet, and throw up a column from an inch-jet, 180 feet high, or 200 horizontally; or two streams, 156 feet high; the jerk, usually felt in suction, is avoided, and the stream of water rendered continuous by an extra air-vessel. In an experiment made with an English fire-engine, upon the edge of the Serpentine, this Canadian engine spouted the water nearly a third higher. It is stated, however, that, on the conducting-pipe being held in a horizontal position, the English machine sent its stream farther along than the former; and it was added, that the British-built engine threw a greater quantity of water in proportion to the number of men pumping.

Mr. Geary, of Euston-place, exhibited a model of a Patent Stationary Fire-engine, to be fitted within a street post, or cast-iron box let into the foot-pavement; and to contain hose-pipe and other apparatus. The same inventor showed a Patent street Watering Cart, combined with a fire-engine.

A great variety of Fire-escapes were shown,—some of them ladders on wheels acting from the street; others, either rope-ladders or lines for descent, acting from the roof or windows. We will enumerate a few of the leading ideas in this respect. Walter's Fire-escape is an iron ladder, hooking to the parapet commonly made in front of houses, immediately before the lower part of the roof. Jackson and Clay showed, we believe, the only Self-acting Escape exhibited. It is in form of an ordinary bed-room table, the top of which turns over the window-sill, thereby forming a seat for the person, while buckling round the waist a leathern belt. A copper-wire cord, for lowering, passes over a pulley in the end of a lever, which projects sufficiently through the window to clear all ordinary projections on the face of the wall. The inner end of the lever forms a break to the drum, round which the cord is wound, and the break is so adjusted as to allow any weight, from an infant to the heaviest adult, to go down at a steady, uniform rate, without any assistance whatever. The lever is jointed, to double up into the body of the table alongside the drum, and the top shuts over all. Another Bedroom Escape consists of a strong funnel of canvas, which can be flung into the street, and through which the persons in danger would slide: this machine could not, of course, be used in the case of flames bursting from a lower window. A Bobbin Ladder Escape is simple, and probably cheap: there were a number of these simple ladder forms in rope, iron and wood. Mr. Walley exhibited an Escape, with which ranges of houses may be fitted, and persons conveyed horizontally along from one window to another; while a great number of escapes, to be managed by the people below, many of them sliding out, on the principle of telescopes, were shown.

There were several models of contrivances for making houses fireproof. One is by a complicated system of water pipes proceeding through the walls, like veins through the body; others depend upon more manageable and less expensive systems of building, and upon peculiarities of material, such as the hollow bricks with which are constructed Prince Albert's cottages, described at pp. 173–4.

Phillips's Fire Annihilator may be mentioned here: by which, instead of pumping water, an incombustible gas is discharged against the flame, which it quickly extinguishes.

GUTTA PERCHA MANUFACTURES.

It is not quite eight years since a specimen of Gutta Percha was transmitted from Singapore to the Society of Arts, when the Secretary, Mr. Whishaw, made a variety of experiments with the new substance; and two of the articles, viz., a Pipe and a Lathe-band, as made by hand, previously to the introduction of machinery for that purpose, were placed in the Exhibition by Mr. Whishaw, next to some specimens of the raw material.

The Gutta Percha of commerce usually contains a large amount of foreign substances; sometimes, even earth has been enclosed within the blocks, which are usually square, but are occasionally made up into fanciful forms, as of fish, birds, &c. Messrs. Bunn showed some Twisted Gutta Percha as imported to this country, and also Flat Cakes of fine quality: with specimens to illustrate the process of manufacture, as slips cut by the knives; then in its minced state, and, subsequently, as masticated, ready to be converted into pipes, bands, or other articles. Here, too, were Pipes, Soles, Staves, Whips, Picture-Frames, Balls, String; and Wires coated with Gutta Percha for telegraphic purposes.

The Gutta Percha Company made a grand display of this useful article in every variety of form; and, for the purpose of illustration, exhibited sections of the wood from which the *gutta* is derived, with the gum adhering to it; as also the bark and the leaf, together with the pure *gutta* as it drops from the tree. In addition to the above, were bowls, traces, watering-pots, shoe-soles, life-buoys, thread, card-trays, whips, life-preservers with whistles, inkstands, music cases, valves, cog-wheels, pen-trays, picture-frames, chemical bottles, clock cases, lathe-bands, pipes for various purposes, slop and other pails, bottle-holders, &c.

Mr. Thomas Walker contributed Gutta Percha Hat-bodies and Norwesters, some of the former having perforations in their crowns for the sake of ventilation: he also showed a Hat-box.

Mr. Charles Hancock, by whose enterprise the manufacture of Gutta Percha by machinery was first brought about in this country, exhibited Draughtsmen, Life-preservers, Pipes, Water-buckets, Frames, Curtain-rings, &c.; also, "Stags and Dogs"—a most elaborate production made of a material peculiar to the West Ham Gutta-Percha Factory, and known as *metaline*, or *metallo-thionised* gutta-percha, which is in appearance similar to bronze. This artistic composition is made up of many pieces, each of which, being first united with its neighbour, is subjected in iron moulds to very considerable hydraulic pressure: when put together, the whole is finished by the practised hand of a first-rate artist.

Mr. N. J. Herens exhibited the Hoof of a Horse shod with Gutta Percha; M. Caplin showed a Rope-ladder, the rounds of wood and the lines of Gutta Percha; Dr. O'Leard, a *double* Stethoscope for ascertaining the state of the lungs; single Stethoscopes of Gutta Percha have been in use for the past three years. Weiss, the surgical instrument maker, exhibited Bougies and Catheters of the same material, adapted for hot climates.

Mr. Truman contributed Artificial Teeth made from pure Gutta Percha, durable, and most comfortable in wear.

Mr. Whishaw showed several applications of Gutta Percha in connexion with Telegraphs: first, a pipe of gutta percha made by hand by him in 1845, and also a lathe-band; then we found three examples of his *Telekouponon*, or Speaking Telegraph, a substitute for bells; one for houses, having whistles and indicator complete, a second for communicating between guard and driver, and a third for private carriages. The next application was that to the manufacture of Whishaw's Telephones, which are used in pairs, being placed at considerable distances from each other, and necessarily in the same focus, and are applicable in cases where the tubes cannot be laid down.

In connexion with Whishaw's Index Electric Telegraph, were coils of copper wire coated with Gutta Percha, for effectual insulation from wet or atmospheric influence. Two specimens of the Submarine Telegraph Conductor were also shown; which are simply the Gutta Percha covered wire first braided with whip-cord and painted white, to prevent the attacks of fish; and, secondly, coated with marine glue, to prevent the attack of the *teredo navalis*, &c. These conductors were made years before the experiment of completing an electric circuit across the Channel was carried out, in the year 1850. The wire and covering was increased in section to 7·16ths of an inch diameter, as it was used without the additional strength of braiding, as above mentioned. Lastly, were Gutta Percha Plugs perforated for as many wires as are intended to be conveyed under ground, in strong glass or earthenware pipes.

Messrs. Brett contributed a sample of the Wire Coated with Gutta Percha, as used in the experiment across the Channel. In the same class, Mr. Heeps exhibited a Pulpit Telephonic Apparatus to full scale: the sound-receiver, however, is of different form from that of Mr. Whishaw, and, instead of being placed in one corner of the pulpit or reading-desk, is fixed outside in front.

Mr. Roberts showed the Hammer of his Alpha Clock made of Gutta Percha, which is found to answer its purpose very well.

There were six contributions of Gutta Percha,—Life-boats and Life-boat Appurtenances, which have been already noticed.

Messrs. James Clark, of Street, near Glastonbury, exhibited their patent "Elongating Gutta Percha Goloshes," which may be put on or removed from the feet without the aid of the hand.

Messrs. Parr, Curtis and Madeley, showed Small Bevelled Cog-wheels of Gutta Percha in place of those of iron, whereby the noise of their cotton machinery, whilst in motion, is considerably reduced.

A large Printing Press, for printing from circular type made of Gutta Percha, was also shown; near it were specimens of printing and copies of engravings executed from Gutta Percha type and plates; as also the matrix and stereotype plate produced therefrom. First is obtained the matrix from the metal type, as set up, with the cuts interposed; the Gutta Percha stereotype cylinder is then moulded, and figured from the same in the patent cylinder press. The cylinder may be ready for printing within half-an-hour from the time of taking the matrix, which process lasts but a few minutes. The patent press is constructed for at least three cylinders, from two of which one side of the paper is printed, as it passes by them in continuous length and in opposite directions; while, by the third, or inner cylinder, the other side of the paper is printed.

In the Agricultural Implement department, Messrs. Burgess and Key exhibited their Patent Gutta Percha Union Joints for Pipes; and also their Patent Hose for Fire-engines, and for the conveyance of liquid manure; the hose is made of canvas saturated with a solution of Gutta Percha.

In the Furniture department, Messrs. Thorn and Co. contributed specimens of Gutta Percha Picture Frames, various Decorations, Brackets, Mouldings, &c.—*Abridged and selected from a paper by Mr. Whishaw; Illustrated London News.*

AGRICULTURAL IMPLEMENTS.

The unrivalled excellence of English Farm Implements at the Exhibition was not contested by a single foreigner; and at the preliminary trials at Pusey, and elsewhere, not more than two or three really valuable machines were entered against them.

The Agricultural Implement Department was divided into ten heads, of which we can only notice the principal. First, were Implements for Tillage, where the principal novelties were Machines and Models shown by Lord Willoughby De Eresby, and other contributors, for Ploughing and Digging by Steam.

Lord Willoughby De Eresby's Steam Plough is, perhaps, the most workable machine of the kind yet constructed. The steam-engine is portable, but not locomotive, and drags the ploughs towards it by a chain. There are four iron ploughs, with coulters before them and subsoil tines behind; all fastened in one iron frame, and so arranged as to follow each other at a suitable distance in four separate furrows. The frame or carriage, composed of longitudinal and cross-bars, is mounted upon three small wheels, besides two in front, apparently intended for steering. Each end can be lifted or lowered by means of two levers, the handles of which meet about the centre of the carriage, where there is a platform seemingly for the driver to ride upon. An endless chain, extending from a drum or barrel upon the engine to a pulley fixed at some distance down the field, passes double through friction-rollers on the carriage; and, by pinching either of the chains with two wedges and levers, the frame, with its ploughs, travels either forward or backward at the rate of five miles per hour; and, by letting the chains go, the progression can be instantly stopped. The difficulty in such machines has hitherto been the power wasted by the engine in drawing the ploughs back again from the engine towards the pulley; but this seems to draw the ploughs backward, and out of work, to the far side of the plot to be ploughed, and thus perform the work only by a direct pull—the land being all turned one way, as in turn-wrist ploughing. The engine is mounted by springs upon wheels with flat tires, so as to run on common roads; and in the field it traverses tram-rails at right angles to the direction of the chain and furrows—the sectional form of the rails, so as to fit the flat-rimmed wheels, being this : L L. There are two horizontal cylinders within the boiler, just above the fire-box, which work an axle with fly-wheel and gear-work, turning the drum underneath the boiler, upon which the chain is once or twice wound. There are two pairs of eccentrics and links for reversing the valves. The regulator is not like the common "governor," but consists of two balls at opposite ends of a bar, the middle of which is attached by a joint to the end of a horizontal spindle. When motionless, the bar is inclined to the spindle; but when revolving, the centrifugal force of the balls tends to draw the bar at right angles to it: an eccentric curve upon the bar slides a rod within the spindle which communicates with the steam valve.—*Gardener's Chronicle.**

A Locomotive Steam Plough, exhibited in model, by Mr. Usher, is of simple construction: the power is communicated by the engine to the revolving ploughs behind; by which means the weight of the whole machine bears advantageously on its acting parts.

Digging Machine.—Mr. G. Thompson, of Great George-street, Westminster, exhibited a patent Machine for Digging, a strong timber frame, about 11 feet by 8, horizontally resting on an axle with two carriage-wheels, each of nearly 7 feet diameter. One of these wheels is iron, having internal tooth-work near its circumference, and driving, by two motions, a shaft along the hinder end of the frame. This shaft has six cranks, three pointing one way, and three, which alternate with them, pointing in another direction at right angles with the first. Six iron spades are suspended from these cranks by their "handle" ends; and about three quarters of the way down the shaft of each, is a cross piece with friction wheels, working up and down in slides; so that, as the cranks revolve, the spades receive much the same motion as that given to a common spade in the hands of a labourer. Three spades enter the ground at once, and three deliver their load together,—a fixed knife or scraper taking the earth cleanly off from them. Just below the point where the spades deliver, are six scuppets or boxes fixed on an axle, which receive the soil from the spades and tip or turn it over. There are two axles, one inside the other, and three scuppets attached to each, so that three receive and three tumble together—the axles being partly turned and then back again in a rapid manner, by means of short levers at their ends, actuated by two eccentrics on the opposite ends of the crank-axle. Immediately preceding the spades, and close to the ground, is an axle turned by small wheels at its extremities running on the ground; this carries one row of six teeth like harrow tines, apparently designed to cut and separate the land into as many slices or stripes as there are spades, and thus render it looser and readier for digging. The spades measure about 9 inches broad across the upper part or shoulder of the blade, tapering downward like draining tools, but are very short. Their distance apart, measuring from the middle of each, is about 15 inches, and they rise and fall about 22 inches. The spur-wheel and pinion, connecting the crank-shaft with the driving-wheel, can be slided out of gear by a lever. In order for the spades to work, the progressive motion of the machine must be very slow indeed; and we presume that the inventor's design is to have a steam-engine upon this large frame, which shall work the digging machinery, and propel the whole from behind.

The Archimedean Agricultural Machine, invented by D. J. Murphy, of Cork, was next shown; the main portion consisting of a large barrel, or roller, upon the surface of which fixed cutters are arranged in a spiral manner. These cutters may be either heart-shaped

* See, also, Illustrations of the Invention, published by Ridgway, Piccadilly.

knives, radiating from the surface of the cylinder, with their flat sides towards its ends, and with conical spikes between the different rows; or with the knives in a direction at right angles to the cylinder; or a continuous blade may be curved round the cylinder like the thread of a screw—the different forms being for varying soils and purposes. The weight of the barrel sinks the knives into the ground, horses dragging it onward and causing it to revolve. It may be set by screws in its frame to a greater or less depth.

Among the Ploughs were to be seen, here and there, specimens of the great monster implements used for bringing up the subsoil and mingling it with the surface mould—as in the peat fens, where the clay lies sufficiently near; and in districts where an underlying stratum of clay or marl offer a ready means of manuring the exhausted soil above, or of changing its texture and qualities. Ransomes and May exhibited an immense Double-breasted Plough for Trenching, each mould-board being in two pieces, joined by hinges. It is intended to act upon the land in the same manner as double digging, to the depth of from 18 to 20 inches. By removing the left-hand frame, it can be used as a draining plough, opening drains to the depth of 20 inches, or more if required.

Fowler's Patent Improved Draining Plough was also shown: it is stated to execute any drainage above 4 feet deep, at less than half the cost of the present system, and without disturbing the surface soil. In commencing work the plough is taken to one end of the field, and to the other the capstan, off the drum of which is run off a wire rope attached to the plough. The plug and coulter are then dropped into a hole prepared for them, and the pipes are threaded upon a rope attached to the back of the plug; when the horses harnessed to the levers of the capstan, by walking in a circle, wind the wire rope on to the drum, and pull the plough forward with the drain-pipes, which are thus laid more accurately than by hand work.*

Harrows, which are the commonest implements of husbandry next to ploughs, occurred but scantily in the Exhibition: possibly because the forms produced for the last years by the best makers, especially those of Howard and Bedford, leave little room for novelty combined with improvement. The peculiar zigzag shape of Howard's harrows is well known, giving the utmost simplicity to the framing, with the least liability to clog; and the arrangement and fastening of the tines appear all that can be desired in this kind of implement. Some admirable Harrows were shown by Sanders and Williams, of Bedford: the general shape is just like Howard's, and the two outside bulls of each harrow are bent in the same way; but the rest traverse it diagonally, so that a greater rigidity of framing seems to be secured, and a village blacksmith may more easily mend it without making a "bull." One exhibitor had a number of iron harrows hung together so as to cover a large surface, and furnished with short

* This Plough is described more fully in the Year-Book of Facts, 1851, page 92.

levers and small wheels, by pressing on any one of which a portion of the harrow is lifted to clear it from clods or weeds. A "Patent Four-wheel Harrow" was shown by Mr. A. F. Campbell: it consists of two rows of teeth, in shape and fixture resembling those of Finlayson's Harrow; the frame supporting them being slung by four parallel connecting bars from an iron framing upon two large wheels. This upper frame rises or falls in front by means of a lever sliding it up and down on a spindle from two small front wheels; and the frame carrying the teeth can be set higher or lower by a chain wound upon a small barrel with a ratchet. The excellence of the Norwegian harrow is sufficiently established: its rowels are exactly adapted for stirring as well as breaking cloddy land, and for keeping each other clear. Messrs. Barrett, Exall, and Andrews, of Reading, showed one with a simple apparatus for raising the rowel axes out of work, or *vice versâ*. The frame from which they hang is supported, when out of work, upon vertical levers, at the lower ends of which are the wheels, one in front and two behind. This frame is lowered by bringing these into a slanting position, the upper ends towards the horses. They are connected above and below the frame by parallel rods, and the movement is made by a crank with screw axle. Messrs. Crosskill, of Beverley, also exhibited a Norwegian Harrow, which is put in or out of work by levers at each side, lowering or raising it upon its wheels. A spindle runs along the top from a crank or winch to the front of the frame, and by a worm working a toothed segment, sets the fore part of the machine more or less high above a small wheel.—*Gardener's Chronicle.*

Rollers.—Among this description of implements, Crosskill's Patent Clod-crusher undoubtedly stands without rival; its sharp points being as well adapted for pressing and denting in wheats as for breaking and pounding clods, while its loose rings shake out all dirt, and cannot clog. But there were several others of great merit. Mr. Chenery, of March, Cambridgeshire, has invented a "Land-presser," particularly adapted for the light peaty fen land, consisting of fifteen large iron rings upon an axle, the section of the rim of each ring being thus $\sqcup$, the flat circumference rolling upon the ground. Messrs. Mapplebeck and Low, of Birmingham, showed a Roller or Crusher which has two axles, one before the other, and carrying a number of rings with sharp or narrow rims. These rings are about 2 feet in diameter, and about 3 inches apart, working into or between each other. The two axles are braced together at their ends by two bars, upon the middle of which the shaft frame is supported by pivot joints. By this excellent arrangement, the frame bears equally upon each roller, and is free to follow the vertical movement of the horses; while the rollers can accommodate themselves to slight inequalities of surface without altering the position of the shafts. The only implement, however, which appears likely to compete with Crosskill's, is the Improved Clod-crusher, made by Pearce, of Poole, Dorsetshire. This consists of two axles, carrying rings of a peculiar form. The rims are narrow, or sharp, but instead of being straight are waved, or vandyked. One axle has ten rings, and the other eight working between them. The rings are 26 inches in diameter; they are fixed upon square axles, but the centre wheel on each can revolve independently of the rest. As there is an intervening space of 4 inches between adjacent wheels, no clogging can easily ensue; and all the land is subjected to pressure, the clods slipping between the first row of wheels being caught by the second. As the resistance is thus not met all at once, it is supposed that the draught is lighter than it would otherwise be: the width covered is 6 feet, and, on rough land, three or four horses are required. Not having points like Crosskill's, it does not need encumbrance and delay of plain wheels to carry to and from the field; and yet its piercing and grinding power is supposed to be little short of what it would be had the wheels been serrated.

Cultivators or Scarifiers were shown in great variety, each maker having done his best to contrive a good form of tooth or tine, to fasten and arrange the teeth in the most useful and efficient manner, and to scheme the simplest and easiest method for lifting or lowering the frame which contains them. And all are constructed entirely of iron, with the exception of some of the wheels.

Mr. Beart's Patent Cultivator ranks in the first class. The frame is a triangle of cast iron; the tines are fixed in the same way as in the Uley Cultivator, and the method of raising is the same as in that excellent implement—with an improvement. The objection to the Uley wheel and screw is the length of time occupied in turning it; if the simple parallel motion could be effected by the mere depression of a lever handle, it would be the best movement yet invented for the purpose. A smaller pinion, working in that on the wheel axle, is turned by a lever; but while time is saved, the distance raised is, perhaps, not so great as in the Uley drag. To Beart's cultivator are attached two immensely heavy rowels, which either ride upon the frame to weight it, or run behind to break the larger clods.

Mr. H. Cowan, of Corstorphine, near Edinburgh, exhibited a Two-horse Grubber, which obtained the first prize at Edinburgh in 1848, and at Glasgow in 1850. The tines fit by studs upon their sides into mortises in the bulls or bars of the frame. They cannot be set higher or lower. The lift is very simple, but we fear not sufficiently gradual to be done with ease. Ransomes and May showed Biddle's Scarifier, and their West Indian Cultivator. The forms of both are well known; the former being decidedly the rival of the Uley cultivator, as regards its working capabilities, though not so simple in form and mechanism. The Indian cultivator is undoubtedly a good implement; but its double frame gives it a needless complication.

Steam Engines for farmyard use, were exhibited, both as moveable and fixed, in fifteen specimens; some of them of superior construction and finish, and these from purely agricultural counties.

They were all non-condensing, or high-pressure; with tubular boilers, as in railway locomotives. One of the best writers on the subject has predicted the time to be not "far distant when a steam-engine will be one of the matters to be thought of in every well-conducte farm with 300 or 400 acres of arable land ;" and smoke from a tall chimney will constantly give notice that the iron horse is engaged in churning, or cutting chaff, or roots, or crushing oats or beans, or thrashing, dressing corn, or grinding corn, or pumping water, or steaming roots and chaff.

Stanley's Two-horse Portable Engine was exhibited, with improved boiler, by Medworth: to this engine were attached various farm-machines. Messrs. Clayton, Shuttleworth and Co., exhibited their Lever horse-power Engine, for which they have received several prizes at agricultural shows: it is well adapted for counties where there is a great breadth of corn land, and may be made available for many purposes, as well as for thrashing, such as sawing, pumping, or driving the whole of the barn implements upon a farm. They also exhibited an Improved Fixed Steam-engine, having an oscillating cylinder, which greatly reduces the number of working parts, thereby less liable to get out of repair, better to be understood, and easier to be managed than the ordinary table or top-beam engine ; it also occupies comparatively little space when compared with its power.

Mr. Fincham, of Lynn, Norfolk, exhibited a Model of "a Steam and Human Power Cultivator, or Universal Tillage Machine and Irrigator." This appears to be a long gallery or shed, supported above the ground at one end by a sort of pivot, and at the other by an engine-house on wheels. A great number of men are stationed in a row along this gallery, each having charge of a lever shod at its lower end with something like a hoe. The idea seems to be that, while the engine moves the whole apparatus, like the radius of a great circle around the pivot, these hoes or stirrers are to do, by the help of the men, what is required for the land. Along the opposite side of the machine a number of large scissors are designed, apparently for cutting corn. A circular index at the central pivot tells the quantity of ground passed over.

A Steam Farm.—Mr. Tyson, of Selby, contributed a Model of Farmsteads and Buildings, where steam-power is used; displaying an English farmyard, constructed on a scale of 2 feet to an inch, and covering an area of 100 square feet. On the north side are situated the most lofty buildings, in the centre of which stands the barn, containing a steam-engine, thrashing-machine, chaff-cutter, and a pair of millstones for grinding corn for the cattle. Behind the barn is a lofty shed, sufficiently capacious to contain a large corn-stack, which is brought in at once by a truck on a tramway from the stackyard in the rear of the buildings. The sheds, stables, shops, and houses, are commodiously arranged; the fattening sheds being in parallel lines, head to head, with a tramway between them, for the more expeditiously supplying them with food. Between the barn and the fattening-house, is the steaming-house, where all the food for the cattle, pigs, &c., is cooked by steam, from the boiler of the engine, whence it is taken by tramway to the place where it is required.

Above the steaming-house there is a large tank for the supply of water to the cattle-troughs by means of pipes and taps. The tank is replenished by the steam-engine from a reservoir, into which is conveyed by spouts, all the rain-water which falls from the buildings.

Thrashing Machines.—Messrs. Hornsby and Sons' Patent Thrashing and Shaking Machine was shown : in addition to thrashing all kinds of grain, combines a Double-crank Straw Shaker upon a frame, moveable on four wheels, upon which it stands to work, for separating the corn from the straw, with a reciprocating trough beneath, which delivers all that drops through the shaker to a riddle placed on the end of the trough, where all the corn, chaff, short straws, &c. are separated.

Messrs. Hornsby and Sons' Patent Portable Engine, also shown, will thrash quite as much per day as six horses. It is so light in its structure that two horses can easily draw it on average good roads; it can also be applied to thrashing, grinding, sawing, chaff-cutting, and other analogous uses. The engine is mounted upon four wheels, with shafts, and its important construction consists in having the cylinder and its connecting-pipes placed inside the boiler or steam-chamber, being thus effectually protected from the weather and frost, besides diminishing the consumption of fuel; and, in the governor of this engine, the gun-metal caps receive the heavy iron balls when the engine is not in use, and prevent them from swaying about when the engine is travelling. Tuxford and Sons' Patent Six-horse Portable Engine, has all its working parts enclosed, and thus protected from grit and dust and chance of injury.

The Patent Two-horse Thrashing Machine of Messrs. Barrett and Co., has a wrought-iron concave or breasting, formed of separate bars, with serrated faces, working through slots in the sides of the machine, and brought nearer to, or carried further from the drum by means of two circles. These work round its centre with a continuous grooved worm cut on their faces by machinery, in which the endings of the breasting-bars move: and which allowing them to separate wider from each other, as well as more distant from the drum, which gives the larger corn (beans, peas, &c.) a wider space to escape through when thrashed.

But the most interesting feature of this class was M'Cartney and Drummond's Complete Scotch Thrashing Mill, with winnowing apparatus above, and fitted with elevators for raising the corn from under the shakers to the hopper above. The action of this machine is different from the ordinary English ones, as in the latter the grain is rubbed out between the drum and the concase; while, in the Scotch machines it is beaten out, the straw being held between two rollers, and the beaters striking it out as they revolve. This plan was the invention of the celebrated Andrew Meikle, in 1786, and remains the same in principle to this day.

In Clayton, Shuttleworth and Co.'s Thrashing Machine, also shown, the most recent improvement consists in the vibrating trough, which extends the whole length of the machine and straw-shaker, and has a reciprocating motion given to it by means of a crank. By means of this vibrating trough, the whole of the pulse, &c., as it drops from the thrashing-drum and straw-shaker, is caught, and passed over a riddle, under which the blast is directed; thereby effectually separating the corn, chaff, and pulse from each other, each being discharged into the place assigned for them. Messrs. Barrett and Co. exhibited a Six-horse Patent Bolting and Thrashing Machine, with shaking apparatus, mounted upon four travelling-wheels, to thrash from 30 to 50 quarters of wheat per day; the breastwork to be altered, if requisite, in one minute. The same firm also showed Thrashing-Machines, with patent gear, for one, two, or four horses attached; and a Hand-power Patent Thrashing-Machine, with the exhibitor's new patent breasting.

To most of these machines are attached Straw Shakers, by which the grain is prevented from being carried out, and mixed up in the straw: they are generally perforated parallel bars or plates (fitted with screws and teeth), the alternate ones rising and falling with an eccentric motion, so that the straws moved vertically, displaces any grain, and a horizontal movement delivers it at the extreme end of the shaker. Robinson's Shaker differs from others in consisting of wooden plates made to revolve separately in one direction, by means of small wheels at both ends.

The Rotatory Screening Machine, by Mr. A. K. Smith, was exhibited. The materials to be screened are thrown into a hopper, from which they pass into a cylinder from 3 feet 4 inches to 5 feet in length, and from 2 feet 2 inches to 2 feet 6 inches in diameter, and formed of from 80 to 200 rods of various thicknesses, from a quarter to half an inch. These rods pass through four strong rings of wrought iron, and are fastened by a screw at one end, so that each alternate rod can be taken out if required by unscrewing it with a key (sent with the machine), thereby making the width of the mesh double, added to the thickness of the rod. By turning the handle, a rotatory motion is given to the cylinder by aid of a mitre-wheel and pinion; thereby causing the material to be screened to revolve partially with the cylinder until it attains a certain point in the circumference, from whence it rolls by its own gravity down over the wires until it reach the bottom of the cylinder again. The continuous rising and falling of the material over the wires of the cylinder, during its passage from the inlet to the outlet, effectually and with astonishing rapidity, separates the larger parts from the small. For screening coarse and fine gravel, for roads, walks, or building purposes, earths, and other composts, for garden or lawn manures, for effectually separating the waste ashes, &c., it will be found useful.

Boyce's Machine for Reeing Corn and Seeds, was also exhibited; with a novel combined motion given to a sieve, whereby the corn is made to turn over and revolve round. By centrifugal power, the good corn is carried to the outside; the sprouted and moulded corn and rubbish is, on the contrary, worked to the centre of the sieve, when it is taken up by an exhausting apparatus, the small seeds and dust going through the wire bottom of the sieve.

Boyce's Smut Machine was likewise shown: its new principle consists in exhausting the air from the centre of a cylinder armed with iron beaters, revolving 1200 times per minute. This cylinder is enclosed in another, with perforations, through which all the dust and dirt in the corn are driven. Every smut-ball and all the clods of dirt are broken up by the iron-beaters, and at the same time they scour the fibrous end of the corn clean and bright.

Steaming Apparatus, by Richmond and Chandler, was exhibited: it requires no setting for steaming roots, hay, corn, cut chaff, &c.; and is also provided with a self-acting motion to supply the boiler water.

Turnip-cutters, described by Mr. Pusey as among the most valuable improvements in English farming, were represented by five exhibitors. Key and Mitchel's Patent Double-acting Cutter was shown; in which the knives are merely projecting-blades, fastened to the bottom of the machine, which, by a double crank and handle, is moved backwards and forwards, the knives working into sockets cut in the cross pieces, and equally cutting every slice. The other cutters were mostly modifications of Gardner's machines, which cut the roots with two-sided knives fixed upon a cylinder, in a wooden frame, with feeding-hopper, and turned by a handle.

Chaff-cutters were exhibited by 19 inventors. In Richmond and Chandler's new machine, (combining the best points of former machines with improvements on the whole system,) the mouth adjusts itself to any given feed by a weight appended to the extremity of the lever, which keeps an uniform pressure on the upper roller, while it is always at liberty to rise or fall according to the substance which the rollers are receiving.

Mr. Crosskill exhibited an improved Chaff-engine, for cutting straw for litter, which is a great desideratum, and one of the points which has hitherto almost baffled the ingenuity of inventors. In Smith's powerful Chaff-engine, also exhibited, the drawing, instead of the ordinary chopping action of the knife, is much to be recommended, five feet of the knife passing through eighteen inches of the material cut. This has hitherto been almost the only machine that would effectually cut straw into lengths for litter: it cuts, cheaply and effectively, any length, from a quarter of an inch to five inches.

Tile Machines were shown by five Exhibitors. Clayton's Patent Double-action Machine combines the vertical and horizontal working. Brodie's machine makes tiles and pipes of various sizes, and makes from 10,000 to 12,000 2-inch pipes per day, or the driving speed may be brought to produce from 12,000 to 18,000 pipes in ten hours.

Hay-making or Tedding Machines were well illustrated by Wedlake, Burnett, and Smith.

Churns were numerously represented. Some of the specimens were in metal, to be immersed in a water-bath, so as to regulate the temperature. Among the square box Churns, one had a novel rotatory movement, vertical. Anthony's Double-acting American Churn was shown; in which, by a simple contrivance, the particles of air are quickly separated from the cream, without the slightest froth on the latter—the great desideratum in butter-making: this churn can produce butter from the cream in twelve minutes, and not only better in quality, but more in quantity, than the ordinary churn. Among the Dairy Utensils, some beautiful specimens from the Vale of Ailesbury, were exhibited by Mr. Jolly. In the Swiss and other foreign departments, were utensils of the same description.

Grinding and Crushing Mills.—Among the specimens exhibited was Crosskill's Universal Mill, with almost unlimited powers; flints, coprolites, bones, &c., being reduced to a fine powder with apparently as much ease as barley or wheat. It also splits beans, bruises oats, crushes linseed, &c. Its action consists in two plates running in the same direction, and at the same velocity, but not on the same centre; hence it is sometimes called the Eccentric Mill.

Next was Deane and Co.'s Domestic Flour-mill, which dresses and separates the flour, seconds, and bran at the same time, and in such a manner as we should not have expected, in so small a machine, which is a good and effective hand corn-mill, for occupiers of small holdings and emigrants.

Westrup's Patent Conical Flour-mill, also exhibited, has conical stones in lieu of horizontal ones, with a working surface of only eight inches instead of two feet. By the first pair of stones, the wheat is broken and delivered in a state of half-ground meal, unheated; and, by the natural laws of gravity, the flour is instantly passed through a wire cylinder, fixed beneath, by the aid of brushes fixed upon the same shaft as the stones. The flour being thus instantly separated from the unground meal, the latter passes down to the second pair of stones also fixed upon the same shaft, and the grinding is then completed. The lower, or running stones, are keyed upon the shaft; whilst the upper or stationary stones drop into a turned ring, necessarily rise and fall upon four inclined planes, and are capable of regulation to the utmost nicety.

In this class was also exhibited Ashby's Vertical Dressing-machine, and one for dressing flour in vacuum; Millington's Patent Smut-machine, a valuable improvement—a mill worked by levers, with the same action as is used in rowing; Samuelson's presses for manufacturing oil-cake; and an improved form of gutter, being the last eaves-tiles bent into the shape of a gutter, ingeniously joined, and secured to the eaves-board. This specimen of roof is composed of different kinds of tiles, and a stream of water was constantly flowing over it, to test its capability.

Reid's Washing and Mangling Machine was exhibited. It consists of an adaptation of Mr. Reid's lever mangle, combined with a washing-tub of novel construction, into which the clothes and water are thrown, shut in, and thoroughly washed by machinery; after which, by an equally simple process, they are well wrung. This is managed by placing the wet clothes in a stout netted bag, and the bag—not the article that is in it—is twisted so that the water is thrown off, not by being screwed out so much as by simple pressure.

Pumps.—There were shown some excellent varieties of pumps, adapted to agricultural purposes, for lifting or forcing liquid manure, or water; also some small fire-engines, suitable to farmeries.

Carts and Waggons.—There were but few Waggons shown; but the Carts presented novelty in carrying the draught, the placing of shafts, the tilting apparatus, &c. Mr. Crosskill exhibited some Carts and Waggons, fitted with his Improved Wheels: of these wheels he exhibited a variety of specimens in another department.

Apparatus for Sheep-dipping, or washing; and for weighing farm stock, (live or dead,) or loaded carts, were also represented.

A Centripetal Barrow, invented by T. Windus, Esq., F. S. A., was exhibited: the wheels on the sides move to-and-fro, loaded with half a ton weight, by a slight impulse, without any pressure on the arms; and two wheels or one can be placed in front of the barrow, with four rotatory movements, to cross ditches, &c., on a plank, or otherwise; a moveable wire-rack may also be placed on the barrow.

Models.—There was shown a model of Farm Steading, formed of galvanised corrugated iron; also, Garrett's model of a Thrashing-barn, fitted with the necessary gear. In this class, likewise, was placed an elaborate model of Mr. Mechi's much-talked-of Farm; showing every detail of his practice; with moveable roof, for the inspection of the machinery, &c.

Bees, and Bee-hives.—There was a Great Gathering of Bees in "the Palace of Industry," which were variously distributed; and, by a simple contrivance, the Bees had egress and ingress through the Great Building without molesting the visitors. The improved Hives and Apiaries were far too numerous to be detailed here: the novelty in the hives consists in the facilities for taking the honey at any time of the gathering season, without destroying or even injuring the bees. Some Glass-hives, and hives with moveable bars, were also shown. (In the *Illustrated London News,* Nos. 519 and 521, see notices of the several Bee-houses, &c., by Mr. F. Whishaw.)

The largest number of *Foreign Agricultural Implements* were in the United States department. They consisted of Ploughs, all remarkably heavy in appearance, full breasted, high framed, and having the stilts unusually short and elevated, with the holding part inclined at a flatter angle. There were Horse-hoes, Grubbers, Cultivators, and Drills, and two specimens of remarkable machines for reaping corn.

Cormack's American Reaping Machine was the principal implement exhibited here. The principle of the cutting action is a blade about an inch in breadth, slightly toothed on the front edge, and extending the whole breadth of the machine, a quick reciprocating motion being given by a crank. The straw, as the machine moves round, passes into the space between the projecting fingers, and is sawn off by the cutter. Directly over the blade is a light reel, with flat transverse blades of deal, set at a slight angle with the front of the machine, revolving as it moves round, and holding the straw firmly between the fingers, and against the blade while being cut. When the corn is thus cut, it falls upon the floor of the machine, and is removed by a man who sits on a saddle-shaped piece of the machine, and is carried forward with it. In the *Cultivator*, an American work, this machine is described to "cut all the grain; and, if the raker is careful, none is scattered; and if the binders carry a rake and use it, none need be lost. Fields harvested by these machines have a beautiful appearance. The stubble is uniform in height, while no prostrate scattering straws speak of waste. If the binders have felt at all interested in doing their work well, there is nothing to glean with the sickle, bagging-hook, or rake. Weeds, brush, pitchforks, rakes, if standing in the way, or even horses' legs, are all cut smooth alike." This implement has been rewarded with one of the Great Exhibition Council Medals; and it was shown at work at Mr. Mechi's farm; at Farmingham; and the Agricultural College at Cirencester; and, wherever the crop stood at all well, it was removed with perfect precision and evenness, both on level lands and on the most rapid declivities and curves, at the rate of fifteen acres per day.*

In the Belgian department were a number of the usual kinds of Grubbers, Land-pressers, Horse-hoes, Drills, and some Ploughs. In the department of France was a Wool-cleaning Machine, and some specimens of Corn-mills. Denmark exhibited a large well-made Chaff-cutting Engine. Switzerland sent a Double Plough, and some good specimens of Dairy Utensils. Austria sent Scythes, Reaping-hooks, &c. In the British Colonial department, some Wooden-framed Ploughs, very similar to those exhibited by the United States. In the same department were specimens of Hay and Manure-forks, Scythes, and Malt Shovels.

MINING OPERATIONS, AND MINING MACHINERY.

The objects in section 1 of the Exhibition which included Mining and Metallurgy, were extremely varied. They comprehended specimens not only of all the more important mineral ores, building-stones, gems, and native metals; but also numerous illustrations, both of their useful applications and of the several processes by which

* In the *Scots' Magazine* for 1762, page 404, is an Engraving of a machine invented by Peter Williamson, whereby a man might "with his own hands cut down several acres of corn in a day," or do the work of six shearers. The Edinburgh papers of August 1762, record "that several successful experiments were made with Williamson's machine in different fields in the neighbourhood of that city; and in September of the same year it is stated, that a "further experiment was made with the new machine for cutting down of corn; when, in presence of many gentlemen of character, Mr. Williamson cut down, in the space of an hour and twenty minutes (including the time of whetting the machine), a full quarter of an acre of barley, measured off for the purpose, which he laid in the most regular order." Other attempts have been made with Reaping Machines in Britain: including one to cut by a series of clippers or shears, and another by a revolving plate. In 1827, the Rev. P. Bell received a premium from the Agricultural Society of Scotland, for a machine that cut a breadth of 5 feet, and did its work exceedingly well.

the natural productions of the mineral kingdom are made subservient to our daily wants. We shall not specify the several collections of specimens; but rather pass on to the Models of Mining Operations and Mining Machinery, as the more interesting portions of this class.

Mining Pumps.—An ingenious Compound Valve for large Pumps was exhibited by Mr. Hosking, of Falmouth, by which the loss of power from raising the water on the piston is obviated. In this model, the piston works air-tight, and raises the water above a valve opening upwards during the upward stroke, and in the downward stroke forcing it through another valve at the side, which is opened by the pressure of the water, and closes from its own weight when the pressure is removed, and thus preventing the return of the water.

Steam Crane.—Mr. Gowans, of Edinburgh, exhibited a Model of a Steam Crane, with travelling gear, worked from a horizontal shaft, and capable of raising 20 tons; and a Drawing of another Steam Crane, worked by crab gearing, attached to a horizontal steam-engine, and capable of raising 50 tons. The same inventor showed a Drawing of a Boring Machine, used in Redhall quarry, and with which holes are bored to a depth of 40 or 50 feet, of from 3 to 6 inches diameter. There was also exhibited a specimen of Bitumen used in conjunction with a Galvanic battery for separating the large masses of rock in the quarry, some of which have exceeded 6,000 tons weight.

Quarrying Machines.—Messrs. Randell and Saunders exhibited models of a remarkably successful adaptation of Machinery to Quarrying. The first model shows how saws are driven, for the purpose of cutting the stone in its natural beds. The machine has eight saws, 24 feet long: which lying downwards at an angle across the bed of stone to be cut, act by their own weight, and are worked up and down by cranks. When the stone has been thus cut across, it has to be taken out by means of wedges; then removed by a traversing crane, which, as well as the saws, is worked by steam. There was also shown a model of a Portable Balance Saw Frame, for cutting blocks of stone after having been quarried.

Safety Fuse and Blasting Cartridge.—The Safety Fuse for igniting the charge of powder in blasting is a very valuable invention; it consists of a tube made of coarse canvas, and covered on the outer surface with some kind of pitchy or bituminous matter, which will render it impervious to moisture; the tube is filled with gunpowder in such a way that the fusee burns with a uniform rapidity, and gives the men sufficient time to get out of the way of danger. This, although inferior to the use of the galvanic battery, is a great improvement upon the practice of using a rush filled with gunpowder.

By the side of this Fuse were several Blasting Cartridges, the object of which is to prevent the accidents which occur in "tamping or ramming the powder down with sand or clay, as well as to save the time which is taken up in drying blast holes that are wet. These cartridges are made of all sizes, and by boring a piece of the above-mentioned fusee down into the middle of the powder, it is fired in the centre, and the greatest effect produced. They may also be used under water. The Fuse is invented by Mr. Brunton, and the Cartridge by Mr. Copeland, of Pendennis.

Model of a Coal Mine.—No one, even amongst those who have themselves practically explored Coal Mines, could fail to be struck with the clearness of perception which was obtained of such works from this model, sent from the Northumberland and Durham coal-fields. Thus we have, first, those parts of the works which are above ground exhibited, such as the mouths of the shafts and the engines which work them. There is, first, the shaft by which the coal is raised; next, that by which the mine is drained; and third, that by which it is ventilated. This latter process is usually accomplished by a furnace, which creates a draught of air up one of the shafts, which is necessarily followed by currents of air down the others.

In the lower part of the model is exhibited the state of the workings. The beds of unworked coal are represented by a black *stratum*, the workings being exhibited by cuttings through it; the railways being shown upon which the waggons move, in which the coal is brought to the bottom of the shaft, through which it is elevated by the power of the steam-engine erected at the top.

The partitions and other contrivances to regulate the ventilation of the works, are represented by brick-work in this interesting model. The timber supports used for sustaining the roof of the workings are also shown.

This model suggests the prodigious depth at which this subterranean industry is carried on. In some cases, the depth of the workings is 1800 perpendicular feet, or one-third of a mile; and the area of a single set of pits sometimes amounts to 1000 acres. The manner of working the beds may be collected, in some measure, from inspecting the model. The coal itself is first cut in narrow galleries—that is to say, a space is excavated 12 feet high, and 4 or 5 feet wide—and such a gallery is continued in a given direction for a certain distance, as represented in the model. Others are then excavated parallel to it; afterwards, a series of similar excavations are made at right angles to these; the result of which is, that there will remain square pillars of uncut coal, formed by the intersection of these rectangular galleries, and the plan of the bed will resemble a chess-board, the black squares indicating the uncut pillars, and the white the open cuttings; only that the square pillars do not touch each other diagonally, as in the case of the chessboard. The use of these square pillars is to support the roof, which would otherwise fall in. After the bed has been worked in this way by parallel and rectangular galleries, the square pillars of coal are removed, one by one, and the roof of the working is allowed to fall. This method of working a coal mine is called technically the method of "pillar and stall."

The apparatus for the ventilation of the mine, as indicated in the model, is extremely important, inasmuch as upon its efficiency the safety of this class of industrial labourers mainly depends. The gas which, by artificial processes, is extricated from coal for the purposes of illumination, is found to issue spontaneously from the coal in the mine in more or less quantity; so much so, that, by holding a candle against the walls of the workings, jets of flame may be often produced. When this gas is mixed in a certain proportion with atmospheric air, which fills the workings—a mixture highly explosive—if a flame or spark comes in contact with it, a destructive catastrophe ensues. Good ventilation prevents this evil. The current of air kept continually flowing through the workings, descending at the shafts No. 1 and No. 2 in the model, and rising at the shaft No. 3, is a safeguard against the evil;* but, as this ventilation sometimes fails, a further security is afforded in the safety lamp, which, as is well known, is a lantern surrounded with fine wire gauze instead of glass or horn. This wire gauze has the property of preventing the passage of flame through it. Flame is nothing more or less than gas rendered luminous by intense heat. In passing through the wire gauze, it parts with so much of its heat to the metal of the wire, that when it has issued from the meshes, it loses the character of flame, and is incapable of producing explosion.

According to the returns, it appears that in the Newcastle and Durham coal-field, represented by this model, there are about 200 pits or different collieries, employing 26,000 pairs of hands, the value of the coal at the port where it is shipped being about 11s. per ton. The extent of the coal area in Northumberland and Durham is, in round numbers, 500,000 acres, and, consequently, its total contents amount to not less than 10,000,000,000 tons of coal, of which 1,500,000,000 only have been worked. The present annual consumption is estimated at 10,000,000, including the waste; and it consequently follows that, at this rate, it would take above *eight centuries* to exhaust this single field!

We had samples from South Wales, accompanied by models of the apparatus used for shipping the coals at Cardiff dock, where 400 tons per day can be shipped by steam power from a coal field presenting about 600,000 acres of coal area, consisting of the sorts best adapted for steam navigation, and thence called "steam-coal." There were also specimens from the Derbyshire, Forest of Dean, and South Yorkshire, Nottinghamshire, and Derbyshire Coal-fields.

It appears, in fine, that the total extent of coal area of the British islands amounts to 12,000 square miles, being about one-tenth of the entire area of the country; their annual production being 32,000,000 tons.—*Abridged from the Times.*

Ventilation of Coal Mines.—An apparatus for this purpose was exhibited, together with a Sectional Model of a Coal Pit Shaft, to illustrate its working, by the inventor, Mr. Cawley, of Soho, near

* In some of the great old mines near Newcastle the air has to travel through upwards of seventy miles of passages before it arrives at the furnace to which it is steadily moving, and it is calculated that from 24 to 30 hours are consumed upon the journey.

Birmingham. The means by which he proposes to remove the foul gases from the mine are the following:—A revolving fan is fitted into a close case, which is connected with a series of sheet-iron pipes fitting into each other ; these are carried along the roof of the workings as far as they extend, and into the cavities called "goafs," filled with foul air. When a rotatory motion is given to the fan, it acts as a pump, and draws up through the pipes all the air which is contained in the gallery and passages of the mine; this tends to create a vacuum, which is immediately counteracted by the pure air which rushes in at the top of the shaft, and replaces that which is removed by the fan. The fan may be either an ordinary blade one, or in the form of a screw, according to the circumstances of the case. This apparatus is capable of displacing 7000 cubic feet of air in one minute, when driven at a comparatively slow rate, and in about thirty minutes would so completely clear out the largest mine as to render it perfectly safe. The expense attending its use is very small; it can be worked by the winding engine for about half-an-hour before the miners go down. Another advantage is, that it only requires one shaft, instead of making the expense of an upcast and downcast shaft necessary.—*Daily News.*

Safety Apparatus.—Messrs. White and Grant, of Glasgow, exhibited a Safety Cage for drawing up the materials or men from the mines. Mr. Fourdrinier, of Sunderland, exhibited, in model, his ingenious and simple invention, for preventing shaft accidents caused by the breaking of the rope; and beside it was shown another contrivance upon the same principle. The method is strikingly intelligible. The pressure upon the rope when the car is ascending or descending—"riding," as it is called in Northumberland and Durham—bends back, and renders inoperative, certain spring clasps, which, however, the moment the strain upon them is relieved by the parting of the rope, leap out, as it were, on either side, and catch hold of the upright beams down which the car slides, thus holding the whole machine suspended in the shaft until assistance reach it from above. In Mr. Blee's model, the shaft is provided with a set of metallic notches, like those which prevent the back play of a winch, and, on the cessation of pressure, the motion of the car is arrested in an instant by projecting pieces of metal, which at once change their position, and become fixed in the notches.

Ventilation, Dressing Copper Ores, &c.—Mr. Mills, of the Fox Hole Collieries, near Swansea, exhibited a model of his invention for opening and closing the doors which are used in the galleries of mines, by the aid of which he proposes to obviate the necessity of employing boys for the purpose. The object is effected by a reversion of levers, which are so attached to the doors, that the carriages close the door through which they have just passed at the same time that they open the one through which they are to pass. The levers act the same whichever way the carriages are going. This arrangement has been adopted in the collieries of C. H. Smith, Esq. of Llansamlet, with satisfactory results.

After the ores have undergone a rough process of picking in the mines, to separate the pieces of rock and other matter which are not of any use, it is still necessary that they should be subjected to some more effectual method of purification before they are fit for smelting. The way in which this is done with many ores is to reduce them to powder, while a current of water is running more or less rapidly over them, which carries the whole away in the form of a fine mud. This is made to traverse a long series of channels, called the labyrinth, and sometimes is passed through sieves or gratings. In its passage, the metallic particles are first deposited, in consequence of their superior density, while the lighter earthy matters are washed away. The machines which were formerly used for puddling the ore, consisted of a series of wooden pillars, armed at the lower end with a heavy lump of iron, and having projecting arms about their middle; these were arranged perpendicularly in a wooden framework, at the side of which was fixed an axle, on the surface of which were arms, placed in such a way as to come in contact with an equal number of those on the stampers, and thus to raise them in succession. The ore was placed in a trough under the stampers, powdered, and washed away to the channels and vats for separation. The axles are turned either by hand or water power—in some cases by steam.

Mr. Hosking exhibited a Reversing Apparatus for Stamping Machinery, by which the handle may be turned either way in order to move the stamps: it has also the advantage of giving a better purchase over the machine. Latterly, these machines have been partially superseded by crushing-rollers, which are far superior. One of these is erected at the Tywarnhaile Mines, in Cornwall, the property of his Royal Highness the Prince of Wales. A model of it was exhibited by Mr. Taylor. The cylinders are made of hardened cast iron, and are either plain or fluted—the latter for breaking the larger and harder fragments. The ores are brought in waggons on a tram-road to the machine, and are then shot into the hopper which feeds the cylinders; one fixed, the other moveable, so that the fineness of the powder to which the ore is reduced may be regulated by their distance. By means of a weighted lever attached to the moveable cylinder, a slight liberty of motion is allowed, so that any very hard lump may pass through without stopping the machine or damaging the cylinders. After being crushed, the ore falls into a cylindrical sieve called a shaking trunk, which is kept continually rotating; the fine part falls into a trough, by which it is shot into a waggon, and conveyed on another tram-road to a large reservoir, into which it is thrown. Several currents of water fall upon it here from a canal at the top. It is here stirred up, and run through sluices into another cylindrical sieve, which separates the rough pieces from the smaller; the latter is run by water through a long channel into a trough, where it is agitated by arms fixed on an axle. This is repeated several times, with some modifications, until the ore is sufficiently purified. Every part of this machine is moved by the same power. It crushes and washes the ore more rapidly and cheaply than any other. It is capable of crushing and sifting 20 tons of the best ore fit for sale in one hour, at a cost of $1\frac{1}{4}$d. per ton, 10 tons of drage ore in the same time, at a cost of $2\frac{1}{2}$d. per ton, or 10 tons of halvans at $3\frac{1}{8}$d. per ton.—*Abridged from the Daily News.*

Washing Minerals.—Messrs. Boyd and Hunt exhibited respectively two Machines for Washing Minerals. The practical use of the latter is proved by the fact of the inventor having obtained 550,000 francs worth of silver and lead by its use, from the debris of the old mine of Pont Pean.

Copper-Mine.—Mr. A. Richards, of Redruth, exhibited a Sectional Model of East Pool Mine Copper-lode, Cornwall; showing the direction and underlies; the excavations with the lodes undeveloped, and whether worked profitably; the levels, winzes, pitches, &c., being labelled.

Models of Veins.—Mr. Sopwith, F. R. S., exhibited a collection, illustrative of the Geological position and usual products of the North of England Lead Mines, including a series of Models, to illustrate Mineral Veins, exact duplicates of a series made for the Museum of Practical Geology.

Lead Mines.—The Duke of Buccleuch exhibited a Model of the Furnaces and Pots employed on his Grace's Mines, at Wanloch Lead-hills, in Dumfries-shire, for separating pure silver from the rich lead ore of that district; the operation depending upon the property of lead in weak alloys of crystallizing at a certain temperature, at which moment the crystals can be extracted, and thus separated from the silver mass. There was also shown a Model of the Lead Vapour-condensing Apparatus, at the above mines, as improved by the Duke of Buccleuch.

Mining and Quarrying Tools.—The picks, borers, &c., used at the Abercarne collieries, were exhibited. The forms of the picks are essential; and cast-steel borers have been advantageously substituted for iron ones with steel ends, in working hard rock. The relative size of the bits and stocks is novelty in the manufacture of these tools. Adjustments for blasting by galvanism were likewise shown; with the gutta-percha Hogar-pipe, for drawing water from the bottom of the shaft.

Pattinson's Desilvering Process was illustrated by a series of model pots, slabs, and crystals.

Cumberland Lead.—Mr. Brockedon exhibited some interesting processes, by which the powder of Graphite, or Plumbago ("black lead"), otherwise almost useless, is rendered available for the manufacture of fine pencils. The mode is by extremely powerful compression: the mineral, in powder, is deprived of air under an exhausted receiver, and then condensed in a dry state, a mass weighing 7 ounces being consolidated by two blows in a press, with a force of 5000 tons, leaving it compact and solid; from these blocks is cut the lead for pencils; and the process has almost superseded the necessity of having the mineral in the rarer and more expensive form.

ORNAMENTAL IRON-WORK.

The Art of Ornamental Iron Casting in Britain was illustrated in the Exhibition by stoves, grates, balustrades, garden-seats, and other utilities, rather than merely ornamental accessories, such as groups of figures, statuettes, or vases; although there were some meritorious works of the latter class.

Messrs. Hoole, Robson, and Hoole, of Sheffield, exhibited Grates and Chimney-pieces of dead polish steel, combined with bright steel, showing an adaptation of tasteful classic forms in new combinations and artistic arrangements.

Messrs. Stuart and Smith, of Sheffield, exhibited a Grate, in the Alhambra or Moresco style, introducing light bronze effectively with enamel blue. The castings were excellent, and the stoves tasteful in form and ornamentation.

The Coalbrook-Dale Company exhibited a lofty dome, supported by six pilaster-like columns of open rustic-work, the double stems of which are interlaced with ornamental details of the same character. From these stems rise branches of oak, which form the arches for the springing of the dome, the leaves and details being admirable examples of casting. Each column or pilaster is surmounted with a cleverly modelled falcon as a finial; and from the centre of the dome springs a vane, surmounted by a winged Mercury. Beneath the roof is a large Eagle. Within was placed a Gothic Garden-seat, a very excellent example of casting, and the adaptation of a given style of ornament to a special purpose; the Gothic details are well introduced in combination with the rustic-work which forms the basis The same Company also exhibited an Ornamental Fountain of Cast-iron, bronzed, (Cupid and the Swan,) designed by John Bell; and an Ornamental Park entrance of cast-iron, bronzed, consisting of a pair of Principal Gates, and two Side-gates, hung on iron pillars of new construction; each of the four gates was cast in one piece; from the original design by Charles Crookes.

A Cast-iron Ornament, exhibited by Messrs. Baily and Sons, was "not only in good design, but in the *casting* of the foliage, which appears intended to revive and imitate that beautiful class of old *wrought*-iron of 1700, which is so much admired by travellers in Spain, the Low Countries, and Southern Germany. In looking over the many examples of ornamental iron-castings, we have not observed any attempt at such very full relief (technically, undercut work), it being generally the practice to construct the design in such a manner as to allow the pattern to be readily lifted from the mould; a practice which can never give the fine effect produced in this instance, each individual leaf being in itself an elaborate casting, and both sides of the work being equally ornamental."—(*Illustrated London News.*)

Berlin Iron-Castings.—The perfection to which those works may be carried in the smaller kinds, if used for personal decoration, was well illustrated by the examples exhibited by A. F. Leymann, of Berlin. Instead of massive columns, was delicate tracery, so minute as to require careful examination to detect the lines; in finger-rings, ear-rings, brooches, bracelets, and caskets, all highly decorative.

A casting of low paneled Balustrade was very bold and effective. Some exquisite Ornaments in Steel wire, (chains, bracelets, pins, and purses,) showed to what extent this beautiful art may be carried in skilful hands.

The Raised Letter-Castings of Fehr and Eiserung, of Augsburg, for the purpose of embossing books for the Instruction of the Blind, were admirable examples; whilst the more ornamental specimens of A. R. Seebers and Co., of Offenbach, displayed great excellence in design and workmanship, the castings being very pure and delicate.

Amongst the useful articles may be instanced a Steaming Apparatus, by F. A. Wolff, of Heilbrun, in which the classic decorations of the iron chamber were admirably adapted to the rectilinear form required.

H. C. Graamans, of Rotterdam, (Holland,) exhibited two pretty stoves, the design and casting of which were admirable; the perforated side panels being excellent examples of modelling. An Embossing Roller, exhibited by Nering, Bogel, and Co., of Devintre, was also a very superior specimen of skill in iron-casting: this is used for calendering Utrecht velvet.

French Iron Castings.—The balustrades of M. Boidé Martin, of Paris, were excellent examples of their class; and a casting, intended for the end of a bedstead, exquisitely designed in the Italian style, was a fine example of workmanship and adaptation of material. Dietrich and Sons, of Niederbrun, Lower Rhine, exhibited some excellent examples, in which bold modelling is combined with fine casting.

The Statuettes and groups of figures in iron were very numerous.

Among the larger objects were the examples exhibited by M. Matifat of Paris, whose tazza is a very boldly-designed and admirably executed work, of 5 feet in height, and 8 feet in diameter. It is in the style of Louis XIV., and is an excellent example of the bolder features of that school of ornament. Near this was a fountain, by M. André, Val D'Osde.

THE VIEILLE MONTAGNE ZINC COMPANY'S CASTINGS.

The great variety of specimens in the Exhibition, demonstrated the progress within 50 years in the production and manufacture of Zinc; and the Vieille Montagne Mining Company claims the merit of having introduced the following great and useful applications, viz.:—1st, The Cheap and Solid Zinc Roofings on Buildings; 2nd, Zinc Sheathing for Ships; 3rd, Zinc Casts, imitating Bronze; 4th, Zinc Oxides for Paints, as a beautiful and healthy substitute for Poisonous White Lead.

The most important work of art in Zinc was the Statue of Queen Victoria on her throne, undertaken by the Company, in commemoration of the Great Exhibition. This Statue, cast with the Metal from their mines, is 21 feet high from its basis, and was commenced and brought to its present state within three months. The design and modellingare by the celebrated M. Dantan, Ainé, of Paris. The etchings of the Pedestal are by M. Lenormand, Architect, and produced by M. Harduoin, Ornamental Sculptor, both of Paris. The Statue was cast at the Foundries of the Company, in Paris, under the immediate inspection of M. Paillard, Paris. The Company also exhibited its sundry products, and specimens of Zinc Ores, amongst which was a block of Polished Rock Calamine, weighing 9 cwt.; Raw Zinc, or Coke Spelter, of the purest quality known; samples of White and Grey Oxides of Zinc, used for paint and cement, as a substitute for White Lead and Minium; extraordinarily massive thick Rolled Plates; sheets rolled 30 feet in length; sheets for Roofing, and for Ship Sheathing; Zinc Bolting, four times cheaper than Copper Bolting; Busts cast in Zinc, imitating Bronze; Statuettes, Groups, &c., for Clocks, Chandeliers, and Lamps, all of Zinc Bronzed, Ormoulu, and Gilt; Stamped Mouldings in Zinc; splendid model of a Great Door, ornamented with Zinc Mouldings, and painted with Zinc paint; Sugar Moulds in Zinc; new form of mould for Manufacturing Wax and Spermaceti Candles; Model for preserving one and two cwt. of Gunpowder; Howitz Bombs of Zinc; two models of Ships, made by Mr. Philip Trant, of the Royal Dockyard, Port of Plymouth, one sheathed with Zinc and the other bolted with Zinc Bolts; also, casts in Zinc; busts of Her Majesty and Prince Albert, life size; and a statuette of the late Sir Robert Peel. There is also published a list of 335 English and some Foreign Ships sheathed with Zinc in the Ports of Great Britain within two years and a-half.

IBBETSON'S CASTINGS.

Three kinds of these beautiful Castings were exhibited; and each may be said to contribute a new power to the manufacturer. The first of these comprised Castings in Brass from works of nature, in which Capt. Ibbetson has rendered the leaf with all its detail, in a manner not heretofore accomplished. Chantrey some years ago had a high appreciation of casting from nature, and he devised means by which the object was encased in clay, baked, and then the powdered part driven out by means of a current of air; but he could only take one cast from a mould, whilst Captain Ibbetson states that he can make any number of copies. He exhibited, also, a casting, of brass, of a raised map of the Isle of Wight, made from his own surveys.

The second kind of casting consists of deposits of an alloy of gold and copper by electrical agency, in the highest degree difficult, because the current will reduce that metal which requires least force, to the exclusion of the rest. Ibbetson states, that his specimens have been analysed, and are found to consist of an equivalent of each metal—a fact of much interest to the chemist. By this plan he has covered the fairy-like maiden's hair-fern, the pitch-plant, the humming-bird, and many other curious species which he has procured from the national gardens at Kew.

The third invention consists in a new mode of bronzing iron. He states by his plan he contrives to throw the bronze, as it were, into the texture of the iron, and that it dispenses with the use of varnish or any other similar substance.—*Illustrated London News.*

LOCKS.

The collection of Locks exhibited was very numerous; but we shall not be expected to detail their peculiarities.

First, were several historical illustrations of Lock-making, in Roman, old French, Mediæval, and old English specimens.

A contrivance by Aubin, of Wolverhampton, contained the movements of the most celebrated locks, (37 specimens,) which, with their connected mechanism, contained upwards of 3000 parts, all put in motion by the arm of a lever communicating by hidden works.

Bramah's Locks were represented by the padlock, which for many years has been exhibited in the window of Messrs. Bramah's shop in Piccadilly, with a promise of 200 guineas to any artist who would make an instrument that would pick or open the lock. There were also other specimens of Bramah's locks: the principle consisting in an arrangement of slides, each with a peculiar motion, which fall into notches in a shot-bolt, and detain it there; and as each slide will do this, it ensures great security.

Messrs. Chubb contributed specimens of their Patent Detector Locks and Latches. Each lock consists of six distinct tumblers (except in the very smallest sizes), working on a centre pin; all of which require lifting to various heights by the key before the lock can be opened or shut; and not until each tumbler is lifted to its proper position, can the stud, which forms a part of the bolt, pass through the slots in the tumblers. A "detector," forming the peculiar feature of Chubb's lock, is added; and, in the event of either of the six tumblers being overlifted, in an attempt to open it by a false key or picklock, one of them is caught by a detecting spring in such a manner as to render it impossible to open the lock on the application of its own key. Notice is thus given of the attempt, and the lock may be set right by turning its key in a contrary direction, as in locking.

In design the locks were of various styles, Norman, Gothic, Elizabethan, &c., with appropriate steel and ormoulu mountings, and richly ornamented keys.

The Patent Quadruple Lock for a Banker's strong-room door, consists of a combination of four separate and distinct locks in one, all being acted upon at the same time by a single key with four bits. For further security, there is a check lock in addition, throwing a hard steel plate over the large key-hole. The patent rim lock contains eighteen tumblers, with three different detectors, each acted on by six of the tumblers, and has been constructed to show the principle of Chubb's three different patents, dated 1824, 1833, and 1847.

The Patent Fireproof Banker's Safe is made of wrought iron, the iron of the body being ½ inch thick at the thinnest part, and the doors 1 inch thick, the whole being lined throughout with hard steel plates to prevent drilling. To render the safe fireproof, it is lined with two separate and distinct chambers, 6 inches thick, filled with dried non-conductors of heat. The interior is fitted up with drawers, cupboards, &c,, in a manner suited to bankers' or merchants' use. The folding-doors are secured by two patent detector wheel locks, throwing twenty-eight bolts out all round, and are further fitted with case-hardened iron scutcheon locks over the keyholes of the principal locks. Its dimensions are 6 feet 6 inches high, 4 feet wide, and 3 feet deep, and its weight is 3 tons 5 cwt.

Messrs. Chubb also exhibited a Model of their Patent Well Safe, by means of which a safe containing any valuable property can be lowered to any distance below the surface of the ground, and secured by a fireproof door and framework at the mouth of the well.

In the United States Department was exhibited Newell's Patent Parautoptic Bank Lock, by the proprietor, Mr. A. C. Hobbs. Its most important feature is that the owner can, with the greatest facility, change the interior arrangement to a new and more complex one at any moment he pleases, simply by altering the arrangement of the bits of the key; and this is accomplished without removing the lock, or any part of it, from its position on the door. Its operation is as follows:—At the closing or locking of the lock, whilst the bolt is projecting, the moveable combination parts assume precisely the position prescribed to them by the key, according to the particular arrangement of its bits at the time the key is turned The combination parts do not consist in one set of tumblers only, such as are found in most other locks, but there are three distinct sets or component parts, fitting into each other. When the bolt is projected, it dissolves the mutual connexion of the constituent pieces, and carries along with it such as are designedly attached to it, and which assume the particular positions given them by the key in its revolution. These parts are rendered permanent in their given form by means of a lever adapted for the purpose, while the parts not united with the bolt are pressed down by their springs to their original places. If now the bolt is to be returned again—in other words, if the lock is to be unlocked—the constituent pieces, or tumblers, which are in the original state, must, by means of the key, be again raised into that position in which they were when the lock was closed; otherwise, the constituent parts attached to the bolt would not lock in with the former, and the bolt could not be returned. Nothing, therefore, but the precise key which had locked the lock can effect the object. This lock is said to have another peculiar feature, one of considerable value, that it will withstand the action of gunpowder.—*Illustrated London News.*

One of the results of the Exhibition has been the picking of a lock of Chubb's make, and Bramah's Padlock, by Mr. Hobbs. A long controversy ensued as to the actual compliance with the conditions of picking: the case of Messrs. Bramah was referred to a Committee of arbitrators, who, having witnessed certain experiments, decided that Mr. Hobbs had picked the lock without injuring it, and Messrs. Bramah accordingly paid him the 200 guineas; though he had used three or four instruments, instead of one, stated in the challenge.* The *cui bono* of the affair has been thus pertinently illustrated:—"The public, while they admire the expertness with which this mechanical feat has been performed, will not attach more importance to it than it deserves, or undervalue the merit of our best locks, because an American operator, highly accomplished in such matters, has succeeded, after an arduous struggle, in opening them. The facilities given to him were such as no thief could ever possess, even if he had the necessary ability; and it is quite clear that the operation has not been one of ordinary picking."—*Times, Sept.* 4.

The Safe for the Koh-i-noor Diamond, the work of Messrs. Chubb, may be described here. It consists, first, of an octagon table, the top and sides of half-inch wrought-iron plates, rebated together with angle-iron. In the interior is a fire-proof safe, 12 inches square, and 2 feet 9 inches deep, the wrought plates being 1 inch thick. In the centre of the safe is a platform, 9 inches square, on which the velvet cushion, jewls, and setting are fixed. A hole is cut out of the table to allow the platform to descend into the safe. In order to secure the diamonds at night, a small door, 3 inches square, in one of the panels of the table, was unlocked, and, by turning a winch, the platform gradually sank into the safe, and a sliding iron door was drawn over the opening at the top. The cage was secured to the table by L pieces at the bottom ring dropping into corresponding holes, and these were locked by two separate detective locks; the keys of these locks are held by the crown officers; and, without them, access to the jewels cannot be had. The key of the small door allows the platform to be raised or lowered only, but does not give access to the jewels. The weight of the whole is 36 cwt., and it was bolted to the floor.

BIRMINGHAM "BRASSES."

Messrs. Winfield's Plain and Ornamental Tubes, variously used for domestic purposes, were among the best specimens of the kind in the Exhibition. The same firm exhibited a beautiful design—a Shell Cradle in gilt-bronze, lined with blue silk, and covered with thin drapery, held by a winged figure. Messrs. Peyton and Harlow's Patent Bedsteads combined elegance of form and lightness of appearance with facility of use. The pillars, too, are drawn, not rolled and soldered, as in ordinary tubes; and the separate sections of the pillars are fastened upon a new principle, a strong welding being *cast* round the parts at the joints, which makes the latter the strongest instead of the weakest part of the pillar. Messrs. Hardman's display of Ecclesiastical Brass-work, differed from the casting, in its being beaten out with the hand, and worked up to the nicest finish by the same means: their splendid *coronæ lucis* in the Mediæval Court were almost wholly produced by the hand and hammer.

* This Padlock is stated by Messrs. Bramah to have been imperfect; and they have produced another Lock, which they challenge Mr. Hobbs to pick—for 200 guineas.

Messrs. Messenger and Sons exhibited a fine group of metalliferous art, consisting of objects in bronze and ormoulu, besides others, illustrative of the manufacture, from the first rough casting to the most finished work. The centre of the group is composed of a column and capital in high relief; in the foreground are figures of the Queen and the Prince of Wales, modelled by Bell, and most artistically finished. To the left of the column is a bronze figure of the Duke of Wellington on his charger; the whole backed with specimens of bracket mouldings, elaborate iron scroll work, and groups of animals, interspersed with columnar candelabra, and fronted with a rich bronze balustrade. The quality of the metal, and high finish of the work, are very remarkable. Mr. W. Potts also contributed a similar bronze display; and, among a variety of beautiful objects, was a Metal-framed Boudoir-glass, executed for the Duchess of Sutherland. The frame is about 6 feet long by 4 wide; on each side are seated two naiads in porcelain, whose figures are reflected in the glass; just above are a couple of herons, each having in its beak a chain, at the end of which is a pastille-burner; while the toilet-bottles rest on a metal scroll, above a shell; besides other ornamental devices, highly characteristic.

In certain of the bedsteads, the taper pillars are made out of one tube, by a new process dependent upon the expansion of metals; and the combination of opalescent and coloured glass with the stamped brass, and Parian with rich bronzed metal-work, is strikingly beautiful. In some "brasses," the iron rods are laid in moulds, wherein are sunk the hollow ornaments; when, by pouring in melted iron, the various joints are effectually held together.

The display of Gas Chandeliers, Lamps, and Girandoles, some with Parian figures, was much admired. Here was also shown a portion of a chandelier in bronze, designed by Gruner, for the summer-house in Buckingham Palace Gardens: the supports for the lights are vine-branches running down into the base, with crouching panthers; a group of young satyrs also embellishes the base, and the upper part consists of a female bearing an urn upon her head.

Bell-hanging, Brass-works, Door-handles, Tea-bells, Cornice-poles, and a multifarious collection of articles for household use and decoration, were represented by Messrs. Harcourt, who stand alone in this branch of Birmingham trade.

METALLIC PENS.

A Steel Pen is as great a wonder of the present day as a Pin was to our ancestors. Large black and red pens were made of steel early in the present century; but the extensive introduction of steel pens dates from 1828, when Mr. Gillott, of Birmingham, patented a machine for making them; and 1830, when Mr. Perry, of London, added to their flexibility by apertures between the shoulder and the point. About the years 1820 and 1821, the first gross of three-slit pens was sold wholesale at £7 4s. the gross; the cheapest pens are now sold at *twopence* the gross, and the price rises with the elasticity and finish of the pen up to 3*s.* 6*d.* and 5*s.* per gross. Nearly 150 tons of steel are stated to be now annually made into pens; and, in one Birmingham establishment, 500 hands are daily employed. Here is an outline of the several stages of the manufacture. The rolled sheet-steel being received from Sheffield, is cut into strips, put into cast-iron boxes and softened by heat, and rolled between metal cylinders to the required thickness. The steel is then passed to a woman, who, with a hand-press, cuts out at a single blow the future pen; and a good hand will cut 28,000 per day of ten hours. The central hole and side slits are cut by another press; the semi-pens are then softened by heat, by a die worked by the foot are stamped with the maker's name, and then by a machine pressed into a cylindrical form. The pens are again heated, and then thrown into oil, which makes them very brittle; but they are cleansed and restored to elasticity by placing them in a tin cylinder, turned over a fire, like a coffee-roaster; the pens are next scoured with sawdust, in cans placed in a frame which revolves by steam. Each pen is then ground at the back, in two ways, at right angles to each other, or rather over each other; the girl holding the pen with nippers for a moment on a revolving "bob." The pens are then slit with a tool very nicely fitted into a hand-press, turned by a handle. They are then examined and sorted; and lastly, varnished with lac, dissolved in naphtha, evaporated by heat.

Messrs. Gillott's specimens ranged from a monster pen, weighing 5lbs., and measuring one yard in length, to a Lilliputian weighing 4 grains; the monster containing metal enough to make 1,092,397 of the tiny ones: the colouring of the metal is very rich. In a glass case, too, the whole history of the manufacture was wonderfully told. In an adjoining case, by Wiley and Co., were shown silver and gold pens, some tipped with iridium and osmium, the hardest of known metals; and in Hinckes and Co.'s case was a series of nut-shells, each containing an incredible number of infinitesimal pens of great finish, which it required a microscope properly to appreciate. Messrs. Perry also exhibited some fine specimens.*

WIRE-DRAWING AND WORKING.—PINS AND NEEDLES.

The Newly-improved Patent Process of transforming a bar of iron into fine wire is principally carried on by Edelston and Williams, Birmingham. After the rod is cleansed, it is drawn on a series of blocks, through hard steel plates, perforated with holes, and graduated to the size of the wire, until the latter attains the required thinness. It is next fined by heat, cooled, and then cleaned in vitriol. "The number of times the wire passes round the blocks, or, in other

* The manufacture of Metallic Pens was ably described in the series of letters from Birmingham, published in the *Morning Chronicle*, in 1850; and their economy has been illustrated by the genius of Faraday. See also "the World in its Workshops," an offshoot of the Great Exhibition, by James Ward. Orr and Co.

terms, the velocity with which the block moves, depends entirely upon the thickness of the wire. The thick wires are generally used for fencing and telegraph purposes; while the finer are required for the manufacture of wire blinds, hooks and eyes, needles, brushes, &c., which consume great quantities. Electro, or copper-coloured wire, is drawn through wet acids, and is used for sofa and other springs. Tinned wire is produced by a swift, or wheel of wire running through boiling tin, after being prepared in acids; it is principally used for lacing and bottling purposes. Wire in a finished state is made up into bundles of 63lbs. each. Number one wire contains 84 yards to the bundle, and number twenty 52 yards. The finer gauges, such as 20 to 36, are made up into 12lb. parcels, number twenty containing 1008 yards, while number 36 measures 18,133 yards."—(*The World in its Workshops*)

Pins are now chiefly made by machinery, and pointed on a steel file, making 6000 revolutions in a minute. The head is formed out of the same piece of wire as the shank, by a machine invented by Messrs. Taylor, and perfected by Messrs. Edelston and Williams; at whose establishment 8000 pins can be made every minute, or about 6,000,000 per day of 12 hours, which, allowing 300 working days for the year, gives 1,800,000,000. Every kind of pin was exhibited, from the minutely-shaped pin for the entomologist, to the blanket-pin.

Needles were sent by fourteen Exhibitors; ten of whom are British manufacturers—one from France, one from Austria, and two from Aix-la-Chapelle; in the last case, the raw material being of English origin. The process of Needle-making was shown in the apartment of Machinery in Motion, by a very nice small machine. The finest needles shown were those from Redditch. Messrs. Bartlett and Sons furnished specimens of the different stages of the manufacture; and Messrs. Boulton and Son sent with their needles, steel meshes, surgeons' needles, sail-hooks, bodkins, harpoons, &c., Mr. J. James illustrated the different processes of the manufacture of needles and fish-hooks, which, however, being in locked cases, could not be examined by the angling craft.

MEDAL DIE-SINKING AND COINING.

This process was illustrated by four Exhibitors. The Dies are cut from steel or iron by handle-tools; the inscription is then punched, and the die hardened. The medal is produced by a large screw-press with a fly-wheel; if of hard metal, the medal is annealed, and brought up with blows.

Stamped Brass, as window cornices, curtain-bands, &c., is made from sheet-metal, placed upon a steel die or pattern, and struck with a heavy hammer worked by a cord over a pulley. Of this foundry there were six Exhibitors.—(See Coining Presses, at page 150)

BUTTON MANUFACTURE.

Birmingham is the seat of the Button Manufacture; and the principal varieties are Metal Buttons, cut out of rolled sheets, the eyes made of wire, and soldered on; those with raised designs being struck with steel dies. Metal brace-buttons are cut out and pierced by the press. Glass Buttons are pinched by means of a pair of pliers; the black glass buttons, for coat-links, are made at a lathe. Agate, Carnelian, and Stone Buttons are imported from Bohemia, and shanked and finished in Birmingham. The Florentine Button is composed of four discs and a Florentine cloth covering. Horn Buttons are made from heated horn, which readily receives the patterns or impressions. Steel Buttons are made by the steel toy manufacturers. Bone Buttons are shaped from shank-bones by revolving cutters, and pierced by the same operation; the brilliant surface being given by whitening and rag held against the button whilst it revolves rapidly. Wood Buttons are cut by the same means as bone, but are French-polished and varnished. Pearl Button-making employs 2000 persons in Birmingham: the buttons are cut from the shells of the oyster, by small saws, of a trepan construction, revolving in a lathe; they are then split horizontally, and rasped of equal thickness. Buttons generally are made by women and children; men being employed to attend to the tools and machinery.

Buttons were well represented in the Exhibition. Messrs. Twigg showed handsome specimens of the Livery Button, and boldly embossed Naval Buttons; and their Cut-glass Buttons in metal were very effective. Messrs. Piggott had some Bronzed Buttons, with sporting subjects. Messrs. Aston not only showed a handsome assortment of all kinds, (especially the Florentine,) but introduced a series designed to illustrate their maunfacture.

In connexion with Mr. Banks's Buttons were shown some large and fine specimens of the shells used for Pearl Buttons, these shells being from the Gulf of Persia and from the Sooloo Isles. Mr. Knowles contributed Gold-plated and Enamelled Buttons. Messrs. Smith, Kemp, and Wright showed Sporting Buttons, representing the neck-and-neck end of a race, the hunter clearing a hedge, the sportsman bringing down his partridge, with other varieties of amusement, cleverly designed; and there was a very rich multiplicity of devices, enamels, crests, buildings, military and naval buttons. Mr. Aston showed Velvet Buttons, very superb in their effect. Messrs. Elliott exhibited Pearl Buttons with metallic rims. Messrs. Ingram illustrated very fully the Horn Button in its history and varieties. Mr. Nash, a die-sinker, showed the dies by which the Metal Buttons are stamped. In a case, exhibited by Mr. Brisrabb, were specimens of the Mother-o'-pearl Button, and among them of the Black Pearl.

These specimens were chiefly sent by first-rate producers.

GUNS, SWORDS, AND OTHER WEAPONS.

The contributions to "the mystery of murder," as the art of war has been termed, were very numerous; from our home manufacture, as well as from foreign countries. The British division was specially marked by four life-size figures, with characteristic wax faces, of

British Infantry of the Line, placed there to exhibit the contrast between the present and Mr. Bentley's proposed mode of slinging the knapsack. Colonel Peter Hawker not only sent a famous Stanchion Gun, which loads at the breech, and balances so nicely that a finger touch is sufficient to adjust the aim; but a very neat model of an improved Punt, for wild-duck shooting. Col. Hawker also exhibited "a New Double Gun for 1851," the novelty of which is the self-adjusting primers, without cover or spring, that will not only defy wet weather, but also the saline atmosphere in sea-coast service—in which he has proved the failure of all copper-caps and fine powder. This new Gun has conical breechings that will admit, when required—as in wet weather, or at sea—the use of the largest grain cannon-powder.

Among the guns, one case from Birmingham presented an epitome of the trade. First was a common Flint Musket with a stained beech stock, sold wholesale for about a dozen shillings, for the African trade, and a much better article than what used to be made in the old slave-trade days, when a gun was the price for a man; still, although warranted, the African musket is of low manufacture. By steps, improvements and ornaments are introduced, until we are led from the plain double gun for the American market to the best article that Birmingham can produce, elaborately ornamented.

Some of the guns were £400 each; and the low-priced 5*s.* 6*d.* A very instructive collection was exhibited by Mr. H. Hart, showing the complete manufacture of gun-barrels, from the old horse-shoe stubs of the earliest periods, to the latest improvements.

In the collection of Messrs. Tipping and Co. there was a complete collection of iron and steel in various combinations, for being ultimately welded into gun-barrels. The metal was shown formed into a "bloom," welded into a rod, rolled into a flat bar, coiled round a mandril like a ribbon, then welded into a barrel, ground, filed, and finally finished. All the separate parts of a gun, showing the vast number of pieces that go to make up the whole, were also to be seen.

British Guns.—There were not exhibited many remarkable novelties, the chief merit consisting in excellence of workmanship and high finish. Messrs. Manton and Son, of Dover-street, were exhibitors of several of their celebrated Double Barrels, most beautifully finished. Messrs. Westley, Richards, and Son, of Birmingham, exhibited specimens of Rifles and "Double Tiger Guns." Nearly all the best makers, indeed, sent contributions in some form or other. Among the novelties, may be noticed the Protector against Wet, invented by Mr. Gibbs, of Bristol, which consists of a small India-rubber cover that fits over the nipple of the gun, and prevents any wet from getting to the powder. Mr. Needham, of Piccadilly, showed several peculiarities in the form of Self-priming Muskets, Self-loading Carbines, and Guns to Load at the Breech. Mr. Beckwith, of Snow-hill, exhibited some Blunderbusses, with six radiating barrels. Erskine's Newly-invented Waterproof and Safety Gun (also exhibited) provides, in one action, against the percussion-cap being prevented from exploding by exposure to the rain, and also prevents the accidental discharge of the gun by the hammer falling. This is effected in a very simple manner. A metal shield, containing a ring of India-rubber, encloses the cap completely, so as to keep out all damp; and, at the same time, prevent the hammer striking the cap, should it fall accidentally. The instant the gun is brought to the shoulder, for the purpose of firing, a spring in the butt of the gun, by the mere pressure against the shoulder, releases the shield, which flies up, and leaves the cap free for the action of the hammer.

Mr. Greener, of Birmingham, exhibited a numerous collection of Guns; one being intended to fire a rocket with a line from a lifeboat to a ship in distress, and another to discharge a barbed harpoon into the bodies of sperm whales. Both these guns are formed of Bramah's metal (bronze)—copper with a small proportion of tin. Here were also several varieties of steel in connexion with iron, demonstrating its tenacity, capability for extension, and density; and this was well exemplified in a pair of Double Guns, which are stated to be, by the elasticity of their material, superior to any other combination of metal for gun-barrels.

Among the *Curiosities*, was a Gun fitted up in the Shank of a Whip; another in an ordinary Walking-stick, &c. Mr. Hart, of Birmingham, showed an invention "to make any gun shoot well, however lightly or heavily charged," and by which "a single shot of any guncharge, fired at the distance of 40 yards, will appear upon an iron target, the size of a fourpenny-piece; or, in its progress, a single corn of shot will go through a penny." Mr. Goddard showed first-class Fowling Pieces—an American Duck Gun, an East India Company's Pattern Musket, an African Musket; and "a Californian Protector," from which are fired sugar-loaf balls, which kill at near 800 yards' distance.

Continental Guns.—The Continental side of the Exhibition presented more novelties in fire-arms than the British. The method of loading at the breech, which is scarcely introduced in England, has been for some time common on the Continent: several specimens of this kind were exhibited. The greater rapidity of loading, by using rifle-barrels, has led to their being introduced in several Prussian regiments: it is stated that the heavy Prussian rifle, with a conical shot, has an effective range of 1000 yards. Prussia also exhibited some highly-ornamented and well-finished Guns and Pistols. France exhibited several cases of Guns and Pistols. M. Flobert carries the plan of loading at the breech into operation in a very novel manner: he uses a small cartridge made of percussion powder alone; the ball is fixed to the end of the cap, and is introduced at the breech by the doubling down of the barrel; and the blow of the lock explodes the percussion powder, which propels the ball without the addition of gunpowder. It is stated that a pistol-ball may be made effective in this manner at 100 yards, and that a rifle will double that range. In the Prussian Zund-nadel-gewehr, or Needle-gun, loading by the breech is effected by the cartridge, on one end of which is stuck a patch of detonating powder, which becomes exploded by the rapid darting forward of a needle, whence the appellation *Burn-needle Gun* is derived.

The Belgians displayed here Guns and Pistols of all kinds, to suit various nations—European, African, Asiatic, and American. From the small-bored, long-barrelled gun, with short stock, used by the turbulent hordes of North Africa, to the delicacies of Breech-loading Rifles and Revolving Pistols, the Belgians had them all.

Colt's Revolvers, in the American department, excited considerable interest. The great difference between these Revolvers, or "Patent Repeating Pistols," and the revolvers made in this country, is, that our pistol has a barrel for every shot; while the "Repeater" has but one barrel, and a six-chambered revolving cylinder for the reception of the charges. The tubes for the caps are placed horizontally at he back of the cylinder. The hammer is placed behind the cylinder, sufficiently low to form, by the help of a groove in the fore-part, when cocked, a back sight. When half-cocked, the cylinder rotates freely on the base-pin, so as to bring in turn all the chambers in a position to receive their charge. When cocked, the cylinder is fixed ready for a discharge, by pulling the trigger; and re-cocking produces like results, till all the chambers are discharged. In loading, balls of soft lead, without wadding or patch, are placed upon the mouths of the chambers, turned under the rammer, and forced home by the lever—so completely filling the chambers, as to preserve the powder in a condition for firing, even after completely immersing the arm in water. Colt's Holster Pistol projects a ball 1200 yards; and, during some trials at Woolwich, at a distance of 50 yards, the whole six shots repeatedly struck the target within a circle of 6 inches radius from the centre of the bull's-eye. Again, when the hammer is down, it rests between two of the pillars, which prevents the breech from turning, and secures it from accident.

There was an exact copy of Colt's Revolver in the Belgian department, which seemed equally well made, and rather smarter in appearance.*

Rifles.—Specimens of Rifle-barrels in every stage of finish, were sent by several exhibitors, to show the mode of making the twist. Among the most recent improvements, was Mr. Lancaster's "Elliptic smooth bore, twisted, or spirally inclined." Manton and Sons sent a Double Rifle; and Wilton and Daw a Two-ounce Rifle "for India and Africa."

Telescopes were fixed on many of the rifles, with cross hairs in them, to assist the shooter in taking aim. From Prussia were exhibited a Rifle loading at the breech, by Schaller, of Seehl; a

* There is in the United Service Museum, a pistol supposed to be two hundred years old, which, with the exception of the lock, is constructed upon precisely the same principles as the weapons exhibited by Mr. Colt, as will be seen by the following description extracted from the catalogue of the institution, published in 1843:—"No. 1,168, a snap-haunce self-loading petronel, probably of the time of Charles the First. The contrivance consists of a revolving cylinder, containing seven chambers, with touch-holes. The action of lifting the cock causes the cylinder to revolve, and a fresh chamber is brought into connexion with the barrel. Six of the seven chambers are exposed to view, and the charges are put in without the need of a ramrod." A revolving gun upon this principle was made by Rigby, of Dublin, twenty-five years since.

Rifle with seven barrels, all to be fired at once with needles; and a Belgian Rifle, in which the charge is placed in a cylinder, which revolves in the breech, the lock being cocked at the same time; it is fired by a needle.

L. Sauerbrey, of Gotha, contributed a Double Rifle of solid cast-steel; the barrels bored in a converging direction, so as to aim at the object with both balls. And L. Tentenberg, of Heiter, showed a "Rifle with Seven Barrels," for wild-fowl shooting; in which all the barrels can be fired and loaded at once.

Revolving Guns and Pistols were exhibited both in the English and Foreign collection; with from 6 to 21 barrels, which revolve, and bring each barrel in turn under the hammer of the lock; or they have one barrel, surrounded by several revolving chambers, which are fired like the barrels. Revolving Barrels were shown in great numbers: one from France had a dagger projecting between the screws; there was also an American Self-cocking and Repeating 10-barrel Pistol, and a Belgian 21-barrel; each adjusted by pulling the trigger. An English Revolving Hammer, with six barrels, was likewise shown.

Safety Locks and Self-priming Locks were exhibited in great numbers; and a Foreign Lock was shown of such simple construction as to consist only of the hammer, the plate, and one spring, put together with three screws. The ingenious contrivances in Locks were likewise very numerous. *Flint Locks*, by English makers, for foreign markets, were exhibited; and one showed the mode of turning flint into percussion guns. Richly ornamented Locks were contributed from Turkey, Russia, and Tunis; and several Damascus twist-barrels from India. In the Turkish and Indian collection, there were some superbly inlaid *Matchlocks*.

Rocket Guns.—Capt. Manby exhibited his well-known Gun for Discharging a Rocket with a Line to Ships in Distress; and from France was shown a gun for the same purpose, by throwing a cylinder containing a coiled line.

Air Guns.—Mr. Townsend exhibited some fine specimens of all diameters of bores of "fancy twist" metal, and the locks reduced to the simplest construction. Some of the varieties, by a new arrangement, load at the breech, and with twenty-six balls to the pound will kill at a distance of three hundred feet. In the earlier form of the gun, the magazine depended upon the lock: in these guns it is concealed in the butt, while the barrel is a japanned cane of a dark colour. In Shaw's Patent India-rubber Air-gun, also exhibited, without any previous pumping, the requisite pressure of air for one discharge is procured instantly at the pull of the trigger, by a single stroke of a condensing syringe, actuated by a previously extended India-rubber spring. There is no separate pump, no reservoir of condensed air, nor valve of any kind: the whole apparatus is enclosed in a case, which, being stocked, has the appearance of a light and elegant fowling-piece without a lock. The air which expels the ball is powerfully compressed at the moment of discharge by a piston acting within a cylinder, and moved with great force and rapidity by the sudden contraction of a spring of vulcanized India-rubber rings, previously extended by hand: its range is much greater than that of the ordinary air-gun.

Pistols were exhibited in great variety, including fancy patterns, fluted barrels, with improved heads, inlaid with silver; double-barreled, swiveled, and those with bayonets; a Five Barrel Revolver; and ladies' pistols, which fire balls 700 to the pound. Cooper and Co. showed, in their specimens, many new applications, ensuring a greater amount of safety; and, among others, a Twelve Barrel Revolving Pistol, perfectly manageable and efficient; the whole principle and internal mechanism of the lock is shown by the removal of a portion of the lock-plate. There was also exhibited a pair of Double-barreled Pistols, cut open, to show their superior finish.

An amusing collection was shown by Brookes and Son, of Articles for Barter; including Spanish Carabines, Dane Guns, Pistols, Fowling Pieces, Rifles, and a Revolving Gun, all gaudy, to attract the savage, and intended for the South American and African trade.

Ordnance.—Iron Guns and Mortars.—Among the English specimens, were two noble guns from the Low Moor Iron-Works; one a 52-pounder, and the other for 10-inch Shells, mounted on Improved Carriages and Slides. The Belgian Government exhibited six Guns and Howitzers, and a Mortar, cast at Liege, rough as from the mould, the cast-iron prepared with coke and wood: one of these guns, re-vented, has stood 6000 rounds; and another, 2118 rounds, with its vent scarcely injured. From Prussia was shown a Field-gun, of forged cast-steel. There were also a Wrought-iron Howitzer and Mortar from Spain; Turkish Guns, (twisted,) with gold touch-holes, and superbly inlaid; an Indian Iron Field-gun upon a curious carriage; besides Camel Guns on Pivots, or fixed to the saddle-bow. A Brass Howitzer, 9 inches bore, was shown from the Royal Foundry, at Seville. Among the *Shells* exhibited, was one of the monster Paixhain Mortar, used at the siege of Antwerp, and one of whose shells made "a hole large enough to bury two horses."

Bows and Arrows.—Some English Steel Bows and Cross-Bows, with India-rubber strings, for archery amusement, were exhibited. There were also shown Indian Bows, Cross-bows, and Steel-headed Arrows; Poisoned Arrows from Africa; and Arrows from British Guiana, dipped in the rapidly-fatal wourali poison. In the Guiana collection, was shown the Assagai, the light spear of the Kaffirs.

Swords, Daggers, and Spears.—The manufacture of English Swords was exhibited in all its stages; those from Birmingham were beautiful specimens of cutlery. The Indian collection, including Battle-axes and Light Spears, showed the finest tempered steel, and the most elaborate ornament. Among the ornamented specimens were three Daggers manufactured in the states of the Rajah of Johdpore; one from Nepaul; one of dark steel inlaid with gold from the states of Rajpootanah; two Burmese; and a stiletto Malacca dagger. There was a beautiful enamelled hilt, from the Rajpootanah states; and the large knife of the Burmese.

In the Indian collection was a Dagger, with gold hilt and handle, and rich case; by pressing upon a certain part of the handle, the single blade opened into four double-edged pointed blades, with a four-edged spear-like addition in the centre; thus forming a five-bladed weapon, with twelve sharp edges. In the same collection was a knife with three blades, two of which, with their handles, were concealed in the third blade and handle, being thus *two knives within one:* this, together with a two-bladed dagger, was manufactured at Ulwar, is of the finest Damascus steel, and of beautiful workmanship. There were also shown some curious swords of black Persian and Caucasian steel; a Tunisian sword bent the reverse of the usual way; and in the Chinese collection, a sword made of coins of the country. From Spain were sent two specimens of the famed Toledo blades: one is the property of Don Manuel de Ysasi, to whom it was presented by General Espartero: it is straight when drawn, and its remarkable elasticity is tested by the circular scabbard, which actually rolls up the blade as it receives it. A. and E. Holler, of Solingen, exhibited a sword or two, some foils, and rapiers, and damask blades with oriental ornamentation. In the Portuguese collection was displayed the splendid sword presented to Lord Beresford by his brother officers in the Peninsular War: the hilt is of gold, set with diamonds; and the sheath, wholly of gold, bears bas-reliefs of his Lordship's personal heroism. A presentation Cimeter, manufactured in superb taste, by Wilkinson and Son, may be mentioned here: it is of Arabesque pattern, silver-gilt, richly chased, and set with emeralds, rubies, turquoises, topazes, amethysts, carbuncles, garnets, &c., 104 in number; the blade is embossed and engraved, blued and gilded, with two elevations of patterns above the dead-gold ground; the sword-knot is of gold, and the waist-belt purple and gold, the clasp set with gems.

Mail, Breastplates, Shields, &c.—Among the Indian armour were two suits from Lahore, the helmets and breastplates corresponding with the antique; the gauntlets of the swords are superbly inlaid. Here, too, were Coats of Mail, with the rings gilded in patterns. Of English manufacture for India was shown a Cavalry Sword, with electro-plated hilt and German silver scabbard; a coat of steel chain mail, electro-plated with silver; and helmets covered with the same. These specimens were shown by Wilkinson and Son; with a Highland claymore, copied from a genuine Andrea Ferrara; and a series of the Regulation used in the British army and navy. There was, likewise, a wrought-steel Prussian Cuirass, stated to have turned a musket-ball fired at ten yards distance. Among the Shields, one from India, inlaid with gold, has four central bosses, each holding a pistol.

Percussion Caps.—The French and Belgians sent specimens, but neither will resist damp or fire so certainly as the English; and it may be questioned if the Austrians equal the French. Sellier and Bellot, of Prague, furnished a handsome specimen of their Percussion Caps, and stated that "the total manufacture of 'caps' for sporting guns in Europe may be estimated at one thousand three hundred millions yearly, and the quantity of copper requisite for its production is 396,000lbs. weight."

Among the best English Caps were those exhibited by Walker and Joyce.

CAPTAIN WARNER'S PROJECTILES.

The following specimens of Capt. Warner's Inventions, for what he may term the certainty of warfare, were exhibited in the West-end gallery of the Building.

Invisible Shell, so named by Admirals Sir Thomas Hardy and Sir Richard Keats, who in their Report, say: "the many ways in which it can be applied leave no doubt upon our minds that it is impossible for any ship whatever to avoid coming in contact with it. For the defence of harbours, riverways, or roadsteads, it would be of the greatest service to this country, as they could all be defended at a trifling expense, and in a very short space of time." The shell here exhibited is the counterpart of the one which destroyed the *John-o'-Gaunt*, a ship of 400 tons burthen, off Brighton, on July 20, 1844.

Long Range Shot.—One of thirty dug up on Cannock Chase, imbedded in hard gravelly soil, at six and seven feet depth, after an experiment made there, in which Captain Warner undertook to deposit ten shots at 3, 3½ and 4 miles distance; which was accomplished.

Projectile, weighing 66lb., which can be propelled to a distance of four miles, and suited for sea and land uses, particularly against fortifications.

Spike Shell, for sea purposes, to be projected ten feet under the surface of the water-line, with such precision as to sink the adversary's ship at the first discharge. This has been admitted by Sir R. Keats and Sir T. Hardy, by Earl Hardwicke, R.N., Earl Talbot, R.N., and other naval officers.

HOLLOW WARE.

Specimens of this new manufacture were exhibited from Wolverhampton, by Messrs. Clarke and Co. They consisted of cast-iron Saucepans, whitened with enamel within, and varnished black without. The matrices being formed, the molten metal is run into them from the furnaces: it soon solidifies, and the saucepan, after passing through several other stages, is enameled by the inside being spread with a fine dry powder, and then placed in an oven well-heated, till the concrete fuses, when the enameling is complete.

Specimens of Hollow and Enamelled Ware were also exhibited from Sheffield.

SHEFFIELD MANUFACTURES.

The conversion of Iron into Steel, (to the extent of many thousand tons annually,) is the principal manufacture of Sheffield; and the several processes of cementation, blistering, shearing, casting, tilting and tempering, were illustrated by specimens in the Exhibition. Thus, Messrs. Johnson, Cammell and Co., of the Cyclops Works, exhibited progressive specimens, from the imported iron up to the most refined state of the metal—in the varieties of "cemented blister," "double-refined cast," "double-shear," or "elastic spring." Their display of tools included their "curvilinear tanged file;" and their "continuous tooth concave and convex file," the latter rewarded by a medal from the Society of Arts. The careful finish of their work was also shown in their springs for Railway Carriages; and in a piston-rod, weighing 16 cwt., the finest and largest piece of steel in the Exhibition. Another assortment, forwarded by Turton and Son, illustrated Steel-manufacture from Swedish bar-iron. The same firm contributed a Steel Ingot, weighing upwards of 1 ton 4 cwt., intended for one of a pair of piston-rods for a marine engine. It consists of the contents of forty-eight crucibles, each charged twice with 80lbs. weight of steel; the operation was performed by forty workpeople, and the pouring of the melted liquid steel into the mould was accomplished by three men in eight minutes.

From the various kinds of steel are manufactured Cutlery, Needles, Hooks, Ornaments, &c.—a class of production, which has made this seat of industry famous since the days of Chaucer's "Sheffield Thwittle." Among the tools exhibited was a cast-steel circular Saw, 5 feet in diameter, by Spear and Jackson. Messrs. Unwin and Rogers's display of Spring-knives, Pistol-knives, and Surgical Instruments, was good: a case contained the preparations of steel wire, in the process of manufacturing needles. The Etna works displayed Circular Saws, Files, Hammers, Adzes, &c. An assortment of files and rasps, from 1 to 46 inches in length; and a case of scissors and shears of every variety, highly ornamented, with specimens arranged, from the rough steel to the finished article, were exhibited by Hunter. Messrs. Turner and Co. displayed a pair of Albert Venison-carvers, with stag antlers; and the Prince of Wales' sailor's knife. We must not, however, omit to record a brilliant trophy of Sheffield Cutlery, arranged in a case in the Western Nave of the Building. It contained 230 pairs of Scissors of every size and pattern, grouped and mounted upon a white ground; the centre object was a pair of huge scissors, 22 inches long, the bows and shank representing in outline two crowns; the upper one surmounted by a thistle; all the ornamental work is wrought with the file, some portions of the surface being chased. This object is by far the most expensive pair of scissors ever produced in Sheffield. On each side of this appeared another pair, nearly the same size, and scarcely less beautiful or costly. One pair represents, in chasing, the bruising of the serpent's head; in the centre is wrought out with the file the Prince of Wales's feathers; and the bow is the shamrock, rose, and thistle, and scrollwork—all wrought out with the file.

Next was illustrated the Scissors' Manufacture, in its ten stages. Among the most striking specimens was a pair of 16-inch fancy nail-scissors, ornamented with etching; a group of surgeons' scissors, curved, angular, and distorted for difficult operations; a sportsman's

Knife, containing eighty blades and other instruments; also, one three-quarters of an inch long, with fifty-one blades and other instruments; and a case containing twelve perfect pairs of scissors, yet so small that they do not weigh half a grain.

Another striking feature was the variety of Stoves; Register and Air, Cooking and Gas, Heat-reflecting, Smoke-curing, &c.

Among the Gas-burners exhibited was the Self-regulating Apparatus, by Mr. Biddell, who introduces into the centre of the burner a vertical compound rod of about ¼ inch diameter, the cylindrical case being of brass, and the core within of steel. By the expansion and contraction of this rod, which is surrounded by the flame, a small lever and simple valve, in connexion with the bottom of the rod, are acted upon so delicately, that the exact amount of gas required to preserve uniformity of flame is preserved.

One Exhibitor, who has great faith in a new name, sent a Saucepan with a false bottom, upon which, potatoes being placed, covered up, and set upon the fire, steam is generated, and thus the potatoes are cooked in the water they contain—a contrivance called the *Anhydrohepseterion*.

Dr. Arnott's Stoves, and Ventilating Apparatus, were exhibited: with Peirce's Pyro-pneumatic Stove, made of fire-clay in pieces, through which are air-ways, the whole cased with iron; an open fire warms the fire-bricks, the passages between which are connected with a pipe leading to the external air, when the warmed air rises into the apartments, and a supply of fresh air is obtained from without.

Among the Gas-stoves was King's Cooking Range from Liverpool. It is divided into three compartments, for roasting and baking; the burner is arranged inside the oven, at bottom, around the sides, back, and front, with a dripping-pan in the centre. The meat is hooked on to a sliding-frame or carriage, which, when pushed in, allows it to be suspended surrounded by the gas. On the top of the range are eight spiral burners, in round well-holes, for boiling, stewing, frying, &c.

Edwards's Patent Atmopyre was shown: it consists of a porcelain chamber; within is the Gas-fire, which escapes through minute perforations; the mass thus becomes red-hot, or, in the words of the patentee, a "solid Gas Fire" cooking stove.* Several Gas-meters were also shown here.

The Stove-grates tastefully displayed painted china and ormolu, encaustic tiles, gold medallions and scrollwork, marble and alabaster; and we learn from Mr. Hunt's excellent *Hand-book*, that seven of these Grates and six Fenders have been designed by pupils of the Government School. The fire-irons and fenders were also of corresponding elegance.

There were several specimens of Patent Wire Ropes exhibited by Messrs. Newall; and of Flat Chains with wooden Keys, for collieries, by Mr. Edge. Messrs. Henn and Bradley supplied a good assort-

* The Atmopyre is detailed in the Year-Book of Facts, 1851, page 75.

ment of their Crown-tapered Screws, of the most delicate structure for pianofortes, as well as for the heaviest railway purposes.

Here, too, were shown the Wenham Lake Ice Safe; Fire-proof Safes; and a variety of Ornamental Iron-castings, Letter-copying Machines, and Perforated Brasses and Woven Wire-Blinds (in one of the brass specimens, 14,400 square holes to the square inch), with Copper Wires, Vases, &c.

Sheffield-plating, Electro-plating, and Lamps, belonging to this class, will be described elsewhere.

Among the Foreign Cutlery, the Prussian and Belgian specimens approached nearest the excellence of English manufacture.

SHEFFIELD PLATING.

Although the Electro-plating Process is extensively applied, Mr. J. G. A. Creswick, of Sheffield, states, in a letter to the *Times*, that the old and substantial method of plating on the ingot by fire still obtains in that town, and is almost entirely used in articles for the London trade—such as dishes and covers, tea-sets, candelabra, &c.; and in many cases such goods (made by the first class of Sheffield manufacturers) have stood the wear of from 20 to 30 years use.

Mr. John Gray, of Billiter-square, exhibited a series of articles illustrative of this method of Plating, commencing from the ingot and terminating in the finished article. The ingot is composed of copper alloyed with other metal, so as to impart to it the necessary toughness and rigidity. The plate of silver is tied upon its polished surface with wire, and the combined metals are then heated in a furnace, till both bodies are in a molten state, and thus become most effectually united. After this process, the two metals united form an ingot which is subjected to rolling and hammering into form; which test the electro-process never subjects articles to, as they are all coated after the goods are finished so far as manipulation and annealing is concerned. Soldering the silver upon any baser metal is only practised in making cutlery, and does not at all apply to plated manufacture, being a distinct branch of business.

Mr. Gray also exhibited an ingot of copper previous to this process, with the plate of silver tied upon it with wire; ingots of copper and white metal after the silver plate has been united to them by an elevation of temperature only; and a sheet of plated metal, rolled from a plated ingot. A table dish, made from the rolled metal, was the next in the series, with the silver mountings laid upon it, but not yet soldered. The steel dyes in which the silver mountings are struck, together with the mountings produced by them were also shown; in fine, the table dish was exhibited in its finished state, as well as a specimen of a salver produced by this manufacturer.

The metal now used at Sheffield as a foundation for plating, is German silver to a very great extent, (whereas, formerly copper was used,) and is thus, on a white foundation, little inferior in colour to the silver which forms the outer coating or surface.

Plating by fire is the mode that has been practised in Sheffield for more than a century, and is still styled in the London shops "best Sheffield plate," in contradistinction to other spurious and inferior productions.

ELECTRO-PLATING.

Mr. Lyons, of Birmingham, exhibited this process, in the room appropriated to Machines in Motion. Having placed silver in solution, in a glass jar, which communicates with a battery by means of a wire, a brass medal is attached to another piece of wire, and the medal being immersed in the solution, the wire that holds it is hooked on to the wires connected with the battery; *the instant* the contact of the two wires takes place, the metal is covered with a coat of silver. By the same process, all Electro-plating is performed: it only requiring larger jars or tanks for larger substances. Any metals may, by this method, be deposited; and one part of an article may be coated with gold, another with silver, a third with platina, and so on, through the whole class of metals.

The Electro-plate specimens in the Exhibition were very numerous. Among the more noticeable specimens were the following:—

Mr. G. R. Collis, of Birmingham, exhibited an Electro-plated Wine-cooler, a reduced Model of the Warwick Vase, on a scale equal to one-fourth of the original.

Messrs. Elkington and Mason, of Birmingham, exhibited many fine examples of Electro-deposit applied to high-art works; among which was the Statue of Geoffrey Earl of Gloucester, modelled by Westmacott, and here produced in electro-metallurgy. Here also were—a Bust of the late Sir Robert Peel; a large Vase, commemorative of the Exhibition; Statues of Shakspeare and Watt; besides Candelabra, Vases, &c. Some of the race plate is manufactured by this process: the last Warwick Cup, for example, by the above firm.

A Superb Jewel Casket was exhibited by her Majesty. It was designed by Mr. Gruner, and manufactured by Elkington and Mason: the case is of large size, and richly enamelled, in the *cinque-cento* style; the material is bronze gilt, and silvered by the electro-process. The two front panels of the doors are porcelain portraits of her Majesty and Prince Albert, after the well-known miniatures by Thorburn; they are beautifully painted, and in that of her Majesty is introduced a portrait of the Prince of Wales. The frames of these portraits are plated silver upon an ultramarine blue ground, and dotted with gold. The corresponding panels on the back contain the royal arms, and the arms and legend of his Royal Highness Prince Albert. Round the base are six raised medallions, containing portraits of the young princes and princesses, modelled from life by Wyon, and produced in silver upon a blue ground. At each corner of the casket is a large-sized female figure, in oxydised silver, supporting a corresponding pediment. Two boys in silver, supporting cornucopias, occupy niches between the panels of the doors, one on either side. The sloping top consists of about 2000 scales of enamelled blue and gold metal, secured by double screws; the apex being crowned by a fanciful combination of the royal arms, with children for supporters. The massive handles are in excellent keeping, and exhibit an ingenious mechanical contrivance for concealing the hinge when the handle is closed against the side of the casket. They are surrounded with coloured enamelled wreaths of the rose, thistle, and shamrock.

A Table of Gold and Silver Electro-plate was also exhibited by the Queen. It was manufactured by Elkington and Co., from a design by George Stanton, a student in the Birmingham School of Design. The top of the table is an electrotype of a fine plate, obtained and copied for Mr. H. Elkington, under the direction of the Chevalier de Schlick. The eight subjects in bas-relief represent Minerva, Astrology, Geometry, Arithmetic, Music, Rhetoric. The centre figure represents Temperance surrounded by the four Elements. At the bottom of this plate is an inscription pointing to the artist.

Mr. J. Harrison, of Sheffield, exhibited a large collection of beautiful articles, showing the application of Electro-plating upon Britannia and Imperial metals, and nickel silver. Articles are cast in brass moulds when their forms are complicated. Certain parts, such as the body of a teapot or coffeepot, are "spun" by pressing thin plates of the rolled metal against a wooden mould or block, which revolves in a lathe. When two or more parts are required to be connected, they are united by a tin solder. Among the latest improvements in the electro-metallurgic art is the application of this mode of silvering the softer and less valuable metals.

Mr. Alexander Watt exhibited Quill Pens, gilt and silvered by electro-chemical agency; the nibs being tipped by rhodium, so as to unite the advantages of the gold pen with the elasticity of the quill. He also showed Ostrich Feathers and various similar articles gilt and silvered by the same process.

Mr. John Walker, of Princes-street, Leicester-square, exhibited a Drawing-room Clock, designed by Mr. C. Grant, with panels embossed by Mr. G. Abbott. The case, which is electrotyped, consists of a base and a pedestal of turquoise blue glass, surmounted by seven subjects revolving at the base:—1. The savage life of the ancient Britons. 2. The Roman governor introducing agriculture. 3. The encouragement given to Flemish weavers to settle in England. 4. The introduction, by Caxton, of Printing. 5. The improvement of the steam-engine, by Watt. 6. The opening of the Liverpool and Manchester Railway. 7. The Great Exhibition. The clock shows the hours and minutes on an open dial supported by upright figures. The signs of the zodiac are made to represent the months; and seven subjects embossed in silver, *fac similes* of those on the pedestal, have been grouped so as to be seen at one view.

GOLD AND SILVER PLATE.

The works exhibited in this group represented the industrial excellence of England in the precious metals; combining art and manufacture in a high degree; the designs being truly artistic, and the workmanship presenting admirable specimens of casting, embossing, chasing, engraving, &c.

Messrs. Hunt and Roskell (late Storr and Mortimer), rank at the head of the exhibitors, in the beauty and originality, and the richness and variety, of their works. The collection numbered nearly 100 pieces, and comprised some of the finest Racing-plate (shields, groups, and cups), executed of late years for Goodwood, and Doncaster, and Ascot, the latter including the magnificent Prizes presented by the Emperor of Russia. The testimonials exhibited were numerous, and extremely interesting, as compositions; but the most important work was a centre ornament and plateau, in rich *cinquecento* style; with figures of the Seasons, the quarters of the world, the Elements, Day and Night, &c. The same firm exhibited a Shield, composed of silver and iron, a specimen of embossing, unfinished; also, the Shield of Æneas in copper, deposited by the galvanic process.

Several exquisite groups in silver, were also contributed by Messrs. Garrard, Mr. Hancock, and others.

Mr. Collis, of Birmingham, exhibited a Silver Table-top, 55 inches in diameter, weighing nearly 900 ounces, and manufactured for the Pasha of Aleppo. Next was a Dessert Service, exhibited by Messrs. Gass, of Regent-street, in silver: the designs are modelled after water-plants in Kew Gardens. This firm also exhibited a Silvered Jewelled Dessert Service in the Elizabethan style; and a Bracelet set with brilliants and carbuncles, and including portraits of the Queen and the Prince of Wales, after Thorburn, executed in niello, and engraved by J. J. Crew. In their collection likewise was a silver Gauntlet Niello Bracelet, designed by Maclise.

Messrs. Morel exhibited an Equestrian Statue of Queen Elizabeth, taken from her great seal: the figure is 4 feet 2 inches high, and 3 feet long: it is embossed with the hammer, and presents a fine specimen of silversmiths' work, as practised in the sixteenth century, and lately to some extent revived. This was one of the finest works of its class, in the Exhibition. The same manufacturers exhibited a Centre Piece, in silver, 2 feet high, and 3½ feet long, weighing 1260 ounces: the design, Children playing with a Panther, and branches for basket and twelve lights.

Among a group of beautiful articles exhibited by Mr. J. Angell, was a Tea-service, with miniature illustrations from *Esop's Fables*—the "Fox and the Grapes," the "Dog and Shadow," the Wolf and Lamb," the "Lion and Mouse," the "Fox and the Crane," &c., all standing out in delicate relief, and so contrived that the whole can be separated, and the articles used plain. The dead or frosted silver, turquoise enamel compartments, and line-engraved vignettes, are exquisite.

A *Fontaine à Thé*, a centre piece for the tea or breakfast table, by Durand, was exhibited: it is of silver, in parts oxidized, with enamelling, incrustations, &c.; and consists of a standard, supporting a tea-urn, four tea-pots, sugar-basins, and cream-ewers; around the base are places for sixteen or twenty cups.

In the Zollverein department, Weishaupt and Son, of Hanau, exhibited a Set of Chessmen and Board in the *Renaissance* style, the squares of the board alternately tortoiseshell and mother-of-pearl. The framework of the stand is silver and gold, inlaid with rubies; each corner, the bust of an angel, the wings in silver and blue; the sides are ornamented with silver swans, and festoons of gold and rubies. The chessmen are in gold and silver: the principal figures are costume portraits of Emperors of Germany and Kings of France —their retinue, knights, and castles mounted on elephants, and men-at-arms for the pawns. Rubies are profusely introduced upon the dresses of the principal personages and the pedestals.

Messrs. Phillips exhibited also a set of Chessmen, with their board in silver and gold in the *Renaissance* style, ornamented with enamel, precious stones, and pearls. The principal figures are the portraits of the Emperor Charles V. and his daughter, Margaret of Parma, Francis I. and his daughter, Margaret de Valois, the Stadtholder of the Netherlands, &c.

In the United States department was displayed a magnificent Tea-service of Gold Plate, a testimonial from the citizens of New York to Mr. Collins, the founder of the American steam-packet line. The service consists of a large teakettle, teapot, cream ewer, and sugar basin, on a large salver; the whole made of Californian gold, 23 carats fine, without admixture of any other metal.

One of the largest lumps of Native Gold yet discovered in California, worth between £700 and £800, was exhibited by Messrs. Garrard.

Mr. E. S. Marshall exhibited a series of Specimens illustrative of the Malleability of Metals, consisting of Gold Leaf suited to gilders, bookbinders, japanners, writers, and printers, and decorators in gold; also manufactured specimens, showing the Malleability of Silver, Copper, Tin, Zinc, Lead, and Tellurium.

Mr. G. Angell exhibited a Tray illustrative of the Purposes of the Exhibition; bearing the Ship of all Nations, commanded by Britannia, and steered by Father Thames, entering the Pool attended by Neptune, and followed by figures personifying Navigation and Commerce, Justice, Fame, and History. Engraved medallions on the border illustrate commerce, steam-navigation, and machinery. The engraving and designs are by Donald and Son.

PRECIOUS STONES AND JEWELLERY.

The Precious Stones exhibited were so numerous, that we are only enabled to point to a few of the finest specimens. Messrs. Hunt and Roskell displayed 254 gems, &c.; of which 200 were from the collection of the late H. R. Hope, Esq., now the property of H. T. Hope, Esq. M.P., of Picadilly.

Diamonds take precedence. This gem, when pure, is transparent and colourless, and consists of pure carbon. When it has colour, it always contains some foreign matter, such as the oxides of metals, which exists in it in very minute proportions. The art of cutting diamonds was discovered towards the end of the fifteenth century, by rubbing them against one another, and polishing them with their own powder; whence arises the adage of "diamond cut diamond." These operations are now abridged by two methods: first, by availing ourselves of the direction of the laminæ of the stone, or what is called in the science of crystallography its planes of clevage, to split them so as to produce several facets. Some stones, which seem to belong to the crystals called *Macle*, resist this mode of clevage, and are called *diamonds of nature*. A second method of cutting the diamond is by sawing it by means of an extremely fine wire coated with diamond-powder.

Specimens of rough Diamonds, of the first and second water, were exhibited; and collections of gems, by Mr. Thistlethwaite and Mr. Tennant, well illustrated the natural forms of diamonds. They are generally colourless; the finest are quite free from any speck or flaw of any kind, and resembling a drop of the purest water. Varieties of colour occur, but are scarce; and clear distinct shades of colour in fine diamonds of considerable size are so extremely rare, as to give a great addition to their value. Thus, the remarkable sapphire-blue diamond, exhibited by Mr. Hope, being of gigantic size, perfect water, great depth, and brilliant lustre, possesses a value greater even than it would do if of the usual appearance. Mr. Hope's collection, it should be added, contains twenty-eight Diamonds, several Sapphires, Rubies, Topazes, Amethysts, &c.

The Diamonds in the Exhibition may be distinguished into several groups. There is first the "Koh-i-noor," or Mountain of Light, formerly the property of Runjeet Singh, but surrendered to the Queen of England, on the annexation of the Punjaub by the British Government; this gem was exhibited by Her Majesty.* Its shape is an irregular oval, 1½ inches in length by 1 inch across; weighing nearly 280 carats. Two smaller diamonds were placed on either side; one weighs 34 1-6 carats, and the other 19¼ carats.

The Koh-i-noor was estimated by Tavernier at £468,959; but, according to the rule proposed by Jeffries, it would be worth £622,000: it is said to have lost half its original weight in the cutting.† It was formerly valued at three millions, and then at £1,500,000; but, soon after it came into the possession of the British, it was stated in a Bombay newspaper to have been strangely over-estimated; and, after its first flush of attraction at the Exhibition, the lustre of the Koh-i-noor was thought inferior to that of Mr. Apsley Pellatt's Glass models of this and other brilliants.

The "Sea of Light" was exhibited in the Indian collection: it is an immense diamond, set as an armlet, with ten smaller stones

* Messrs. Chubb's "Safe," in which this Diamond was shown, has been described at page 234.

† The conventional value of Diamonds is one of the popular errors of the day; the celebrated Napuck Diamond, estimated by the East India Company to be worth £30,000, realized when sold in London in 1837, only £7,200.—See *Popular Errors Explained and Illustrated.*

around it; and was shown with a necklace of 224 large pearls, and a shorter one of 104 smaller pearls; a necklace of four large rubies, a pair of emerald armlets, a carved emerald and diamond turban ornament, an emerald and diamond bridle and martingale; a gold mounted saddle, set with diamonds, emeralds, and rubies; a brocaded robe, decorated with pearls; and an emerald girdle, the stones of immense size, and mostly of very fine quality.

Among Messrs. Hunt and Roskell's Brilliants, was a Diamond Bouquet, in seven sprigs, containing nearly 6000 diamonds, the largest weighing ten carats, and the smallest the thousandth part of a carat: this group is a fine example of diamond-setting. Another fine specimen was the Ruby and Diamond Bouquet of Messrs. Morel, valued at £15,000.

Messrs. Garrard exhibited a large collection of ornamental objects in precious stones and jewellery, among which were a suite of the finest opals and brilliants, consisting of necklace, stomacher, earrings, bracelet, and pin; and a suite of sapphires, pearls, and brilliants.

A large Opal, 1 $\frac{5}{16}$ inch long, by 1 $\frac{1}{8}$ wide, from Mexico, was exhibited; and, among the Emeralds, was one oval-shaped, and skilfully cut, of a deep blue tint, approaching the sapphire colour, and of almost matchless brilliancy. A gigantic Crystal of Emerald belonging to the Duke of Devonshire, exhibited with Mr. Tennant's goods, and three others of very large size and beauty, showed the way in which the stone occurs. Mr. Tennant also showed a magnificent Beryl; and some white Topazes, of great beauty, from Van Diemen's Land. Among the numerous Pearls displayed, was a specimen attached to the shell of an oyster; and a portion of a shell containing Pearls of fish-like form, from China.

A Case of Artificial Gems, shown beside these natural gems, was curious; though the former are but coloured glasses, made highly refractive by the large proportion of lead in their manufacture.

A fine collection of Coral was shown; including a branch of natural rough coral of great size and value; a Bacchus Carving of the Finest Coral, and a variety of Coral Cameos.

A Jewelled Hawk, the property of the Duke of Devonshire, was exhibited: it contains a Gold Drinking-cup; the wings and body of the bird are chiefly covered with rubies, turquoises, emeralds, and other precious stones. The bird stands about a foot high, and cost its noble owner 600 guineas.

The Jewels of the Queen of Spain, exhibited by Lemonnier, in the French collection, were very attractive. In the centre was a bouquet of large diamonds, on elastic sprigs; the buds were enormous pearls, and the green foliage were emeralds. Above were a tiara of sapphires, surrounded by diamonds, and festoons of diamonds and pearls. There were also a circlet of diamonds; necklaces and bracelets, and stomachers, studded with brilliants; and a brooch and pendant, the central ornaments of which were two enormous rubies. Near these gems was a display of jewels, prepared for the Emperor of Hayti, of great beauty; and models of the crown, sceptre, state-swords, &c.

PAPIER-MACHE AND CARTON-PIERRE.

Papier-Maché is a substance employed for decoration, of English invention, though bearing a French name. It was first made by the father of Joseph Wilton, R. A., a few years earlier than the middle of the last century.* The term properly means paper reduced to a pulp, and then manufactured; and this is employed considerably for ornaments in relief, and is pressed into moulds made of metal, from plaster models. This application, a revival of the old *papier-maché*, was made by Mr. C. Bielefield, of London, some five-and-twenty years since; and several fine specimens of his manufacture were shown in the Exhibition, including ceiling ornaments, wall decoration with Gothic detail, and fruit and flowers; over-doors, and picture and glass frames. Among the novel applications was a repetition of the celebrated Elgin Horse's head; and two Statuettes after Michael Angelo. There were likewise shown two nice copies of classic Capitals, for columns; two Cherubim forming a cartouche; besides Consoles and Corbels.

Mr. Bielefield also exhibited, in *Papier-Maché*, a model of Dundee, n relief; and his new patent for obtaining sheets of *Papier-maché* of any size and thickness, at present applied to the partitions of steamers only. It is stated that *Papier-maché* is of utility out of doors, and that its rival, *Carton-pierre*, is not, which may be the case; as the other manufacture seems to consist of plaster of Paris, with other ingredients mixed therein, poured into moulds, allowed to set, and backed with stout paper, to ensure the adherence of minute portions.

Carton-pierre is made in France and Germany to a considerable extent, which is not the case with its rival. The best specimens were those exhibited from France; Huber showed an Italian frieze, a Greco-Raffaelesque vase, and a cinque-cento pilaster, of considerable merit; but totally eclipsed by a beautiful over-door executed for the Ecôle des Mines; and by a superb frieze in the real style of Louis XIV., made for Fontainbleau. Hardouin supported the same reputation almost in the works repeated for Versailles; but, altogether, these productions were excelled by the works of Bielefield and Jackson.

Messrs. Jackson and Sons, besides some forty pieces of ornament in all styles usually employed in England, a ceiling in the Elizabethan manner, and a most noble centre flower, exhibited a very superb chandelier, with sixty lights, in the style of Louis XVI.; a very fine terminal console or bracket, and specimens of the work executed by them for the new Army and Navy Club, in Pall Mall.

Gropius, of Berlin, contributed specimens of *stein-pappe*, of similar materials with *carton-pierre*. There were about fifty pieces, nearly all being statuettes in the modern German taste.

Messrs. Lincoln and Burnett exhibited a Work-box and Table, made of calico; but the fabric too clearly displays itself, by its lines of the warp and woof, and by the ragged threads. Somewhat similar were Mr. G. Hart's two handsome Snuff-boxes, a pair of Vases, and of Candlesticks, and a Work-box well moulded.

* See Mr. Bielefield's interesting Memoir on Papier-maché, &c.

The other branch of the subject may be termed Japanned Paper-ware; the better sort of which is produced by obtaining the required form from a mould by placing a sheet of paper on or in it, and then fixing sheet upon sheet, as the work dries, until the requisite thickness is gained; the lathe, the rasp, or the plane is then employed to give a general finish to the forms produced in this species of mill-board, or pasteboard; and it is several times varnished, being submitted to so severe a heat as 180 degrees: the inequalities are reduced by scraping and polishing with pumice-stone. Then the design, if any, is put on, and re-varnishing and polishing with rotten stone is performed, until the final lustre is given by the female palm, as to some sorts of cutlery.

Sometimes mother-of-pearl is employed, but this enters into the manufacture in a slightly different manner. The design being marked upon the mould, thin portions of shell, cut to the necessary forms, are laid upon the pattern when the first sheet is applied, and the operations above mentioned are continued. When the requisite thickness is gained, the shell is found bedded in the paper; and the scraping, varnishing, painting, and polishing are completed, as before.

There is a large consumption, both at home and abroad, of articles, in which the form is almost invariable; such as portfolios, albums, envelope and papeterie cases, paper-knives, card-cases, and trays; card racks, work and knitting, netting, and similar boxes; screens, chessboards, &c.: these rely almost entirely on their pictorial attractions, while beauty of form should be almost an element of as much consideration as the pattern of decoration in tables, chairs, cabinets, desks, *sécrétaires*, vases, inkstands, tea-caddies and tea-poys, trays, mirror frames, coalscuttles, canterburies, music-stools, and pianos.

Both in taste of ornament and execution, as might be expected, the London houses seem to stand first; then the works from Oxford, Wolverhampton, and Birmingham follow.

Messrs. Rau and Co., of Göeppingen, in Wurtemburg, were the only representatives of these manufactures on the foreign side. The articles were in good taste; but the colouring was not so good as that on the English side: the ornamental portions were much better worked than ours.—*Abridged from the Illustrated London News.*

RELIEVO LEATHER.

Specimens of this beautiful manufacture were exhibited by three firms, two French, and the other English.

In the French department, M. Dulud, of Paris, displayed several pieces of Tapestry and Ornamental Hangings in Embossed Leather, which appeared identical in subject and the method of their preparation with those of Mr. Leake in the Fine Art Court. He likewise showed two Elbow-chairs lined with embossed leather, and other articles of furniture.

M. A. A. Despreaux exhibited a collection of Venetian Leathers of similar pretensions, but differing as widely as possible in their result.

Mr. Leake, too, to whom we are indebted for the revival of this branch of manufacture, was the third exhibitor. His models were selected in the best and most classic styles. The leathers are much sharper, and of greater boldness, than those of former day; and they exhibit a degree of *undercutting*, so to speak, which is characteristic of the modern school, and never to be met with in the ancient examples. Leather can be made to represent almost any kind of wood; and an upright Scriptural Figure Subject, framed, had so close a resemblance to an old copper casting, that it was only by close examination the deception could be detected. The Architectural examples of the Gothic Eras, and the time of Elizabeth, &c., were very good.

WOOD-CARVING.

The specimens of Sculpture in Wood, contributed by English and Foreign Exhibitors, were rich in artistic ornament and variety of character. Those in the Swiss department consisted of boxes, baskets, and other small articles; but the Zollverein and French examples were principally portions of furniture. Belgium contributed some finely-carved articles; but the most attractive Foreign display was the Furniture and Flooring for a suite of four Rooms, in the Austrian department; where was a magnificent Gothic Book-case in Oak, by Bernardis and Klauner, sent as a present from the Emperor of Austria to Queen Victoria. A massive and superbly carved Locust Wood Bedstead, by Leistler, was much admired: it has crimson and gold hangings, but is overcrowded with floral ornament and statuettes, in which the markings of the wood have an almost ridiculous effect. The floors and ceilings of these rooms were elaborately wrought in woods. The florid specimens from Tuscany were of the most elaborate beauty.

Foremost among the English Carvings were those by Mr. W. G. Rogers, who very nearly approaches the excellence of Gibbons in this branch of art: a pair of Glass Frames, with dead Game, Fruit, and Flowers, was priced £700; and an elaborate Frame, carved for the Exhibition, at £350. Mr. Rogers's most popular work, however, was the Cradle carved in Turkey box-wood, (designed by his son, W. H. Rogers,) and exhibited by Her Majesty. It symbolizes the union of the Royal House of England with that of Saxe Coburg and Gotha. One end exhibits the armorial bearings of the Queen, surrounded by foliage, natural flowers and birds; on the rocker, beneath, is the head of "Nox," a beautiful sleeping female, crowned with poppies, supported upon bats' wings, and surrounded by the seven planets. The other end, or the back of the head of the cradle, is devoted to the arms of Prince Albert. Below, on the rocker, is a head of "Somnus;" and over the chin a wimple, which, on each side, terminates in poppies. In the interior of the head of the cradle, guardian angels are introduced; and above, the royal crown embedded in foliage. The friezes are composed of roses, poppies, conventional foliage, butterflies, and birds, pinks, &c. The edges and the insides of the rockers are enriched with the insignia of royalty and emblems of repose.

In exquisite delicacy of touch, and minute anatomy, the Birds, by J. W. Wallis, of Louth, perhaps, excelled those by Rogers. A group of flowers, &c., allegorizing Spring, carved in lime-tree, by Mr. Wallis, comprised 1060 buds, and forty-seven varieties. Hanson and Son contributed some superbly carved Frames of admirably arranged design; and a Kestrel-hawk and Butcher-bird, by J. Batsford, is full of spirit and truth. Stevens, of Taunton, exhibited a Cabinet of fine walnut wood, grown in the neighbourhood of that town, elaborately carved, representing youth, manhood, maturity, and old age; also, the Seasons of the year, in carving and needle-work, the Passions, &c., crowned with a figure of Peace extending over the globe. A Cabinet of walnut wood, with carved copies of the rarest and most graceful tropical plants in the Royal Gardens, at Kew, presented a rich and varied group of design.

More attractive, however, from its historic portraiture, was the Kenilworth Buffet, carved by young men of Warwick, from a colossal oak which grew near Kenilworth Castle, and was cut down in 1842.

The subject is the Kenilworth pageant of 1575, in honour of Queen Elizabeth's visit to the Earl of Leicester. The centre panel, carved out of a single block of oak, represents Elizabeth entering Kenilworth Castle. Leicester is on foot, bareheaded, leading the horse on which the crowned and ruffed Queen is seated. A long train of fair ladies, statesmen, knights, warriors, &c., on prancing steeds and on foot, follow; in the distance are seen, soldiers, peasantry, &c. At the opposite end of the panel, is the Earl of Essex, Leicester's rival, mounted on a charger. The horses are very fine. On the table part, beneath the centre panel, is the Tudor rose, surmounted by the royal crown, with the motto "semper eadem;" on the spandrils are marine subjects taken from the pageant. The panel on the right represents Elizabeth meeting Amy Robsart at the grotto in the Castle grounds; the left panel has the interview of the Queen with Leicester after the exposure of the deceit of the latter. At the corners are statuettes of Sir Philip Sidney, Sir Walter Raleigh, Shakspeare, and Sir Francis Drake. The oak is in its light, natural colour, so as to show the elaborate details.

The specimens of Irish Bog Yew and Oak, were very fine: among them were Side-boards, State-chairs, Fire-screens; and a Tea-poy, with carved designs, emblematic of the ancient commerce of Ireland.

MEDIÆVAL ORNAMENT.

The artistic wealth of the Mediæval Court of the Exhibition has already been incidentally noticed. (See page 105.) Its specimens of Ecclesiastical and Domestic Decoration presented the results of an union of art-workmen, whose attention has been more exclusively devoted to the revivals here illustrated, with the designs and superintendence of Pugin. We had the furniture of Crace, the stained glass and metal work of Messrs. Hardman, the stone and wood carving of Myers, and the encaustic tiles of Minton. In the centre stood a font of stone-work, admirably executed by Mr. George Myers, the panels on the sides being decorated with bas-reliefs, and the whole surmounted with a richly carved canopy of oak. The great group of ecclesiastical furniture comprised a Stone Altar, beautifully carved with bas-reliefs of the Agony, Bearing the Cross, and the Crucifixion; the whole surmounted with hangings of rich and varied texture, and with suitable devices, such as the *fleur de lis*, roses, and the sacred monogram. The sconces, candelabra, and chandeliers, all of wrought metal, are truthful; and the lecterns bold and effective; the smaller one, with the sacred monogram for the tablet, and a small figure of St. John the Evangelist, as the surmounting ornament, is at once elegant and novel. A highly decorated Rood Cross occupied the corner, the carving of which is of a very high character. The monumental brasses, the balustrade of a staircase, the gold and silver vessels for the service of the altar, the vestments for the priests, and the tomb of Dr. Walsh, with its admirable encaustic life escutcheons, are the finest ecclesiastical examples. Nor must some Windows of Painted Glass be omitted.

The domestic specimens included richly-wrought Cabinets, Tables, and Chairs, of the best periods; besides And-irons, Fire-places, &c. There was also a large Stove of coloured and perforated tiles, by Minton.

In connexion with the Mediæval Court may be mentioned Mr. Gilbert J. French's examples of Church Embroidery, Foot-cloths, and Carpets. Mr. French's exertions in this direction are now well known and appreciated; and the excellent character of his productions entitles his display to our attention, in connexion with the larger, though not more complete. A Vested Altar of rich crimson velvet, embroidered with gold, and a Flowing Communion-cloth of ruby velvet, also elaborately embroidered, were striking and beautiful objects; with Embroidered Velvet Book-covers, Wall-hangings, and Carpets.

BOOKBINDING.

The specimens of Bookbinding, considering the smallness in number of the trade, occupied rather a large space. They will be found well described in *The Bookbinders' Trade Circular*, No. 6; wherein the editor thus sums up the merits of the collection:—

"In remarking on the specimens exhibited by each nation, it appears to us, that in all that relates to workmanship we are unsurpassed; in design, though there are some most elegant specimens, taken as a whole, we are very deficient. The French collection exhibits exquisite workmanship,—the lettering, however, taken as a whole, we think is not equal to the other parts. In design, the French binders are very felicitous; there are few inferior designs, and none possessing absolute defect, while there is great ingenuity in making the most of very simple means. The Austrians, in superb decorations, distance all competitors. It is true this is not the work of bookbinders alone; but each nation exhibits specimens of this kind,—none, however, to be compared for a moment with those in the Austrian collection. The American collection, taken as a whole, though inferior, is respectable. The Account Books, taken together, seem to be the best. The highly ornamented style of some of these, as well as a Ledger in the Hamburg collection in red morocco, full gilt, is very unusual, if not unknown in England. Of our own collection it may be said, that while in excellencies and defects we are fairly represented, work equal to the best in it is continually being done by those who, from diffidence or other causes, have not sent specimens."

Thus, Remnant, Edmonds and Co., had some splendid specimens in russia and morocco, and their antiques were fine. Barritt and Co., Fleet-street, exhibited some fine specimens in Carved Wood and Polished Oak, encrusted with electro-type metallic ornaments. Mr. John Wright imitated the lighter styles of the Continent in Vellum and other bindings very successfully. Macomie had a Bible in Buhl and Tortoiseshell; and Messrs. Ackermann fully sustain their reputation by various fine specimens.

PAPER-MAKING.

Among the *Curiosities* exhibited in this collection was a Sheet of "Double Long Elephant," which, hanging down from the very roof of the Building, coiled up the greater portion of its unwieldy bulk upon the stand of the Messrs. Spicer, Brothers, its manufacturers. This mammoth sheet is 2500 yards in length, and double the breadth formerly used in the trade. Messrs. Spicer also exhibited a series of the Material of which Paper is made; beginning with the broken-up nightcaps, fragments of old linen, &c., and ending in the fine and colourless pulp which forms the last stage of preparation previous to the production of beautiful sheets of "hot-pressed" and "cream-laid" The finest rags, it appears, come from Hungary, but they are latterly becoming scarcer and scarcer; as, thanks to our Excise Laws, the manufacture of paper is rapidly increasing on the Continent.

Messrs. De la Rue and Co. collected an almost endless variety of that Fancy Stationery for which their house has long been famous; among the specimens of Varnished Paper, for ornamental purposes, upon which the iridescent colours are produced solely by the means of colourless varnish in great perfection, some shone like a drake's neck, and in others a perfect imitation of mother-of-pearl is produced.

Mr. Saunders, of Darenth, Kent, exhibited a novel kind of Paper, with a water-mark portrait of the Queen, contrived, not as the ordinary water-mark in mere outline, hitherto used in bank-note and other paper, but so as to give the gradation of light and shade of an Indian-ink drawing. It is the invention of Mr. Oldham, the engineer of the bank of England; and, as its production involves many difficulties, an opinion is entertained that it may form a valuable addition to bank-note paper for the prevention of forgery.

A beautiful illustration of Paper-making, by rags put in at one end of the machinery, and delivered as fine paper at the opposite end has already been noticed.

PAPER-STAINING AND PAPER-HANGINGS.

The contributions to this branch of the Exhibition were rich and varied; those of France taking precedence in the highest class of Paper-staining. Some of the large panels by M. Delicourt were admirable specimens of pictorial composition, fine colouring, and rare feats of block-printing. The red flocks of Mader Frere were bright, deep, and vivid; and the ordinary papers from France were excellent. The Russian and American papers were poor; and the Austrian and Belgian specimens were little better.

The English contributions were altogether excellent. The Messrs. Hinchliff, in machine-work, approached nearest the taste and fancy of the French manufacturers. In the machine section of Paper-staining the English are unrivalled: among the exhibitors, Messrs. Heywood took the lead; they are able to print fourteen colours with fourteen cylinders, on the same paper; the utmost hitherto attained being ten colours with as many separate cylinders.

Among the novelties was Clark's "Seamless Flock Decoration," made from the woollen flocks obtained in the cloth-finishing process; and, being manufactured on the wall of the apartment, may be extended over any given space without seam, joining, or repetition, such as are unavoidable in paper-staining.

CABINET-WORK.

The Foreign contributions to the Exhibition have been thus ably characterized:—"France, Austria, Spain, Germany, Belgium, and the United States, have furnished us with the finest specimens of their several excellence in Cabinet-making, in each of which may be traced the mechanical skill and prevailing taste of the present time. France is light, elegant, yet convenient, in the forms of her objects; Austria is heavy, lugubrious, and colossal, with one or two exceptions; America is smart, original, and adaptive; while Spain has sent us a Table, the wonder of the world of inlayers and marqueterie-workers. Nor ought we to omit the equally surprising contributions from the Eternal City, whose Mosaic Work is one of the marvels of the Exhibition."

Among the French specimens was a Fancy Writing-desk, by MM. Daubert and Co., every part of which flies open by turning a single key, yet each part can be isolated from the rest, and secured when required; it contains a secret case, which conceals or exhibits its contents at pleasure; the exterior is of rose-wood, violet-ebony, inlaid with brass and diamond pegs; the interior is lined with green scales and Britannia metal. Kreigler and Co., of Paris, exhibited a beautifully-carved Bookcase; and M. Marcelin a Work-box, containing 80,000 pieces of wood; and a Table of 100,000 pieces. Of the Austrian furniture we have already spoken.

Among the English Cabinet-work, the works of Messrs. Gillow, Hunters,* and Johnstone, and Jeanes, were most striking. Messrs.

* Sons of the present Lord Mayor of London.

Burroughs and Watts contributed a splendid Billiard Table and Marking-board, in English oak, in the Elizabethan style. Mr. King, of Whitehaven, sent a Cabinet of British oak, in pale brown and black varieties, picturing the commemoration of early Printing and the Reformation, from Scott's *Antiquary*, wherein Aldobrand Oldenbruck is prominent. A Mosaic Table, by E. Nye, near Tunbridge Wells, represents a Ship at Sea · the ropes, shades of the sails, port-holes, and the rippling waves, being imitated in numberless small squares of various woods. There was also a *Marqueterie* Table of inlaid woods, the subject the Battle of the Nile, with Fame crowning Nelson. Mr. Newton, of Glasgow, sent a Table composed of nearly 7000 pieces of foreign woods; and a Cheffonier, of 4000.

The State Bedsteads included a Model by H. Scrimegour, of Edinburgh, with an Elizabethan canopy, of pine and plane wood elaborately carved, with royal insignia; the blankets of the finest Cheviot wool, and the sheets of Tweed linen, trimmed with lace. There was also shown a beautiful Needlework State Bed; and the canopied Bedsteads comprised some tasteful specimens of upholstery.

We must likewise record a Chair, designed in honour of the Prince of Wales, by John W. Papworth, and carved by W. Jones. The tapestry work displays the triple plume and coronet, the garter, and a Welch harp, English roses, and Scotch thistles, and shamrocks, convolvuli, oak leaves, and apples, tastefully arranged upon a rich diaper ground of damascene-coloured silks.

A Collection of all varieties of Ornamental Woods, by Messrs. Harrison and Sinclair, of Leeds, was beautifully instructive.

ROPES AND CORDAGE.

Among the Foreign specimens in the Exhibition, those from France were remarkable for laborious finish; especially, a White or Manilla Hemp Rope.

Among the English cordage, Robertson, of Limehouse-hole, exhibited specimens of Large Rope for Shrouds, &c., and Smaller Cordage for Topmast Rigging, of very excellent manufacture. Some 11-inch Rope applied as stop-rope to a cannon (to counteract the rebound after a discharge), was particularly strong and well made. Haggie, Brothers, besides some very fine specimens of ordinary Cable-laid Rope, exhibited Flat Ropes, of great strength and finish, for the winches by which baskets are raised from coal pits.

We may here notice some Round and Flat *Wire* Rope, by R. S. Newall and Co., of Gateshead on Tyne, intended for the standing rigging of vessels and the support of suspension bridges, to which they appear eminently adapted. For, on the same principle that a Damascus blade, hammered out of an infinity of wires, is stronger and more trenchant than an ordinary sword, these wire ropes must be superior in sustaining power to the chains in ordinary use made of solid masses of metal.

The Patent Rope, manufactured from Manilla hemp, by Spyvee and Coopers, of Hull, was shown; as were also the Flat Ropes, made under the improved patent of S. H. Hawke, of Truro. We cannot say much in commendation of the Gourock Rope-work Company, of Greenock; though, perhaps, want of external finish is the only fault. Sir Joseph Huddart and Co., of Limehouse, exhibited a very ingenious Machine for Twisting the Yarn and Strand. We presume Sir Joseph is either the original patentee or the son of the Joseph Huddart, of Islington, who some fifty years ago took out one of the earliest patents for a rope-making machine. The specimens of this firm were among the finest in the Exhibition. Joseph Crawhall's (of Newcastle) Improved Patent Rope-making Machine, in the Machinery-in-motion department, is, however, the most perfect thing of the kind yet invented. It twists the yarn, the strand, and the rope by one and the same process, several smaller wheels turning round the principal spindle.

In the Russian department, were only two exhibitors of Ropes—Michael Milnikoff Glouskoff, of the government of Tuertown Ryeff, and Cazalet, of St. Petersburg—whose specimens, though not equal to the French or English ropes, were by no means of striking inferiority.

The Ropes of Felten and Guillaume, of Cologne, were, to all outward appearance, equal to those of our own manufacture. Blenkenburg, of [illegible]stadt, chiefly excelled in small cord and string; but H. J. Hoerkens, of Lubeck, sustained the reputation of that Hanseatic seat of commerce, by specimens of unexceptionable texture.

LEATHER, FUR, AND HAIR MANUFACTURES.

Saddlery and Harness.—This section included certain articles of excellent workmanship and novel design; but we can only refer to the more striking productions. Among these was a Saddle, by Gibson, Coventry-street, fitted with Reid's Patent Girth Regulators, in which a small lever, on the principle of a ship's capstan, winds catgut, to which the girths are attached on a metal roller. The girths may be tightened at cover side, or even when cantering along, without lifting up the flaps of the saddle. Thomas, of Stratford-on-Avon, sent Flexible Saddles, which are said to yield to the motion of the horse, and yet allow a free current of air between the back and the saddle. Cuff, of Cockspur-street, exhibited a magnificently-embroidered Velvet Military Saddle.

Several *Racing Saddles* were shown; but for form, workmanship, and weight, nothing can exceed the one exhibited by Mr. Cooper, of York, and pronounced by one of the leading members of the Jockey Club the best he ever saw. The best side-saddle in the Exhibition was that sent by Urch, covered with brown buck-skin, very light (only 12¼lb.), elastic, yet sufficiently strong.

Bridles.—Among those exhibited were several for stopping or holding *pullers.* The display of Brace, of Walsall, consisted of magnificently-chased Stirrups in gold and silver plate, Spurs, Bits, and other ornaments, manufactured for the South American market, and particularly for Mexico and Cuba, where the horse-trappings of a cavalier of fortune will sometimes cost £1200.

Messrs. Peat, Old Bond-street, exhibited an extremely elegant White Bridle, linked with silver, made of untanned (green) hide, in the province of Rio Grande da Sal, Brazil.

Earnshaw exhibited a magnificent Blue Morocco Bridle, with gold ornaments. Ashford, of Birmingham, showed a Bridle of Caoutchouc, of neat shape, and cool neutral colour; besides an ingenious registered invention for Driving-whip sockets, in which an India-rubber ring keeps the whip tight.

There was also shown by Stone, Union-street, a State Pony Bridle, designed by W. H. Rogers, for the Prince of Wales.

Harness.—A good deal of Harness was shown: the leather a good colour, and well tanned, the sewing neat, but the design for the most part clumsy and tasteless.

The best improvement in harness was White's Invention, by which the clumsy buckle of the traces and the crupper is superseded by a hollow cylinder of leather and metal, which, when in use, lies flat: when there is any need to alter the length of the traces or crupper, a peg attached to a metal slide can be opened, and the hole of the trace moves either way in a moment, instead of requiring you to strugglo to unfasten the tongue of a huge buckle. The same ha[illegible]s, exhibited on a wooden horse, had improved gig harness tu[illegible]r confining and releasing the shafts rapidly.

A number of Collars in the English, and one in the Belgian, department, were exhibited as improvements. There was an Air Collar, capital in theory, because it can be blown to the requisite fit. Birmingham sent a neat Straw Collar; but one of the best was from Musselwhite, of Devizes, stuffed with cork and horse-hair, and opening at the top, so as not to require forcing over the head.

Mr. Bywater, of Piccadilly, sent a Harness, in which the hames have shifting draught eyes, so constructed as to be easily moved higher or lower, to suit the draught of the horse; and are fixed in the required position by an ornamental cover, which effectually removes the unsightliness hitherto so objectionable in this description of hames. The Patent Silvered Glass Front and Rosettes, likewise the newly-designed Terrets, are a great improvement in the general appearance of the harness.

The Foreign Saddlery was, for the most part, an inferior imitation of English, although Paris sent some articles very respectable, except in metal-work. There were some White Flax Cord Reins exhibited in the Belgian section, admirable for ladies, as they will wash and keep their colour.

Boots and Shoes.—The various adaptations of Caoutchouc were the principal novelties in this section. Among these, was Mr. Sparkes Hall's vulcanised India-rubber webbing system of easing the sides of Boots. Mr. J. Medwin exhibited his resilient Boots; and W. Thomas and Brothers, Boots and Shoes made without stitches, pegs, nails, or rivets, with India-rubber sides, &c., and Boots with Gutta-percha soles. Mr. Godeyer contributed a pair of Top-boots, which weigh only three ounces, can be made to order in two hours, and sent by post. Next were some perspiration-absorbing Waterproof Boots by Currie; the Spring-sided Boots by Wildsmith; and the Siccopedes or Elasticus, of silk, with cork soles and elastic waist-pieces—Dowie's patent—giving freer play to the bend of the foot than ordinary soles.

The Foreign Boots and Shoes were mostly destitute of any striking novelty in make or fashion; but the specimens of Hungarian Boots, of Viennese embroidered Velvet Slippers and Boots, handsome French Slippers, and those from India and Turkey, were curious illustrations of costume.

Among the historical *Curiosities* was Mr. Sparkes Hall's set of imitations of the Shoes of various reigns, showing the caprices of centuries of fashion at a glance.

Goodyer's Patent American Shoes, made entirely of vulcanised India rubber, were also exhibited—the soles being made rough to prevent slipping, and a polish being given by heat, without any extraneous substance. By a recent invention, the uppers can be perforated with minute holes, so as to allow perfectly free ventilation, the want of which has hitherto prevented shoes of India-rubber from coming into general use.

Gloves and *Parchment* were exhibited in this section.

Furs were displayed in instructive variety, most carefully arranged; they are classified in the *Illustrated Official Catalogue*, and in an abridged form in Hunt's *Handbook*.

Wigs,* *Perukes*, *&c.*, were shown by several makers; and the Works in Hair were very ingenious.

HAT-MAKING MACHINERY.

Messrs. Gaines, Sanders, and Nicol, contributed a model representation of the process of manufacturing Silk and Felt Hats. There are a number of model men and women pursuing the different branches of their art, the figures being 6½ inches in height; and all the instruments on the same scale, including Irons, Rounding-machines, Rules, Brushes, Bottles, Scissors, Needles. The process of making the Hat-body of linen and cork, covered with silk plush, is here seen. To produce a Felt Hat, the workmen are busy in the various stages. The materials are also shown to be two kinds of wool,—cleared rabbits' and carded Saxony,—which, by being rolled together, become matted, or felted, so as to form the material of the felt hat. This part of the model is furnished with its large hot-water tank, around which are the workmen, scalding, felting, and blocking.

* It is worthy of remark, as indicative of some strange, perhaps hereditary inquietude in this class of articles, that we find their single Exhibitor in the Russian department, a French hair-dresser at Odessa, actually petitioning the Russian Commission to induce Her Majesty to postpone the solemn opening of the Exhibition on the 1st of May for the space of three days, to enable him to get his six interesting wig-blocks in becoming order for the occasion.—*Edinburgh Review*, No. 192.

CARPETS, TAPESTRY, AND FLOORCLOTH.

In number and variety of manufacture, Great Britain took the lead, as might be expected; considering that we use more carpets and export more carpets than all the rest of the world put together. England, Scotland, and Ireland claimed upwards of thirty manufacturer exhibitors; that is to say, from London, Kidderminster (whence about twenty date), Wilton, Leeds, Halifax, Durham, Kendal, and Stourport in England; from Glasgow, Kilmarnock, Bannockburn, and Lasswade, in Scotland; and from Dublin: and, in addition to these manufacturers, there were several enterprising firms, who displayed goods prepared by their direct orders for sale in London, in various parts of England and Scotland; and even in Turkey and India, not to mention France.

Seven exhibitors were French, two Algerian, five Belgian, three Dutch, two Austrian, and eight of the Zollverein; two were Swiss, one Danish, one Portuguese, two Tunisian. The East India Company displayed several splendid specimens of Oriental workmanship; among others, a Silk Carpet of incalculable value from Cachmere. The United States contributed only one carpet.

At the head of these manufactures, in point of antiquity, were the Gobelins Carpets, whose brilliant colours and harmonious designs are not the result of accident or intuition, but of 200 years of uninterrupted practice and instruction, at the expense of the French Government.

Next in order after the costly Hand worked Looms, where everything depends on the skill of the workman, came the contrivances for producing the effect of rich handiwork by machinery, at more moderate cost.

The first successful attempt of the kind was *Whytock's Patent Tapestry and Velvet-Pile Carpets*, by which process each worsted thread is coloured in all the colours intended for the design before commencing weaving.

The second machine-made fabric is the *Patent Axminster Carpet*, invented by Messrs. Templeton and Co., of Glasgow, which has great advantages where one design of moderate size is frequently repeated, as nearly the whole process can be effected by the patented machinery. The worsted is woven in stripes as *chenille*, the various colours intended to be used in the pattern being inserted in their proper places. The stripes are then separated, and, by machinery, the worsted ends are made to stand upright. These stripes in weaving are used as weft, and form the face of the carpet. By this process, there is also an economy of woollen over the Turkey and Axminster mode, in which the worsted passes to the back as well as the front.

The third process of manufacture is that of the *Patent Wool Mosaic Carpet* fabrics, exhibited by Messrs. Crossley, in Rugs, Tapestry, and one Carpet—the first of the kind ever made. These fabrics resemble externally Axminster work, but are produced in the following manner, first invented in Prussia, but since patented and extended in application in this country:—The pattern is composed of threads arranged longitudinally, the ends forming the design. This having been completed, and the whole compacted together by strong pressure, a back of coarse linen, covered with a solution of caoutchouc, is applied to the ends; and, as soon as they adhere firmly, a slice of wool of the length required is sheared off. On this slice, the pattern is of course displayed, and the operation is repeated until the material is exhausted. The economy of this process is founded on the same principle as that by which an intended inlaid floor or piece of *parquetterie* is made a foot thick, and then sawed into veneer sufficient for fifty rooms on precisely the same pattern.

A fourth mode of producing Carpets and Tapestry, is that known as Bright's Patent, from the name of the principal manufacturers, but which ought properly to be called Sievier's and Burch's patent. Sievier invented a mode of weaving Carpets and Tapestry in a Power-loom, and Burch succeeded, after many failures, in printing the fabric by machine-worked blocks. In this manufacture, as in Brussels and in Whytock's Patent, where the brass rods which formed the loop are allowed to remain, the result is a tapestry, a plain-looped face; where they are cut out, a velvet pile.

Brussels.—To describe the process of a manufacture so common as that of Brussels, would be unnecessary; but there were in the Exhibition some specimens of the best Brussels carpet, of the quality known as five-frame, woven by steam-power, by Mr. Bigelow, of the United States. This invention will very soon revolutionize the trade.

Another important improvement has been made by Alfred Beach, a Carpet-weaver, in the employ of Mr. Fawcett, of Kidderminster, and patented and exhibited by that gentleman. Hitherto six-sevenths of the wool used was buried in the fabric; while, by Beach's improvement, nearly this quantity is brought to the surface, and an equally rich and durable carpet is manufactured with half the usual quantity of wool, and less than half the cost; yet the arrangement of the loom and the mechanism is very simple.

Foreign Carpets.—The specimens made on the Turkish or Axminster principle were very good. As *Curiosities*, we note in the Tunisian bay two Carpets, or rather long Rugs, of singular but comfortable appearance, one of them adorned with rude figures of men and women. These could scarcely have been woven by Mahommedans, whose creed forbids the representation of living forms. They are not cheap—£22 for about 18 feet by four.

In the French department, the great feature was the Gobelins carpets. The Austrian Carpet swere inferior copies, in workmanship and design, of the French. A Carpet made by Maria Louise, with the aid of several royal relations, is interesting as an historical specimen of amateur workmanship.

The Royal Dutch manufactory of Deventner, and the Belgian of Tournai, were both respectably represented by specimens which offered no novelty.

M. Salandrouze de Lamornaix, MM. Demi Doineau, Laroque, and Castel, displayed Carpets only second in execution to the Gobelins. The French also sent specimens of cut velvet or Brussels carpets, from MM. Flaiser, of Nismes; and Requillaut, of Turcoing. Among the English exhibitors of Carpets rivalling the royal and national manufactories of the Continent, were Messrs. Jackson and Graham, who actually manufacture tapestry as well as carpets at their establishment in Oxford-street. There was also a carpet in the Louis Quinze style, of Messrs. Watson and Bell, made at Wilton, by Blackmore, and commanded by her Majesty; and among the contributions of Messrs. Lapworth, an Axminster Carpet in the *Renaissance* style, in rich and subdued colours, the centre and borders having a prettily devised Fondé, in crimson. It is surrounded with an imitation gold fringe, wrought in the same material and quality as the carpet—a special novelty. A similar carpet, with the national emblem, and the Prince Consort's cipher, 1851, is beautifully commemorative of the Great Exhibition.

Of the patent Axminster Carpets, the one designed for her Majesty by Mr. Gruner, executed by the patentees, and exhibited by Messrs. Dowbiggen, leaves nothing to be desired either in beauty or texture.

Messrs. Crossley's Patent Mosaic Berlin Work follows in natural order. In Whytock's Patent, we would note the contributions of Messrs. Henderson and Widnell, especially one in which the fern-leaves form a beautiful feature in the design; and another of orchidaceous plants.—(*S. Sidney; Illustrated London News; abridged.*)

The Berlin Wool Carpet, exhibited in the Transept of the Building, and designed by J. W. Papworth, the patterns painted under the superintendence of W. B. Simpson, and executed by 150 ladies of Great Britain, has been presented to her Majesty. The dimensions of this carpet are thirty feet in length, and twenty in breadth. The pattern, originally designed and painted by the artists, was subdivided into detached squares, which were worked by different ladies; and, on their completion, the squares were reunited, so as to complete the design. In the pattern, which consists partly of geometrical, and partly of floral, forms, heraldic emblems are also introduced. The initials of the executants are ornamentally arranged, so as to form the external border. The whole design is connected by wreaths or bands of leaves and foliage, the centre group representing the store from whence they have been distributed.

CHINA, PORCELAIN, EARTHENWARE, ETC.

A glance at this class of the Exhibition verified the assertion of M. Kohl, that the common Earthenware of England is not only excellent in quality, but also highly ornamented and unsurpassingly beautiful; whilst the common French and German is comparatively ugly, coarse, and mis-shapen. In the manufacture of Porcelain, which requires a higher class of art, and a greater amount of skilled labour, our manufacturers have not, however, attained such excellence as in the less costly productions.*

One of the branches of the manufacture of Porcelain in which British industry and art has of late years had the start of the Continent, is Statuary Porcelain. This imitation of marble originated with Mr. Thomas Battam, the superintendent artist of Mr. Alderman Copeland's porcelain manufactory, at Stoke-upon-Trent, early in the year 1842. It is now, however, fabricated in almost all the great Staffordshire works; and numerous specimens of it were seen in the Exhibition, among the collections exhibited by Messrs. Copeland, Minton, Rose, Boote, Meigh, Keys and Mountford, Bell, &c.

We select a few examples. A group of Ino and Bacchus has been taken from an original marble by J. H. Foley, R.A.; the reduction being effected by Cheverton's process. A figure of Sappho, three feet high, from the original marble of W. Theed, is of extraordinary magnitude—a circumstance which immensely enhanced the difficulties and hazards of its execution.

The Indian Girl and the Nubian, by Cumberworth; the Prodigal's Return and Rebecca, by W. Theed; a Venus, by J. Gibson, R.A.; a Bust of Juno (colossal), from the antique; Sabrina, by W. C. Marshall, R.A.; a Dancing Girl, by W. C. Marshall, R.A.; Innocence, by J. H. Foley, R.A.; and Narcissus, by J. Gibson, R.A. (the three last executed for the Art Union of London as prize statuettes); an Equestrian Statuette of Emanuel Phillibert, duke of Savoy, by the Baron Marochetti; the Princess Alice as Spring, the Princess Royal as Summer, the Prince Alfred as Autumn, and the Prince of Wales as Winter, from the original models by Mrs. Thorneycroft, executed for her Majesty. The Pleiades adorning Night, a large group, by Rose and Co., of Coalbrook Dale, is a highly poetic composition, otherwise remarkable for the above difficulties of execution. A Tripod for a Conservatory claims to be the largest work hitherto attempted in this beautiful material. Messrs. Boote, of Burslem, contributed some very tasteful combinations of Parian and China.

Among the Statuary Porcelain purchased in the Exhibition by her Majesty are the Equestrian Figures of the Amazon (after Feuchères); Theseus, Flora, and Temperance, from bronzes in the possession of the Duchess of Sutherland; and Love restraining Wrath, an original group.

A Chimney-piece in Parian, by Messrs. Minton, is a novel application of this chaste material.

* M. Faujas de St. Fond states:—"The excellent workmanship of English porcelain, its solidity, the advantage which it possesses of sustaining the action of fire, its fine glaze, impenetrable to acids, the beauty and convenience of its form, and the cheapness of its price, have given rise to a commerce so active and universal, that in travelling from Paris to St. Petersburg, from Amsterdam to the furthest part of Sweden, or from Dunkirk to the extremity of the South of France, one is served at every inn upon English ware. Spain, Portugal, and Italy are supplied with it, and vessels are loaded with it for both the Indies and the continent of America."

The British department of the Exhibition was extremely rich in Ornamental Porcelain; prominent among which was a Dessert Service, exhibited by Messrs. Minton and Co., which is original in design and ornamentation. The combination of statuary porcelain, which is the hard species, with the coloured and gilded porcelain, which is the tender species, is here successfully accomplished. The turquoise ground on this porcelain is very little inferior to that of the old Sèvres. The service consists of 116 pieces, the principal of which are two Flower-stands, with figures representing the four Seasons; two Wine-coolers, with Hunting Groups; and two Oval Baskets, with Oriental figures. Several of the pieces are supported by figures in statuary porcelain, with fanciful designs, and the plates, 72 in number, are perforated and richly ornamented. This service was purchased for 1000 guineas by her Majesty, on one of her visits to the Exhibition, as a present to the Emperor of Austria. Another striking example of the combination of statuary with painted porcelain was presented in the Parnassus Vase, exhibited by the same manufacturers; the *bas-relief* illustrating Apollo and the Muses.

Several Vases were displayed in the Copeland collection, of novel design, executed in imitation of pearls and gems, inlaid in gold, and executed in coloured enamel. The following beautiful articles were exhibited by the same manufacturer:—a large Porcelain Vase, with blue and gold enrichments, and wreaths of flowers; and a pair of large Vases, Etruscan form, 28 inches high and 26 wide, *Bleu de Roi* ground and ornamentation, with green scroll on burnished gold.

The progress made by the British manufacturers, in the colours of Porcelain, was strikingly exemplified in the following :—

A set of Vases with a Rose Du Barri ground, chased gold panels, wreaths of flowers, and musical emblems. A large copy of the Warwick Vase, with *Bleu de Roi* ground, the embossments in silver and gold, chased and burnished. A pair of Vases, "Queen's colour" ground, richly decorated with panels of raised and chased gold, embedded with pearls, and having landscapes within the panels. Several Vases of novel design, executed in imitation of pearls and gems, inlaid in gold, and ornamented in coloured enamels. Among the colours in which great excellence has been attained are, a strong and brilliant green, a cobalt blue, *Bleu de Roi*, and "Queen's colour." As illustrating these we may mention—An assortment of Dessert Plates, with various designs; a set with the Royal arms emblazoned in the centre, with foliated scroll border, and the Royal cypher; a set with Spanish views; a set with turquoise band and wreath of pansies; and a set with varieties of fruit in the centre, the blossoms and foliage forming the border.

There was a variety of Porcelain Panels, Plateaux, and Slabs for the covings of fireplaces, tops of consoles, toilet and chess tables, the panels of doors and window-shutters. Among the articles of this class exhibited, were panels executed by order of Prince Albert for Osborne-house, shutter and furniture panels, &c.

Some large and costly Panels of this manufacture were also exhibited in connexion with Mr. Featham's display of Grates; and among them some jewel designs, executed for the mansion of Mr. Hope, in Piccadilly.

Messrs. Wedgwood and Sons illustrated the improvements made by the celebrated Wedgwood, in a collection of examples of classic design. Among the productions from Worcester, was Messrs. Chamberlain's curious Tea-service of pierced or honeycomb china.

The works from Coalbrook Dale, by Messrs. Rose and Son, were among the finest in this class; more especially the revived Rose Du Barri, a pale pink, employed upon Sèvres china, and named after the celebrated mistress of Royalty: this colour and the turquoise, the painting and gilding, novelty of form, and brilliancy of ornamentation, were unequalled in the whole Exhibition. The Egg-shell China, also by Messrs. Rose, nearly approached the delicate Oriental manufacture.

The specimens of Earthenware, Stone-china, and Stone-ware, and printing on Earthenware,* were too numerous for us to specify.

Some very interesting specimens of imitative Majolica, Italian soft enamelled pottery, or Raffaelle-ware, were exhibited by Minton and Co.; who also contributed two Terra Cotta Vases, modelled by the Baron Marochetti, and stated to be the largest ever made in this country in plastic material. There were two enormous Garden-pots in Stone-ware, with Medallions in Statuary Porcelain, after Thorwaldsen, representing the four Seasons and the four Stages of Human Life. A figure of Galatea, seven feet high, claims to be the largest perfect object in pottery which has yet been produced in a single piece.

Messrs. Minton exhibited specimens of Encaustic, Venetian, and other ornamental Tiles for Flooring. A large quantity of this article is now exported to the United States and the Colonies, as well as to certain parts of Europe. The palace of the Sultan at Constantinople is paved with this tiling; as are also the House of Lords, Osborne-house, and St. George's-hall, Liverpool. This flooring has got into very general use in churches, private mansions, conservatories, &c. Several specimens were exhibited in the Mediæval Court.

Messrs. Minton also displayed their Tesseræ, manufactured by pressure, as practised in making tiles.

In the Foreign departments were exhibited several fine specimens of china. All the Sèvres Porcelain was *hard*, that being the only description fabricated in Sèvres for the last fifty years. The portraits of the Queen and Prince Albert, placed in the nave of the Crystal Palace, are exquisite examples of the largest porcelain painting produced at Sèvres. Among the Paintings and Vases exhibited, were single specimens, the prices of which ranged from £50 to £1000 each.

The Dresden Porcelain specimens were likewise beautiful and

* This process dates from 1757, according to a mug before us, printed with a portrait of Frederick the Great, a group of Prussian military insignia, a Cupid with a wreath, and Fame with two trumpets; and to the left "R. W., Worcester." There is a fellow-specimen in the Museum of Practical Geology.

costly: among them were vases painted after Watteau; the grotesque Tailor of the Count de Bruhl; and a Camellia Japonica in a pot, priced at £90. From the Royal Manufactory of Meissen, were exhibited two Light-blue Vases, with portraits of the Queen and Prince Albert; and three collections of Paintings on China, after the most celebrated old masters.

Among the Bohemian porcelain, the vases and jars of Elbogen were novel in shape and exquisitely ornamented.

The conventional productions of India, China, and Japan were exhibited in abundance; but other specimens were of great rarity and beauty. Among those from China was a set of Early Cups and Saucers, with the gilding laid on by a process unknown to our English manufacturers—in solid gold plates; of these plates, each cup contains no less than 961, and of these 260 are ornamented with imitation rubies. Each cup is also enriched with 269 solid silver plates, of which 34 bear small emeralds. The saucers are still more highly enriched, each being inlaid with 1035 plates of pure gold, and of these 415 bear imitation rubies. They have also 432 solid silver plates inserted in each, in 56 of which are emeralds. This unique set belonged to a mandarin of the highest rank, and is the first specimen of the kind ever imported into this country. Not the least important of the articles displayed was a complete collection of the various materials employed at the Great Porcelain Works of Kiaing Tiht Chin, in the vicinity of Poyang Lake.

GLASS.

In neither of the departments of Manufacture in the Exhibition were the several stages better illustrated than in the processes of Glass-making. Thus, Mr. Apsley Pellatt, who has written the best practical treatise upon this beautiful art,* exhibited a most interesting collection of models and specimens of Glass of every description, and in every stage of its manufacture. A specimen, called a "Batch," showed the raw material of flint-glass. The Crucibles used for melting the glass were also exhibited, composed of Stourbridge fire-clay. A Model of a Patent Glass Furnace was likewise shown; the form and construction of which is such, that it produces a reverberation of the flame from the centre towards all the parts of the circumference, and downwards between the crucibles, so that all the parts may be equally heated.

Specimens of the Glass were exhibited in the several stages of its progress. After the first ten or twelve hours, it appears as a sort of honeycombed mass, very white, and perfectly opaque. In the next stage, it becomes transparent, but is filled with thousands of bubbles of air; the white colour now gives place to a light purple tint, produced by the oxygen supplied by the manganese; as the melting

* Curiosities of Glass-making; with Details of the Processes and Productions of Ancient and Modern Ornamental Glass Manufacture. By Apsley Pellatt. With coloured Illustrations. Small 4to, 1849. See also Year-Book of Facts, 1848, page 83; and 1849, page 95.

continues, this purple tint gradually disappears, the air bubbles are disengaged, and the glass is at length rendered fine and uniform, and ready for manipulation.

The various implements and tools used in this manufacture were exhibited; consisting of the Blowing-iron, the Workman's Chair, the Pucellas, the Punty, the Shears, the Battledore, and the Pincers.

Specimens of Coloured Glass were next shown. Iron, copper, cobalt, manganese, gold, and uranium, are the metals chiefly used in imparting colour to glass. The shades of green, such as were shown in the specimen marked No. 18 in the collection of Messrs. Pellatt and Co., are produced by the oxides of iron and copper combined in different proportions; the yellow tints being due to the iron, the blue to the copper, and the green to their combination. Specimen No. 19 is a dull, yellow coloured glass, produced by the carburet of iron. Specimen No. 20 is a blue glass produced by the oxide of cobalt. The purple specimen, No. 21, is produced by the oxide of manganese; and the varieties of rose and ruby glass, marked 22, are produced by the oxide of gold. The oxide of uranium is said to produce the topaz specimen, No. 23; and the same metal, with the addition of a small quantity of copper, produced the emerald-green specimen, No. 24. It is not, however, only the colours of transparent gems which can be represented by this artificial process, but even the opaque stones are imitated. Glass is rendered opaque by the addition of arsenic; and the peculiar colour of opal, as shown in specimen No. 25, is produced by the addition of phosphate of lime.

A more beautiful process consists in the combination of different colours in the same object; which, with cutting, produces infinitely various effects, illustrated among the ornamental articles exhibited. This process is very simple. The object being formed first in white transparent, and colourless glass, and allowed to cool until solid, it is dipped for a moment in a pot of coloured glass in a state of fusion; and, being suddenly withdrawn, it carries away upon it a thin coating of coloured glass, which immediately hardens upon it, and becomes incorporated with it. The article is then shaped by the glass-maker; and, if it be afterwards cut, those parts which are cut will disclose the clear transparent glass, those not cut remaining coated with the colour. In this manner was executed the Portland Vase in the British Museum. Two or more colours may, in the same manner, be combined on the article, after being coated as already described.

Numerous and beautiful examples of the productions of this manufacture were shown, both in the British and Foreign departments, especially in that of the States of the Zollverein and Prussia.

Messrs. Hartley and Co., of Sunderland, exhibited a Collection of Manufacturing Models, in which an Eight-pot Furnace Glass-house was the most conspicuous. The cone is made of bent glass, which enables the visitor carefully to inspect the interior arrangement of the furnace and "pots," or crucibles, in which the material is mixed; and also the "cone," or tunnel, by which alone any air is admitted; which, of necessity, passing through the furnace, forms a constant blast, by which means a greater heat is obtained than is required in any iron-works.

Messrs. Hartley and Co. also exhibited the Model of a Greenhouse, 4 feet 2 inches square, being constructed on the "ridge-and-furrow" principle adopted in the construction of the roof of the Crystal Palace; and upon which they built, in 1846, a conservatory in the Horticultural Society's Gardens at Chiswick. Messrs. Hartley and Co. likewise showed a series of Models, illustrative of the Manufacture of Crown or Sheet Glass; including the Melting-pot; the Blow-pipe, and Ball of Metal as taken from the pot; and Sheet Glass when swinging, fully swung, when finished by blowing, and when partially flattened.

Messrs. Rice, Harris and Co., of Birmingham, exhibited a beautiful Collection of Table Glass, produced by pressure and moulding; and Ornamental Glass, transparent and opaque, imitating opal, alabaster, turquoise, amber, canary, topaz, chrysoprase, pink, blue, light and dark ruby, black, brown, green, purple, &c., the colours being produced chiefly by the oxides of copper and gold. The articles made in other colours were gilt, enamelled, cut, and engraved—Tazzas, Liqueur Services, Compotiers, Butter-coolers, Sugar-basins, Toilet-bottles, &c. In several of these objects, the coatings of colours upon one another amounted to two, three, or even four colours.

Messrs. David Greathead and Green, of Stourbridge, exhibited a large Collection of Glass objects, highly ornamented with colours and enamelling; including Vases and Jars in the Egyptian, Etruscan, and Grecian styles: cut, coated, gilt, painted in enamel colours, after the antique, with figures, ornaments, flowers, landscapes, &c.

Venetian Glass, gilded, threaded, and frosted, was exhibited in Bottles and Glasses, in sets.

Messrs. Osler and Co., of Birmingham, contributed a stupendous Glass Fountain—the grand central ornament of the Transept. It rises 27 feet, and is composed entirely of pure flint crystal cut into the most elaborate forms, the stalks to the overshading projections in prisms; the latter, supported by spandril pendants, represented as the result of crystalline droppings. The superior plinth, which is of marble, is surmounted by a minor one of glass, and adorned with shells. The water falls in three separate masses, the upper one springing gracefully over the curved surface or rim of the glass orifice, which crowns the whole structure. It contains upwards of 4 tons of crystal glass; the principal dish is upwards of 8 feet in diameter, and weighed before casting nearly a ton. Messrs. Osler also exhibited a Pair of Candelabra, upwards of 8 feet high, and carrying fifteen lights each; executed by command of Prince Albert, and presented by him to her Majesty, on her birthday in 1849.

Among the Chandeliers was a large and beautiful example, manufactured for Messrs. Perry, to hold 144 candles; the prismatic drops being so cut and arranged, that the general result is the appearance of one elegantly formed mass of crystal.

The examples of Plate Glass were exceedingly good. The Thames

Plate Glass Works showed the largest Plate hitherto manufactured.

Messrs. Chance, Brothers, and Co. exhibited a collection of specimens of crown Window Glass, of five different thicknesses, weighing respectively 13, 16, 21, 26, and 32 ounces per square foot. The Crystal Palace itself is glazed with glass which weighs 16 ounces per square foot; each of the panes is 49 inches in length; and the apparatus by which they are produced is extremely simple and beautiful. A quantity of molten glass having been collected on the extremity of the iron blower, is first distended by blowing into a spherical form; it is then heated in the furnace, and the soft mass is swung round by the operator, who stands on the edge of a pit, until it becomes elongated to the required extent; the cylinder thus formed is then cut off at both ends, cut through the middle, and placed on a flattening furnace, when it is spread flat upon a slab; then annealed, and the pane completed.

The same firm exhibited some beautiful specimens of Painted Windows, consisting of leaded work, with medallions in the early Gothic style.

Messrs. Bacchus and Son, of Birmingham, contributed a variety of beautiful articles fabricated by a coating of coloured glass being produced upon the article to be ornamented, and afterwards cut in various figures. The specimens included Vases enamelled on ruby and engraved; sugar basins, &c., enamelled on green with gold leafage; a vase, cased, ruby and white, cut and ornamented; a jug, cased, enamelled on blue flint, engraved and gilded; and green and ruby decanters, similarly cut.

Mr. Green, of St. James's-street, exhibited a beautiful collection of objects engraved in the Greek style, and the taste of Francis I., with thistle and ornamental work, and engraved with various natural flowers.

Messrs. Ballantine and Allan exhibited Stained Glass in the Elizabethan style, consisting of the window of the entrance-hall of Glenormiston.

Messrs. Coathupes and Co., of Bristol, showed some Glass Water Pipes, plane jointed and angular, intended as a substitute for the iron pipes now used for the distribution of water through towns. Glass Shades, of late years a considerable manufacture, were exhibited, from the largest to the smallest ever made.

Messrs. Powell and Sons, of the Whitefriars Glass Works, exhibited their patent Pressed Glass for Windows. The pattern is pressed in the glass, and next, by a subsequent process, glass of another colour is flowed into it; the whole is then ground down to a uniform surface, and the result is an inlaid pattern of glass of one colour in glass of another. Busts in Glass, produced by pressure, in moulds, were also exhibited.

Glass Cutting and Engraving were shown in progress; with a fine specimen of an Ornamental Cut-glass Window.

Lace-pattern Glass, representing net or muslin curtains, with embroidered borders, was exhibited in tasteful variety.

Specimens by Mr. Kidd, of his new process for illuminating, embroidering, and silvering flat surfaces, were displayed. All the designs are cut on the under face of the glass; and then being silvered, are thrown up, producing an interesting optical deception.

Silvered Glass was exhibited in several examples. All this glass is double, to enable the maker to fill the inside with a solution of nitrate of silver and grape sugar, when all the silver held in solution is deposited in a film over every part of the glass; the surfaces are then washed and dried, and hermetically sealed, so as to prevent tarnish. The effect, however, is garish, and the articles appear as if made of looking-glass, rather than of silver-plate, which they are intended to represent.

Among the novelties was a Glass Chimney-piece, capable of high polish, and economic ornamentation in colour and gold. Perforated Glass panes for ventilation, a sanitary suggestion, were likewise exhibited.

Stained and Painted Glass Windows were displayed in the north-western Gallery, and other portions of the Building; as also in the Dante example in the eastern nave; Messrs. Marechal and Guyon contributed the only rose or marigold window; M. Thevenot, in a stained window of the 13th century style, represented the slaughter of the Paschal Lamb. Among the British artists, Powell and Baillie, of London; Holland, of Warwick; and Wailes, of Newcastle-upon-Tyne; were pre-eminent. In some examples, the reformed drawing was substituted for the unartistic work of old; but the principal novelty was windows in one sheet of glass, so that the composition of the picture is not broken up by frames.

Messrs. Cogan and Co. contributed a memorial Glass miniature of the Crystal Palace, in the proportion of 1 inch to 20 feet.

CHEMICAL AND PHARMACEUTICAL PRODUCTS.

In this Class were exhibited some novelties of much value: as the Stannate of Soda of Mr. Young, and his contributions of Paraffine, &c. Paraffine was at first obtained by him from a mineral oil which flowed for some time from a coal-bed, at Alfreton. This, however, stopped; and Mr. Young set about endeavouring to imitate the operations of nature, and produced it at will from coal. The results were exhibited, and their commercial value is exceedingly great.

Mr. Pattinson exhibited, and employed in painting the Exhibition Building, a new white lead—the oxichloride of lead, which he prepares directly from the lead ore, by a wet process.

Messrs. Pontifex and Wood displayed many surprising examples of the perfection of modern chemical processes. Their tartaric and citric acid were singularly fine; and the pigments contained in their case were of a superior character. The chemicals of Messrs. Tennants and Co., which are those employed by the calico-printers, were also of the higher class. Alum manufacture was well illustrated by Mr.

Spence, of Pendleton ; and Mr. John King, of Glasgow. The pharmaceutical chemicals of Messrs. Howard and Kent, containing the cinchona barks, and the quinine prepared therefrom; camphors in all states ; borax in all its natural and manufactured states ; kelp, iodine, and its salts ; well sustained the high reputation of this house. Messrs. Hopkins and Williams were exhibitors of a variety of rare chemicals, such as tannin, bromoform, the new medicinal salts of iron, kreatine, &c. Messrs. J. F. Macfarlan and Co. displayed a very remarkable collection of the salts of opium, of gallic acid, and the sulphate of beberine.

The vegeto-alkaloids, such as morphia, quina, strychnia, and brucia, were exhibited by Mr. Morson ; and we are of opinion that finer preparations than these were never formed. The pharmaceutical preparations were tolerably numerous. The extracts prepared by Mr. Squire should be particularized ; and also those prepared by Messrs. Kent, of Stanton, and Austin, of Banbury. The English rhubarb of Messrs. Tustian and Usher is remarkable as offering very fine examples of the culture of rhubarb in England, confined almost exclusively to Melcombe, near Banbury. The pigments exhibited require a more extended notice than we can possibly afford. Those exhibited by Messrs. Pontifex and Wood, and by Blundell, Spence and Co., appeared to present the greater number of interesting objects.

In the French department we had a large number of exhibitors of chemical preparations --their artificial ultramarine being in many respects superior to any other. The French lakes and madder colours were also exceedingly beautiful. Nassau, in the Zollverein, was a very striking exhibitor of chemical preparations. The ultramarines and cobalts of this collection were very fine. Austria, Belgium, and the United States swelled the list of chemical products, and on the whole this class may be considered to have been admirably represented.—*Abridged from the Morning Chronicle.*

CHEMITYPY, STYLOGRAPHY, AND GALVANOGRAPHY.

The process of Chemitypy, as practised by Pül, of Copenhagen, was exhibited, and may thus be described :—A zinc plate is taken and covered with etching-ground; the plate is then etched, and the surface covered with an easily-fusible metal : the plate is then scraped, so as to leave the metal in the hollow parts produced by the etching. The surface is then again etched, to remove part of the zinc plate for the elevation of the design. The plate thus made, resembles a woodcut fit for printing.

The process of Stylography, also exhibited, is adapted for the copper-plate printers. A block of black composition is cast upon a smooth metallic surface. The compound is then covered with silver, and the drawing is made through the silver ground. By electro-metallurgy, a reverse is then made ; and again, from this, a duplicate fit for printing is effected. Such is the process as it appeared in the department for Denmark.

The Imperial Printing-office of Austria exhibited examples of Galvanography. They paint upon a plate, and over the painting form an electro-metallurgical deposit, which is at once ready to print. This process is identical with that described in the *Philosophical Magazine* for May, 1840, and which was subsequently called the Electrint. In this country, some beautiful specimens were executed, but the process is now abandoned, or, at any rate, not now practised.

Electro-metallurgic specimens were also sent by the Austrian Imperial Printing-office. They not only exhibited various embossed surfaces in copper, but they also sent many frames made by the electro process. As an example of the excellence of the copper, there were copper bars, large copper sheets, and one copper sheet rolled out to a great extent. Specimens of electro duplicates of printing surfaces were likewise sent.

The Ordnance showed a series of the copper-plates under the Maps hanging up at the extreme western end of the Building, and which were admirably illustrative of the application of electricity to the multiplication of engraved plates.

Specimens of Glyphography were also exhibited. The process is as follows:—A drawing is made through the ordinary etching-ground; the plate is then etched, and the plate is rolled up with a mixture of various substances: over the whole a copper-plate is made. This process is found to be the best for maps which has ever been devised; greatly surpassing wood-engraving.

CLOCKS AND WATCHES.

The contributions to the Horological section of the Exhibition were so multifarious, that, instead of enumerating their varieties, we shall glance at the newest and most improved constructions

The principle of the Remontoir Escapement is adopted in those Clocks that were most prominently placed. It is on this principle that Mr. Shepherd's gigantic Electric Clock is constructed; and it is well illustrated in the large Turret-clocks of Mr. Dent; and the Alpha Clock of Mr. Roberts. The construction of Mr. Shepherd's electric clock has been already described at page 123. In the remontoir escapement of mechanically-impelled clocks, motion is given to the pendulum by means of a small weight or spring, which imparts its impulse directly to the pendulum; and is itself wound up every half minute, by the heavy weight acting through a train of wheels, for the purpose of prolonging the clock movement. The large pendulum of Mr. Dent's clock has its vibrations sustained by means of a watch-spring, which is wound up at regular short intervals by the actions of the weight; and, in Mr. Roberts's clock a small weight is employed, which is attached to a chain, and is wound up every half minute by the great weight. A remontoir escapement, of a very ingenious kind, combined with magnetism, was exhibited by Mr.

Webster, jun., of Cornhill. Permanent magnets are fixed to each side of the pendulum, and a forked magnet, turning on a pivot, and carrying the palette, has its poles placed on a level with the poles of the vibrating magnets. The forked magnet is so arranged that its poles are alternately repelled at each vibration, and the escapement wheel is thus liberated without being in connexion with the pendulum. There were several other clocks with remontoir escapements; but in those we have mentioned, the principle is most clearly exemplified.

A great novelty in Dent's Turret-clock is the bell, of union metal (cast iron and tin), far more sonorous than the ordinary bell-metal, and of about one-third the price of the former. The weight of this bell is about 18 cwt. The inventor is Mr. Stirling, a gentleman of fortune, living near Stirling, North Britain.

A new and economical Self-adjusting Pendulum was exhibited. Instead of the ordinary rod, by which the ball is suspended, being attached to its centre, a bar is secured to the side of the ball, and a wooden rod fixed thereto; so that the elongation or shortening of the rod, by change of temperature, turns the ball on its axis, and thus preserves accurately the distance between the points of suspension and oscillation respectively.

The pendulum of almost every clock exhibited had an arrangement of some kind for correcting the variations of length, caused by expansion or contraction. The mercurial pendulum is the most simple arrangement for the purpose. The quicksilver, contained in a glass cylinder, forms the pendulum bob; and, as the rod expands by heat, the more readily expansible liquid metal, by taking a higher position on the cylinder, compensates for the expansion of the rod, and keeps the centre of oscillation at the same distance from the point of suspension at all temperatures.—*Morning Post.*

Mr. Hutton contributed his Patent Clock, having a new compensation glass pendulum, and a barometric contrivance, to prevent the error arising from the changes in the density of the atmosphere. The metallic compensation is effected *without any friction*, by the ascent and descent of two spring levers, with three adjustable weights; and which lengthen or shorten as they rise or fall. The mode of compensating is regulated by a screw in the top of the ball, which, in case of heat, is moved towards the centre of motion of the spring lever, or in the contrary direction in case of cold. The glass rod is attached to the pendulum-spring, by means of a screw cut on it; and below, a glass regulating-nut works into a glass screw, cut on the bottom of the pendulum-rod. The compensating wires being very small, a simultaneous action is ensured at each change of temperature. In the barometric contrivance, the ivory piston rests on the mercury, thus counterpoising the air-vanes; so that, when the barometer is low, it causes them to approach the plane of the pendulum's motion; and raises them, on the contrary, when the barometer is high: thus the mechanical resistance to the pendulum is increased or decreased according to the density of the atmosphere.

Messrs. Smith exhibited their 400-day Clock, which is worked by a spring, and has a mercurial pendulum; with the advantage of having to wind it up only once in 400 days.

William Harvey, of Stirling, N.B., exhibited an Eight-day Striking Clock, with only one mainspring and one train of wheels to do all the work, including the striking, which is performed on one bell placed on the top.

Mr. Thomas Cole showed a Horological Eight-day Lantern; a flat Clock of new design; a *small Eight-day Clock*, about 2½ inches high, and about 1⅝ inches wide; and four semi-circular Flat Clocks.

There were many *Curiosities* in Clock-work, one of which exhibited the time of day in any part of the world; another limits its chronicling of time to a few countries; some indicate the month and day of the month; and the Exeter Clock, which occupied its maker, Lovelace, thirty-four years, contains a great variety of chronological, astronomical, and fanciful movements, and requires to be regulated only once in 130 years. Some of these curious pieces of mechanism were made by persons not in the trade. One, for instance, made by a tailor, exhibits the days and months, the motions of the sun and moon, the state of the tide in many parts of Europe, and goes for twelve months; and a blacksmith contributed a musical clock, which plays a tune every three hours. A Detector Clock, invented by Mr. Kaiser, of Park-terrace, Regent's Park, marks when a watchman is off duty during the night; and Mr. Pace, of Bury, St. Edmund's, exhibited a Skeleton Clock, with springs of the united force of two hundred and fifty pounds, which goes for three years without winding. In another clock, a Magician, actuated by wheels and pinions, rises from his seat, waves his wand, and answers questions; and another piece of tiny mechanism consists of a Pillar, the spring capital of which opens when touched, and up jumps a pea-sized Bird, flutters its wings, and chirps for two minutes.

Mr. Loseby exhibited an Astronomical Clock, with an arrangement which isochronizes the oscillations of the pendulum;—"a contrivance," in the opinion of the Astronomer Royal, "successful in removing a defect in clocks weich has been required for above a century."

A Glass Time-piece was exhibited; apparently consisting of only a dial of glass, with an index-hand, turned without any visible mechanism.

In the Foreign Department, there was a large and brilliant display of French Clocks. M. Wagner's contributions were on the Remontoir principle; and the dial of one exhibits a second-hand moving continuously, instead of by step-by-step motion. This effect is produced by employing a second train of wheels, governed by a rapidly revolving fan, the movement of which is ingeniously regulated by the pendulum, in causing it to raise or depress a cover over the fan, so as to check or accelerate its speed. Opposite was a dial, the hands of which were moved by electro-magnets in connexion with the mechanism of M. Wagner's clock. Messrs. Detouche and Houdin exhibited, also in the central avenue, some most beautifully finished Clocks, with elaborately constructed pendulums, for the maintenance of equal arcs of vibration; the amount of dilatation being shown by a small index. The French collection was also resplendent with a great variety of Clocks in every conceivable form of ornamental case. In the Austrian department, were some remarkably curious Clocks, exhibited by M. Anderwalt, of Trieste; and by M. Kralik, of Pesth. One of these is wound up by the gradual disengagement of hydrogen gas from a vessel of water placed beneath the works, and will, it is said, go for thirty years. Another professes to be a realization of perpetual motion, by continuing to move until the materials are worn out; the power which winds it up being the varying pressure of the atmosphere acting on quicksilver, which turns a wheel in the same manner as a wheel barometer turns the index.

Among the American Clocks was "Crane's Patent," exhibited by the "Year Clock Company" of New York, which differs from all the others shown in this department; in that the pendulum, instead of vibrating as usual, is made to rotate, first in one diroction, and then in the other, within a circle of short radius.

The Chronometers and Watches exhibited with the English Clocks were more remarkable for excellence of workmanship and finish, than for novelty of construction. Mr. Alexander Watkins contributed an original Eight-day Chronometer Repeater, the labour of eight years. It strikes the hours similarly to the old striking watches, and chimes the quarters on five bells; it also shows the day of the month, the whole consisting of 200 pieces of mechanism, including a newly-invented Compensation Pendulum. Mr. Watkins likewise showed two very small *Chronometers*, supposed to be the *smallest of the kind in the world.*

Mr. Dent exhibited Chronometers with Glass Balance-springs; Mr. Frodsham, of the Strand, Pocket as well as Marine Chronometers, and gauges to the thousandth part of an inch; Mr. MacDoual, of Dorset-place, Pall-Mall, Watches and Clocks without escapements, and with India-rubber Springs; and Mr. Jones, of the Strand, a Watch with a dead-second beat by means of a single train of Wheels. Among the *Curiosities* of Watch-making was a Water-tight Watch-case, the proof of its efficacy being afforded by the suspension of a going Silver Watch in a Glass Globe of water, in companionship with a gold fish. There was also a diminutive specimen, a Watch the size of a Threepenny Piece, contributed by Mr. Funnell, of Brighton.

The renown of Geneva for the manufacture of Miniature Watches was sustained in the Exhibition by a brilliant display. There was in the collection a Watch $\frac{3}{16}$th of an inch in diameter, inserted in the top of a Pencil-case, which indicates on its microscopic dial, not only the minutes, hours, and seconds, but the days of the month. A novelty, in the shape of a Half-Chronometer, for the use of the deaf and blind, which, with a Pencil-case attached to the key, was exhibited by S. Mercier, of Geneva.

Messrs. Rotherham and Sons, of Coventry, (in whose establishment machinery for watch-making is impelled by steam-power,) exhibited the various parts of a Lever-Watch, in the progressive stages of manufacture, labelled and described. All were shown as roughly cast, then as formed into proper shapes, and lastly as finished. Several movements were also shown; and a beautiful display of 137 watches of all kinds, from the plainest silver watch to the most elaborately finished and ornamental watch of gold.

The different parts of a Watch and the various escapments, sent to the Exhibition by a few British and foreign contributors, afforded much information to the visitor. Such were the various escapements on a large scale, exhibited by Messrs. Robert Bryson and Sons, of Edinburgh: first, the vertical escapement, showing the action of the regulator; second, the horizontal or cylinder escapement, as in Swiss watches; third, the duplex escapement; fourth, the lever escapement; and, fifth, the chronometer or detached escapement.

Phillibret Bally exhibited his Chronoscope, by which the exact time may be ascertained without calculation at any place on the globe. "This instrument will set itself according to any place, is of service to all parties, and is very useful for country residences; it marks the time with a precision which no sun-dial, the best finished, is able to reach, which after all gives only the quarters of an hour."

There was also exhibited Whishaw's Centrimetral Chronometer, with moveable ring, for taking velocities on railways with the greatest accuracy, and for other purposes; besides the uniformity of time Clock and Telegraphic code ring of the same gentleman: the former made by Johnstone, and the latter by Messrs. Smith and Sons—all of Clerkenwell.

The Autochronograph, for instantaneously stamping or printing time, giving the days of the month, hours, and minutes, night and day, was also exhibited. The register is a roll of paper, which passes over wheels, bearing the date, hour, &c., in raised figures, which are stamped upon the paper by a roller drawn across it, in a second; at the same time moving the register forward.

Electric Clocks.—Mr. Shepherd's Large Clock has been already fully described.

Mr. Bain showed an assortment of Electro-magnetic Clocks, in which the pendulum weight consists of a hollow cylindrical coil of insulated copper wire. Two cylindrical bar magnets, with their opposite poles adjacent to each other, are fixed to the opposite sides of the clock-case, so that the coil at the end of the pendulum may pass over them. The impulse is given to the pendulum by the mutual action of the coil on the bar magnet; the direction of the galvanic current through the coil being reversed by a light sliding piece moved by the pendulum at each extremity of its oscillation. In these clocks, the uniformity of impulse on the pendulum will depend on the constancy of the galvanic current.

M. W. Brocking, of Hamburg, exhibited a small Electro-magnetic Clock, in which the impulse is given to the pendulum by a lever weight raised periodically by an electro-magnet; and thus a uniform impulse is communicated to the pendulum.

PHILOSOPHICAL INSTRUMENTS.

Telescopes and Microscopes.—In the higher department of Astronomical Instruments exhibited, the great Equatorial Telescope by Mr. Ross, the Transit-Circle by Messrs. Troughton and Simms, the Equatorial Telescope by MM. Merz and Son, and the Universal Instrument by M. Ertel—the two latter both of Munich—were most prominent. Mr. Ross' telescope is stated to be the most powerful achromatic instrument ever made; the diameter of the object-glass is eleven inches and a half, and a magnifying power of six hundred times in diameter may be used without prejudicially darkening the field of vision. The glass discs for telescopes exhibited by Messrs. Chance, gave satisfactory evidence of the great progress that has been recently made in the manufacture of British glass. We noticed also the flint-glass discs of Daguet, Switzerland.

Our three leading makers of Achromatic Microscopes—Messrs. Ross, Powell and Lealand, and Smith and Beck—were exhibitors. The most important point, in connexion with this class of instruments, is a recent improvement in illumination, the invention of an amateur microscopist, which was brought forward by Mr. Ross. Among several Orreries was a very complete one by Newton and Son, which is moved by clock-work. A vertical Orrery on a large scale, made by Mr. Facey, of Wapping, after seven years' labour and exercise of ingenuity and skill, was exhibited by him daily; the mechanism being put in motion by turning a handle. Nasmyth's large Model of the Moon was also shown.

As a valuable accessory in astronomical observations, we may name the Clock by Mr. W. Bond, United States, by which the epoch of any observed fact may be determined to the one-tenth, or, if necessary, to the one-chundredth of a second. The Planimeter, by Professor T. Gonnella, was the best of the several mechanical arrangements by which the area of a surface may be determined, and that by merely passing a tracing point along the whole extent of its outline. For exactness and facility of application, we noticed Bessell's instrument for the comparison of standard measures of length, exhibited by M. J. Baumann, Berlin; although, possibly, it may be inferior to that of Whitworth in the minuteness of its indications.

The Equatorial Compass, by Mr. J. R. St. John, United States, is much in advance of any instrument for similar purposes at present in use in this country, particularly in its application to railway surveys, in which the proximity of large masses of iron is very likely to disturb the compass-needle.

The arrangements both of M. F. Vedy, France, and of M. E. Bourdon, France, by which indications of pressure are obtained from the alterations of form of a closed metallic cavity, possess much merit.

There were many specimens of chemical and hydrostatical balances. A very small magnetized balance, exhibited by Mr. Fox, of Falmouth, professes to weigh the ten-thousandth part of a grain. Messrs.

De Grave and Co., and Mr. Oerthing, contributed some delicate balances: one by Mr. Oerthing is stated to weigh the thousandth part of a grain when the scale is loaded with a thousand.

In the construction of Meteorological Instruments, the most important improvement was in the Barometer invented by Mr. Griffith; in which, by a contrivance conspicuous alike for its ingenuity and simplicity, that great desideratum of a standard barometer—a perfect Torricellian vacuum—may easily be obtained. Another novelty is Cassella and Co.'s Barometer, the tube and scale reaching from the floor of the gallery nearly to the top of the Building, and the rise and fall of the indicating fluid being marked by feet instead of by tenths of inches. The column of mercury supported by the pressure of the atmosphere communicates with a perpendicular tube of smaller bore, which contains a coloured fluid much lighter than the mercury. When a diminution of atmospheric pressure occurs, the mercury in the large tube descends, and by its fall forces up the coloured fluid in the smaller tube; the fall of the one being indicated in a magnified ratio by the rise in the other.

M. Bourdon, of Paris, exhibited a variety of Aneroid Barometers, and of Steam and Vacuum Gauges depending upon the same principle; the compressing force being indicated by pressure on a spring. Dollond's Atmospheric Recorder was exhibited in action in a temporary building at the western end of the Crystal Palace.

Mr. Brooke's Self-registering Meteorological Instruments (used at the Greenwich Observatory) were shown. They comprise instruments for registering the variations in the magnetic needle, in temperature, and in the pressure of the atmosphere, by the employment of an unerring and untiring pencil of light, instead of the pen of an assistant.

Mr. J. Hewitson, of Newcastle-upon-Tyne, and Mr. Newman, exhibited Tide-gauges for registering with a pencil, on a cylinder covered with paper, the elevations of the tide during the day and night. In Mr. Newman's Tide-gauge, the pencil is connected with a float, which moves it along the cylinder as the water rises or falls; and as the cylinder revolves by clock-work, the height of the water is continually registered. Mr. Newman also exhibited Self-registering Wind and Rain Gauges, that act on the same principle.

Galvanometers and Electronometers, for indicating the excitement of electricity and measuring its intensity, had scarcely any representatives other than those in Electric Telegraphs, which we shall presently notice.

Spectacle frames of steel, weighing only seven grains and a half, were exhibited by Mr. Weaber; and Mr. Whitehouse had a frame, cut out solid of silver, that weighs but nineteen grains. Binocular Opera Glasses, that seemed to require telescope stands for their support, were exhibited by several opticians.

The Artificial Magnets exhibited by M. Lozeman (Netherlands), and magnetised by a process discovered by M. Elias, of Haarlem; and the Air-pumps by Messrs. Watkins and Hill, by M. L. J. Deleuil

(France), and by Mr. J. Newman, are powerful, ingenious, and well-finished instruments.

The Saccharometer, and apparatus for experiments on Polarised Light, by M. Duboscq-Soleil (France), with the gigantic Platinum Still, and the crucibles and other chemical vessels of the same precious metal, (value 900*l.*,) by M. Quennessen (France), attracted attention as very remarkable works of art.—*Morning Chronicle.*

Chemical Apparatus were exhibited by various makers; the Electrotyped Retorts, by Mr. Edwards, of Liverpool, being the principal novelty, promising to be of great service in facilitating the application of heat, and in preventing fractures of the glass vessels.

Photography was illustrated by Exhibitors from various countries; and the apparatus, chemical agents, and finished-plates, were very numerous. M. Claudet's apparatus is adapted for all sorts of object-glasses, whether with short or long focus, simple or combined; and is thus rendered capable of adaptation to the increasing facilities of operating, and especially the improved lenses continually introduced. By this means, M. Claudet seems to vary his sizes either at the caprice or according to the capacities of the sitter. Among Knight and Sons' chemical combinations, the latest was labelled "Collodion," a solution of gun-cotton and ether: when this fluid is used, the plate seems to contain two different images; and when reversed, the lights are changed, as is the case in damask cloths. Next was the chloride of gold, first invented by Fizeau, for which Mr. Beard wishes to substitute the enamelling process, thereby enabling the plate to be washed without risk.

Mr. Kilburn, Mr. Mayall, and Mr. Beard, exhibited Coloured Daguerreotypes; and Mr. Mayall a group of Bacchus and Ariadne, said to be the largest photograph ever executed, remarkable for the novel darkening of the ground-work, subsequently added by a secret process. Messrs. Henneman and Malone exhibited Talbotypes tinted by means of caustic potash and a lead salt; also specimens of Sir J. Herschel's Cyanotype and Chrysotype, Hunt's Chromatype, &c. There were also shown beautiful Talbotypes from glass negatives by Messrs. Ross and Thomson, and by M. F. Martens (France); and soft but well-defined Calotypes from negatives on paper, by Mr. S. Buckle. Beard's Enamelled Daguerreotypes were also finely exemplified.

The Electric Telegraphs exhibited included almost every instrument; from the multi-wire electric telegraph of Alexander, to Dering's novel telegraph. At the office, on the west side of the principal entrance to the Crystal Palace, were the different telegraphs *practically* at work, as the wires were in connexion with all the main lines of telegraph in Great Britain. There were also several telegraph stations in different parts of the Building, at which boys worked Cooke's Needle Telegraph, sending messages—not too long—to various parts of London, for the charge of 1*s.* Highton's instruments were exhibited by the British Electric Telegraph Company.

Here also were the instruments of C. V. Walker; Henley's splendid instruments, and his immense Permanent Magnet; Bakewell's important Writing Telegraph; the American Printing Telegraph, exhibited by the Messrs. Brett, and Mr. A. Brett's instrument; and, lastly, Whishaw's one-wire Index Telegraph, a model of his Hydraulic Telegraph, his Mechanical and Acoustic Telegraphs, were also conspicuous in this division, with his Telephones and Telekouphona.

Mr. G. R. Smith exhibited a *Comic* Electric Telegraph, with a variety of accessories. And Mr. Joseph Burdett showed an improvement upon the system of bells for the call of servants, consisting of a Domestic Telegraph, which requires only one bell for all the rooms in the house, however numerous they may be.

Among the Foreign contributions, the most important was Siemens and Halske's "Prussian Telegraph."*

The Surgical Instruments, British and Foreign, included many curious contrivances; but these, with the Anatomical and Microscopical Preparations, were too numerous to be detailed here.

A Calculating Machine, made by a Polish Jew, named Staffel, was exhibited. It is about the size of an ordinary toilet, being about 18 inches by 9 inches, and about 4 inches high. The external mechanism represents three rows of ciphers. The first and upper row, containing thirteen figures, is immovable; the second and third, containing seven figures each, movable. The words addition, subtraction, multiplication, and division, are engraved on a semi-circular ring to the right; and underneath is a hand, which must be pointed to whichever operation is to be performed. The figures being properly arranged, the simple turn of a handle is then given, and the operation is performed at once as if by magic. The most singular power of the instrument is, that if a question be wrongly stated, as, for instance, a greater number being placed for subtraction from a lesser, it detects the error, and the ringing of a small bell announces the discovery.

MUSICAL INSTRUMENTS.

In the Musical department was the Organ by Messrs. Willis; remarkable not merely for its magnitude, but for the greatly increased facility of performance, due to the introduction of the pneumatic lever, in several important parts of its construction. Its weight is 30 tons; and the number of pipes 5000. The other Organs distributed over the building did not present any features requiring special notice. The Musical Instruments included the Pianofortes of Messrs. Broadwood, Collard, Erard, Wornum, and Mott; Robson's Enharmonic, with corrections for alterations in temperature; Holdich's Organ of three stops, equivalent to one of six stops of the ordinary construction; Dawson's Autophon, which enables the unlearned in musical manipulation to play the most difficult tunes of the best composers; and a fine array of Kohl's Sax's Wind Instruments.

* The application of the Photographic Instruments to the taking of views of the interior of the Exhibition Building, was very successful. The Electric Telegraph Company, at their office, notified on a large painted board, the state of the wind and weather, at many of the principal towns in the country, where it has stations. The arrangement for the wind consists of a small arrow, made to turn upon a pivot over the principal towns in any required direction. By this means the eye can trace the directions of the different currents of wind throughout the country.

CLOSE OF THE EXHIBITION.

The last day on which the public were admitted to the Exhibition was Saturday, October 11. On Monday and Tuesday following, only the exhibitors, jurors, and their friends, were admitted. On Wednesday, October 15, the final closing took place, in the presence of about 25,000 persons; when Prince Albert and the Royal Commissioners assembled on a dais in the centre of the transept of the Building, and received the Report from Lord Canning, on behalf of the juries. Prince Albert replied. The Bishop of London then delivered an impressive thanksgiving service; and the Hallelujah Chorus, finely sung, ended the proceedings.

Lord Canning's Report describes the constitution of the thirty juries, and explains that the Council of Chairmen had advised that one of the three medals originally proposed, should be withdrawn.

"Of the remaining two, they suggested that one, the Prize Medal, should be conferred wherever a certain standard of excellence in production or workmanship had been attained—utility, beauty, cheapness, adaptation to particular markets, and other elements of merit, being taken into consideration, according to the nature of the object: and they recommended that this medal should be awarded by the juries, subject to confirmation by the groups.

In regard to the other and larger Medal, they suggested that the conditions of its award should be some important novelty of invention or application, either in material or process of manufacture, or originality combined with great beauty of design; but that it should not be conferred for excellence of production or workmanship alone, however eminent: and they further suggested that this medal should be awarded by the Council of Chairmen, upon a recommendation of a jury, supported by its group."—(See pages 26 and 27 of the present volume.)

"Still," continues the Report, "the award of a Council Medal does not necessarily stamp its recipient as a better manufacturer or producer than others who have received the Prize Medal. It is rather a mark of such invention, ingenuity, or originality as may be expected to exercise an influence upon industry more extended and more important, than could be produced by mere excellence of manufacture."

The number of Prize Medals awarded is 2918. The number of Council Medals, 170. The number of exhibitors, 17,000; so that two out of every eleven exhibitors have medals: of others, honourable mention is made.

The following honours have been given in connexion with the Exhibition:—Mr. Joseph Paxton, Mr. William Cubitt, and Mr. Charles Fox, the designer, engineer, and contractor for the Crystal Palace, have been knighted,—and the first-named gentleman has also received a vote of £5000 from the Royal Commission, out of the surplus fund, for his "able and ingenious design" for the Crystal Palace. Lieut.-Col. Reid, chairman of the Executive Committee, has received promotion in the Order of the Bath, and is now a Knight-commander of that Order. Mr. Henry Cole, Dr. Lyon Playfair, and Sir Stafford Henry Northcote—all three, civil servants of the Crown—have been made Companions of the Bath.* Col. Mayne, Chief Commissioner of Police, has been made a Knight-commander of the Bath.

* Mr. Dilke, of the Executive Committee, not being a civil servant of the Crown, could not receive the honour of C.B.; although this gentleman contributed to the success of the Exhibition equally with his collaborateurs.

APPENDIX.

The Great Exhibition of 1851.

OFFICIAL AWARD OF THE PRIZES.

NOTE—*Where no country is mentioned, the Exhibitor is of the United Kingdom.*

UNCLASSIFIED COUNCIL MEDALS.

His Royal Highness Prince Albert, for the original conception and successful prosecution of the idea of the Great Exhibition of 1851, joint medal with that granted for the model lodging-house in Class VII.

Chamber of Commerce, Lyons, for the collection which it exhibits, in which is shown the general progress made through their exertions in the silk manufactures of Lyons

East India Company, the Honourable, for the very valuable and extensive collection, illustrating the natural resources and manufactures of India

Egypt, the Pacha of, for the very valuable and extensive collection, illustrating the manufactures and natural resources of Egypt

French Minister of War, for the part taken by him in exhibiting the valuable collection of raw products from Algeria

Spain, the Government of, for the very valuable and extensive collection of raw products, showing the natural resources of Spain

Tunis, the Bey of, for the very valuable and extensive collection, illustrating the manufactures and natural resources of Tunis

Turkey, the Government of, for the valuable and extensive collection of raw products, showing the natural resources of Turkey

CLASS I.—(JURY 1.)

Mining, Quarrying, Metallurgical Operations, and Mineral Products.

COUNCIL MEDAL.

Bérard and Co., France, process for washing and purifying coals

Brockedon, W., Cumberland lead, condenser and blocks

Estivant Brothers, France, brass of superior quality.

Güttler, W., Prussia, treatment of arsenical ores, and the extraction of gold from them

Kleist, Baron Von, Austria, iron of superior quality and manufacture

Krupp, Fried., Prussia, cast steel of superior quality

Pattinson, H. L., process for treating lead ores, and separating silver from lead

PRIZE MEDAL.

Abercarn and Gwythen Collieries Company, process for blasting, &c.

Adirondac Manufacturing Company, New York, United States, steel and iron

Amand, Joseph, Belgium, quality of iron

Archibald, C. D., Nova Scotia, cast iron

Bagnall and Jesson, section sample of coal from South Staffordshire thick seam

Bagnall, J., and Sons, rod iron

Baudry, A. T., France, quality of steel

Bickford, Smith, and Davey, safety fuze

Bird, W., and Co., collection illustrating the iron trade

Blackwell, S., collection of iron ores, with descriptive catalogue

Bowling Iron Company, the, Class XXII., quality of iron

Buccleuch, the Duke of, apparatus for condensing the fumes of lead works

Byers, J., the manufacture of lead

Chaudoir, C. and H., Belgium, brass and brass tubes

Cocker, Samuel, and Son, Class XXII., quality of steel

Colin, J. R., France, polished granite and serpentine

Delloye-Matthieu, C., Belgium, iron, sheet iron, and steel

Demidoff, Messrs., Russia, iron and copper

Dervillé and Co., France, marbles from the Pyrenees

Deyeux, —, France, crucibles
East India Company, the Hon., India, Wootz steel and manufacture
Ebbw Vale Company, the, collection of manufactured iron, models, &c.
Egger, Ferdinand, Count Von, Austria, iron and steel
Ferrier, Hon. J., Canada, quality of iron
Fischer, Anton, Austria, steel and iron, iron wire
Gallicher and Co., France, quality of iron (known as Berry iron)
Gandillot and Co., France, iron tubes
Glenanth Brothers, Bavaria, iron and steel
Graham and Hallett, South Australia, specimens of copper from the mines of Burra Burra
Greaves, J. W., specimens of slates, &c., from Festiniog
Groult and Co., France, copper tubes, &c.
Gueuvin, Bouchon and Co., France, millstones
Hird, Dawson, and Hardy, Low Moor Company, Class XXII., quality of iron
Huth and Co., Prussia, steel
Johnson, Cammell, and Co., Class XXII., quality of steel
Johnson and Mattey, collection, metallurgic .
Jonghaus and Venator, Duchy of Hesse, geological maps
Königshütte, Royal Iron Foundry at, Prussia, cadmium
Konigsberg Silver Works, Sweden and Norway, silver ores, illustrative
Landau, S., Prussia, lava millstones of Anancherd
Lehrkind, Falkenroth, & Co., Prussia, steel
Leneuse Asturian Company, Spain, iron and steel
M'Donald, Major C., collection of turquoises
Malapane, the Royal Iron Foundry at, Prussia, zinc
Mansfeld, the Combined Mining Works of, Prussia, copper and copper smelting
Méhu, J. M. F., France, apparatus for raising miners and materials
Meinig, C., collection of grindstones, hones, &c.
Mills, R., plan for opening and closing doors in mines
Moncheur, F. and A., Belgium, quality of iron
Montreal Mining Company, Canada, copper manufacture
Morris, Jones, and Co., United States, plate iron
Motala Iron and Engine Works, Sweden and Norway, quality of iron
Mueseler, M. L., Belgium, safety lamps
Nassau, the Government Engineers of Mines of, Nassau, collection of mineral produce and metallurgy of Nassau
Naylor, Vickers and Co., Class XXII., quality of steel
Neuhas and Blosch, Switzerland, fine iron wire
New Jersey Exploring and Mining Company, United States, zinc ores, iron (Franklinite) ores, smelting process, &c.
Northumberland and Durham Coal Trade, collection exhibited
Nouvelle Montagne Zinc Mining Company, the, Belgium, zinc smelting and manufacture
Orban, J. M., & Son, Belgium, sheet iron
Oxland, R., the separation of wolfram and tin
Pommerœul Smelting Company, the, Belgium, quality of iron
Ponomareff, Madame, (Iron Works of Khamounitsky,) Russia, sheet and other iron
Poulet, J. F., France, spun lead
Remacle & Perard, Belgium, sheet iron
Rochatz, C., and Co., Prussia, zinc and its preparations
Ruffer & Co., Prussia, zinc & zinc plates
Russia, Imperial Manufactories of, Russia, iron and copper
Schwartzenberg, Prince, Austria, iron and steel
Selby & Johns, iron tubes and enamelled iron
Sopwith, T., illustrations of lead manufacture, &c.
St. Hubert, Ed. de, Belgium, millstones
Stolberg, Eschweiler Mining Company in, Prussia, lead and zinc
Töpper, Andreas, Austria, sheet and bar iron
Trenton Iron Company, U. S., iron of fine quality, ores, &c.
Turton and Sons, Class XXII., quality of steel
Tuscany, Royal Mines of, Tuscany, illustrative mineral and metallurgic series
Tuscany, Royal Technological Institute of, Tuscany, mercury ores
Welsh Slate Company, the, slate from Festiniog
Wilkins and Weatherley, Class XXII., fine iron wire
Wöllersdorf Tin Plate Works, Austria, sheet iron for tin plates
Vienna, Depôt of Imperial Mines at Austria, iron and steel (cast) and cinnabar
Zois, Widow, Carl, Austria, quality of iron and steel

Class II. — (Jury 2.)

Chemical and Pharmaceutical Processes and Products generally.

COUNCIL MEDAL.

Guimet, J. B., France, artificial ultramarine
Larderel, Count F. de, Tuscany, boracic acid, and method of preparing it
Longmaid, W., Class I., process for treating copper pyrites with common salt
Prat and Agard, France, salts of potash, and other products of sea water

PRIZE MEDAL.

Avignon, the Chamber of Commerce of, France, garancine
Barnes, J. B., valerianates
Batka, Wenzel, Austria, metallic preparations, &c.
Bischof & Rhodius, Prussia, white lead
Bleekrode, Professor S., Netherlands, oxide of zinc
Blundell, Spence, and Co., painters' colours
Bobée (Widow) and Lemire, France, acetic acid and acetates
Bonjean, J., Sardinia, ergotine
Bouxwiller Mining Co., the, France, prussiate of potass, alum, &c.
Bramwell, T., & Co., prussiate of potass
Brosche, F. X., Austria, succinic acid and oxide of chromium and uranium
Brown, F., oxide of zinc
Brown and Co., salts of ammonia
Büchner, W., Grand Duchy of Hesse, ultramarine
Bullock, J. L., rare organic products
Burt, S. J., cantharadine
Cappellemans, Deby & Co., Belgium, pink salt, &c.
Cerceuil, L. P., France, dyed flocks
Cochius, E. E., Prussia, prussiate of potass
Colville, Mlle. Anna, France, colours for porcelain painting
Conrad, W., France, chemical preparations
Corridi, G. Tuscany, santonine and other chemicals
Cournerie & Co., France, iodine, &c.
Courtial, —, France, ultramarine
Curtius, J., Prussia, ultramarine
Dauptain, Gorton & Co., ultramarine
Davenport, J. T., chemical products
Davy, Mackmurdo and Co., glycerine, and various salts
De Cavaillon, France, salts of ammonia
Dentith, W., and Co., salts and colouring matters, and oxide of zinc
Drouin and Brossier, France, printers' colours, &c.
Dufour, L., Sardinia, quinine
Fouché-Lepelletier, France, chemical products
Gademann, H., Bavaria, ultramarine
Godfrey and Cooke, pharmaceutical products
Hähnell and Ellis, sulphate of copper
Heinzen Brothers, Austria, cudbear and archil
Hemingway, A. and W., United Kingdom, salts of iron
Herbert, F. P., Baron von, Austria, white lead
Herrman, O., Prussia, glacial phosphoric acid, &c.
Hills, F. C., sal ammoniac
Hopkin & Williams, chemical products
Howards and Kent, alkaloids, and other preparations
Hurlet and Campsie Alum Company, alum and prussiates
Huskisson, J. W. and H., chemical products
Jobst, F., Wurtemberg, quinine
Kent, J. H., dried pharmaceutical herbs
Kuhlmann Brothers, France, chemical products
Kunheim, Dr. Louis, Prussia, pink salt and oxide of uranium
Kurtz and Schmersahl, colouring matters, &c.
Lefebre, T., & Co., France, white lead
Leroux, —, France, salacine
Leverkus, C., Prussia, ultramarine
M'Farlan, J. F., and Co., chemical products
Mathes & Weber, Prussia, chemicals
May and Baker, chemicals, mercurial preparations
Meissonier, Charles, France, chemical products
Menier and Co., France, pharmaceutical extracts
Michel, A., France, extracts, colouring woods
Moberly, W., alum
Moreau, A., France, products of distilled bitumen
Morson, T., and Son, organic products
Pauli, Otto, Prussia, phosphorus, &c.
Pontifex and Wood, tartaric and citric acids
Power and Weightman, United States, chemicals
Röhr, F., Nassau, ultramarine
Sanin, —, Russia, salts of leads, &c.
Scharenberg, A., Mecklenburg-Strelitz, red leads
Schlippe, C., Russia, prussiates, alum, &c.
Scott, L., oxide of zinc
Siegle, H., Wurtemberg, red lakes
Smith, T. & H., aloine & cantharadine
Sorel, —, France, oxide ofzinc

Spencer, J. A., chemical products
Squire, P., chemical and pharmaceutical products
Stohmann & Wüstenfeld, Prussia, chemical preparations
Sturge, J. and E., red phosphorus
Vieille Montagne Zinc Mining Company, The, Belgium, oxide of zinc
Wagenmann, Seybell and Co., Austria, chloride of potassium
Wallich, Dr. N., collection of chemical and pharmaceutical preparations
Ward, J., iodine, &c.
Watt, W., iodine, &c.
Watts, J., chemical and pharmaceutical products
Weiss, J. H., Prussia, red lakes
Wesenfeld and Co., Prussia, sulphate of soda
Wisemann, A., and Co., Prussia, products of distilled schist
Wilson, J., and Son, alum
Winsor and Newton, artists' colours
Young, J., stannate of soda, mineral oil, paraffine from coals, &c.
Zimmer, C., Frankfort-on-Maine, quinidine
Zuber, J., and Co., France, ultramarine

CLASS III. — (JURY 3.)

Substances used as Food.

COUNCIL MEDAL.

Borden, Gail, jun., United States, for the preparation called "meat biscuit"
Darblay, —, jun., France, for the gruaux and household flour, of very fine quality, obtained by his novel and economical process
Grar, N., and Co., France, for the sugar obtained from beetroot by the barytic process
Lawson, Peter, and Son, for their admirably displayed, very complete, instructive, and scientifically arranged collection of the vegetable products of Scotland
Masson, E., France, for dried vegetables, prepared by his new and economical process
Serret, Hamoir, Duquesne and Co., France, for beetroot sugar, procured by a method, the result of which is to save valuable substances previously lost in the manufacture, and consequently to reduce materially the price of the sugar itself

PRIZE MEDAL.

Abbas Pasha, Egypt, soft white wheat
Albert, H.R.H. Prince, sample of beans and winter oats
Albrecht, Greenhill and Co., Ceylon, a very fine series of cinnamon
Aska Sugar Factory, Madras Presidency, India, Ganjam sugar
Assam Company, assortment of teas
Astagram Sugar Company, India, different kinds of sugar
Anderson, G., and Co., British Guiana, sugar
Avilés, Commune de, Spain, a Montanches ham
Baguer, —, Russia, wheat (Arnaout) from the government of Saratoff
Barn, T. A., Cape of Good Hope, soft wheat
Barnes, W., United States, maple sugar
Batty and Feast, pickles
Baup, H., Switzerland, for meats preserved by simple desiccation
Bazin, —, sen., France, a new variety of wheat, and an important collection of agricultural produce
Bell, T., United States, soft wheat from Genessee
Benson, W., a fine selected series of varieties of American and other tobacco, raw and manufactured
Blondel Gaston and Co., Sardinia, rice
Buck, Peter, and Son, oatmeal and wheat flour
Cabanes and Rambié, France, flour (thirds)
Carstens, D. H., Lubeck, excellent preserved meats
Chevet, jun., France, preserved meats and vegetables
Chitty, E., flour (best whites)
Christie, D., Canada, white wheat
Clarence, R., Cape of Good Hope, dried fruits
Claus and Caron, Belgium, cane sugar
Clemens, J., Malaga raisins and Jordan almonds
Cohen and Orr, Havannah cigars (Hugues brand)
Copland, Barnes, and Co., preserved meats and vegetables
Cossacks on the estates Petrosskaja and Nova-Spasskaja, Russia, wheat, black and blue-eared, called Boolgarka
Crespel-Delisse, T., France, beet sugar
Da Fonseca Vax, Pinto, Portugal, dried fruits
Damainville, France, artificial honeycomb
Dean, L., United States, maple sugar
Dean, Dray and Deane, Van Diemen's Land, white wheat
De Arietta, Jose Joaquin, Spain, sugar from Havannah, prepared by the vacuum process in the plantation itself

De Beauvoys, Ch., France, a hive on the plan of Huber
De Cabanas et Cabazal, La fille, Spain, cigars of Havannah
De Sandoval and Co., France, chocolate
De Zulueta, J., Spain, sugar from Havannah
Dill and Mulchahey, United States, Cavendish tobacco
Duffield, C., United States, ham
East India Company, The Hon., India, a collection of rices, teas, spices, and cigars
Enriquez, J. N., Spain, cane sugar from Malaga
Ershoff, Lieut.-General, Russia, fine samples of millets
Etteib-Mehsen, Tunis, a collection of varieties of dates
Faulkner, R. and C., preserved fruits
Féry, A., France, rice, from the Landes of Bourdeaux
Feyeux, N. D. M., France, a series of fécules, and similar substances
Fisher, Arthur, Canada, maple sugar
Fortnum, Mason and Co., a fine collection of dried fruits
Fry, J. S., and Sons, a series of cocoa and other substances used in the preparation of chocolate
Gamble, J. H., preserved meats
Garrisini, P., Sardinia, vino di Arancio
Gomes, G. L., Portugal, dried figs
Gonzalez-Alberr, Buenaventura, Spain, cigars of Havannah (Ramas)
Grant, J. H., United States, Cavendish tobacco
Grose, H., Grenada, nutmegs
Guihéry, Deslandelles and Co., France, preserved meat and vegetables
Hallet, R. and Sons, South Australia, wheat (white, soft), wheat flour
Hammond, W. P., and Co., Labuan, sugar from Siam
Heath and Burrows, South Australia, wheat (white soft)
Hecker and Brother, United States, Genessee flour
Heriot, E. T., United States, Carolina rice
Hills and Underwood, malt vinegar
Jeanti, Prevost, Perraud and Co., France, beet sugar
Jonas, E., and Brothers, English cigars manufactured from Havannah tobacco
Jones, B., and Co., a collection of Havannah cigars, representing the state of the English market
Jones, D., Canada, white peas
Jordan and Barber, Austria, Gruaux and common flour
Kidd and Podger, flour
Kirtland, B. B., United States, a collection of maize, 34 varieties
Koucheleff, Count, Russia, a collection of corn and hops
Lambert & Butler, English cigars, manufactured from Havannah tobacco
Le Couteur, Col., Jersey, a series of wheats
Lepelletier, Algeria, soft wheat
Limoges, D., Canada, white peas
Lundyfoot and Co., snuff
MacClelland, Dr., India, isinglass, from the *Polynemus plebeius*
MacHenty, —, Borneo, coffee
MacKillican, J., white wheat
MacPherson and Francis, Van Diemen's Land, wheat
Magnin, J. V., France, maccaroni, vermicelli, and hard wheat of Auvergne
Maille and Segond, France, wine vinegar aromatized
Maund, B., hybrid wheats
Medina del Campo, the Mayor of Spain, wheat
Milligan, A. M., Van Diemen's Land, biscuits
Milton, A. M., Class IX., improved cottage hive
Monteiro, L. A., chocolate
Moore, E. D., preserved milk and cream
Newcastle, N. S. W., Fresh Meat Preserving Company, New South Wales, preserved boiled mutton
New York State Agricultural Society, United States, collection of wheats
Paine, J. M., Golding's hops
Paoletti, F., Tuscany, maccaroni, vermicelli, &c.
Payne, H., Trevitt wheat
Perron, E., France, chocolate
Portugal Royal Tobacco and Snuff Company, Portugal, cigars and snuff
Purdie, W., Trinidad, nutmegs, cloves, black pepper, and cigars; cocoa, as prepared for the Spanish market
Raymond and Schuyler, United States, flour (thirds)
Raynbird, Hugh, hybrid wheat
Reinhardt, G., Canada, ham
Richardson Brothers, roll tobacco and snuff
Richardson, Timothy, and Sons, for Golding's hops, grown by Mr. Phillips, of Offham, in Mid Kent
Richter, Anton and Co., Austria, beet sugar
Ripley, P. W., China, a large assortment of teas of the finest quality
Ritchie and M'Call, preserved meats
Robb, J., Canada, biscuits
Robinson, P., United States, Cavendish tobacco
Roussanoff, —, Russia, wheat and flour
Rousseau Brothers, France, beet sugar
Schooley and Hough, United States, ham (Cincinnati)

Selivanoff, —, Russia, oats, grown from English seed
Shabelsky, Colonel, Russia, wheat (hard Odessa)
Simpson, J., & Co., Canada, wheat flour
Smith, B., Canada, hops
Snowden, R., coffee prepared by his process of separating the tough membrane from between the folds of the seed or berry
Spiglazoff, Alexis, Russia, Russian cigarettes, from Russian grown tobacco
Squair, R., Canada, oatmeal
Stein and Schröder, Grand Duchy of Hesse, hops
Sublime Porte, The, Turkey, hard wheat, and a very fine collection of Turkish tobacco, also honey
Travers and Co., a collection of spices
Turpin, F. A., France, chocolate
Valencia, Province of, Spain, samples of rice
Vézon Brothers, France, gluten, granulated
Vickers, James, Russian isinglass, Class IV.
Watrelot-Delespaul, France, chocolate
Watts, R. M., Canada, Polish oats
Webb, Richard, Talavera wheat
Webb Brothers & Co., Mauritius, sugar
Wittekop and Co., Prussia, maccaroni, vermicelli, &c.

Class IV. — (Jury 4.)

Vegetable and Animal Substances chiefly used in Manufactures, as Implements, or for Ornament.

COUNCIL MEDAL.

Belfast Flax Improvement Society, The Royal, for the persevering and successful efforts made to improve the quality of the fibre of flax, as illustrated by the series of specimens exhibited
Graux, Jean Louis, de Mauchamp, France, the origination of a new and valuable quality of wool, giving to the variety of merino the best quality for combing, and possessing increased strength, brilliancy, and fineness of fibre
Grenet, L. F., France, a new and improved mode of obtaining a pure, inodorous, and colourless gelatine from the refuse parts of animals, and valuable and diversified modes of applying the materials, as illustrated in the collection exhibited.
Mercer, John, Class XVIII., the process of modifying the fibre of cotton by the action of caustic alkali, whereby its physical and chemical properties are altered and improved in a most remarkable manner.
Pepelin-Ducarre, France, for the novel and economical mode of preparing vegetable charcoal from the small branches of trees, and from annual plants.

PRIZE MEDAL.

Abdul Hamid, Egypt, collection of raw produce
Adams, John, flax
Alcan, M., France, silk
Almeida, Messrs., India, collection of lingoa wood
Angola, The, Governor of, 1850, Portugal, tacula wood
Arbuthnot, Messrs., India, indigo
Ardamatsky Brothers, Russia, flax
Arduin and Chancel, France, silk
Averseng, Delorme, and Co., Algeria, palm fibre
Bazley, T., Cape of Good Hope, cotton
Beauvais, France, silk
Bee, J. F., British Guiana, cotton and woods
Belleville Brothers, France, starch, &c.
Berger, S., Class III., rice starch
Besnard, Richoux, and Genest, France, hemp, &c.
Bethell, J., preserved wood
Birnbaum, Jacob, Austria, hemp
Bishop, T., India, fixed oils
Bissé, Louis-Emile, Belgium, oils
Blair, D., British Guiana, cotton
Blundell, India, collection of woods
Bond, S., United States, cotton
Boucherie, J. A., France, wood preserved
Boudon, L., France, silk
British Guiana, The Royal Agricultural and Commercial Society of, colonial produce
Bronno - Bronski, Major, Count de, France, silk
Broussa, Ecole de Siriciculture de, Turkey, silk
Brown, W., New Zealand, Kauri gum
Brownrigg, Van Diemen's Land, woods
Brünneck, Von, Prussia, wool
Burch, W., collection of dye substances
Burn, R., Class III., cotton-seed oil
Burnett, Sir W., preserved woods
Busk, C. J., Cape of Good Hope, red ebony wood
Butterworth, the Hon. Lieut.-Colonel, India, colonial produce
Calderon, J., Spain, hemp and flax
Canales, J., Spain, essential oils
Cape of Good Hope, The Agricultural Society of, Cape produce
Casissa and Sons, Sardinia, silk

Castelle, H., France, gelatines
Champanhet-Sargeas, J., France, silk
Chuffart, —, Algeria, cottons
Clarence, R., Cape of Good Hope, sheep's-tail oil
Claussen, P., flax, and flax cotton, process of preparing it
Cleghorn, Dr., India, gamboge
Cockburn, Messrs., India, starch
Cockerill, —, United States, wool
Colegate, W., and Co., United States, starch
Colonial Assurance Corporation, Australia, collection of raw produce
Collas, M. A. C., France, essential oils, &c.
Colman, J. and J., Class III., starch
Curtet, jun., Algeria, collection of oils
Curtis Brothers and Co., tanning substances
Cutch, The Rao of, India, raw produce
David and De Boe, Belgium, flax
De Gémmy, France, cotton oil
Denison, Sir W. T., Van Diemen's Land, collection of raw produce
Desmedt and Co., Belgium, flax
De Tillancourt, France, silk
Dorrien, C., wool
Dotres and Co., Spain, silks
Ducci, A., Tuscany, walnut-wood veneers
Dumortier, L., France, flax
Dupré de St. Maur, Algeria, cotton
Duval, A., France, silk
Elliot, W., Visagapatam, India, cattimundoo (resin)
Esthonia, Government of, Russia flax
Ewing, J. H., United States, wool
Fabian, C. G., Prussia, pine-needle fibre
Fauntleroy, R., and Sons, collection of woods
Figdor, Isaac, and Sons, Austria, wools
Filemonoff, Kosma, Russia, hemp
Fisher, G. F., India, indigo obtained from whritia and cotton
Fowler, —, Van Diemen's Land, woods
Franceschini, G., Tuscany, silk
Frankenfelde, the Royal Flock at, Prussia, wool
Garnett, H. T., British Guiana, starch, cassava
Gibelin and Son, France, silk
Gilta, J. L., Belgium, hemp
Girod, de l'Ain le Général, France, wool
Godfrey, Messrs., India, oil of roses
Grätz, Steirmark Silkworm Breeding Association at, Austria, silkworms, breed of
Gwalior, H. H. the Maharaja Rao Scindia of, India, fixed oil
Hadden, Capt. W. H., Van Diemen's Land, woods
Haller, J. C., Prussia, wheat starch
Hammond, W. P., and Co., India, collection of Siam produce
Hampton, W., cotton
Hardy, A., Algeria, cottons
Haro, E. F., France, United States, essential oils, &c.
Harris, Lord, Governor, Trinidad, produce of Trinidad
Harrison, R. and J., collection of woods
Hentig, Labuan, Borneo, cotton
Hernandez, J., Spain, wool
Hicks, Geo., United States, Tillandsia usnoides
Hillas, F., purified oils
Holmes, G. L., United States, cotton
Holtzapffel and Co., collection of woods for turning
Hood, R. V., Van Diemen's Land, woods
Hotchkiss, H. G. & L. B., United States, oil of peppermint
Huffnagle, Dr., India, series of lacs, &c.
Hughes, jun., France, essential oil
Hunter, Dr., India, vegetable fibre
Hunyady von Ketheley, Count Joseph, Austria, wools
Hutchinson and Co., vegetable fibres
Jacquet, H. and Co., Sardinia, silk
Jaeger, W. and Co., Tuscany, silk
Jame, Bianchi, & Duseigneur, France, silk
Jardine, D., Calcutta, silks
Jennings, India, silks
Jenkins, Major F., India, Assam produce
Jeypore, the Rajah of, India, attar of roses
Jocadah Factory, The Proprietors of, India, indigo
Jone, J. R., United States, cotton
Jones, J. V., United States, cotton
Jones, O. and Co., Class III., starch from rice
Joubert-Bonnaire and Co., France, hemp
Karnovitch, E., Russia, flax
Kaufmann, A., Russia, woods
Key, Professor J., Madras, fixed oils
Kimber, A. M. and Co., United States, wool
King, Emma, anatomised plants
Kishangurk, The Rajah of, India, fixed oils
Kotah, The Rajah of, India, collection of raw produce
Krashenenekoff, Russia, hemp
Küpfer, Prussia, wool
Lailler, E. H., France, flax
Lainé-Laroche & Max-Richard, France, hemp
Lapeyre and Dolbeau, France, silk
Larisch-Mönnich, Count H., Austria, wools
Lazare and Lacroix, France, dye colours
Leal, F. M. C., Portugal, collection of oils, fixed and volatile
Leclerc Brothers, France, hemp & flax
Lefèvre, Elizée, France, wool

Lepori, T., Tuscany, silk
Lindenberg, J., Cape of Good Hope, vegetable wax
Lisinsk, Forest Institution, Russia, birch oil, turpentine, &c.
Loulé, Marques de, Portugal, collection of woods
Lübbert, E., Prussia, wool
Lüttwitz, Baron Von, Prussia, flax
MacArthur, Col., New South Wales, collection of wools
Mackenzie Brothers, India, silks
Macleod, W. W., United States, cotton
MacNair, —, India, indigo
MacNair, W., India, silks
MacNaughten, Van Diemen's Land, woods
Madrid, The Cabinet Botanical Garden of, Spain, collection of Cuba woods
Manuel, C., Cape of Good Hope, cotton
Markwick, M., "spongio-piline" fabric
Martinez, P., Spain, hemp
Maryland, The State of, United States, collection of produce
Meeherdetz Djezairlioglu, Turkey, silk
Méneville and Robert, France, silk
Mercurin, H. J., Algeria, oils
Méro, C. D., France, essential oils
Meriweather, J. B., United States, cotton
Mevissen, G., Prussia, flax
Milligan, J., Van Diemen's Land, collection of raw produce
Millner, R., collection of Irish wools
Mittrowsky, Count Anton Von, Austria, wools
Moulines, L., France, silk
Montfort, F., Spain, silks
Montigny, G. de, Algeria, dyes
Montreal Central Commission, Canada, collection of woods
Morin, Algeria, cottons
Moses, Son, and Davis, New South Wales, tallow
Mottet, C., France, dyes
Mourgue and Co., Turkey, silks
Murcia, The Province of, Spain, silkworm gut
Nailor, J., United States, cotton
Nordlinger, Professor, Wurtemberg, collection of woods
Nordmann, G. L., Prussia, wool
Nouri Mehemet, Pacha, Turkey, silk
Oswego Starch Factory, United States, starch
Outridge, J., British Guiana, collection of woods
Parlett and Co., Ceylon, oils
Paulsky, J., Turkey, silk
Pelissier, C., Algeria, cottons
Pellouz, Brentano and Co., Bavaria, silk
Perkins & Brown, United States, wool
Philippine Islands, Economical Society of, Spain, fibrous substances
Pieris, T. A., Ceylon, collection of oils and gums
Pope, J., United States, cotton
Preston, J. and Co., flax
Prins, C. C., Netherlands, potato starch
Querini, Giovanni, Austria, silk
Rambouillet, National Sheepfold of, France, wool
Ravagli, P., Tuscany, silk
Rea, E., collection of resins
Reed and Meakins, Canada, hard woods
Rebow, J., Gurdon, wool
Regard Brothers, France, silk
Rey and Co., Spain, silks
Richer, F., France, wool
Rier, Peter, Russia, silk
Ripalda, Count, Spain, hemp
Rouxel, F., France, flax
Ruas and Co., France, silk
Ruez, L., France, starches
Rüfin, Alfred, Prussia, flax
Sainte, Messrs., India, cocoa-nut oil
Saragossa, Agricultural Society of, collection of produce
Saunders, W. W., collection of woods
Scheibler and Co., Austria, silk
Schomburgk, Sir R., St. Domingo, collection of produce
Schonberg Yarn Spinning Mill, Austria, hemp
Schöneveld and Westerbaan, Netherlands, starch
Scoti, Brother, Tuscany, silk
Scott, Turkey, silk
Scott, E. and Co., collection of woods
Seabrook, W., United States, cotton
Semenoff, J., and Faleyeff, Alexis, and Basile, Russia, bristles, &c,
Shier, D., British Guiana, starch, cassava
Sidi Mahmoud Benyad, Tunis, collection of native produce
Smith, Captain, India, munjeet
Smith and Son, lichen and cudbear
Speede, India, starch
Steinbach, J. J., France, starches
Steinböck, A., Austria, samples of oil
St. Ubery, France, collection of woods
Stutchbery, J. S., British Guiana, woods and oil
Tao Nui, New Zealand, collection of woods, &c.
Tandler, Stefan, Austria, wood fibre
Teissier du Cros, L. and E., France, silk
Thompson, Rev. Z., United States, woods
Tulloch, Lieut.-Col., India, fixed oils and collection of woods
Tucker, R. G., British gum
Technological Institute, Tuscany, collection of woods

Jllersdorff Flax Retting Establishment, Austria, flax, &c.
ʼalencia, the Agricultural and Commercial Society of Spain, collection of raw produce
ʼanbogaert, J. B., Belgium, flax and hemp
ʼan der Gon Netscher, A. D., British Guiana, cotton
ʼan Geeteauyen, C., Belgium, starch
ʼan Riet, P. J., Belgium, hemp
ʼan Wiele, J. B , Belgium, flax
ʼerbeeck, P. J., Belgium, flax
ʼerhelst, F., Belgium, hemp
ʼerza Brothers, Austria, silks
ʼiolette, J. H. M., France, charcoal
ʼizianagram, Rajah of, India, fixed oils
Volkhonsky, Prince, Russia, hemp and starch
Watson, Ceylon, silks
Weber, L., India, vegetable fibre
Welcker, A. C., Prussia, potato starch
Western, W., Western Africa, oils, &c.
White, —, flax
Whitesides, —, Van Diemen's Land, collection of woods
Wight, Dr., India, collection of various specimens of cotton
Wood and Bedford, lichens and dyes
Wright, L. W. and Co., flax and China grass
Yun Kee, of Shanghae, China, silk
Zavagli, P., Tuscany, silk

(CLASS V. — JURY 5.)

Machines for Direct Use, including Carriages, and Railway and Naval Mechanism.

COUNCIL MEDAL.

.ppold, J. G., a centrifugal pump with curved vanes
ʼockerill, J., Belgium, pair of 140 horse power vibrating cylinder engines for river navigation; a locomotive engine; an oscillating cylinder 3-horse power land engine; tubular boiler; a vertical cylinder 16-horse power land engine. (The award is made for the whole).
ʼrampton, T. R., two passenger locomotive engines
ʼunn, T., a railway traversing frame
ʼromont and Son, France, a double turbine
enn, John, and Son, two pair of compact marine engines, of light construction, for small vessels

PRIZE MEDAL.

.dams, W. B., light locomotive engine and double railway carriage
.rmstrong, W. G., hydraulic crane
.therton, C., for the application of an eccentric to working expansion valves
ʼaines, W., railway switches and chairs
ank Quay Foundry Company, great hydraulic press
ʼarlow, W. H., wrought iron permanent way
ʼeecroft, Butler & Co., railway wheels and axles
ʼéranger, J., and Co., France, weighing machines
ʼheavin, S., filtering pump
ʼlair, P., France, a dynanometer and indicator; and a mode in section of a locomotive
ʼlayton, Shuttleworth & Co., an eight-horse power vertical oscillating cylinder engine
Collinge, C., & Co., a five-horse power direct-action steam-engine
Croskill, W., oscillating cylinder direct-action steam-engine
Cwm-Avon Iron Co., railway bars
Davies, J and G., a patent revolving elliptic steam-engine, with an ingenious governor, equilibrium valves, and feed-valves
Davidson, J., and Co., scales and weighing-machines
Day and Millward, weighing-machines
De Bergue, C., railway buffers
Derwent Iron Company, large plates of rolled iron, for sway-beams of engines and ship-building purposes; and a railway bar 66 feet long
Ebbw-Vale Company, railway bars
Edwards, T., five-horse power direct-action steam-engine
Enfer, E., France, blowing-machine
England, G., and Co., tank locomotive engine; traversing screw jack
Enthoven, K. L., Netherlands, iron crane for lifting and weighing
Flaud, H. P., France, five-horse power vertical cylinder direct-acting high-pressure engine, for working at high velocities with high-pressure steam
Fourdinier, E. N., safety cage for mines
Fox, Henderson and Co., derric crane
Great Western Railway Company, Swindon, passenger engine
Haddan, J. C., papier maché carriage
Hawthorn, R. and W., locomotive passenger engine
Henson, H. H., railway goods waggon
Hosking, R., treble-beat pump valve
Jackson, P. R., railway tires; hydraulic press
James and Co., weighing crane

Kitson, Thompson and Hewitson, locomotive tank engine
Lee, J., wheels, axles, & railway breaks
Letestu, —, France, fire-engine
Lloyd, G., blowing-machine
Mauzaize, J. N., France, friction clutch
Merryweather, M., fire-engine
M'Connell, J. E., corrugated iron railway carriage
M'Niccoll and Vernon, steam traversing crane
Mersey Iron Company, patent roller iron for ship-building
Nasmyth, J., four-horse power direct-acting engine
Parent, —, France, scales
Patent Shaft and Axletree Company, railway carriage and other axles
Perry, G, and Brothers, Canada, fire-engines
Piepenstock & Co., Prussia, disc wheels and hollow axles
Pooley, H., & Son, weighing-machines
Pope, W., & Son, four-horse oscillating cylinder direct-acting steam-engine
Pouyer, Quertier Fils, France, apparatus by which any number of movers may be connected or disconnected at pleasure
Ransomes & May, water-crane, patent compressed tree-nails, and wedges for railways
Schmid, H. D., Austria, weighing-machine, parabolic governor for a steam-engine
Shand and Mason, fire-engine
Siemens, C.W., chronometric governor
Simpson and Shipton, ten-horse power reciprocating engine
Smith, F. P., a series of screw models, showing the progress of screw propulsion
Société Anonyme des Hauts Fourneaux, Usines et Charbonnages de Marcinelle et Couillet, Belgium, mine ventilator
Spencer, J., and Son, Bailey's patent volute springs
Thorneycroft, G. B., and Co., railway wheels and axles
Thornton & Sons, hydraulic lifting-jack
Watt, James, & Co., pair of horizontal cylinder steam-engines for screw-propellers
Williams, C. C., railway carriage
Worsdell, G., and Co., railway axle, wheel-tire, and axle-box
Young, C., and Co., simultaneously-acting gates for railway crossings

Class V*a*. — (Jury 5*a*.)

Carriages.

PRIZE MEDAL.

Andrews, R, a neat pony carriage
Belvallette Brothers, France, a Stanhope or sporting phaëton, of excellent design, and well finished
Briggs, G., and Co., a town chariot, admirably carried out as to good taste
Browne, W., a caned car, very neat and well finished; a curricle car, made with Fuller's patent shafts, to be used occasionally with one horse
Childs, C., United States, a slide-top buggy or phaëton; enamelled leather of apron of very superior quality: the whole well got up and neatly finished
Davies, D., & Son, a Basterna Brougham, a very good piece of work
Dunaime, J. A., France, a town Berline, well formed and got up in a superior manner
Hallmarke, Aldebert and Hallmarke, a green barouche: a very good carriage
Holmes, H. & A., a park phaëton, very neatly finished, and in good taste
Hooper, G., a green Brougham, got up in the neatest manner, all in good taste, and well done
Jones Brothers, Belgium, a cab phaëton; a well-finished carriage
Peters and Sons, a park step-piece barouche, highly finished, and with good taste
Robinson and Co., a park phaëton, very neat, and an excellent piece of work
Rock and Son, a patent diaropha, very ingenious as regards the shifting, and well shaped
Silk and Brown, a full-sized park phaëton, elaborately finished; a very superior specimen of workmanship and art
Van Aken, P., and Son, Belgium, a cabriolet chaise, neatly got up
Ward, J., a Bath chair, with patent noiseless wheels; the whole well shaped, well arranged, of excellent form, and well finished
Watson, G. W., United States, a sporting waggon, very neatly finished in all respects
Wyburn, Meller & Turner, an elegant dress chariot, in all respects very highly finished

Class VI. — (Jury 6.)

Manufacturing Machines and Tools.

COUNCIL MEDAL.

Barlow, A., Jacquard loom, with two cylinders, simultaneously raising and lowering the suspended wires
Cail & Co., France, vacuum apparatus for the manufacture of sugar
Donisthorpe, G. E., double wool-combing machine
Donkin, B., and Co., paper machinery
Dick, D., United States, various engineers' tools and presses
Fairbairn, W., and Sons, rivetting machine, and a corn-mill
Hermann, G., France, a set of chocolate machines
Hick, B., and Son, mill gearing, radial drill, engineers' machine tools, improved mandrils, portable forges
Heckmann, C., Prussia, vacuum apparatus for the manufacture of sugar
Hibbert, Platt and Sons, a complete series of machines employed in the cleaning, preparation, and spinning of cotton, showing the whole process, to the weaving inclusive
Lawson, S., and Sons, numerous machines employed for the preparation of flax
Mason, J., woollen carding machine, also slubbing and roving frames
Maudslay, Sons, & Field, coining press, acting by an eccentric
Mercier, A., & Co , France, machinery for spinning and carding wools
Nasmyth, J., and Co., steam hammer
Parker, C. E., and Co., power-loom for weaving sailcloth
Pontifex and Wood, vacuum apparatus for the manufacture of sugar, in copper and brass
Reeds, T. S., and Co , new power-loom for weaving fringes without shuttles
Risler, M. Fils, France, "Epurator," a machine for cleansing and preparing cotton for spinning
Sharp Brothers and Co., large double lathe for railway wheels, slotting machine, and other engineers' machine tools, also a beautiful constructed ring and traveller throstle
Uhlhorn, H., Prussia, coining press
Whitworth, J., and Co., a large collection of engineers' machine tools of all kinds, screw stocks, standard gauges, and a knitting machine. Also his machine for measuring less than the 200,000th part of an inch

PRIZE MEDAL.

Acklin, France, Jacquard employing paper instead of cards
Adorno, J. N., cigarette machine
Ball, Dunnicliff, and Co., warp lace machine
Berry, B., and Sons, machinery for manufacturing worsted
Berthelot, N., France, circular hosiery frames
Bessemer, H., centrifugal machine for refining sugar
Birch, J., machine for cutting wood sash bars
Birkin, R., bobbin-net lace machine, with Jacquard
Black, J., paper-folding machine
Blodget, S. C., United States, sewing machine
Boland, A., France, kneading machine
Bonardel Brothers, Prussia, Jacquard, and punching machine for Jacquard cards
Borie Brothers, France, machine for making hollow bricks
Baranowski, J. J., France, machine for printing and numbering tickets
Brewer, C. and W., rollers of wire cloth for paper-makers
Bullough, W., stopping motion to a power-loom
Calvert, F. A., wood-burring and cotton-cleaning machine and cylinders
Church and Goddard, machine for cutting card-boards, and printing and preparing railway tickets
Claussen, P., circular hand-loom for hosiery
Crawhall, J., machine for manufacturing hemp ropes
Crichton, D., new taking-up motion for a loom
Cuyere, Mrs., Tuscany, weavers' reeds
Davenport, J. L., various machines for manufacturing silk
Dalgety, A., small lathe, with self-adjusting chuck
De Bergue, C , reeds made by machinery
De la Rue and Co., envelope machine
Dandoy-Mailliard, Lucq, & Co., France, rollers for spinning machinery
Darier, H., Switzerland, press for cutting out watch-hands
Dorey, J. F., France, machine for weaving improved healds
Earle, T. K., and Co., United States, card clothing
Frey Fils, France, machine for making nails
Frost, J., improved silk machinery
Furness, W., machines for tenoning, morticing, planing, & moulding wood
The heirs of P. Gamba, Austria, Jacquard cylinder

ing for the commercial marine, almost all showing the greatest and most important improvements in strength, symmetry, and efficiency, and mostly coming from the establishments within the jurisdiction of the port of London

Claudin, F., France, guns, rifles, and pistols

Deane, Adams and Deane, double and single guns and pistols

Dent, E. J., Class X., for a successful attempt to construct a compass that should not be disturbed by the motion of the ship at sea, nor by the firing of guns on board

Daumeng, M., France, for his improvements in the shading of maps, by printing different colours at the same time

Delvigne, G., France, apparatus for saving life from shipwreck. A projectile discharged by means of a howitzer. This invention involves a new principle,—that of a portion of the line to be carried out being contained in the projectile

Devisme, —, France, sporting guns and arms

Ditchburn, T. J., models of paddle and screw steam vessels

Fischer, C. A, Lübeck, double gun, rifle, and pistols

Fox, A., fine specimens of nets, seine, &c., for pilchards

Gauvain, J., France, pistols—form and execution; sporting guns, &c.

Gastinne-Renette, France, sporting guns and arms

Greener, W., guns—barrels perfectly forged and finished; harpoon guns, for whale fishery, and for saving life from shipwreck

Green, Messrs., for a specimen model of a merchant vessel, designed and built by them for the East India trade

Groom, J. J., specimens of deep-sea fishing-lines and hooks

Hawker, Colonel P., for his improvements and perfection in punt guns

Hinks, Henry, design of a life-boat. Also recommended for the prize of 100 guineas to be awarded by the Duke of Northumberland

Houllier-Blanchard, H., France, pair of pistols and apparatus

Jansen, A. D., Belgium, collection of sporting and ornamental guns

Jeffery, Walsh and Co., specimens showing the advantages of marine glue, as a substitute for pitch, and for other purposes connected with ship-building

Jerningham, Capt., R. N., for an anchor, bent on to a line, to fire from a Manby mortar, a sufficient distance to afford the means of hauling a life-boat through the surf

Lang, J., double and single guns and pistols

Lahure, —, France, iron life-boat

Legoff, —, France, for an excellent system of stopping chain cables

Lardinois, N. C., Belgium, target rifle, with accessories of every kind

Leopold, Barnard, France, double and single barrels, of damasque workmanship

Lepage, Belgium, numerous collection of sporting and trade guns

Lepage-Moutier, France, sporting guns, ornamental arms, swords and side-arms of De Luynes, damasque of remarkable novelty

Manby, Capt. G. W. (representatives of), mortar apparatus, for shipwreck purposes. The object of this instrument is that of saving life from shipwreck, by means of firing a projectile with a line attached, over a vessel when on shore

Mare, C. J., and Co., models of sailing and steam-vessels, both paddle and screw; ditto of yachts designed and built for various merchants' services

Mortimer, T. E., guns, rifles, and pistols

Napier and Son, for a compass used for registering the hourly deviation of the needle, and for detecting errors in the steerage of a ship

National Institution of Washington, United States, models of ships of war and large merchant vessels

Needham, Henry, guns, rifles, and pistols

Plenty, J. and E. Pelew, for having exhibited a good specimen of a life-boat

Parsons, W., guns, rifles, and pistols

Plomdeur, N., Belgium, best guns, rifles, and pistols

Reeves, Greaves and Reeves, swords and other side-arms, artistically embellished

Renkin Brothers, Belgium, numerous collection of sporting and trade guns

Rhind, W. G., deck seat to form raft. This seat can be readily formed into a safety raft capable of sustaining eight people

Richards, Westley, best guns, and sporting guns

Rigby, W. and J., guns, pistols, and rifles, and barrels of damasque

Rigmaiden, Lieut. J., R.N., model of improved mode for setting up the standing rigging of ships

Robinson and Russell, placed in Class V., models of steam-boats designed and built by them

Rocher, M., France, distilling and cooking galley

Rodger, Lieut. W., models of improvements in form of anchors

Royal Thames Yacht Club, models of vessels, belonging to their club

Saunders, J. E., placed in Class XXXIX., model of a welled smack for fishing, fitted with auxiliary screw propeller. A novel application to vessels of this description

Semmens, J. and T. W., model of Mount's Bay fishing-boat. A fine description of boat for the purpose

Schneider, —, France, specimen and plans of steam-boat *L'Ocean*, for the River Rhone, which vessel has attained great speed, and rendered much service to the commerce on that river

Sochet, —, France, distilling apparatus

Sauerbrey, V., Switzerland, target rifle

Smith, S., model of a spring machine for modelling ships of any form or dimensions; an ingenious and ready means of setting up a design and model

Smith, Thomas and William, specimen models of fine merchant vessels, designed and built by them for the East India trade

Teasdell, W., for a good specimen of a life-boat

Tourey, —, Belgium, an ornamental double gun, guns, and arms

Trulock, E., and Son, guns, pistols, and rifles, and barrels of good damasque

Tutt, G., placed in Class XXIX., model of a Hastings fishing-lugger; a very fine description of boat for the purpose

White, J., models of vessels for merchant service, and yachts; designed and built by him

White, T. J., and R., models of fine sailing and steam-vessels and yachts

Wigram, M., and Sons, models of sailing and steam-vessels, both paddle and screw; designed and built for various merchant services

Wilkinson and Son, guns, rifles, pistols, and swords. Swords highly ornamented

Zulaga, D. E., Spain, firearms and swords

MONEY AWARDS.

Birnie, Alex., for having exhibited a complete set of fishing-nets, lines, and hooks, for deep sea-fishing, £50

Bothway, Joseph, for having exhibited models of his improvements in the construction of blocks, combining strength and other advantages with much less weight, £50

Harvey, Daniel, for having exhibited a model of the *Victoria and Albert* yacht, executed by him, being a fine specimen of workmanship, £40

Dempster, —, for an ingenious system of signals for merchant ships, £20

Class IX. — (Jury 9.)

Agricultural and Horticultural Machines and Implements.

COUNCIL MEDAL.

Busby, W., two or four-horse plough, horse hoe on the ridge, ribbing corn-drill, and cart

Crosskill, W., Norwegian harrow, meal mill, cart, clod crusher, and gorse-bruiser

Garrett and Sons, horse hoe, general purpose drill, 4-row turnip drill on the flat, improved hand barrow drill for grass seeds, steam-engine, and thrashing-machine

Hornsby and Sons, corn and seed drill, drop drill, 2-row turnip drill on the ridge, oil cake bruiser, steam-engine

M'Cormick, C. H., United States, reaping machine

PRIZE MEDAL.

Ball, W., two-horse plough

Barrett, Exall, and Andrews, thrashing machine and patent gear, linseed and corn crusher

Bentall, E. H., cultivator, dynamometer

Burgess and Key, improved American churn and turnip cutter

Burrell, C., gorse bruiser

Claes, P., Belgium, corn drill and roller

Clayton, Shuttleworth and Co., steam-engine

Clayton, H., tile-machine

Coleman, R., cultivator, expanding harrow

Comins, J., horse hoe

Cornes, T., chaff-cutter

Crowley and Sons, cart

Delstanche, P., Belgium, plough

Duchene, J. J., Belgium, churn

Gibson, M., clod crusher

Gray and Sons, cart

Hensman and Son, thrashing machine, 4-horse plough, corn drill

Holmes and Sons, thrashing machine

Howard, J. and F., 2-horse XX plough, 4-horse plough, horse rake

Hurwood, G., meal mill

Jenkin, W., Netherlands, plough

Lavoisy, A. D., France, churn

Newington, Dr. S., top-dressing machine

Nicholson, W. N., oil-cake bruiser

Odeurs, J. M., Belgium, plough
Prouty and Mears, United States, plough
Ransomes and May, drop drill
Reeves and Bratton, water drill and liquid manure distributor
Samuelson, B., turnip-cutter
Scragg, T., tile machine
Smith and Co., haymaker, chaff-cutter, horse rake
Stanley, W. P., linseed and barley crusher
Talbot Brothers, France, plough
Tuxford and Sons, steam-engine
Wilkinson, T., churn
Williams, W., light and heavy harrows
Whitehead, J., tile machine
Vachon, Son, and Co., France, a seed and corn separator

Class X. — (Jury 10.)

Philosophical Instruments, and processes depending upon their use; Musical, Horological, and Surgical Instruments.

COUNCIL MEDAL.

Bain, A., electric telegraph
Bakewell, F., copying electric telegraph
Bond, W., and Son, United States, for the invention of a new mode of observing astronomical phenomena, &c.
Bourdon, E., France, for the invention of metallic barometers, and for his manometers
Brett, J., printing telegraph
Brooke, C., for the invention of a means of self-registering natural phenomena, by photography
Buckle, S., Class XXX., for his photographs on paper
Buron, —, France, for his good telescopes, the object glass being of rock crystal
Chance Brothers, Class XXIV., a disc of flint glass 29 inches diameter
Claudet, A. F., for his several inventions based upon experiments in the practice of photography; and for his non-inverted pictures
Daguet, T., Switzerland, for the superiority of glass for optical purposes, good specific gravity, clear; crown-glass as clear as flint
Deleuil, L. J., France, for his balance air-pump; and for the invention of an arrangement to keep the charcoal points in electric light at a constant distance
Dollond, G., for atmospheric recorder, by means of which the reading of the barometer, those of the thermometer, evaporator, fall of rain, direction of the wind, its strength, electric state of the air, &c., are simultaneously registered
Dubosq-Soleil, J., France, for a very ingenious heliostat, on a new construction, by Silberman; the invention of an apparatus for fixing the charcoal points for electric light; a saccharometer of delicate structure and much ingenuity, and an elegant novel instrument, by Brevais, for exhibiting the phenomena of polarized light
Dunin, Count E., for the extraordinary application of mechanism to his steel expanding figure of a man
Froment, G., France, for the goodness of the work of his theodolites and divided metre
Gonella, Professor T., Tuscany, planometer, a machine for measuring plane surfaces
Griffith, J., for his barometer, with a vacuum, capable of complete restoration by an air-trap at the top
Henley, W. T., for his convenient and ingenious application of magnetic electricity to the purpose of electric telegraphs
Logeman, W. M., Holland, for the excellence of the magnets shown by him
Martens, F., France, for his Talbotypes on glass, by the albuminous process
Merz and Sons, Bavaria, equatorial, combining cheapness, with excellence of workmanship
Newman, J., for the originality, excellence, and perfection of his air-pumps, and self-registering tide-gauge
Oertling, L., for very delicate, large, and small balances
Quenessen, France, a platina alembic, to hold 250 pints, all in one piece, without solder or seam, &c.
Ross, A., for great improvements in microscopes, and for the solidity of structure, good mechanism, and distribution of strength, great size, &c., of his large equatorial
Ross and Thomson, Class XXX., for great improvements in photography
Siemens and Halske, Prussia, electric telegraph
Smith and Beck, for excellence of microscopes
Taurines, France, dynamometer
Vidie, France, for the invention of the aneroid barometer

PRIZE MEDAL

Ackland, W., dividing engine
Allan, T., electric telegraph
Bache, A. D., United States, balance
Batka, W., Austria, chemical apparatus
Baumann, T., Prussia, comparateur
Bayard, H., France, talbotypes
Beaulieu, A., Belgium, theodolites and sextants
Bertaud, Junior, France, slices of crystals
Beyerlé, G., France, cylindrical lenses
Blunt, Henry, model of Eristothenes; part of moon
Bourgogne, J., France, microscopic preparations
Brady, M. B., United States, Daguerréotypes
Breithaupt, F. W., and Son, Prussia, surveying instruments
British Electric Telegraph Company, their series of electric telegraphs
Burt, W. A., United States, solar compass; surveying instruments
Challis, Professor, scales for calculating the corrections for a transit instrument
Chuard, France, safety-lamp
Collot, E. and A., Brothers, France, balance
Cotton, W., coin weighing-machine
Crichton, J., drawing instruments and sextants
De la Rue and Co., Class XVII., irridescent films
Denton, J. B., process of relief mapping
Dolberg, A., Prussia, balance
Dover, J., balance
Elliot and Sons, drawing instruments
Engel, F., Prussia, wave surface
Ericsson, J., United States, sea lead, pyrometer, &c.
Ertel and Son, Bavaria, universal astronomical instrument
Facy, R., orrery
Flachéron, F., France, talbotypes
Galy-Cazalat, France, manometer, upon the hydraulic principle
Griffin, J. J., and Co., chemical apparatus
Gysi, F., Switzerland, drawing instruments
Hamann, E. F., France, planometer
Henneman and Malone, talbotypes
Hett, A., microscopic preparations
Hewitson, J., tide-gauge
Hjorth, S., Denmark, electro-motive power
Hommel-Esser, F., Switzerland, drawing-instruments
Horne, Thornwaite and Wood, good work in photograph apparatus
Hughes, W., topography for the blind
Johnson and Matthey, Class I., palladium crucibles
Johnston, W. and A. K., geological and physical globes
Jürgensen and Sons, Denmark, metallic thermometer
Kilburn, W. E., photographs
Kinzelbach, T., Zollverein, diolitic telescope
Knight and Sons, chemical apparatus
Kummer, K. W., Prussia, large relief globe
Lawrence, M. M., United States, Daguerréotype
Leeson, Dr. H. B., Class I., for exhibition of crystals
Lloyd, Lieut.-Colonel, J. A., storm-indicator--a typhodeictor
Luhme, J. F., and Co, Prussia, chemical apparatus
Maes, J., France, prism of zinc glass
Marchesi, G. B., Austria, instruments for the blind
Mitchell, Rev. W., models of crystals, Class I.
Nachet, France, microscopes
Nasmyth, J., moon maps
Negretti and Zambra, meteorological instruments on glass
Newton and Son, globes
Nobert, F. A., Prussia, fine lines on glass
Oerrling, A., Prussia, balance
Penrose, F. C., helicograph
Perreaux, France, dividing engine
Phillips, W. H., fire annihilator, Class V.
Pillischer, M., elliptic compass
Plagniol, A., France, camera obscura
Pretsch, Paul, photographs
Reade, Rev. J. B., solid eye-piece
Sacré, E., Belgium, balance
Schiertz, J. G., France, photographic apparatus
Schoell, C. A., Switzerland, model of Mount Sentis
Schröder, J., Hesse, descriptive models of joining in wood, crystals, &c.
Seel, H., Prussia, pharmaceutical apparatus
Shadbolt, G., microscope condenser
Simms, W., fine astronomical instruments
Smith, Capt., India, coin-weighing machine
St. John, John R., United States, detector compass
Staffel, I. A., Russia, calculating machine; machine for weighing precious metals, &c.
Stoehrer E., Saxony, electric telegraph
Thomas, C. X., France, calculating machine
Topping, C. M., microscopic preparations
Van Schendel, P., Belgium, a model of descriptive geometry; perspective

Varley and Son, telescopic camera lucida

Vedy, F., France, sextants and reflecting circles

Walker, C. V., graphite batteries, &c.

Ward, W. B., botanical cases

Watkins and Hill, Class V., dry pile apparatus, galvanometer, &c.

Westmoreland, J., electrical machine

Whipple, J. A., United States, Daguerréotype of the moon

CLASS X. *a.* — (JURY 10 *a.*)

Musical Instruments.

COUNCIL MEDAL.

Boehm, T., Munich, for important scientific improvements of the flute, and the successful application of his principles to other wind instruments

Ducroquet, P. A., France, for his application of the pneumatic lever to a church organ

Erard, P., United Kingdom and France, for his peculiar mechanical actions applied to pianofortes and harps

Gray and Davison, for their invention in organ building, of a new method of connecting the great organ with the swell organ, by means of a pedal, and of a new stop called the Kerau-lophon

Hill and Son, invention of a stop of great power, and for their mode of shifting the stops by means of keys

Sax, A., France, for his invention of several classes of wind instruments in wood and metal

Vuillaume, J. B., France, for new modes of making violins, in such a manner that they are matured and perfected immediately on the completion of the manufacture, thus avoiding the necessity of keeping them for a considerable period to develope their excellences

Willis, H., for his application to organs of an improved exhausting valve to the pneumatic lever, the application of pneumatic levers in a compound form, and the invention of a movement in connexion therewith for facilitating the drawing of stops either singly or in connexion

PRIZE MEDAL.

Addison, R., for a "Royal Albert" transposing pianoforte

Bernardel, sen., France, for violins

Besson, G., France, for various metal musical instruments

Betts, A., for two violins

Breitkopf and Hartel, Saxony, for a grand pianoforte

Broadwood, John, and Sons, for their successful improvements in pianoforte making

Bryceson, H., for a church barrel organ

Buffet, A., France, for oboes, clarionets, flutes, and a corno-inglese

Callcott, J., for his invention of a French horn without loose crooks

Chickering, J., United States, for a square pianoforte; and the jury think highly of his grand pianoforte

Collard and Collard, for pianos, and for their successful application of several improvements in pianoforte-making

Debain, A., France, for a mechanical pianoforte

Ducci, A. and M., Tuscany, for an organ with a "Baristata" stop

Eisenbrant, C. H., United States, for clarionets and flutes

Forster, S. A., for a violoncello, violin, and viola

Franche, C., France, for a repetition action in a pianoforte

Gallegos, J., Spain, for a "guitarra harpa"

Gebauhr, C. J., senior, Prussia, for a pianoforte

Gemunder, G., United States, for a Joseph Guarucrius violin (chiefly), and for three other violins and a viola

Godfroy, C., senior, France, for flutes

Heckel, J. A., Nassau, for a bassoon of a new and improved construction

Heeps, J. H., hearing apparatus made of gutta percha

Helwert, J., Wurtemburg, for a bassoon with 19 keys, of an improved construction

Hopkinson, J. and J., for a horizontal grand pianoforte with new patent action

Hund, F. and Son, for a cottage pianoforte, in the form of a lyre, termed the "Lyra" pianoforte

Jastrzebski, F., Belgium, for an upright pianoforte

Jaulin, J., France, for a panorgue, and for his improvements in free reeds

Jenkins, W., and Sons, for an expanding piano, for yachts, &c.

Kirkman and Son, for a semi-grand piano, and an oblique piccolo piano

Knocke, A., Bavaria, for his mechanical improvements in kettle-drums

Köhler, J., for a slide trombone, and for the application of his patent valves to other metal wind instruments

Lambert and Co., for a cottage pianoforte
Macfarlane, G., for an improved cornet-à-piston
Mahillon, C., Belgium, for clarionets, and a trombone and ophicleide
Meyer, C., United States, for two pianofortes
Montal, C., France, for four cottage pianofortes
Nunns, R., and Clark, United States, for a 7-octave square pianoforte
Oates, J. P., for improvements as applied to cornets
Pape, J. H., France, for certain improvements in pianofortes
Pask and Kœnig, for clarionets and brass instruments
Purdy and Fendt, for a double bass (chiefly), and for four violins, and two violoncellos
Roller and Blanchet Fils, France, for three pianofortes
Rudall, Rose, and Co., for a Boehm's patent flute
Schiedmayer and Son, Wurtemburg, for a square pianoforte, in mahogany
Schulze, J. F., and Sons, Prussia, for an organ
Southwell, W., for a grand pianoforte
Stodart, William, and Son, for a square pianoforte
Triebert, F., France, for oboes and a "corno-inglese"
Ward, C., for a newly-constructed bassoon and a pair of kettle-drums
Wheatstone and Co., for a novel invention of a portable harmonium
Wornum, R., for an improved piccolo pianoforte

Class X. *b.* — (Jury 10 *b.*)

Horological.

COUNCIL MEDAL.

Dent, E. J., for his large turret clock, on account of the combination of strength and accuracy of time keeping attained in it, which are also accomplished by a cheaper mode of construction than in other turret clocks of high character
Japy Brothers, France, clock and watch movements, made by machinery, much cheaper than any other movement, and equally good
Lutz, C., Switzerland, for his watch balance springs, which were submitted by the jury to the test of stretching out and beating without affecting their form
Wagner, J., France, for his clock with a continuous motion for driving telescopes, and for his collection of turret clocks, which, on the whole, display great fertility of invention

PRIZE MEDAL.

Audemars, L., Switzerland, watches and watch movements
Benoit, A., Sardinia, watches and tooth-polishing machine
Brocot, A., France, half-dead jewelled escapement
Du Bois, F. Williams, Switzerland, astronomical clock
Detouche and Houdin, France, good collection of clocks
Frodsham, C., chronometers and watches
Grandjean, H., Switzerland, pocket chronometers
Gros Claud, C. H., Switzerland, two watches
Gannery, V., France, astronomical clock
Gowland, James, clock escapement
Gourdin, J., France, small turret-clock
Hutton, J., chronometers
Jackson, W. H. and S., watches, solid key
Jürgensen and Sons, Denmark, chronometer
Loseby, E. T., compensated balance
Lecoultre, A., Switzerland, watches, watch movements, and pinions
Mercier, S., Switzerland, watches
MacDowall, Charles, escapement (clock)
Montandon, Brothers, France, watch mainsprings
Patek, Philippe and Co., Switzerland, chronometers, watches, &c.
Parkinson and Frodsham, chronometers and watches
Richard, Louis, Switzerland, chronometer
Reydor, P. G., Brothers, and Colin, France, cheap house clocks
Redier, A., France, cheap watch alarums
Rieussec, N., France, watch with printing seconds hand
Roberts, R., turret clock, and watch-plate drilling machine
Roskell, J., collection of models and watches
Rotherham and Sons, collection of watches
Vissière, France, chronometers

Class X *c*. — (Jury 10 *c*.)

Surgical.

PRIZE MEDAL.

Arnott, Dr. J., mode of applying cold as a novel therapeutical agent
Auxoux, Dr. L., France, anatomical models. These models are calculated to aid the study of anatomy, human and comparative
Avery, J., illuminating apparatus, for exploring long and narrow canals
Bigg, H., and son, for collection
Burat Brothers, France, herniary bandages
Calamai, Prof., Tuscany, a series of models in wax, representing the anatomy of the torpedo
Caplin, Madame, Corsets
Caplin, J., gymnastic apparatus and orthorochidic instruments
Charrière, J. F., France, for collection
Coxeter, J., for collection
Evans, W., artificial leg
Evans and Co., for collection
Ferguson and Sons, for collection
Gordon, J., anatomical model in ivory
Gowing, Thos. W., veterinary instruments
Grossmith, W. R., artificial eyes
Hutchinson, Dr., spirometer
Junod, T., Switzerland, apparatus for hemospatic
Lüer, A., France, for collection, and the great ingenuity and admirable workmanship of several instruments for operations on the eye
Machell, T., saw, or ostestome
Palmer, B. F., artificial leg
Polycarpo, A., Portugal, a case of surgical instruments
Rein, F. C., acoustic instruments for the deaf
Simpson, H., for collection
Simpson, G., anatomical model of the human figure. This figure consists of pieces that may be detached at pleasure, and is calculated to stand the heat of tropical climates
Thier, France, Téterelle
Towne, J., anatomical models in wax
Weiss and Son, for collection

Class XI. — (Jury 11.)

Cotton.

PRIZE MEDAL.

Amoskeag Manufacturing Company, United States, an assortment of drillings, tickings, sheetings, and cotton-flannel
Anderegg, T., Switzerland, cambric muslins of unusually fine yarns
Anderson, D. and J., ginghams
Brook, Jonas, and Brothers, two to nine cord sewing-thread
Christy and Sons, Turkish bath towel
Daudville, A., France, excellence of manufacture in harness window curtains, and piece muslins
De Bast, C., Belgium, grey calicoes
Dubar Delespaul, France, cotton trouserings
Duranton, J. B., France, shirt fronts, loom made, in imitation of needlework
Fehr, J. C., Switzerland, Jacquard muslins
Férouelle and Rolland, France, novelty of design and beauty of manufacture, in coloured and figured muslins
Finlayson, F., and Co., beauty of design and superiority of execution, in fast-coloured sprigged lappets
Gardner and Bazley, fine yarns
Hartmann and Son, France, figured cottons
Horrockses, Miller, and Co., shirtings and long cloths
Houldsworth, T., and Co., fine yarns
Johnson, J., quiltings and toilet covers
Jourdain, X., France, muslin
Lamberts, A. (Christ. Son), Prussia, cotton kalmucks and beavers
Lang, Johan, Austria, ginghams: design suited to French and German taste
Leumann Brothers, Switzerland, specimens of Turkey red
Lisbon Weaving Company, Portugal, cotton blankets and shawls
M'Bride and Co., cotton diaper woven by power
Mallet (of Messrs. Vantroyen and Mallet), France, yarns
Major and Gill, loom-made double coutils and nankeens for corsets
Nair, I., Son, and Co., cheap window curtains by a new arrangement of the Jacquard loom
Martin, W., and Son, furniture dimities
Myerscough, Steele and Co., toilet quilts, and bed covers
Naf, M., Switzerland, toilet quilts and bed-covers
Nef, J. J., Switzerland, spotted muslins
Ourscamp, the Company of (Peigné De-

lacourt, manager), France, bleached madapollams
Owtram, R., and Co., figured and chequered cambrics
Pansa and Hauschild, Saxony, four-thread and other numbers of knitting cottons
Patterson, Jamieson and Co, imitation of Madras handkerchiefs
Raschle and Co., Switzerland, imitation of Madras handkerchiefs; those with blue grounds especially good
Ransauer, Aebly, Switzerland, tartan and book muslin
Symington, H. H., and Co., Harness window curtains
Thümer and Topham, Saxony, cotton table-cloths
Vogel and Carner, Prussia, levantines
Weigle, J. J., Wurtemburg, waistcoatings (with relation to cost)
Willimentic Duck Manufacturing Company, United States, cotton sail-cloth

Class XII. — (Jury 12.)

Woollen and Worsted.

PRIZE MEDAL.

Akroyd, J., and Son, damasks, including also the award for Genappe yarns
Aksenoff, J., Russia, woollen cloths
Albinet, jun., France, blankets
Apperley, J. and D., black cloth
Armitage Brothers, woollen cloths
Astorian Company, articles made of hare fur
Bacot, P. and Sons, France, fancy black and satin doeskins; also, fine piece-dyed black cloths, of a thin make
Barnicot and Hirst, woollen cloths
Beardsell, Isaac and Co., woollen cloths
Beardsell, C., and Co., woollen cloths
Bennett, I. and A., woollen cloths of new materials
Benoist, Malot and Walbraume, France, fine flannels
Bernhard, W., Saxony, woollen cloths
Bertèche, Chesnon, and Co., France, fancy doeskins
Biétry and Son, France, Cashmere cloths
Billiet and Huot, France, yarns
Biolley, F. and Son, Belgium, thin piece-dyed black for exportation
Bottomley, M., and Son, figured goods
Braun Brothers, Prussia, woollen cloths
Brooke, J., and Sons, woollen cloths
Brown, J. and H., and Co., Scotch tweeds, &c.
Brown, W., damask made of wool, silk, and cotton
Bruhm and Nägler, Prussia, cloths of worsted weft and silk warp
Caillet Franqueville, France, merinos
Carr, T. and W., woollen cloths, also beavers
Chatelain and Foron, France, flannels
Chennevière, T., France, woollen cloths
Clarenbach and Son, Prussia, woollen yarns
Clark, J. and T., woollen cloths
Crombie, J., and Co., Scotch tweeds
Croutelle, Nephew, France, yarns
David Brothers and Co., France, merinos and cloths, mixed with organzine and spun silk
David-Labbé and Co., France, merino fabrics (lowness of price).
Davies, R. S., and Sons, fine scarlets
Dauphinot-Perard, France, merinos
Deheselle, A J., Belgium, flannels, swanskins, &c.
Delattre and Son, France, worsted fabrics and merinos
Dicksons and Laings, woollen fabrics
Dubois, G. and Co., Belgium, trowser-cloths
Early, J., and Co., Witney blankets
Ecroyd, W., and Son, Carder and Genappe-yarns
Eyres, W., and Sons, woollen cloths
Fiedler, A. G., Russia, woollen cloths
Firth, E., and Sons, blankets with cotton warp
Forster, F., Prussia, Spanish stripes
Foster, J, and Son, worsted stuff goods, including also the award for alpaca, mohair, and lustre-yarns
Fortin-Boutellier, France, felt-cloths for pianos
Gamble, W., Canada, blankets
Geissler, C. S., Prussia, woollen cloths
Gevers and Schmidt, Prussia, woollen cloths
Gilbert and Stevens, United States, flannels, exhibited by Johnson, Sewell and Co.
Gott and Sons, woollen cloths (for exportation)
Goutchkoff, E. and J., Russia, woollen cloths, worsted and organzine silk warp fabrics, and Cashmere-de-laines
Gray, S., woollen cloths
Grossmann, C. G., Saxony, woollen cloths
Grüner, F. W., Saxony, merinos
Haas, L. F., and Sons, Prussia, woollen cloths
Haas, P., and Sons, Austria, furniture damasks and woollen velvets
Haberland, G.A., Prussia, woollen cloths

Class X c. — (Jury 10 c.)

Surgical.

PRIZE MEDAL.

Arnott, Dr. J., mode of applying cold as a novel therapeutical agent
Auxoux, Dr. L., France, anatomical models. These models are calculated to aid the study of anatomy, human and comparative
Avery, J., illuminating apparatus, for exploring long and narrow canals
Bigg, H., and son, for collection
Burat Brothers, France, herniary bandages
Calamai, Prof., Tuscany, a series of models in wax, representing the anatomy of the torpedo
Caplin, Madame, Corsets
Caplin, J., gymnastic apparatus and orthorochidic instruments
Charrière, J. F., France, for collection
Coxeter, J., for collection
Evans, W., artificial leg
Evans and Co., for collection
Ferguson and Sons, for collection
Gordon, J., anatomical model in ivory
Gowing, Thos. W., veterinary instruments
Grossmith, W. R., artificial eyes
Hutchinson, Dr., spirometer
Junod, T., Switzerland, apparatus for hemospatic
Lüer, A., France, for collection, and the great ingenuity and admirable workmanship of several instruments for operations on the eye
Machell, T., saw, or ostestome
Palmer, B. F., artificial leg
Polycarpo, A., Portugal, a case of surgical instruments
Rein, F. C., acoustic instruments for the deaf
Simpson, H., for collection
Simpson, G., anatomical model of the human figure. This figure consists of pieces that may be detached at pleasure, and is calculated to stand the heat of tropical climates
Thier, France, Téterelle
Towne, J., anatomical models in wax
Weiss and Son, for collection

Class XI. — (Jury 11.)

Cotton.

PRIZE MEDAL.

Amoskeag Manufacturing Company, United States, an assortment of drillings, tickings, sheetings, and cotton-flannel
Anderegg, T., Switzerland, cambric muslins of unusually fine yarns
Anderson, D. and J., ginghams
Brook, Jonas, and Brothers, two to nine cord sewing-thread
Christy and Sons, Turkish bath towel
Daudville, A., France, excellence of manufacture in harness window curtains, and piece muslins
De Bast, C., Belgium, grey calicoes
Dubar Delespaul, France, cotton trouserings
Duranton, J. B., France, shirt fronts, loom made, in imitation of needlework
Fehr, J. C., Switzerland, Jacquard muslins
Férouelle and Rolland, France, novelty of design and beauty of manufacture, in coloured and figured muslins
Finlayson, F., and Co., beauty of design and superiority of execution, in fast-coloured sprigged lappets
Gardner and Bazley, fine yarns
Hartmann and Son, France, figured cottons
Horrockses, Miller, and Co., shirtings and long cloths
Houldsworth, T., and Co., fine yarns
Johnson, J., quiltings and toilet covers
Jourdain, X., France, muslin
Lamberts, A. (Christ. Son), Prussia, cotton kalmucks and beavers
Lang, Johan, Austria, ginghams: design suited to French and German taste
Leumann Brothers, Switzerland, specimens of Turkey red
Lisbon Weaving Company, Portugal, cotton blankets and shawls
M'Bride and Co., cotton diaper woven by power
Mallet (of Messrs. Vantroyen and Mallet), France, yarns
Major and Gill, loom-made double coutils and nankeens for corsets
Nair, I., Son, and Co., cheap window curtains by a new arrangement of the Jacquard loom
Martin, W., and Son, furniture dimities
Myerscough, Steele and Co., toilet quilts, and bed covers
Naf, M., Switzerland, toilet quilts and bed-covers
Nef, J. J., Switzerland, spotted muslins
Ourscamp, the Company of (Peigné De-

lacourt, manager), France, bleached madapollams
Owtram, R., and Co., figured and chequered cambrics
Pansa and Hauschild, Saxony, four-thread and other numbers of knitting cottons
Patterson, Jamieson and Co, imitation of Madras handkerchiefs
Raschle and Co., Switzerland, imitation of Madras handkerchiefs; those with blue grounds especially good
Ransauer, Aebly, Switzerland, tartan and book muslin
Symington, H. H., and Co., Harness window curtains
Thümer and Töpham, Saxony, cotton table-cloths
Vogel and Carner, Prussia, levantines
Weigle, J. J., Wurtemburg, waistcoatings (with relation to cost)
Willimentic Duck Manufacturing Company, United States, cotton sail-cloth

Class XII. — (Jury 12.)

Woollen and Worsted.

PRIZE MEDAL.

Akroyd, J., and Son, damasks, including also the award for Genappe yarns
Aksenoff, J., Russia, woollen cloths
Albinet, jun., France, blankets
Apperley, J. and D, black cloth
Armitage Brothers, woollen cloths
Astorian Company, articles made of hare fur
Bacot, P. and Sons, France, fancy black and satin doeskins; also, fine piece-dyed black cloths, of a thin make
Barnicot and Hirst, woollen cloths
Beardsell, Isaac and Co., woollen cloths
Beardsell, C., and Co., woollen cloths
Bennett, I. and A., woollen cloths of new materials
Benoist, Malot and Walbraume, France, fine flannels
Bernhard, W., Saxony, woollen cloths
Bertèche, Chesnon, and Co., France, fancy doeskins
Biétry and Son, France, Cashmere cloths
Billiet and Huot, France, yarns
Biolley, F. and Son, Belgium, thin piece-dyed black for exportation
Bottomley, M., and Son, figured goods
Braun Brothers, Prussia, woollen cloths
Brooke, J., and Sons, woollen cloths
Brown, J. and H., and Co., Scotch tweeds, &c.
Brown, W., damask made of wool, silk, and cotton
Bruhm and Nägler, Prussia, cloths of worsted weft and silk warp
Caillet Franqueville, France, merinos
Carr, T. and W., woollen cloths, also beavers
Chatelain and Foron, France, flannels
Chennevière, T., France, woollen cloths
Clarenbach and Son, Prussia, woollen yarns
Clark, J. and T., woollen cloths
Crombie, J., and Co., Scotch tweeds
Croutelle, Nephew, France, yarns
David Brothers and Co., France, merinos and cloths, mixed with organzine and spun silk
David-Labbé and Co., France, merino fabrics (lowness of price).
Davies, R. S., and Sons, fine scarlets
Dauphinot-Pérard, France, merinos
Deheselle, A J., Belgium, flannels, swanskins, &c.
Delattre and Son, France, worsted fabrics and merinos
Dicksons and Laings, woollen fabrics
Dubois, G. and Co., Belgium, trowser-cloths
Early, J., and Co., Witney blankets
Ecroyd, W., and Son, Carder and Genappe-yarns
Eyres, W., and Sons, woollen cloths
Fiedler, A. G, Russia, woollen cloths
Firth, E., and Sons, blankets with cotton warp
Forster, F., Prussia, Spanish stripes
Foster, J., and Son, worsted stuff goods, including also the award for alpaca, mohair, and lustre-yarns
Fortin Boutellier, France, felt-cloths for pianos
Gamble, W., Canada, blankets
Geissler, C. S., Prussia, woollen cloths
Gevers and Schmidt, Prussia, woollen cloths
Gilbert and Stevens, United States, flannels, exhibited by Johnson, Sewell and Co.
Gott and Sons, woollen cloths (for exportation)
Goutchkoff, E. and J., Russia, woollen cloths, worsted and organzine silk warp fabrics, and Cashmere-de-laines
Gray, S., woollen cloths
Grossmann, C. G., Saxony, woollen cloths
Grüner, F. W., Saxony, merinos
Haas, L. F., and Sons, Prussia, woollen cloths
Haas, P., and Sons, Austria, furniture damasks and woollen velvets
Haberland, G.A., Prussia, woollen cloths

Hagues, Cook, and Wormald, blankets for various markets, also travelling rugs, including award for Spanish stripes
Hargreave and Nusseys, woollen cloths from new materials
Helme, W., doeskins, cassimeres, &c.
Hendrichs, F., Prussia, woollen cloths
Henry, A. and S., and Co,, woollen cloths
Herrman, W., Saxony, woollen cloths
Hindenlang, sen., France, Cashmere and merino yarns
Hösel, R., and Co., Saxony, damasks
Holdsworth, J., and Co., damask and other furniture cloths
Hooper, C., and Co., fine cloths, also elastic cloths for gloving
Horsfall, J. G., and Co., light cloths
Inglis and Brown, tweeds
Isaeff, P., Russia, woollen cloths
Itzigsohn, M., Prussia, woollen cloths
Juhel, Desmares I., France, woollen cloths
Jowett, T., and Co., fabrics from alpaca weft and silk and cotton warps, also of silk warp and linen weft
Kay, Richardson, and Wroe, chiné goods of worsted, cotton, silk, and linen, with printed warps
Keller, J., Austria, woollen yarns
Kesselkaul, J. H., Prussia, woollen cloths
Knüpfer and Steinhäuser, Prussia, merinos and brocaded satin de chinés
Lachapelle and Levarlet, France, woollen yarns
Lantein and Co., France, barège and woollen yarns
Leach, J., and Sons, flannels
Leipsic Spinning Company, Saxony merino yarns
Lloyd, W., and Co., Welsh flannels
Lockwood and Keighley, woollen cords and velveteens
Lohse, E., Saxony, damask goods made with worsted and cotton, and worsted and silk
Lucas Brothers, France, merino yarns
Lutze Brothers, Prussia, woollen cloths
Marling, S. S., and Co., woollen cloths
Mathieu, Robert, France, merinos
M'Crea, H. C., and Co., damasks
Meissner, F. T., Saxony, woollen cloths for exportation
Milligan, W., and Son, embroidered alpaca goods, under a patented process of the exhibitors
Mollet-Warmé Brothers, France, fabrics of worsted mixed with silk, much used for foreign consumption
Morand and Co., Prussia, draps d'été, or summer cloths twilled like merinos
Mourceau, —, France, stuffs for furniture hangings, screens, table-covers, &c.
Offermann, F. W., Prussia, fancy trouser goods
Palling, W., billiard cloths, and scarlet hunters' or milled cloths
Parnuit, Dautresme, and Co., France, woollen cloths
Patterson, J., Canada, blankets
Paturle-Lupin, Seydoux, Sieber, and Co., France, merinos, draps d'été, mousseline-de laines, barèges, and chalis, including also the award for yarns
Pawson, T., Son, and Martin, woollen cloths
Pease, H. and Co., Coburg cloths, single and double twill, worsted weft and cotton warp, including also the award for yarns
Peill and Co., Prussia, woollen cloths
Pesel and Menuet, France, Cashmere fabrics
Petit-Clément, France, merinos
Pin-Bayard, France, woollen cloths and damask worsted shawls
Pocock and Rawlings, woollen cloths
Pouchea-Potier, France, merinos
Rand, John, and Sons, fabrics of wool, and wool combined with cotton and silk, including the award for yarns
Reid, J., frieze cloths and milled tweeds
Roberts, W., and Co., tweeds
Robinson, T., blankets
Roger Brothers and Co., France, merino yarns
Rogers, G., coburg cloths of worsted and cotton
Salter, S, and Co., woollen cloths
Salt, Titus, alpaca and mohair fabrics, also their yarns; moreens for furniture hangings
Schlumberger, G. and Co., France, damasks for furniture hangings, of worsted and silk
Schmidt, J. G., jun., and Sons, Saxony, folded card-yarns
Schmieger, A., Austria, woollen yarns
Schöl, A., Austria, woollen cloths
Schöller, L. and Sons, Prussia, woollen cloths
Schofield, Brown, Davis, and Halse, flannels
Schürrman and Schröder, Prussia, woollen cloths
Schwann, Kell, and Co, fabrics of various descriptions, and all adapted for foreign markets
Sentis, Son, and Co., France, woollen yarns
Shaw. J. W. and H., woollen cloths
Siegmund, W., fabrics of wool and silk, &c.
Signoret-Rochas, P., France, woollen cloths (economy of production)

Smith, S. and Sons, flannels
Snell, John, beauty of finish in woollen cloth
Solbrig, C. F., Saxony, merino yarns
Spengler, Charles, Saxony, woollen cloths
Stancomb, W. and J., juns., trouser goods
Stowell and Sugden, mohair yarns
Sugden, J., and Brothers, Genappe, mohair, and poplin yarns, including also award for fabrics of English wool combined with cotton
Sykes, D., and Co., woollen cloths
Sykes, J., and Son, woollen cloths
Tchetverikoff, —, Russia, woollen cloths
Thornton, Firth, Ramsden and Co., woollen cloths
Tolson and Sons, trouser goods of, and vestings
Townend Brothers, Genappe, mohair, and poplin yarns
Tremel, A., and Co., fabrics of worsted, alpaca, and mohair, shot with cotton, silk, and linen
Tweedale, J., and Sons, flannel
Vogel, W., Saxony, damasks
Volner, —, Russia, woollen fabrics
Walker, J., and Co., mohair cloths
Walker, J., and Sons, woollen cloths
Weissflog, E. F., Prussia, merinos, and brocaded " Satins de Chiné"
Wilkinson, John, felt cloth for ship's sheathing and other purposes
Wilson, J. J. and W., railway wrappers and Windermere rugs
Winkler and Son, Saxony, Chambard fabrics, merinos, &c.
Wrigley, J. and T. C., and Co., woollen cloths
Xhoffray and Co., Belgium, woollen yarns
York and Sheepshanks, woollen cloths
Zaalberg, J. C., and Son, Netherlands, a fancy blanket
Ziegler and Haussman, Saxony, merinos

Class XIII. — (Jury 13.)

Silk and Velvet.

PRIZE MEDAL.

Alsop, Robins and Co , sewing silks
Andreae, C., Zollverein, velvet ribbons
Balay, Jules, France, ribbons made of silk in the gum
Balleidier, F., France, assortment of vestings and figured velvets and terry
Barth, Massing and Plinchon, France, black silk plush for hats
Barres Brothers, France, their perfection of trams for tulle and organzine, 16, 18, 20, 22, and 26, 28 dernier for satin and plush
Bauman and Streuli, Switzerland, plain and armure silks and Glacé gros-de-Naples
Bellon, Joseph and Co., France, black satins and taffetas
Bertrand, Gayet and Dumontat, France, Chiné and figured silk shawls, scarfs, and cravats
Bischoff, Christopher and John, Switzerland, black taffetas, gros-de Rhin, and some good black satins and ribbons
Bonnet, J. and C., France, black satins and black taffetas
Bonneton, J., France, organzine for plush and satin
Bouvard and Lançon, France, a few specimens of their looms, which exhibit manufacturing talent of a high order
Bravo, Michael Pignerol, Sardinia, organzine for satins
Bridgett, Thomas and Co., sewing silks, purse twist, and sarsnet ribbons
Brisson Brothers, France, black silk plush, principally made by power
Brocklehurst, J. and T., Persians, serges, sarsnets, gros-de Naples, handkerchiefs
Brosse and Co., France, coloured velvets
Brough, J. and J., and Co., sewing silks
Brunet, Lecompte, Guichart and Co., France, Chiné and embroidered silks, gauzes, grenadines, and crêpes for dresses, shawls, collars scarfs, and cravats
Buisson (Widow), sen., France, gauze ribbons
Campbell, Harrison and Lloyd, moiré antique, figured, and brocaded silks
Carquillat (weaver, of Lyons), France, woven portrait of Pope Pius IX., and ditto of the Duc d'Aumale's visit to his workshop; also of the Queen
Carter, Vavaseur, and Rix, figured silks, and moiré antique
Casey and Phillips, plain black radzimere and other plain silks
Chambon, Casimir, Alaix (Gard), France, fine six-thread grenadine, and organzine for satin
Champagne and Rougier, France, assortment of rich figured silks
Chatron and Son, France, organzine, for tulle, for ribbons, and for plush and satin
Chichizola, J., and Co., Sardinia, plain velvets and figured silks
Collard and Coute, France, assortment of ribbons
Cope, Hammerton & Co., figured ribbons

Cornell, Lyell and Webster, ribbons
Couderc, Soucaret, and Sons, France, gaze à bluter, from 10 to 220 threads per inch
Coventry ribbon, an excellent specimen of the skill of the parties concerned in the production of it
Cox, R. S., and Co., an assortment of fancy ribbons
Critchley, Brinsley, and Co., figured silks, handkerchiefs, and cravats
De Bary, T., and Bischoff, Switzerland, figured ribbons
Diergardt, F., Prussia, plain and figured velvets, and velvet ribbons
Donat, André, and Co., France, vestings and silks for cravats, in plain, figured, and broché satin, and grenadine
Donat, J. and F., France, black silk plush
Dumaine, X., France, organzines
Du Cros, T., France, organzines and grenadines
Fontaine, F., France, vesting and garment silks
Freyvogel and Heussler, Switzerland, figured ribbons
Gabain, G., Zollverein, silks in damasks, and brocatelle for furniture
Gindre, L., and Co., France, white and coloured satins
Girard, Nephew and Co., France, black and coloured velvets
Graham and Sons, black moiré satins and velvets
Grout and Co., black crapes, crêpe aérophane, crêpe lisse, &c.
Grosvenor, W., and Co., furniture silks
Guillot, jun., and Co., Sardinia, plain velvets, figured velvets, imitation of white lace on velvet ground
Hadwen and Son, spun silk yarn
Harrop, Taylor and Pearson, an assortment of black and shot plain silks
Heckel, sen., and Co., France, satins in white, black, and colours, of all qualities
Hed, George, Austria, assortment of brocatelles
Herme, Auguste, France, organzine
Hill, James and Co., plain and figured silks
Hochn and Baumann, Switzerland, lustrings
Holdforth and Son, spun silk-yarns in all numbers
Hooper, G., Carroz, and Tabourier, France, plain, figured, and printed silk gauzes; also illusion tulle
Houldsworth, James, and Co., furniture silks
Ibrahim, Aga, Turkey, specimens of figured velvets
Jame, Bianchi and Duseigneur, France, grenadine and organzines
Keith and Co., furniture silks
Kolokolnikoff, Paul, Russia, specimens of gold and silver brocade, chenille, and other textures
Kondrashoff, Russia, a variety of silks in brocade damask, portraits à la Jacquard
Langevin and Co., France, spun silks
Lapeyre, M. N. and O. N. Dolbean, France, damask reps, figured and chiné silk shawls
Larcher, Faure and Co., France, specimens of ribbons
Lemann, J., and Son, France, brocatelle embroidered in gold and silver, also broché gold on chenille and velvet grounds
Le Mare and Sons, black and coloured velvets, satins, moiré and glacé silks
Le Mire and Son, France, figured silks, with their newest styles in lampas, damask, brocatelle, and embroidery
Lyons Chamber of Commerce, France, assortment of fancy silks
Martin, J. B and P., and Casimer, France, black silk plush
Massing Brothers, Hubert and Co., France, a similar assortment of black silk plush
Mathevon and Bouvard, France, specimens of rich silks
Menet, Jean, France, organzine, both white and yellow
Menghius Brothers, Prussia, plain and fancy velvets, and velvet ribbons
Messat, Ant., Austria, figured taffetas, gauze, and crêpe ribbons
Moering, Charles, Austria, figured and chiné ribbons
Molinari, A., Sardinia, plain velvets, and for rich figured velvet for furniture
Montessuy and Chomer, France, crêpes, crêpe lisse, crepe aérophane, and gauze of many kinds
Mustapha, Aga Hadgi, Turkey, crapes
Naef and Schwarzenbach, Switzerland, lustrings and gros-de-Rhin
Orduna, V., Spain, damasks, velvets, and other silks
Poidebard, N., Tuscany, organzines and trams
Poliakoff and Zamiatin, Russia, similar silks
Ponson, France, plain silks
Potton, Rambaud and Co., assortment of rich figured silks, and a woven picture of her Majesty, Prince Albert, and Prince of Wales
Regner, Cousin, France, velvets, gauzes, satins, and taffeta; handkerchiefs, collars, shawls, and scarfs, in excellent taste

Reichardt, F., Austria, plain, figured, and moiré silks, for black and coloured satin

Repiquet and Silvent, France, fancy vests in velvet plush

Richter Linder, Switzerland, plain satin ribbons

Rignon, F., and Co., Prussia, organzine for satins

Robinson, J. W. and Co., a variety of satins, serges, velvets, plush, &c.

Robinson, J. R. and Co., velvet vestings, black armozines, silks and satins, for cravats

Robinson, J. and T., black and coloured velvets

Ryffel and Co., Switzerland, half-Florence, Florence, and marceline

Sanderson and Reid, figured vestings

Saposhinkoff, Prussia, specimens of gold and silver brocade, and other textures

Sarrazin and Co., Switzerland, specimens of figured ribbons

Sarrazin, J. T., Switzerland, specimens of figured ribbons

Scheilber, E. and Co., Austria, organzine, 28 derniers for satin, and for their grenadine 48 derniers in four threads

Scheibler and Co., Austria, plain and fancy velvets and velvet ribbons

Spitalfields School of Design, figured and brocaded silks

Schopper, M. A., Austria, brocatelles

Schwarzenbach, F. J., Switzerland, gras-de-Rhin and poult-de-soie

Seamer, Thomas, moiré, antique, and plain velvets

Simons, J., Heirs of, Zollverein, a variety of velvets, figured silks, cravats, handkerchiefs, scarfs, vestings, gauzes, &c.

Solei, Bd., Sardinia, rich figured silks, armures, and a royale ground for furniture, and some gauze diaphane for the same purpose

Soller and Co., Switzerland, specimens of figured ribbons

Soubeyran, Louis, France, organzine

Stapfer, J., Switzerland, plain, coloured, striped, and checked gros-de-Naples

Staub Brothers, Switzerland, figured silks

Sulger and Stuckelberger, Switzerland, figured ribbons

Tellard, C. M., France, plain glacé silks, armures, moiré antiques, and rep silks

Vatin, F., Son and Co., France, an assortment of fancy silk gauzes, dresses, and shawls

Verza Brothers, Austria, trams

Vigant Brothers, France, chiné ribbons and some figured ribbons

Von Bruck, H. and Sons, Prussia, an assortment of plain velvets and velvet ribbons

Walters and Sons, black plush for hats

Wardle H and T., similar productions

Winkworth and Proctors, shot and glacé gros, and figured & chiné silks

Zeller, Felix and Son, Switzerland, gros-de-Naples & satinet, both gaspé

Zurrer, Jacob, Switzerland, Persians and sarsnets

Class XIV.—(Jury 14.)

Manufactures from Flax and Hemp.

THE PRIZE MEDAL.

Alexandrovsk Manufactory, The Imperial, Russia, canvas

Andrews, Michael, damask table-cloths and napkins

Berthelot and Bonte, Belgium, hand-spun flax yarn

Beyer, Widow and Co., Saxony, damask cloths and napkins

Birrell, David, damask table-cloths and napkins

Bolenius and Nolte, Prussia, fine linens

Boniface and Son, France, cambrics

Clibborn, Hill and Co., diapers

Cooreman, A. J., Belgium, lace thread made from hand-spun yarn

Coulson, J. and Co., damask table-cloths and napkins

Cox Brothers, low-priced striped bedding and hessians

Cumont-Declercq, Belgium, linen threads, colour

Dautremer and Co., France, flax yarns

Decock-Wattrelot and Baudouin, Belgium, fine linens

Eickholt, Anton., Heirs of, Prussia, designs of damasks and colours of linen

Ferrol, The Royal Manufactory of Isabella II. at, Spain, canvas

Finlayson, Bousfield and Co., strength, taste, and neatness in threads, coarse and middle sizes

Fraser, Douglas, canvas made by steam-power looms

Grassot and Co., France, damasks

Haro, E. F., France, canvas for historical painting

Henning, John, damask table-cloths, and cambrics

Hives and Atkinson, Class IV., mill and spun yarns

Houldsworth, W. B. and Co., satin-finish linen threads

Kums, E., Belgium, assortment of canvas, Russia sheetings, &c.

Kirk, W. and Son, brown linens of low description and price Hollands
Kramsta and Sons, Prussia, bleached plattitas for export
Laing, J. and A., ducks, imitation Russia sheeting
Lawson, Alexander, assortment of low-priced dowlas, hucks, sheeting, window-blinds, &c.
McCay, Thomas, fronting linen, made of mill-spun warp & hand-spun weft
McMurray, T. and Co., fine linens
Malo-Dickson and Co., France, canvas
Marshall and Co., Class IV., preparation of "China grass"
Merlie-Lefevre & Co., France, cordage
Mestivier & Hamoir, France, cambrics
Milvain and Harford, canvas made with bands
Moerman-Vanlaere, J., Belgium, assortment of canvas, of tow, flax, and hemp, also railway waggon coverings
Parmentier, P., Belgium, fine linen of mill-spun yarn, also handkerchiefs
Peldrian Franz's Heirs, Austria, fine linen and hand-spun yarn
Richardson, J. N., Sons, and Owden, light shirting linens for export
Sadler, Fenton and Co., heavy shirting linens for export, bleached
Scrive Brothers, France, damask, including their yarn and power-loom goods
Smieton, J., and Son, dowlas, cregudlas, creas, &c., of light and low-priced quality for export
Wäntig, C. D., and Sons, Saxony, damask table-cloths and napkins
Warnes, —, Class IV., growth and preparation of flax
Westermann, A. H., and Co., Prussia, damask and other linens
Wilford, J., and Sons, plain and fancy drills, and China grass sheeting

NOTE.—The Jury award the sum of 10*l.* each to the following subjects:—
Harvey, Ann, Belfast, hand-spun flax-yarn
Heepen Spinning School (for a little girl ten years of age), Prussia, spun flax-yarn
M'Gill, Jane, Belfast, hand-spun flax-yarn

CLASS XV.—(JURY 15.)

Mixed Fabrics, including Shawls, but exclusive of Worsted Goods, Class XII.

COUNCIL MEDAL.

Deneirouse, E., Boise-Glavy, and Co., France, the discovery of a new and important process in the production of elaborate designs

PRIZE MEDAL.

Atkinson, R., and Co., collection of poplins
Berger, Joseph and Son, Austria, a collection of shawls, and a square of Cashmere wool worked with gold
Blakeley, Edward Theobald, a collection of shawls, and also barège scarfs of a novel taste
Bliss, William, a variety of shawls
Boas Brothers, France, shawls of Indian wool-yarn
Bolingbroke, C. and F., plain, striped, and watered poplins
Brown and Forster, vestings, of cotton warp and weft wool; likewise stuffs of other descriptions; also waistcoatings of plush vigonia
Catteaux Brothers, Belgium, pantaloon stuffs of cotton, wool, and linen with cotton
Catteaux Gauquié, —, Belgium, cotton, woollen, and linen stuffs
Chocqueel, Felix, France, cutting and printing of light shawls
Cocu, A., France, vestings
Cormal, di Diego, Austria, vestings, some of them embroidered on a principle
Cross, William, tartans made of fine Indian wool
Damiron and Co., France, collection of fine wool shawls
Day, John, and Son, pantaloon stuff, warp of cotton with weft of carded wool, crossed on one side only, with character of cassinet
Duché, sen., and Co., France, fine shawls of Indian wool
Eehinger Brothers, Austria, vestings
Fassin, jun., France, waistcoatings, &c.
Forbes and Hutchison, shawls
Funke, R. M., Prussia, mixed cloths and dresses
Gaussen, jun., Fargeton and Co., France a variety of shawls of Indian wool
Glen and M'Indoe, excellence and economy in printing shawls
Grafe and Neviandt, Prussia, vestings of cotton warp
Graham, John, embroidered crape shawls, from China
Grillet, sen., and Co., France, two long shawls of elaborate design
Hebert, F., and Son, France, shawls woven from India wool
Heymann, C., & Co., Prussia, vestings
Kauffmann, H., Prussia, woollen velvets of plushes of goats' hair, of various descriptions, printed, and chiné
Keith, Schoobridge, and Co., large collection of printed shawls

Kerr, Robert (Kerr, Scott and Co.), fine specimens of every description of shawls, and a variety of tartans
Laporta, H. F., Austria, embroideries, on several textures
Lawrence, Stone & Co., United States, tartans made from native wool
Learoyd, J. E., cassinetts of superior quality
Learoyd, William, cassinetts of novel and excellent quality
Lees, R. and G., specimens of tartan plaids
Lefébure-Ducatteau Brothers, France, vestings
Lemaire, Descamps and Plissart, Belgium, specimens of pantaloon stuff
Liénart-Chaffaux, Madame, Belgium, specimens of pantaloon stuff
Lion Brothers and Co., France, collection of shawls
Marx and Weigert, Prussia, Utrecht velvet and shawls
Merlin, A. and V., a long white embroidered shawl
Miller & Hall, excellent cashmerettes
Morgenroth and Krugmann, Prussia, woollen velvet, plain and figured
Murley, W. J. C., vestings
Paton, J. and D., collection of tartans
Patriau, C., France, vestings of Cashmere
Pferdmenges and Kleinjung, Prussia, vestings
Pim Brothers & Co., collection of poplins
Robertson, J. and T., shawls
Rockstroh, H., Austria, specimens of waistcoatings
Sanderson, R. and A., and Co., collection of tartans
Stieff and Harrass, Prussia, variety of vestings
Swaisland, C., printed shawls of great excellence
Taylor, J., and Son, vestings
Tee and Son, Class XIV., variety of fabrics
Thierry-Meig, France, collection of shawls
Towler, Camplin and Co., collection of shawls, and first-class printed goods
Van der Beeck, Prussia, fancy tartans
Walmesley, H., Class XI., poplins
Whitehill, M., and Co., merino shawls
Zeisel, J., & J. & C. Blümel, Austria, collection of shawls.

Class XVI. — (Jury 16.)

Leather, including Saddlery and Harness, Skins, Fur, Feathers, and Hair.

PRIZE MEDAL.

Adcock and Co., a collection of feathers for ornamental purposes
Baker, B., United States, light harness of superior workmanship
Barrande, J. P., France, an assortment of morocco and kid leather of varied colours
Bayvet Brothers and Co., France, an assortment of morocco, roan, and calf leather
Berthault, France, an assortment of parchment and vellum
Bevingtons and Morris, a collection of furs and skins, and for an assortment of sheep-skin rugs
Blackwell, S. and R., phaëton harness
Blythe, R., a lady's saddle, and a hunting ditto
Bossard, J., curried calf leather of superior quality
Brace, H., two cases of bits, stirrups, and spurs
Brown & Son, specimen of saddle-trees
Caistor, A. B., hussar and hunting saddles, with pair of hunting pads
Clarke, R., and Sons, a collection of manufactured furs
Clark, C. and J., sheep and lamb-skin rugs
Cooper, M., racing saddle, and a case of saddlery
Corry, J. and J., Italian lamb skins, for gloves
Courtois, E., France, black & coloured varnished calf and hides
Courtépée Duchesnay, France, boot fronts from the calf-skins of Paris
Cozens and Greatrex, tanned and curried leather
Cox, W. H., and Co., two foreign butts, very well tanned
Crawford, H. M., United States, calf-skins tanned in oak bark
Cuff, R., saddle (riding), bridle, and harness
Deaddé, J., France, a large assortment of calf and cow-hides
Deed, J. S., Angora goat and English sheep-skin rugs; assortment of morocco leather. (And honourably mentioned.)
Delacour, H. P., France, horse-hair and "vegetable silk" damask
Dixon and Whiting, an assortment of varnished & enamelled hides & splits
Dörr and Reinhardt, Hesse, Grand Duchy of, an assortment of varnished calf leather
Drake, R., three very beautiful muffs

Draper, —, a remarkable, heavy, and well-tanned English hide
Duport, V., France, three split hides of twice the usual length
Dezaux-Lacour, France, curried calf-skins
Earnshaw, H., a case of harness
Eggers, F., Russia, a fur carpet
Emmerich and Goerger, France, an assortment of coloured and black morocco
Fieux and Co., France, a manufactured sole and harness leather
Forrer, A., Class XXIII., ornaments worked in hair and gold
Gauthier, J., France, black and coloured varnished leather
Geyer, J., Austria, a national cloak made from lamb-skins
Guillot, J. A., France, boot fronts of various kinds
Haussens-Hap, B., Belgium, horse hair, and also fibre stuffing for furniture
Heintze and Freudenberg, Prussia, black varnished calf leather
Hemsworth and Linley, boot fronts and cordovan
Hepburn, John and Thomas, an English crop butt
Herrenschmidt, G. F., France, boot fronts and curried calf
Heyl, C., Grand Duchy of Hesse, varnished calf leather
Hickey and Tull, United States, two portmanteaus
Houette, A., & Co., France, an assortment of black and coloured varnished leather
Hudson's Bay Company, a collection of fur skins
Jetu, C. A., Canada, curried porpoise leather, and samples of leather from the skin of the whale
Jorez, junior, Belgium, white varnished hide
Kane, G., portmanteaus and camp furniture
Keilich, Henry, models of a miniature tigress and cubs
König, L., Prussia, camaille of superior workmanship
Landron Brothers, France, well-tanned sole leather
Lacey & Phillips, United States, a case of harness
Ladoubée-Le Jeune, C., Belgium, saddlery and harness
Lambert and Son, waxed calf-skins, boot fronts, and cordovan
Langdon, W., jun., a light phaëton harness
Last, S., railway portmanteau
Laycock & Sons, horse-hair damask, &c.
Lemonier and Co., France, ornamental hair work
Lever, J. and J., specimens of vellum and parchment for bookbinding, &c.
Lolagnier, —, France, specimens of leather
Mayer-Michel and Denninger, Grand Duchy of Hesse, japanned and varnished hides, and calf leather, and for morocco, roans, and skivers
Mercier, J. J., Switzerland, curried calf leather
Merklinghaus & Wex, Prussia, dressed hides, manufactory for saddlery and harness
Meyer, S. & M., manufactured articles made from the skins of the rabbit
Middlemore, W., a lady's embroidered saddle, & ditto with elastic seat, also mounting-rein for unbroken horses
Morris, R., Canada, a set of double sleigh harness
Nova Scotia, Central Committee of, Nova Scotia, a choice collection of skins
Nys and Co., France, black varnished calf leather
Oastler and Palmer, a large assortment of enamelled and varnished leather, and crop butt
Passmore, W., a set of single-horse harness
Peltereau, August, France, sole leather
Peltereau, F., jun., France, sole leather
Pollock, J., a very perfect set of Scotch harness
Prax and Lambin, France, a varied collection of saddlery and harness
Prin, A., jun., France, russet and black curried calf leather
Pullman, R. W. and J., chamois leather of every description
Russian Imperial Cabinet of Petersburg, Russia, a pelisse lining, made from the necks of the silver fox, &c.
Skvorsoff, M., Russia, curried calf leather, and a few calf-skins curried, with the hair attached
Smith, G., and Sons, an assortment of furs, made from Russian sable, &c.
Stockill, W., specimens of boot fronts
Swaine and Adeney, a large assortment of whips and canes
Suser, H., France, a good assortment of curried calf leather and boot fronts, and boots and shoes, for exportation
Turkey, his Majesty the Sultan of, Turkey, a collection of skins
Texier, jun., France, specimens of buck, doe, and fawn leather
Ventujol and Chassang, France, boot fronts, manufactured from Bourdeaux calf-skins
Warming, E., Denmark, a fur carpet
Webb, E., coloured hair cloth, and cloth composed of silk and hair, and for horse-hair carpets

Weinknecht, T., Belgium, two carpets made of fox-skins and other furs
White, J. C , silver-mounted harness, with improved registered tug
Wisdom, Russell, and Whitman, United States, specimens of curled hair for furniture
Wilson, Walker, & Co., an assortment of coloured sheep, morocco, & calf leather
Zeitz, J. F., Prussia, a coat-lining, made from mink tails, &c.

Class XVII. — (Jury 17.)

Paper and Stationery, Printing and Bookbinding.

COUNCIL MEDAL.

Vienna, Imperial Court and Printing Office of, Austria, novelty of invention, and the number of new combinations in the art of typography

PRIZE MEDAL.

Angrand, France, ornamental, coloured, and fancy papers
Atkinson, William, bookbinders' cloth
Barritt & Co., for general bookbinding
Barère, B., France, engravings by Colla's tracing machine
Besley, R , and Co., types
Blanchet Brothers, and Kleber, France, white and coloured papers
Bone and Son, cloth bookbinding
Brockhaus, F. A., Saxony, for his collection of 356 volumes, the whole printed at his own establishment in the year 1850
Bradbury and Evans, various specimens of printing
Callaux, Belislenoriel de Tinan and Co., France, various specimens of paper
Caslon and Co., variety of types
Chirio and Mina, Sardinia, printing, and printing materials and woodcuts
Clarke, J., various specimens of bookbinding and tree-marbling on calf leather
Claye, J., France, woodcut and other surface printing
Cross, G., new mode of fastening the leaves of scrap-books, without guards
Cussons and Co., bookbinders' cloth
Dewdney, J., writing paper, &c.
Derriez, M., France, music types, founts, &c.
Decker, R. L., Prussia, printing and types
Drewsen and Sons, Denmark, writing paper
Desrosiers, A., France, printing
Doumerc, E., France, printing & paper
Dowling, H., Van Diemen's Land, Tasmanian printing
Dupont, P., France, printing. and facsimiles
Duzonglau, Messrs., Turkey, writing papers
East India Company, the Hon., India, collection of India papers
Ebart Brothers, Prussia, paper, glazing boards, and cartonpierre for roofing
Egyptian Government, Egypt, a collection of 165 volumes of books printed in the Arabic, Persian, and Turkish languages; likewise for a catalogue of all the books published in Egypt
Evans, J. S., specimens of binding in white vellum
Faber, A. W., Bavaria, black-lead pencils
Fisher, J. H., a new mode of printing from copper-plate in two colours at once, with a peculiar sort of ink, suitable for bank notes and cheques
Figgins, V. and J., types
Fischer, C. F. A., Saxony, an assortment of paper; also a specimen of millboard
Gaymard and Géroult, France, a specimen of ledger-binding
Gilbert and Co., France, pencils
Godin, F. L., and Son, Belgium, a great variety of printing, writing and drawing papers
Habenicht, A., Austria, bookbinding, porte-monnaies, and other leather goods
Hardtmuth, L. and C., Austria, pencils
Hanicq, P. J., Belgium, a collection of printed books. The liturgies in red and black are especially worthy of notice
Haase's, G., Sons, Austria, for general excellence of their types, & printing
Hayday, James, bookbinding, exhibited by Messrs. Cundall and Addey
Herrick, J. K., United States, superior ruling of account-books
Honig, B. C. and F., Netherlands, specimens of parchment and double-elephant writing paper
Howe, S. G., United States, a system of character, slightly angular in form, without capitals, for the blind
Höch and Sons, Prussia, a variety of white and coloured writing and tissue papers
Hyde and Co., sealing wax adapted for hot countries
Joynson, W., writing paper
Lamb, J., manufacture of pottery tissues
Laboulaye, C., and Co., France, printing types
Legrand, Marcellin, France, specimens of type founding

Draper, —, a remarkable, heavy, and well-tanned English hide
Duport, V., France, three split hides of twice the usual length
Dezaux-Lacour, France, curried calf-skins
Earnshaw, H., a case of harness
Eggers, F., Russia, a fur carpet
Emmerich and Goerger, France, an assortment of coloured and black morocco
Fieux and Co., France, a manufactured sole and harness leather
Forrer, A., Class XXIII., ornaments worked in hair and gold
Gauthier, J., France, black and coloured varnished leather
Geyer, J., Austria, a national cloak made from lamb-skins
Guillot, J. A., France, boot fronts of various kinds
Haussens-Hap, B., Belgium, horse hair, and also fibre stuffing for furniture
Heintze and Freudenberg, Prussia black varnished calf leather
Hemsworth and Linley, boot fronts and cordovan
Hepburn, John and Thomas, an English crop butt
Herrenschmidt, G. F., France, boot fronts and curried calf
Heyl, C., Grand Duchy of Hesse, varnished calf leather
Hickey and Tull, United States, two portmanteaus
Houette, A., & Co., France, an assortment of black and coloured varnished leather
Hudson's Bay Company, a collection of fur skins
Jetu, C. A., Canada, curried porpoise leather, and samples of leather from the skin of the whale
Jorez, junior, Belgium, white varnished hide
Kane, G., portmanteaus and camp furniture
Kellich, Henry, models of a miniature tigress and cubs
König, L., Prussia, camaille of superior workmanship
Landron Brothers, France, well-tanned sole leather
Lacey & Phillips, United States, a case of harness
Ladoubée-Le Jeune, C., Belgium, saddlery and harness
Lambert and Son, waxed calf-skins, boot fronts, and cordovan
Langdon, W., jun., a light phaëton harness
Last, S., railway portmanteau
Laycock & Sons, horse-hair damask, &c.
Lemonier and Co., France, ornamental hair work
Lever, J. and J., specimens of vellum and parchment for bookbinding, &c.
Lolagnier, —, France, specimens of leather
Mayer-Michel and Denninger, Grand Duchy of Hesse, japanned and varnished hides, and calf leather, and for morocco, roans, and skivers
Mercier, J. J., Switzerland, curried calf leather
Merklinghaus & Wex, Prussia, dressed hides, manufactory for saddlery and harness
Meyer, S. & M., manufactured articles made from the skins of the rabbit
Middlemore, W., a lady's embroidered saddle, & ditto with elastic seat, also mounting-rein for unbroken horses
Morris, R., Canada, a set of double sleigh harness
Nova Scotia, Central Committee of, Nova Scotia, a choice collection of skins
Nys and Co., France, black varnished calf leather
Oastler and Palmer, a large assortment of enamelled and varnished leather, and crop butt
Passmore, W., a set of single-horse harness
Peltereau, August, France, sole leather
Peltereau, F., jun., France, sole leather
Pollock, J., a very perfect set of Scotch harness
Prax and Lambin, France, a varied collection of saddlery and harness
Prin, A., jun., France, russet and black curried calf leather
Pullman, R. W. and J., chamois leather of every description
Russian Imperial Cabinet of Petersburg, Russia, a pelisse lining, made from the necks of the silver fox, &c.
Skvorsoff, M., Russia, curried calf leather, and a few calf-skins curried, with the hair attached
Smith, G., and Sons, an assortment of furs, made from Russian sable, &c.
Stockill, W., specimens of boot fronts
Swaine and Adeney, a large assortment of whips and canes
Suser, H., France, a good assortment of curried calf leather and boot fronts, and boots and shoes, for exportation
Turkey, his Majesty the Sultan of, Turkey, a collection of skins
Texier, jun., France, specimens of buck, doe, and fawn leather
Ventujol and Chassang, France, boot fronts, manufactured from Bourdeaux calf-skins
Warming, E., Denmark, a fur carpet
Webb, E., coloured hair cloth, and cloth composed of silk and hair, and for horse-hair carpets

Weinknecht, T., Belgium, two carpets made of fox-skins and other furs
White, J. C, silver-mounted harness, with improved registered tug
Wisdom, Russell, and Whitman, United States, specimens of curled hair for furniture
Wilson, Walker, & Co., an assortment of coloured sheep, morocco, & calf leather
Zeitz, J. F., Prussia, a coat-lining, made from mink tails, &c.

Class XVII. — (Jury 17.)

Paper and Stationery, Printing and Bookbinding.

COUNCIL MEDAL.

Vienna, Imperial Court and Printing Office of, Austria, novelty of invention, and the number of new combinations in the art of typography

PRIZE MEDAL.

Angrand, France, ornamental, coloured, and fancy papers
Atkinson, William, bookbinders' cloth
Barritt & Co., for general bookbinding
Barère, B., France, engravings by Colla's tracing machine
Besley, R., and Co., types
Blanchet Brothers, and Kleber, France, white and coloured papers
Bone and Son, cloth bookbinding
Brockhaus, F. A., Saxony, for his collection of 356 volumes, the whole printed at his own establishment in the year 1850
Bradbury and Evans, various specimens of printing
Callaux, Belislenoriel de Tinan and Co., France, various specimens of paper
Caslon and Co., variety of types
Chirio and Mina, Sardinia, printing, and printing materials and woodcuts
Clarke, J., various specimens of bookbinding and tree-marbling on calf leather
Claye, J., France, woodcut and other surface printing
Cross, G., new mode of fastening the leaves of scrap-books, without guards
Cussons and Co., bookbinders' cloth
Dewdney, J., writing paper, &c.
Derriez, M., France, music types, founts, &c.
Decker, R. L., Prussia, printing and types
Drewsen and Sons, Denmark, writing paper
Desrosiers, A., France, printing
Doumerc, E., France, printing & paper
Dowling, H., Van Diemen's Land, Tasmanian printing
Dupont, P., France, printing. and facsimiles
Duzonglau, Messrs., Turkey, writing papers
East India Company, the Hon., India, collection of India papers
Ebart Brothers, Prussia, paper, glazing boards, and cartonpierre for roofing
Egyptian Government, Egypt, a collection of 165 volumes of books printed in the Arabic, Persian, and Turkish languages; likewise for a catalogue of all the books published in Egypt
Evans, J. S., specimens of binding in white vellum
Faber, A. W., Bavaria, black-lead pencils
Fisher, J. H., a new mode of printing from copper-plate in two colours at once, with a peculiar sort of ink, suitable for bank notes and cheques
Figgins, V. and J., types
Fischer, C. F. A., Saxony, an assortment of paper; also a specimen of millboard
Gaymard and Géroult, France, a specimen of ledger-binding
Gilbert and Co., France, pencils
Godin, F. L., and Son, Belgium, a great variety of printing, writing and drawing papers
Habenicht, A., Austria, bookbinding, porte-monnaies, and other leather goods
Hardtmuth, L. and C., Austria, pencils
Hanicq, P. J., Belgium, a collection of printed books. The liturgies in red and black are especially worthy of notice
Haase's, G., Sons, Austria, for general excellence of their types, & printing
Hayday, James, bookbinding, exhibited by Messrs. Cundall and Addey
Herrick, J. K., United States, superior ruling of account-books
Honig, B. C. and F., Netherlands, specimens of parchment and double-elephant writing paper
Howe, S. G., United States, a system of character, slightly angular in form, without capitals, for the blind
Höch and Sons, Prussia, a variety of white and coloured writing and tissue papers
Hyde and Co., sealing wax adapted for hot countries
Joynson, W., writing paper
Lamb, J., manufacture of pottery tissues
Laboulaye, C., and Co., France, printing types
Legrand, Marcellin, France, specimens of type founding

Lacroix Brothers, France, writing paper
Leighton, J. and J., bookbinding in various stages, and for the restoration of fac-similes of missing pages to valuable works
Lewis, Mrs. C., bookbinding
Lortic, P. M., France, bookbinding
Mame and Co., France, printing and bookbinding
Mauban and Vincent, Journet, France, printing paper
Mayer, Madame, widow, T., France, fancy ornaments for confectioners
Miliani, P., Rome, hand-made plate and writing papers
Mönch and Co., Grand Duchy of Hesse, porte-monnaies, pocket-books, and dressing-cases
Montgolfier, —, France, paper, and imitation parchment, adapted for many useful purposes
National Printing Office, France, variety of Oriental and other types, and for the beauty of execution of their specimen book, in which great taste is displayed; also for three Oriental volumes, with borders round every page in gold and colours. The ultramarine blue, printed as an ink direct from the type, is pure and bright
Niédrée, J. E., France, specimens of bookbinding
Odent, Sons, and Co., France, variety of papers; also for their paper called animal parchment
Palsgrave, J. T., Canada, printing types
Plon Brothers, France, variety of woodcuts and other printing
Rauch Brothers, Wurtemburg, variety of writing papers
Remnant, Edmonds and Remnant, a novel application of materials in bookbinding
Rivière, R., bookbinding
Rübeland, ducal foundry, inspection at, Prussia, specimens of stereotype in iron, and the Bible printed therefrom
Saunders, T. H., a novel style of ornamental water-mark on paper, the water-mark giving gradation of shaded. It was invented by Mr. Oldham, of the Bank of England, under whose instructions Mr. Saunders applied it in the manufacture of paper
Schaeuffelen, G., Wurtemburg, plate, printing, writing, and tissue papers, the mark put on dry, by a peculiar process, after the paper is made
Schloss, widow, and Brother, France, a large collection of portfolios, porte-monnaies, porte-cigars, and other leather articles
Schreiber, J. C. G., Prussia, enamelled cardboards and paper, &c.
Smith and Meynier, Austria, specimens of writing paper
Sinclair, Duncan, and Son, specimens of printing types
Sœhnée Brothers, France, superior bookbinders' varnish
Spicer Brothers, a collection of papers, showing the present state of the paper manufacture in England
Stephenson, Blake, and Co., types
Thomas and Sons, account books, for excellence of paper, ruling, and binding
Vargoninu & Brothers, Russia, writing paper. There is a great improvement within a few years, in the make and finish of Russian papers
Venables, Chas. J., plate, lithographic, and other printing papers
Venables, Wilson, and Tyler, an assortment of paper from the principal manufacturers of the United Kingdom, and the cheapness of their own printing paper
Venables, Geo., wrapping papers, more particularly that which is used for paper bags
Vieweg and Son, Prussia, variety of publications
Waterston, George, sealing-wax
Westleys and Co., bookbinding, &c.
Westley, J., bookbinding
Williams, J., account books
Wright, J., bookbinding

Class XVIII. — (Jury 18.)

Woven, Spun, Felted, and Laid Fabrics, when shown as Specimens of Printing or Dyeing.

PRIZE MEDAL.

Armitage, G., and Co., Classes XII. and XV., for the dyes of Orleans and Cobourg, cloths of cotton and wool
Bergmann & Co., Prussia, dyed Berlin woollen yarns
Bernoville, Larsonnier, and Chenest, France, fancy fabrics printed in steam colours
Black, James, and Co., printed muslins, jaconets, and fancy fabrics
Blech, Steinbach, and Mantz, France, printed mousseline-de-laines (all wool), calicoes and jaconets, in madder colours
Bockmühl Brothers, Schlieper, and Hecker, Prussia, printed calicoes

Bossi, J., Austria, fancy fabrics, printed in steam colours
Chocqueel, L., France, fancy fabrics, printed in steam colours, for dresses and shawls
Dalgleish, Falconer, and Co., machine-printed calicoes
Delamorimère, Gonin and Michelet, France, fancy fabrics, printed in steam colours, for dresses
Dollfus, Mieg, and Co., France, printed muslins and jaconets; also mousseline-de-laines (all wool)
Evans, D., and Co., printed silk handkerchiefs and table-covers
Francillon, France, for dye of merinos, exhibited by Paturle-Lupin and Co.
Féau, Béchard, V. A., France, skein-dyed woollen yarns for shawls
Godefroy, L., France, fancy fabrics, printed in steam colours, for dresses
Gros Odier, Roman, and Co., France, printed muslins and jaconets; also mousseline-de-laines (all wool)
Guinon, A. P., France, skein-dyed silk, bleaching silk, and the application of picraque acid
Hartmann and Sons, France, fabrics printed in madder colours
Howe, J., and Co., Class IV., skein-dyed silk
Hoyle, T., and Son, machine-printed calicoes
Inglis and Wakefield, machine-printed mousseline-de-laine, and barèges
Japuis, J. B., and Son, France, printed furniture, cotton and chintz
Koechlin Brothers, France, printed mousseline-de laine (all wool), and calicoes
Leitenberger, F., Austria, printed calicoes
Le Lievre, H., skein-dyed black silk
Littler, Mary Ann, Classes XII. and XV., printed silk handkerchiefs
Partridge, N., Classes XII. and XV., for the dye of broad cloths of different colours on each side
Ripley and Sons, Classes XII. and XV., for the dye of Orleans and Cobourg cloths, mixed of cotton and wool
Sale, J. N., printed cotton shirtings
Schlumberger, jun., and Co., France, cylinder-printed calicoes and jaconets
Schwabe and Co., printed calicoes in madder and garancine
Schwartz & Huguenin, France, printed cotton chintz, colours for furniture
Simpson and Young, mousseline-de-laine, cotton warps, printed by cylinder in six and seven colours; also calicoes printed in steam colours
Steiner, C., France, Turkey-red, plain dye and printed
Steiner, T., and Co., Turkey-red, plain dye and printed
Thomson Brothers and Sons, printed mousseline-de-laines, cotton warps
Vaucher, Du Pasquier, and Co., Switzerland, calicoes and jaconets, printed by cylinder
Vessière, A., France, merinos
Wegner, J. R., Switzerland, skein-dyed silk
Welsh, Margetson, and Co., printed silk handkerchiefs
Welch, Thomas, printed table-covers
Ziegler and Co., Switzerland, plain Turkey-red dye

CLASS XIX.—(JURY 19.)

Tapestry, including Carpets and Floor-cloths, Lace and Embroidery, Fancy and Industrial Works.

COUNCIL MEDAL.

Ball, Dunnicliffe and Co., velvet and Simla lace, being new patented fabric suitable for shawls, dresses, and for various ornamental and useful purposes, and of great commercial importance, also for imitation. Valenciennes lace, black and white point tulle, of great merit
Gobelin tapestry, government manufactory of, France, for originality and beauty of design of the different specimens exhibited for furniture, and the extraordinary excellence of execution of most of the productions exhibited

PRIZE MEDAL.

Albro and Hoyt, floor-cloths
Altherr, J.C., Switzerland, muslin curtains
Aubry Brothers, France, laces
Ayers, W., wide thread lace
Bach, G. F., and Son, Saxony, fancy gimps and silk fringes
Bänziger, J., Switzerland, embroidered double-flounce dress of novelty
Beck & Sons, Belgium, broad and narrow Valenciennes laces of good fabric
Bennoch, Twentyman and Rigg, gimps, fringes, and cameo braids
Benkowits, Marie, Austria, embroidered crape on white silk
Berr and Co., France, robe, shawl, scarf, veil, berthe, cape, &c.
Brie, J., and Co., Class XX., embroidered shirt-fronts
Brinton and Sons, carpet, velvet pile, and Axminster rugs
Brown, S. R. and T., book-robe, short

cambric handkerchiefs, stomacher, and collars
Browne, Sharpe and Co., embroidered muslin robe
Burchardt and Sons, Prussia, printed moleskin table-covers, floor-cloths and painted window blinds
Burch, J., & Co., specimens of printed velvet pile and Brussels carpets
Burgh, R., specimens of gimps, tassels, and ornaments
Clarke, Esther, Honiton lace flounce, design and quality unequalled in its class
Castel, E., France, Aubusson carpet
Crace, J. G., Class XXVI., specimens of Brussels and velvet pile carpets
Cronier, —, France, varnished and printed table-covers, &c.
Crossley and Sons, a carpet, rugs, and table-covers
Danby, C. and T., variety of silk fringes, &c.
Darnet, —, France, variety of shirt-fronts
Debbeld, Pellerin and Co., France, a counterpane
Defrenne, Sophie, Belgium, Brussels-point handkerchief
Dinlinger, A. F., Prussia, sofa carpets
Delaroche, Daigremont, France, muslin robe jacket & cambric handkerchiefs
Delahaye, A., Belgium, application of Brussels flounce, real
Demi, Doineau, & Bracknerie, France, Aubusson carpet, tapestry, &c.
Dove, C. W., and Co , specimens of fine frame Brussels carpet
Duhayn-Brunfaut & Co., Belgium, wide and narrow Valenciennes laces, &c.
Ehrenzeller, F., Switzerland, net and muslin curtains
Evans, R., and Co., silk fringes, braids, and fancy buttons
Faudel and Phillips, embroidered hangings for a state bed
Fisch Brothers, Switzerland, net curtain of novelty
Fisher & Robinson, imitation laces, &c.
Fister, J., Spain, a rich black blond dress and mantilla
Flaissier Brothers, France, Alayuck velvet carpets
Forrest, James, & Sons, jacket flouncings, &c.
Foulquié, Mlle , and Co., France, collars, half shawls, &c.
Gilart, R. D., Spain, the royal arms, worked with coloured silks, &c.
Gompertz, B Hamburg, hair, embroidered pictures of the Queen and the Prince of Wales, &c.
Greasley & Hopcroft, Jacquard shawl, &c.
Groucock, Copestake, Moor and Co., Honiton, guipure, half shawl, &c.
Haeck, J. T., Belgium, real Brussels plait veil
Hamburger, Rogers & Co., epaulettes, military hats, &c.
Hammelrath, P. H., Belgium, narrow Valenciennes laces, &c.
Hamrén, Sophie, Sweden, needlework embroidery
Hare, John, and Co., specimens of oil-cloth, &c.
Harris, G., and Co., three specimens of velvet pile
Heald, H., pattern for a broad lace flounce
Henderson and Widnell, specimens of fine tapestry, &c.
Heuschen, Van Eeckhoudt, and Co., Belgium, two bobbin Brussels lace dresses, &c.
Heyler, Mlle. M., France, silk-net mittens and gloves
Heymann and Alexander, machine-made lace
Hietel, J. A., Saxony, seven tableaus embroidered in hair and silk
Holden, J., and Co., Class XIV., muslin insertions and trimmings
Houldsworth, James, and Co., Class XIII., embroidery by machinery
Howell and James and Co., guipure Honiton lace shawl
Hubert, Madame Josephine, France, head dresses, &c.
Jullien, sen., France, specimens of gimps, &c.
Jorez, jun., Belgium, printed moleskin table-covers
Kroonenberg, W. F., Netherlands, a large carpet
Lambert and Bury, Limerick lace shawl and tunic dress
Lambert, Brown, and Patrick, epaulettes and laces, &c.
Lapworth, A., specimens of velvet pile carpets, &c.
Lefébure, A., France, white thread lace counterpane, &c.
Lees, R., & Co., printed mohair velvet
Lester, T., wide white thread lace
Macdonald, D. and J., and Co., embroidered muslin, robe, cap, and bassinet
Mair, J., Son, and Co., Class XI., three muslin robes
Mallet and Barton, imitation black trimming laces, &c.
Mallett Brothers, France, specimens of Valenciennes lace and lappet
Marguerite, Signora, Spain, a dress, from fibre of the pine apple (per N. P. Hammond and Co. London)
Melotte, E., Belgium, gold embroidery

Meraux, J. H., France, patterns for flounces, handkerchiefs, lappets, &c.
Michelin, T., France, fancy ribbon trimmings for dresses and cloaks
Moreau and Co., France, embroidered shirt fronts
Mornieux, F., France, galloons and buttons
Moulard, Mlle., France, lace head-dress, caps, &c.
Naeltjens, G., Belgium, bobbin, Brussels berthe, coiffure, lappet, &c.
Newcomb and Jones, velvet pile carpet
Overman & Delevigne, Belgium, carpets
Pagny, France, point lace shawl and scarf
Pardoe, Hoomans, and Pardoe, velvet pile carpets
Parlanti, E., Tuscany, a piece of embroidery, &c.
Polak, F. Mlle, Belgium, black lace flouncings, &c.
Random, L., France, white blond flounce scarf, &c.
Reallier, Mlle., Belgium, Brussels point lace handkerchief, &c.
Reckless and Hickling, shawls, &c.
Requillart, Roussel, and Chocqueel, France, Morquette or velvet carpet
Riego de la Branchardiere, E., crochet-work frock, berthe, &c.
Robinson, Thomas, lace curtain
Roeller and Huste, Saxony, painted table-covers, &c.
Rolph, J., double-flounce scarf, &c.
Salomons and Sons, Classes XII. and XV., embroidered work
Schaerff, R., Prussia, coach laces, &c.
Schlaepfer, Schlatter, and Kursteiner, Switzerland, net curtains, &c.
Schmidt, G. F., and Co., Saxony, cushions, &c., for a set of furniture
Schoch, Schiess, and Son, Switzerland, embroidered handkerchiefs
Schreiber, F. A., Saxony, pillow lace
Seel, G., Prussia, pictures in hair
Seib, J. A., France, enamelled floor-cloth
Soenen, F., Belgium, lace handkerchiefs, and lappets
Staeheli-Wild, C., Switzerland, embroidered table-covers, &c.
Steegman, H., and Co., lace curtain
Stefani, W., Sardinia, silk embroidered tableaux
Stocquart Brothers, Belgium, black point lace shawl, &c.
Sutter, J. J., Switzerland, chintz book robe, &c.
Tanner and Koller, Switzerland, embroidered muslin dresses, &c.
Tanner, J. U., Switzerland, embroidered work
Templeton, James, and Co., Axminster carpets, &c.
Treadwin, C. E., Honiton lace
Turbeville, Smith, Boyle and Co., carpets, &c.
Vander Kelen, Bresson, Belgium, Brussels lace
Van Halle, J., Belgium, vestments, robes, &c.
Van Kiel, Sisters, Belgium, Mechlin lace
Vaugeois and Truchy, France, embroidery
Viccars, R., lace
Vickers, William, lace shawls, &c.
Victoria Felt Carpet Company, Leeds, a carpet and felt cloth
Videcoq and Simon, France, a Chantilly shawl, &c.
Watson, Bell and Co., carpets
Weedon, Francis, lace
Whitlock and Billiald, laces
Whitwell, J., and Co., carpets
Wright, Crump and Crane, carpets
Wulff, Jeus & Sons, Denmark, lace, &c.

CLASS XX. — (JURY 20.)

Articles of Clothing, for immediate Personal or Domestic Use.

PRIZE MEDAL.

Abt Brothers, and other Exhibitors, Switzerland, straw plait
Addington, W. H., United States, shoes for mining purposes
Allen, James, and Co., straw hats and bonnets
Allen and Solly, collection of articles, showing progress in hosiery
Atloff, J. G., economic plan of cutting leather for shoes
Angrave Brothers, drawers and shirts
Ball, W. Y., and Co., kid gloves
Bathier, V., France, novelty and cheapness in the production of wooden shoes
Berni and Melliard, case of hats
Biggs, H. W., and Sons, specimens of low-priced hosiery
Billson and Hames, good quality of Thibet wool, low panipier, and variety of socks
Buckmaster, W., and Co., various articles of court costume
Cartwright and Warners, yarns prepared from Mexican and Virginian wools, and articles made therefrom
Chenard Brothers, France, beaver hat, and hares' fur hats
Chosson and Co., France, kid gloves
Christil, J., Austria, workmanship of shoes, &c.
Clarke, Cyrus and James, Class XVI., elongating goloshes

Cochois and Colin, France, dresses and embroidery
Coupin, J., France, felt hats
Dent, Allcroft and Co., gloves of high class workmanship
Deschamps, N., France, plan of cutting leather for boots and shoes
Doucet and Duclerc, France, embroidered shirts
Dufossé, sen., France, strong work in boots, &c.
Dufossé and Meenotte, France, excellent workmanship in boots and shoes
Ensor, T., two finger gauntlets and gloves
Feruveladgi (The Tailors' Association) of Janina, Turkey, Albanian costumes (see Turkish catalogue)
Foster, Porter and Co., plush plumage gloves
Fowns Brothers, gloves
Fry, J., Lisle thread hose, of excellent make, and Segovia goods
Gilbert & Co., Class XVI., riding boots
Glaeser, J. S., jun., Saxony, women's cotton gloves
Gregory, Cubitt and Co., straw hats and bonnets
Groshopf, George, Austria, strong boots and shoes
Haight, Mrs. W., United States, shirt
Harris, R., and Sons, examples of hosiery
Hefford and Eacer, Class XVI., glazed Wellington boots
Hickson and Sons, Class XVI., for excellence of light export shoes and boots
Holland, T., and Co., fleecy hosiery for medical uses
Hook, John, Class XVI., ladies' shoes
Houbicant-Chardin, France, gloves
Hurst and Sons, excellence of home and export hosiery goods
Jouvin and Doyon, France, kid gloves
Jouvin (Widow), France, gloves
Jeffers, W. H., (the workmen of,) United States, ladies' boots and shoes (honourable mention to exhibitor)
Joly, Mesdames, Sisters, France, corset of novel description
Josselin, J. J., France, corsets
Kunerth, A., Austria, Turkish slippers
Kratch Brothers, Austria, double pilot cloth coat
Landgraff, G., Saxony, women's single-thread cotton hose
Lauret Brothers, France, embroidered silk hose of high quality
Laydet Son, sen., and Co., France, case of gloves
Locoq-Bréville, France, assortment of habit kid gloves
Lefébure, J. P., France, invention for making boots and shoes
Long, George, hats and bonnets made on the pillow-lace principle, exhibited by Wingrave and Sons
Malatinzky, E., Austria, richly embroidered overcoats
Massez, —, France, excellence of production of boots and shoes
McDougal, D., hosiery knitted by the Scotch peasants
McGee, Jno G. & Co., waistcoat pieces
McKenzie, W. B., Shetland knitted shawls and hose
Meier, F., France, workmanship in ladies' shoes
Meinert Brothers, Saxony, woollen shirts for exportation
Meyances and Sons, France, extra fine embroidered silk hose
Miles, S., collection of articles of dress
Milon, P. D., sen., France, workmanship of hosiery
Mohr, W., Prussia, light clogs and kid boots
Morley, I. and R., silk and cotton hose of the best quality
Muirs, Connell, and Brodie, rye-straw bonnets
Nacke and Gehrenbeck, Saxony, women's cut-up white cotton hose of fine quality
Nannucci, Tuscany, Leghorn hats and capotes
Neville, J. B. and W., and Co, ladies' under clothing, hosiery, drawers, &c.
Neuber, F., Saxony, low-priced cotton hose suitable for exportation
Opigez and Chazelle, France, embroidered silk
Parker, J., Class XVI., boots, strong and light
Parker and Sons, Class XVI., general excellence of boots and shoes
Peplow, W., Class XVI., workmanship, and application of spring to boots
Poirier, P., France, self-coloured leather boots
Prague, Glovers' Association, Austria, gloves
Robert-Werley and Co., France, corsets
Shekonin, Alexis, Russia, embroidered boots and shoes
Simmonds and Woodrow, selection of felt bonnets
Singer, J., Austria, dress coats
Sofialioglou's Daughter, Constantinople, Turkey, veils embroidered in gold and pearls, with silver fringes (see Turkish Catalogue)
Solbrig, E., Saxony, adaptation in price, to export demand in certain qualities of hosiery
Sulzberger and Akermann, Switzerland, variety of Swiss straw plaits
Taylor and Co., plushes made from waste silk

Thierry, C. A., France, gentlemen's boots
Thomas and Son, Class XVI., high class workmanship in boots
Thurman, Piggot, and Co., floss velvet gloves
Torshokwork, Government of Trvei, Russia, shoes, slippers, and other articles
Turkey, his Majesty the Sultan of, Russia, admirable collection of costumes
Van Beneden-Bruers, Belgium, stays of good description, without seams
Vyse and Sons, case of bonnets
Vyse and Sons, Tuscany, Leghorn hats and capotes
Walsh, William, Class XV., welted cork soles
Ward, Sturt, Sharp, & Ward, hosiery, &c.
Wemmrer, J., Luzemberg, shoes for labouring men
Welch and Sons, hats and bonnets
Welch, Margetson and Co., braces, carriage rugs, ties, cravats, &c.
Wex and Linder, Saxony, hosiery of great excellence
Whitby, E., habit lambskin gloves
Wilson and Son, thread hosiery with lace fronts

CLASS XXI. — (JURY 21.)

Cutlery and Edge Tools.

COUNCIL MEDAL.

Spear and Jackson Class XXII., for exhibition of circular saws, and particularly one 60 inches in diameter, of marked and very superior excellence, manufactured by a process of peculiar merit, the result of a novel application of mechanical ingenuity recently effected by themselves.

PRIZE MEDAL.

Addis, J. B., jun , carving tools
Arnheiter, M., France, cutlery
Blake and Parkin, Class XXII., saws and files
Brookes, W., and Son, Class XXII., edge tools
Brown and Wells, United States, tools
Buck, J., turning and other tools
Butcher, W. and S., Class XXII., edge tools and razors
Butterly, Richard, Class XXII., sickles
Cocker and Sons, Class XXII., files and edge tools
Coulaux, sen., and Co., France, saws
Dittmar Brothers, Wurtemburg, cutlery
Eyre, Ward, and Co., Class XXII., cutlery
Fenney, Frederick, Class XXII., razors
Fischer, A., Austria, files
Froely, A., France, fine files
Gibbins and Sons, Class XXII , scissors
Goldenberg, G., and Co., France, saws and tools
Guerre, sen., France, cutlery
Hague, S., Class XXII., penknives
Haindl, A., Austria, cutlery
Haueisen and Son, Zollverein, scythes
Hannah, A., augers, &c.
Hardy, T., Class XXII., dressing-case instruments
Hassan, Turkey, scissors
Hawcroft and Sons, Class XXII., razors
Heljestrand, C. V., Sweden and Norway, razors
Henkels, J. A., Zollverein, cutlery
Higginbotham, G. and W., Class XXII., scissors
Hill, John, saws
Hilliard and Chapman, cutlery
Hoeller, A. and E., Zollverein, cutlery
Howarth, J., Class XXII., edge tools (engraving)
Hunter, Edwin, Class XXII., scissors
Hutton and Newton, Class XXII., scythes and reaping-hooks
Iakovleff, Mme., Catharine, Russia, cutlery
Ibbotson, Thos., a plane
Ibbotson Brothers, Class XXII., cast-steel scythes, &c.
Ibbotson, Richard, Class XXII., saws
Imperial Artinsk Works, Russia, scythes
Johnson & Cammill, Class XXII., files
Jowitt and Battie, Class XXII., files
King and Peach, planes
Kirk and Warren, Class XXII., files
Loy, William, skates
Loy, W. T., cutlery
Makin, W., Class XXII., rag knives
Mannesmann, A., Zollverein, files
Mappin and Brothers, Class XXII., cutlery
Marsden Brothers and Co., Class XXII., joiners' tool
Martin, Stephen, Class XXII., razors
Mathieson and Son, joiners' tools
Matthews, W., Class X., table cutlery
Morton, J. and G., table knives
Moseley and Sons, planes
North Wayne Scythe Company, United States, scythes
Nowill, J., and Sons, Class XXII., cutlery
Peace, Joseph, & Co., Class XXII., saws
Philp and Whicker, Class X., cutlery
Picault, G. F., France, cutlery
Proutat and Co., France, fine files
Rodgers, J., and Sons, Class XXII. cutlery

Saynor and Sons, Class XXII., gardeners' knives
Schmolz, W., and Co., Zollverein, cutlery
Sharp, Brothers and Co., table knives
Simmons, D., and Co., United States, edge tools
Slack, Sellers, & Co., Class XXII., saws
Sorby, R., and Sons, Class XXII., edge tools
Staniforth, Thomas, Class XXII., scythes and sickles
Steer and Webster, Class XXII., scissors
Stotzer, Frederick, Switzerland, fine files
Stubs, Peter, small files
Tahir, Turkey, scissors
Talabot and Co., France, scythes
Taylor, Henry, Class XXII., engravers' tools
Thornhill, Walter, garden tools
Tomlin and Co., sickles and shears
Turner, Thomas, and Co., Class XXII., files, saws, and cutlery
Turton, Thomas, and Sons, Class XXII., files
Unwin and Rodgers, Class XXII., cutlery
Unwin, W., aged 16, Class XXII., sportsman's knife
Waldron and Sons, scythes
Walters, J., and Co., cutlery
Ward and Payne, edge tools
Weinmeister, G., Austria, scythes
Wertheim, F., Austria, tools
Wilkinson and Son, Class XXII., sheep shears, vice and chains
Wilkinson, T. and G., Class XXII., scissors
Wilson and Sons, Class XXII., shoe and butchers' knives
Wostenholm, G., and Sons, Class XXII., cutlery

Class XXII.—(Jury 22.)

Iron and General Hardware.

COUNCIL MEDAL

Andre, J. P. V., France, for iron fountain in nave, and the design of the alligator and fish fountain
Aubanel, J., France, castings of animals, and gilt cast-iron doors
Barbedienne, F., and Co., joint medal with Class XXVI., France, sculpture in metal, bronzes, &c.
Coalbrook Dale Company, cast-iron statues, new method of bronzing steel grates, and diamond flooring for steam engines
Hardman and Co., ecclesiastical brass work
Hoole, Robson, and Hoole, for drawing-room steel grates
Matifat, C. S., France, original designs in bronze
Miller, Ferd., Bavaria, castings in bronze of a colossal lion, and statues of Libussa, and George I. of Bohemia
Minister of trade for the Royal Prussian foundry, Germany, three vases, and candelabra with group of figures in cast-iron
Société des Mines Zinc (de la Vieille Montaigne), Belgium, specimens of zinc castings
Stuart and Smith, drawing-room grates on Sylvester's patent, and the novel application of a revolving canopy invented by Laurie
Winfield, R. W., brass foundry work and metallic bedstead, with taper rolled pillars, and chandeliers

PRIZE MEDAL.

Abade, F., specimens of a new art termed metallography
Adams and Co., United States, bank lock
Allen and Moore, metal buttons
Armitage, M. and H., anvils, &c.
Arnheim, S. J., Zollverein, iron safe bureau
Arrowsmith, G. A., United States, permutation locks
Aston, W., buttons
Aubin, C., locks
Baily and Sons, cast-iron staircase work, brass work, &c.
Baker and Co., flower-stand and cages
Banks, E., buttons
Barnard & Bishop, wrought-iron hinge
Barron and Son, locks
Bartlet and Sons, needles and fish-hooks
Bartrum and Pretyman, wrought copper nails, &c.
Bavay, Paul de, Belgium, pointes de Paris nails, &c.
Bedington and Tonks, brass works various
Beissel (S.) Widow, and Son, Zollverein, needles of English steel
Benham and Son, cooking apparatus
Bentley, W. H., cooking apparatus
Blaeser, G., Zollverein, bronze statue of Beethoven, &c.
Blanzy, Poure and Co., France, metallic pens
Blews and Sons, ship lamps and bells
Boecker, R. and H., Zollverein, hardware, various
Bolton, T., brass and copper tubes
Boobbyer, J. H., locks
Boucher, E. and Co., France, culinary vases, tinned by a new process

Boulton & Son, needles & fish-hooks
Bramah and Co., locks and castings. And special approbation
Braux, d'Anglure De, France, statues of galvanised zinc, bronze busts, &c.
Bricard and Gauthier, France, locksmith's work, &c.
Bright, R., carriage lamps
Brisband, H., buttons
Brown and Redpath, stoves for ships
Burney and Bellamy, tanks for oil, water, &c.
Cain, J., France, bronzes, birds in nest, &c.
Carpenter and Tildesley, locks
Childs, J., brass lamp for lighthouses
Chilson, Richardson, and Co., United States, hot-air furnace
Chopin, Felix, Russia, bronze candelabrum
Chubb and Son, locks and safes. And special approbation
Clarke and Restell, lamps, gas-burners, and locks
Clarke, T. & C., & Co., enamel ware
Cochrane, J., gas meter
Cocker, S., and Sons, Sheffield, needles
Cocker and Sons, Derbyshire, needles
Coombe & Co., iron & copper netting
Cope and Collinson, brass work, various
Corcoran, B., and Co., Class VI., metallic cloth
Cornelius and Co., United States, chandeliers
Cottam and Hallen, gates, cast iron, and enamelled cast-iron horse mane
Cotterill, E., locks and safes
Cottingham, N. J., Main Avenue West, brass lectern
Cowley & James, beds & steam tubes
Crook, W., cooking apparatus
Day and Newell, parautopic permutating locks. And special approbation
Deane, Dray, and Co., stove grates
Deffner, C., Wurtemburg, hardware, various
Defries, N., gas meter, bath heated by gas, &c.
De la Fons, J. B., locks
Desjardins, Lieux, France, medallions, &c.
Devaranne and Son, Zollverein, castings in zinc
Dietrich and Son, France, specimens of iron castings, &c.
Dixon, J., and Son, powder flasks
Dowson, J. E., Cundy's hot-air ventilating stove
Dreyse and Collenbusch, Zollverein, copper rivets
Drion, E., Belgium, wrought nails
Dubsky, Count, Austria, wire tacks, twisted nails
Dugard, N. and H., carriage lamps
Duley, J., cottage cooking stove
Edelsten and Williams, pins
Edge, J., pit chains
Edge, T., gas meter
Edwards, F., Arnott's stove
Egells, F. A., Zollverein, cast-iron chimney-piece
Egger, J. B., Austria, leaden pipe, 900 feet long, in one piece
Einsiedel, Count G., Zollverein, cast-iron goods, &c.
Elliott and Son, buttons
Evans and Son, cooking apparatus
Everitt & Son, brass & copper tubes
Falisse and Trapmann, Belgium, percussion caps
Faraday and Son, gas chandelier on Professor Faraday's principle
Featham, Miller, and Son, stove grates, &c. And special approbation
Firmin and Sons, Class XX., buttons
Fischer, B., Austria, articles of malleable cast iron
Fischer, C. H., Zollverein, figures in bronze, &c
Flavel, S., cooking apparatus. And special approbation
Fontaine, P., France, brass pans
Franz, J., Zollverein, bronze figures of victory, &c.
Frebel, L., Zollverein, bronze, Newfoundland dog, &c.
Furstenburg, Prince, Austria, stoves, monuments, crucifix
Gagneau Brothers, France, lamps, bronzes, &c.
Gardener, M., chandelier
Garton and Jarvis, stoves
Gasser, J , Austria, bronzes
Geiss, M., Zollverein, statues in zinc, "Eve," &c. And special approbation
Gerish, F. W., locks and hinges
Gervais, France, copper boiler with grate
Gibbons, J., sen., locks
Gillott, J., metallic pens
Glover, T., Class I., gas meter
Goddard, H., cooking apparatus
Goodbehere, G. T., ships' stoves
Goodman, G., needles and pins
Gray, J., and Son, locks
Gray and Son, fire-irons, &c
Grey, T. W., brass work, various
Green, T., Class IX., aviary
Greening and Sons, strong wire cloth, woven by steam power
Griffiths, T. & F., tin & enamel ware
Grignon, M., France, bronzes, &c.
Gruhl, F., Saxony, a bell (very fine tone)
Guest and Chrimes, water closet and fire cocks
Hadrot, L., jun., France, moderator lamps
Hale, J., curb chains
Hammond, Turner, and Sons, buttons
Handyside, A., cast-iron fountain

Hanson, J., manufactured lead
Harding, T., Class XX., buttons
Hardman and Iliffe, buttons
Harley, G., locks
Hart and Sons, door-plates
Haslam, W., wrought iron hinges, &c.
Hatfield, J. A., statue in bronze
Hawkins, J., brass, copper, and iron screws and bolts
Haywood, J., church stove
Haywood and Son, locks, gilding, &c.
Hemming, H., fish-hooks
Henn and Bradley, taper screws, &c.
Herring, S. C., United States, salamander safe
Hetherington, T. & C., carriage lamps
Heiger and Sons, Zollverein, hardware
Hincks, Wells, and Co., metallic pens
Hodges, T., bells
Holden, H. A., carriage lamps
Hood, S., cast-iron enamelled stall and manger
Horne, T., curtain poles, &c.
Horsfall, H., pins & wire for fish-hooks
Howland, C., United States, Bell Telegraph
Huffer, J., locks
Hughes and Kimber, copper and steel plates for engravers
Ibbetson, Captain, L. L. B., bronzing, iron, and metallic castings, new method. And special approbation
Ingram, T. W., buttons
James, J., fish-hooks and needles
Jeakes, W., stove grates. And special approbation
Jennings, G., water closet
Jobson and Co., radiating stove
Kalide, T., Zollverein, boy with swan, in bronze, &c.
Karcher, H., and Westermann, France, articles in stamped iron
Keep and Watkins, anvils, vice, &c.
Keith, G., refrigerator
Kell, A., and Co., metallic pens
Kennard & Co., stoves and iron castings
Kenrick and Son, enamel ware
Kent, G., knife-cleaning machine
Kepp and Co., copper bath
Kesseler, C., Zollverein, bronze statue of Polyhymnia
Kirby, Beard, and Co., pins, &c.
Kitschel, A., Austria, cast-iron vases, &c.
Knight and Foster, metallic pens
Knowles, H., buttons
Krumbigel, —, Russia, gilt bronze candelabra
Kuper, W., metal ropes
Lacarriere, A., France, lustres, chandeliers, &c.
Lambert, T., water closet and diaphragm valve
Latour, A. De, Belgium, iron castings
Laureau, L., France, figures, in a galvanized compound of bronze and pewter
Laury, G., France, stove-grates and stoves. And special approbation
Lawrence, T. B., perforated zinc, &c.
Lea, W. and J., lock with bolts, &c.
Lecocq, H., France, ornaments in stamped brass, hot-air stoves, &c.
Lefebvre, V., and Co., Belgium, wire nails and rivets
Limelette, F., Belgium, wrought nails
Lloyd, G. B., iron lap-welded tubes for steam-boilers
Longden and Son, cooking apparatus
Love, J., gas stoves
Lowe, J. and H., carriage lamps, &c.
Mallat, J. B., France, metallic gilt pens, &c.
Mapplebach and Lowe, cooking apparatus
Marchand, J. B., France, bronzes, various. And special approbation
Marr, W., safes
Marrian, J. P., naval brass work
Marriott, W., weighing machine
Marsaux and Legrand, France, stamped copper for decoration
Martin and Gray, carriage lamps
Massey, W., and Co., brass flower stand
Masters, T., ice apparatus
Mathey and Son, Switzerland, cylinder of rolled steel for watch-springs
Mathys, J., Belgium, strong-box and polished stoves
M'Gregor and Lee, United States, bank lock
Mears, C. and G., bells
Mene, P. J., France, bronzes of boar hunt, &c.
Messenger & Sons, bronze & lacquered lamps. And special approbation
Metternich, Prince, Austria, stove for hunting seat
Miguel, F. De, Spain, iron bedsteads, &c. And special approbation
Miller and Sons, signal lamps, &c.
Milner and Son, safes
Mitchell, J., metallic pens
Mitchell, W., metallic pens
Moore, P., & Co., iron & brass hinges
Morel, Brothers, France, moulded cast iron, &c.
Morewood and Rogers, zinc and galvanized tubes
Mossman, W., Class XXX., brass candlestick
Muel, Wahl, and Co., France, chandeliers, fountains, &c.
Murphy, J., bells
Myers and Sons, metallic pens
Naylor, J., lamps for pillars and wall brackets
Newall, R. S., metal ropes
Nicholson, W. N., cottage cooking stove
Nicklin and Sneath, wire weaving
Noirsains, —, ventilating stoves
Paddon and Ford, gas meter

Paillard, V., France, bronzes, &c.
Palmer and Co., candle lamps
Palmer, J. L., France, drawn wire
Papi, Clement, Tuscany, basket of flowers, cast from nature
Paris, E., France, galvanized sheet of iron, &c.
Parkes, H. W., locks
Patent Pointed Screw Company, pointed screws cast out of malleable iron
Paublan, France, safes and locks
Perry and Co., metallic pens
Perry, E., japanned ware
Petit and Fritsen, Netherlands, bells with suspending apparatus
Peyton and Harlow, metallic japanned bedsteads
Pierce, W., cottage grate
Poirier, L., France, copying presses
Potts, W., bronzes and lacquered lamps, &c. And special approbation
Puissant, F., Belgium, wrought-iron crucible and ornaments
Rau and Co., Wurtemherg, japanned tin-plate
Regout, P., Netherlands, chandeliers, two large and two small
Reynolds, J., cut nails
Rickets, C., gas stoves
Riddle, W., apparatus for extinguishing fire in ships, signal lamps, &c.
Robert, A., and Co., France, roll of tinfoil, &c.
Robertson, Carr, and Steel, stove grates
Rometsch, C., Zollverein, metallic writing slates. And special approbation
Rosee, Baron A. De, Belgium, brass cauldrons, &c.
Rowley, —, buttons
Royal Ordnance (Spain), Spain, iron bust of King of Spain
Salm, Prince, Austria, cast-iron statue of Radetzky, considered as a specimen of casting. And special approbation
Salt and Lloyd, bronze and lacquered lamps
Simonite, J., tin and enamel ware
Sanches, Pescader, Spain, bedstead of cast steel, with bronze ornaments. And special approbation
Schleicher, C., Zollverein, galvanized steel wire
Schmautz, C., sen., France, letter-press rollers
Schmidt, Caspar, Zollverein, kitchen stove
Schutz, L. N., Netherlands, zinc castings
Shave, W. J., stoves and ovens
Sherwin, J., kitchen range
Shoolbred, and Co., japanned ware
Stange and Verfel, Russia, bronze candelabrum
Stebe, A., rotatory syringe
Simcox, Pemberton, and Sons, brass work, various
Smith, Kemp, and Co., buttons
Société de la Nouvelle Montagne Zinc, Belgium, zinc tiles
Sommermeyer and Co., Zollverein, iron safe ornamented. And special approbation
Steele, W. and P., cooking apparatus
Stirling, 'Morris (Main Avenue West), alloy bell, for cheapness. Exhibited by J. Warner and Son
Stobwasser, C. H. and Co., Zollverein, japan articles, &c.
Storker Brothers, Class V., beer machine
Stohrer, T. F., Wurtemberg, brass and steel wire, &c.
Stollberg, Wernigerode, Count, Zollverein, cast-iron gothic vase, &c.
Strode, W., gas stove
Susse, Brothers, France, bronze candelabra, fountains, &c.
Tann and Sons, safes
Taylor, J., locks
Taylor and Son, bells. And special approbation
Thompson, J. H., sanatory trap, &c.
Timmins, & Sons, vices, hammers, &c.
Treggon, H. & W., zinc window blinds
Trelon, Weldon, and Weill, France, buttons and China knobs
Tronchon, N., France, iron articles of furniture, &c.
Tupper and Carr, wire fencing (galvanized iron)
Turner, H., and Co., fire irons
Tylor and Pace, perforated metals
Tylor and Sons, bronzed ware and baths
Vantillard and Co., France, tinned iron pins, &c.
Verstaen, L. N., France, strong boxes and safes
Wakefield, F., cooking apparatus
Walker, E., perforated brass
Walker, R., Class VIII., metallic pens
Waller and Co, (Main Avenue West,) monumental brass
Walters, B. and P., locks
Walton and Co., japanned ware
Warner and Sons, japanned ware and bells
Wells, J. T., buttons
Wenham Lake Ice Comp., refrigerator
Whitehouse and Co., iron tubes and fittings
Whitfield, S., brass cornices, &c.
Whitmee and Chapman, coffee mills
Wilkins and Weatherly, metal ropes
Wilson, R. and W., baths, various
Windle and Blythe, locks and steel pens
Wood Brothers, chain cables
Yates, H., locks
Yates, Haywood, and Co., stove grates
Zuccani, B., Class XXX., aviary

CLASS XXIII.—(JURY 23.)

Working in Precious Metals, and in their Imitation, Jewellery, and all articles of Vertu and Luxury, not included in the other classes.

COUNCIL MEDAL.

Elkington, Mason, and Co., artistic application of the electrotype
Froment, Meurice, France, centre pieces, representing globe, &c.
Garrard, R. and S., and Co., artistic plate and jewellery
Gueyton, A., France, his variety of exhibits and his electro-plating
Hancock, C. F., originality and taste in his exhibits
Hunt and Roskell, vase in repoussé by Vechti
Kaemmerer and Zeftigen, Zollverein, diadem, &c., in jewels
Lemonnier, G., France, Queen of Spain's jewels
Marrel Brothers, France, seals, snuff-boxes, and smaller articles
Morel, J. V., and Co., enamels
Rudolphi, J. F., France, silver ornaments
Sazikoff, Ignace, Russia, a centre-piece
Vittoz, E., France, gilt bronzes
Wagner, J., and Son, Zollverein, large centre-piece
Wales, Prince of (Main Avenue), Shield
Weishaupt, C. M., and Sons, Zollverein, chess-board and men

PRIZE-MEDAL.

Angell, J., enamels
Aubanel, J., France, chimney decorations
Aucoc, sen., France, dressing-cases
Audot, L. D., France, dressing-cases
Bennati, J., Sardinia, filigree
Bouillette, Hyvelin, and Co., France, artificial stones
Boyer, V. P., France, electro-gold
Brahmfeldt and Gutruf, Hamburg, inkstand
Bruneau, L. A., France, articles of luxury
Caron, A., France, Damascene pistols
Christofle, Charles and Co., France, electro-plate
Creswick, T. J. and N., plated silver
Dafrique, F., France, cameos
Desfontaines, Maison, Leroy and Son, France, cast-iron clock
Dixon and Sons, Britannia metal
Dubois, A., Switzerland, engraved gold
Durand, F., France, tea-service
Durham, Joseph B., Class XXI., chatelain
Dutertre, A. Switzerland, enamels
Falloise, J., Belgium, Damascene steel
Gass, S. H. and D., setting stone
Gollay Lereche, A., Switzerland, enamels
Grandjean Perrenoud, H., Switzerland, engraved gold
Haulick, G. F., Zollverein, flower, in stones
Heeley and Sons, Class XXII., chatelain
Ibbetson, Capt. L. L. B., Class XXX., electrotypes
Jahn and Bolin, Russia, setting of diamonds
Keith, J., chalices
Keller and Co., Zollverein, (Cat.), tea-service of coloured cornelian, and jewel cases in green moss agate
Lecarriere, A., France, mutation of gilding
Lefaucheux, France, carabine mounting
Lahoche, P. J., France, clock
Lambert and Rawlings, vase
Lerolle Brothers, France, bronzes, &c.
Leuchars, W., Class XXIX., dressing-cases
Levy Brothers and Co., France, mountings
Loleo, J. Sardinia, filigree
Marshall, E. S., gold leaf
Miroy Brothers, France, imitation bronzes
Moratilla, F., Spain, church service
Moutier le Page, France, handle of hanger
Odiot, France, table service
Paillard, V., France, gilt bronzes
Payen, A. R., jun., France, jewellery and filigree
Poussielgue Rusand, P., France, church service
Prélat, F., France, gilt arms
Ratzersdorfer, H., Austria, looking-glass
Romain, D., Netherlands, setting of precious stones
Rowlands, C. and W., jewellery
Royal Prussian Iron Foundry, Zollverein, inlaid silver
Savard, A., France, plated gold
Savary and Mosbach, France, false stones
Strube and Son, Zollverein, vase
Thoumin, A., France, stamped brass
Thouret, F. A., France, electrotypes
Truchy, E., France, black pearls
Vales, Constant, France, false pearls
Villemsens, F., France, candelabra, &c.
Watherston and Brogden, vase
West and Son, Irish brooches
Weygand, A., France, vase
Wild and Robinson, Zollverein, vases
Zuluaga, E., Spain, Damascene arms

Class XXIV. — (Jury 24.)
Glass.

COUNCIL MEDAL.

Maes, M., France, novelty of chemical application

PRIZE MEDAL.

Andelle, G., and Co., France, French bottles
Bacchus and Co., cut glass
Berlioz and Co., Montlucon, France, fine mirror
Bigaglia, P., Austria, Venetian glass
British Plate Glass Company, Class XXVI., plate glass
Brooklyn Flint Glass Company, United States, flint glass
Burgun, Waller, Berger, and Co., France, watch-glasses
Coathupes and Co., glass pipes
Daguet, T., Switzerland, optical glasses
Davis, Greathead, and Green, cut glass
Deviolane Brothers, France, French bottle glass
De Poilly and Co., Folembray, France, French bottle glass
Green, J. G., engraving on glass, & form
Harrach, F. E., Count Von, Austria, glass ware
Harris, R., and Son, cut glass
Hartley, J., & Co., rolled plate for roofs
Leempoel, Van de Colnet, and Co., France, bottle glass
Lloyd and Summerfield, cut glass
Meyrs (Nephews), Austria, Bohemian glass
Molyneaux, Webb, and Co., cut glass
Osler, F., and Co., glass, various—novelty of design
Patoux, Drian, and Co., France, glass
Pellatt, Apsley, and Co., cut glass, &c.
Powell and Sons, fine crystal glass
Regout, P., Netherlands, tubing—table glass
Richardson, W. H. B. and J., cut glass
Robichon Brothers and Co., France, crown glass
Schaffgötsch, Count, Zollverein, Bohemian glass
Swinburne, R. W., glass dome, white flint glass
Thames Plate Glass Co., Class XXVI., (Main Avenue West,) plate glass
Varnish, E., silvered glass
Webb, T., cut glass

Class XXV.—(Jury 25.)
Ceramic Manufacture, China, Porcelain, Earthenware, &c.

COUNCIL MEDAL.

Minton, H., and Co., new application and beauty of design
Sevres Manufactory, France, high art

PRIZE MEDAL.

Alcock, S., and Co., China
Bapterosses, J. C., France, buttons. Prize medal and special approbation
Basto Pinto & Co., Portugal, porcelain
Bettignies, M. De, France, porcelain prize medal and special approbation
Boote, T. and R., Parian vases
Bourne, J., stoneware
Copeland, W. T., Alderman, M. P., statuary porcelain. General excellence
Dimmock, T., earthenware
Finch, J., baths, &c.
Fischer, Moritz, Austria, porcelain
Gille, J. M., France, porcelain
Green, S. and Co., Class XXVII., chemical ware
Imperial Russian China Manufactory, St. Petersburg, Russia, porcelain
Imperial Austrian China Manufactory, Vienna, Austria, porcelain
Jouhanneaud & Dubois, France, porcelain
Madras Pottery, India, terra cotta
Mansard, M., France, stoneware
Mayer, T. J. and J., earthenware
Meigh, C., and Sons, earthenware
Ridgway, John, and Co., earthenware
Rose, J., and Co., china
Royal Bavarian Porcelain Manufactory, Nymphenburg, Bavaria, porcelain
Royal Danish Porcelain Manufactory, Copenhagen, Denmark, porcelain
Royal Prussian Porcelain Manufactory, Zollverein, porcelain
Royal Saxon China Manufactory, Meissen, Zollverein, porcelain
Strahl, Otto, Zollverein, earthenware
Tremblay, A., Baron du, France, drawings by lithography, on porcelain or crystal
Villeroi & Boch, Zollverein, stoneware
Wedgwood, T., and Sons, earthenware

Class XXVI. — (Jury 26.)
Decoration Furniture and Upholstery, including Paper Hangings, Papier Maché, and Japanned Goods.

COUNCIL MEDAL.

Barbedienne and Co., joint medal with Class XXII., France, ebony bookcase,
Delicourt, E., France, paper hangings
Fourdinois, A. G., France, carved sideboard of walnut-wood

Leistler, C., and Son, Austria, carved furniture in four rooms
Liénard, M. J., France, clock-case and other articles

PRIZE MEDAL.

Alcock, R., China, bedstead
Barbetti, A., Tuscany, carved coffre
Barth Brothers, Bavaria, lady's work-table
Beernaert, Antoine, Belgium, oak cabinet
Bellangé, A. L., France, inlaid buhl furniture
Bouhardet, C. P., France, carved billiard-table
Bourgery, Madame, France, models (carton pierre)
Braine, C. T., China, japanned screen
Burroughes and Watts, billiard-table
Capello, G., Sardinia, inlaid table, chair, and pedestal
Cooks and Sons, of Warwick, Class XXX., carved sideboard
Couvert and Lucas, Belgium, mosaic floor and table
Cremer, J., France, marqueterie inlaid furniture
Cruchet, V., France, carton pierre and carving
Daubet & Dumarest, France, cabinets, with mechanical action
De Keyn Brothers, Belgium, mosaic floor
Deonarain, Singh, India, bedstead
Doveston, G., cabinet and chair
Dowbiggin and Co., inlaid cabinet, ornamented with porcelain
Durand, E. P., France, cabinets, &c.
Fortner, F. X., Bavaria, inlaid cabinet
Gambs, —, Russia, cabinet, ornamented with porcelain
Gillow and Co., writing-table
Giusti, P., Tuscany, carved frame
Gröger, F., Austria, ebony cabinet, inlaid with marble, &c., and ornamented with carved figures
Gropius, P., Prussia, carton pierre, figures, &c.
Hagen, A. von, Prussia, cabinet
Hayball, Arthur, Government School of Design, Sheffield, cabinet
Holland, W., of Warwick, table-tops, in imitation of marble
Holland and Sons, of London, carved bookcase
Hoyles, Henry, Government School of Design, Sheffield, sideboard
Huber, J., France, carton pierre
Jackson and Graham, carved sideboard and other furniture
Jeanselme, J. P. F., France, cabinet and sofas
Jennens & Bettridge, Japan inlay pianoforte case
Johnstone and Jeanes, expanding table
Jolly-Leclerc, —, France, cabinet work
Jordan, T. B. (Main Avenue West), oak screen, &c., carved by machinery
Kershaw, T., Class XXVII., imitation of marbles and woods for house decoration
Knecht, Emile, France, carved figures
Knill, J., Austria, billiard-table & cues
Krieger and Co., France, card-tables and mechanical furniture
Lane, T., paintings on pearl glass
Lechesne, Auguste, France, carved frame
Mader Brothers, France, paper-hangings
Marcelin, —, France, inlaid mosaic table
Marchetti, L., Tuscany, carved frame
Mercier, P. E., France, ebony cabinet
Miller, G., jun., Russia, inlaid floor
Montanari, A., Austria, painted ceiling
Morant, G. J., decoration and furniture
Moxon, C., imitation of inlaid marble for decoration
Plambeck, C. F. H., Hamburgh, inlaid table
Pretot, L. H. E., France, collection of inlaid furniture
Reade, C. W., India, paper hangings
Rhan and Vetter, Russia, collection of furniture and designs
Richardson, C. J., carved box
Ringuet-Leprince, E., France, carved cabinet for medals
Rivart and Andrieux, France, furniture inlaid with porcelain
Rogers and Dear, bedstead
Spörlin and Zimmerman, Austria, application of block printing to illustrate works
Tahan, A., France, ornamental cabinet work
Théret, J., France, inlaid cabinet
Thonet, M., Austria, chairs (bent wood)
Thurston and Co., billiard-table
Townsend, Parker, & Townsend, paper hangings
Trollope & Sons, ornamental furniture
Wills and Bartlett, bookcase and candelabra
Zeegers, F., Netherlands, japanned screen
Zuber, J., and Co., France, paper-hangings

Class XXVII. — (Jury 27.)

Manufactures in Mineral Substances, used for Building or Decoration, as in Marble, Slate, Porphyries, Cements, Artificial Stones, &c.

COUNCIL MEDAL.

Barberi, The Cavaliere, Rome, a table in Roman mosaic
Demidoff, Messrs., Russia, malachite manufactured into various articles of furniture and decoration
Minton, H., and Co., encaustic tiles (joint medal with that given to H. Minton and Co., in Class XXV).
Society for Improving the Condition of the Labouring Classes, sundry improvements in the construction of bricks, and the improvement of habitations for labouring classes

PRIZE MEDAL.

Amuller, E. F., France, improved tiles
Bianchini, G., Tuscany, table in Florentine mosaic
Blackburn, B., slate slabs
Blanchard, M. H., materials and workmanship in terra cotta
Borie Brothers, France, tubular bricks
Boschetti, Benedetto, Rome, table in Roman mosaic
Bossi, J. P., France, inlaid marble table
Bottinelli, G., Austria, mantelpiece
Boucher, T., Belgium, gas retort
Bowers, Challinor, & Wooliscroft, imitations of oak-carvings in porcelain
Brown, Robert, Surbiton-hill, Italian and other tiles
Buoninsegni Brothers, Tuscany, table in Florentine mosaic
Cantian, C., Prussia, table and other objects in marble and granite
Cheesewring Granite Company (Outside, West), granite column
Chenot, A., France, metallic pavement
Coates, E. J., combination of iron and glass in the decorative part of the manufacture of stoves
Cowen, Joseph, and Co., gas retorts and other objects in fire clay
Cundy, S. (Main Avenne West), tomb of Queen Phillippa, in alabaster
Dallamoda, T., Rome, tazza of oriental alabaster
Darmanin, J., and Sons, Malta, inlaid work in marble
Decesare, P. P., Malta, carved Malta stone
Déjeant, Portugal, a collection of worked and polished marbles of Portugal
Della Valle Brothers, Tuscany, table and vase in scagliola
Desauges, A., France, mantelpiece and pavement, in stone
Dolan, D., a new kind of scagliola work
Doulton and Watts, and Henry Doulton and Co. (Outside, West), articles in stone ware and porcelain
Ekaterinburg, Imperial Polishing Manufactory of, Russia, jasper vases
Ferguson, Miller and Co., vases in terra cotta
Francis and Sons, Parian cement
Freeman, W. and J. (Outside, West), granite obelisk
Gowans, J., Class I., carved sandstone
Haywood H. and R., tiles and other articles manufactured in metallic clay
Hosken, R. (Outside, West), granite obelisk
Iles, C., and Co., pedestal, &c., of a new material resembling marble
India Company, Hon. East, India, inlaid chess table
Kapeller, L., and Son, Bavaria, graphite crucibles
Kolyvan, Imperial Polishing Manufactory of, Russia, jasper vases
Kullgren, C. A., Sweden, granite cross
Lane and Lewis, niche, and statue of St. Peter, in Caen stone
Lebrun, J. A., jun., France, chimneypiece
Leclercq, Aug., Belgium, chimneypiece
Lomas, J., and Sons, chimneypiece of black Derbyshire marble, introducing inlaid work in marble
London Marble and Stone Working Company, various articles in sculptured marble
MacDonald and Leslie, granite vases, pedestal, &c.
Magnus, G. E., enamelled slate
Margetts, T. K., and Eyles, H., font in Caen stone
Mayo and Co., vases for mineral waters
Meredith, J. H., Class I., slabs of porphyry
Miesbach, A., Austria, bricks and brick clay
Moglia, Luigi, Rome, works in Roman mosaic
Myers, Geo., Class XXVI., carvings in Caen stone
Noirsain, Jules, and Co., Class XXII., polished marble chimneypiece
Organ, J., font, obelisks, &c., of serpentine marble, from the Lizard, Cornwall
Orsi and Armani, various articles in cement
Peake, T., tiles and other objects in terro-metallic
Pearce, W., Cornish granite and serpentine goods
Peterhoff, Imperial Polishing Manu-

factory of, Russia, jewel casket, with basso-relievo mosaic, in pietra-dura
Poilleu Brothers, France, cenotaph of greenstone basalt
Pulham, J., Class XXX., terra cotta
Ransome and Parsons, artificial silica stone
Redfern, G., inlaid marble table
Robins, Aspdin, & Co. (Outside West), Illustrations of Portland cement
Ruel, W. H , Class I., crucibles
Seeley, J. (Outside, West), (Main Avenue West), Portland cement
Séguin, A., France, marble mantelpiece
Seyssel Asphalte Company, pavement at the east entrance
Singer and Co., mosaic pavement
Skinner and Whalley, novel and useful invention of marble paste
Stevens and Son, Martin's cement
Stirling, T., jun., Class I., a collection of manufactures in slate
Testa, F., Malta, carved stone
Theret, J., France, inlaid and other works in marble and pietra-dura
Tuscany, Royal Technological Institute of, Tuscany, specimens of worked and polished marble
Vallance, J., inlaid marble tables, and other articles in marble and spar
Virebent Brothers, France, manufactures in artificial stone
White, J. B., and sons (Outside, West, Class I.), illustrations of Portland and other cements
Willock, E. P., and Co., Ladyshore terra cotta
Woodley, J., inlaid marble tables
Woodruff, Thomas, Class XXX., inlaid marble slabs
Workman, J., waterproof bricks

Class XXVIII. — (Jury 28.)

Manufactures from Animal and Vegetable Substances, not being Woven or Felted, or included in other Sections.

COUNCIL MEDAL.

Goodyear, C., United States, india rubber
Gutta Percha Company, the, gutta percha
Mackintosh and Co., india rubber.

PRIZE MEDAL.

Badin, J. C. F., France, feather baskets
Bailey, J., Canada, pails
Balkfield and Co., Mauritius, straw and shell work
Bardoffsky, T., Russia, felt jugs
Brown, H., British ivory
Chatwin and Sons, Class XXII., pearl work
Claraz, Ambroise, Switzerland, straw work
Crummack, E., tortoiseshell combs
D'Heureuse, C., Prussia, straw work
Dunn, W., Canada, chair (porcupine quill)
Duprat and Co., France, cork in sheets
Engeler, H. M., and Son, Prussia, painting brushes
Esdailes and Margrave, cork veneer
Faessler, J. A., Switzerland, milk tubs
Fauvelle-Delebarre, —, France, tortoiseshell combs
Fenn, J., United States, comb
Fino, J., Sardinia, brushes
Foese, G., Prussia, brushes
Forster, —, waterproof cloaks
Finneby, F. R., brushes
Geismar, L., and Co., Nassau, carving in ivory and bone
Gerona,, the Province of, Spain, cork in sheets
Greig, Misses, Bahamas, cornucopia, &c., of shells
Grey, the Countess, Mauritius, basket and wreath of flowers
Grossman and Wagner, France, articles in Indian rubber
Guinart, J., Spain, corks and bungs
Haas, F. P., Wurtemburg, straw plaitings
Habenicht, A., Austria, ivory combs
Hancock, C., articles in gutta percha
Hayward Rubber Company, United States, India rubber shoes
Höltring and Höffken, Prussia, India rubber braces
Holtzapffel and Co., Class VI., turning in ivory
Horan, H., Class IV., prepared whalebone
Julin, L., Belgium, shell cameos
Kehrli Brothers, Switzerland, articles carved in wood
Lang, G., heirs of, Bavaria, toys carved in wood
Laurencot, E., France, painting and other brushes
Leunenschloss, M., France, India rubber braid
Loncke-Haeze, C. L., Belgium brushes
Loring, G., United States, water pails
Luzon, Economical Society of the Isle of, Spain, cigar cases
McGregor, J. W., casks
Marin, J. E., Belgium, Spa-wood boxes
Marshall, R., Canada, dinner mats
Massue, L. J., France, ivory combs
Maunder, J., turning in ivory

Moulton, S. C., United States, India-rubber goods
Nickels, C., and Co., articles in India-rubber
Nicolls, Miss, Bahamas, shell work
Noël, —, sen., France, ivory combs
Pattak, G., Austria, brushes
Philip, —, France, tortoiseshell combs
Poinsignon, —, France, imitation tortoiseshell combs
Pratt, Julius and Co., United States, ivory veneer
Rangel, A. P., Portugal, wine cask
Randall, J., straw work
Rigby, E. R., brushes
Schwarz, J., Austria, mother-of-pearl ornaments
Shaw, C., mechanical sculpture
Shea, Captain, China, carved coal and pearl
Smith, A., painting brushes
Smith, T., truck baskets
Somzé-Mahy, H., Belgium, floor brushes
Staight, D., and Sons, Class XXIX., ivory veneer
Staight, T., Class IV., carved ivory and pearl
Stevenson, J. and J., combs
Tandler, S., Austria, straw flowers
Taylor, B., tower of vegetable ivory
Thesen, N. P., Sweden and Norway, carving in wood
Tomassia, L., Austria, willow plait
Trancart, A. A., France, tortoiseshell combs
Treloar, T., mats, &c. of cocoa-nut fibre
Turkey, Sultan of, Turkey, collection of horn and ivory
Wansborough, J., waterproof cloth in imitation of velvet
Westall and Co., Class IV., manufactures in whalebone
Wildey and Co., mats, &c., of cocoa-nut fibre
Williams, H., eccentric ivory turning
Wirtz, J., Switzerland, wood carving
Wolf, —, France, ivory carving

Class XXIX. — (Jury 29.)

Miscellaneous Manufactures, and Smallwares.

COUNCIL MEDAL.

Constantin, J., Marques, France, flowers in cambric
Milly, L. A. de, France, invention of practical methods of using lime in the manufacture of stearic candles, and the use of boracic acid in the preparation of wicks

PRIZE MEDAL.

Adamson, O. G., Brazil, feather flowers
Adt Brothers, Bavaria, snuff-boxes in papier maché
Ainge and Aldred, fishing-tackle and archery weapons and accoutrements
Allard and Claye, France, fancy soaps
Allix, A. J., France, wax figures for hair-dressers
Alvargonzalez, R., Spain, preserved fruits
Apollo Stearine Candle Co., Austria, stearic candles
Archer, J. C., collecting and arranging the cabinet of Liverpool imports
Arnavon, H., France, common and Marseilles soap
Astrath, C., Austria, meerschaum cigar tubes, and amber mouth-pieces
Aucler and P. Ledoux, France, confectionary
Audot, E. J., France, dressing-case
Barclay and Son, Class IV., wax, stearic and other candles
Bartlett, A. D., taxidermy
Baur Brothers, Wurtemberg, confectionary ornaments of gum tragacanth
Bautte, T. F., Switzerland, mechanical singing-bird
Bauwens, L. F., Class IV., fat acids recovered from waste suds of woollen, silk, and cotton manufactures
Bazin, Xavier, United States, fancy soaps
Bert, J. J., and Co., Spain, stearic candles, by the processes of saponification and distillation
Bontems, France, mechanical birds
Brandon, N. D., Netherlands, stearic candles
Castello, F., Portugal, preserved fruits
Cazal, France, umbrellas and parasols
Chagot, sen., France, flowers in cambric
Charageat, E., France, umbrellas and parasols
Chevet, jun., France, preserved fruits
Chiozza, C. A., and Son, Austria, fancy soaps and floating soap
Claudo, Joseph, Sardinia, walking-sticks
Cleaver, F. S., toilet soaps
Coimbra, the Nunnery of, Portugal, preserved fruits
Colletta-Lefebvre, France, snuff-boxes
Comba, F., Sardinia, taxidermy
Conti and Son, Tuscany, soaps
Cowan and Sons, soaps
Cowper, E., models for the use of schools
Cubero, J., Spain, three terra-cotta figures
Dark, M. and R., articles used in the game of cricket
Dorvell, Elizabeth, flowers in wax
Douglas, J. S., and Son, Hamburg, toilet soaps

Duke & Son, articles used in the game of cricket
Dumortier and Co., France, stearic candles
Duvelleroy, P., France, fans
Edwards, T. J., dressing-cases
Eichner, G.L., Bavaria, mechanical toys
Farina, J. M., (opposite the Jülichs-place, Cologne,) Prussia, Eau de Cologne
Félix, A., France, fans
Field, J. C., & J., Class IV., stearic acid
Flöge, G., Austria, amber for pipes, and pipe-tubes and bowls
Foster, Son and Duncum, flowers in cambric
Freeman, E. & J., Class IV., spermaceti candles
Friedrich, J., Austria, meerschaum pipe bowls, and cigar tubes
Fürstenhoff, Emma, France, artificial flowers and materials
Gaudet du Fresne, France, artificial flower leaves
Gellé, sen., & Co., France, toilet soaps made by the cold process
Gibbs, D. and W., common and toilet soaps
Grossmith, J., artificial essences and perfumery
Gutrerriez de Leon, R., Spain, three terra-cotta figures
Hadji Miram, Turkey, amber mouth-pieces for pipes
Haller's, J., (Widow) and Son-in-Law, Austria, toys
Hancock, J., taxidermy
Harand, E., France, flowers in cambric
Hartmann, L., Austria, meerschaum pipe bowls, sticks, and umbrella handles
Hauel, J., United States, toilet soaps
Hedinger, C., Wurtemburg, walking canes
Hendrie, R., toilet soaps and perfumery
Hoffmann, C.W., Prussia, manufactures in amber
Hofrichter, C., Austria, cheap snuff-boxes
Holland, Henry, hollow metallic frames for umbrellas
Hull Local Committee, Hull imports
Jaillon, Moinier & Co., France, stearic candles
India Company, Hon. East, India, clay figures, representing the various Hindoo castes and professions, manufactured in Kishnagur
Johansson, J., Sweden and Norway, stearic candles
Jumeau, Pierre, France, dolls' dresses
Kendall and Co., toilet soaps
Kietaibl, F., Austria, automaton toys
Knight, John, soaps
Laurent, F., France, dressing and ornamental cases
Lefort, sen., France, materials for flowers
Leistner, G. L., France, perfumery
Little, G., and Co., fishing-tackle
Louderback, M. J., United States, preserved peaches
Lumsden, Miss J., Class XXX., flowers in wax
Martin, M. C., Poussia, Eau de Cologne, and Melissa water
Masse, V., Tribouillet and Co., France, stearic candles by the process of distillation, and fat acids recovered from waste lyes
Matisen, A., and Co., Russia, stearic candles
Mercier, C. V., France, tortoiseshell and horn snuff-boxes
Meyer, H. C., jun., Hamburg, walking-canes
Meyers, B., collection of sticks
Miller, T. J., Class IV., large block of refined spermaceti, and specimens to illustrate the process of spermaceti refining
Milliau, jun., France, Marseilles soap
Milly Stearine Candle Co., Austria, stearine candles, by the processes of saponification and distillation
Mintorn, J., H. H., Elizabeth and Rebecca, flowers in wax
Montanari, A., dolls
Montanari, N., Class XXX., figures illustrative of Mexican life
Morland, J., and Son, umbrellas and parasols
Motard, A., and Co., Prussia, stearic candles, by the processes of saponification and distillation
Muir, P., archery, weapons, &c.
Naim Effendi, Turkey, amber mouth-pieces for pipes
Oger, J. L. M., France, fancy and common soaps
Ogleby, Chas., and Co., stearic, sperm, and composition candles,
Oudard and Boucherot, France, preserved fruits
Palis, A., Prussia, tallow, oil, and palm soap
Paris Chocolate Company, Class III., chocolate and syrups
Pelayo, San (Oviedo), the Nunnery of. Spain, preserved fruits
Perrott, S., Petit and Co., France, flowers in cambric
Philippe & Canaud, France, preserved fruits
Pitansier, Russia, stearic candles
Piver, L. T., France, toilet soaps and perfumery
Ploucquet, H., Wurtemburg, taxidermy

Price's Patent Candle Co., Class IV.. invention of improved methods of distilling fatty bodies, and for candles made of distilled fat
Quanonne, C. and J., Belgium, stearic candles
Randolph, Wilhelmina, flowers of undyed feathers
Rock and Graner, Wurtemburg, toys
Rödel & Sons, France, preserved fruits
Royle, J. F., India, collection of animal, vegetable, and mineral substances
Sangster, W. and J., alpaca umbrellas
Santa Clara (Funchal), the Nunnery of, Portugal, feather flowers
Sarre, H., jun., Prussia, soaps
Schulz, C., Prussia, walking sticks
Smith, W. and A., Scotch snuff-boxes
Söhlke, G., Prussia, tin toys
Spurin, E. C., toys
Staight, D., and Sons, manufactures from Cheverton's artificial ivory
Stier, H., Russia, soaps
St. John, J. R., United States, soap
Strauss, J., Sardinia, pipes
Strickland, Maria, flowers in wax
Sugden, Borras, and Co., flowers in cambric
Taylor, Humphrey, and Co., soaps and perfumery
Taylor, H. P. and W. C., United States, toilet soap
Tillman, France, flowers in cambric
Touche-Gillès, E., Belgium, toilet and olive oil soaps
Tunis, the Bey of, Tunis, distilled perfumed waters (various)
Turkey, the Sultan of, Turkey, collection of pipes, soap, candles, and confectionery
Vancampenhoudt, C., & Co., Belgium, stearic candles
Williams, J., and Son, toilet and common soaps
Winterfeld, J. A., Prussia, manufactures in amber
Wittich, Kemmel & Co., Wurtemburg, carved ivory toys and cane-handles
Wotherspoon, J., and Co., lozenges and comfits made by steam machinery
Wunder, L., Prussia, soap
Zeitler, J., Austria, pipe bowls of massa

Class XXX. — (Jury 30.)

Sculpture, Models, and Plastic Art.

COUNCIL MEDAL.

Kiss, A., Prussia, the Amazon, cast in zinc and bronzed
Marochetti, Baron (Outside, West), Richard Cœur de Lion, in plaster
Pradier, J., France, Phryne, in marble
Wyatt, the late Richard J. (Main Avenue, East), Glycera, in marble

PRIZE MEDAL.

Appel, R., anastatic printing
Baily, E. H. (South Transept), a youth resting after the chase, and a nymph preparing for the bath, in plaster
Bell, John (North Transept, Main Avenue, West), statue of Lord Falkland; eagle slayer, in bronze
Benzoni, Gio. Maria, Rome, statue, in marble, of Gratitude
Béranger, Antoine (Main Avenue, East), France, head on porcelain; and portrait of Prince Albert on China
Berrus Brothers, France, designs for shawls
Bertini, G., Austria, painted window, representing Dante & some of his ideas
Boesche, C. J., Prussia, fountains, and model of Magdeburg cathedral
Bonnet, France, St. John, in enamel
Bucker, H., Saxony, painting on porcelain
Castellini, Raffaelle, Rome, copy, in mosaic, of medallion of Boniface II., also of head of John the Baptist
Chebaux, J., France, designs for cotton print and calico
Cheverton, B., the Theseus, as exemplifying the reduction by machinery of statues
Clerget, C. E., France, designs, and works in ornament
Collas, A., France, works exemplifying reduction of sculpture
Couder, A., France, shawl designs
Day and Son (Fine Arts Court), chromolithography & lithography united
Debay, Auguste, France, the "Premier Berceau," in marble
Debay, Jean (Main Avenue, East), France, death of the stag, in bronze
Design, Government Head School of (Fine Arts Court), designs
Devers, J., France, Holy Family, on lava
Dieterle, J., France, painting on china, in the Sèvres manufactory
Drake, Professor F., Prussia, cast in plaster, of part of pedestal to monument of Frederick William III. of Prussia
Ducluzeau, Madame A. (Main Avenue, East), France, painting of Holy Family, and of Her Majesty, on china
Essex, W., collection of enamel paintings
Etex, A., France, various works of sculpture in plaster and marble
Fischer, K., Prussia, medals
Foley, J. H. (North Transept—Sculp-

ture Court), Youth at a Stream, and Ino and Bacchus, in plaster
Fraccaroli, Innocenzo, Austria, statues in marble, Achilles Wounded, and David Slinging the Stone
Fraikin, C. A., Belgium, Psyche carrying off Cupid, in plaster
Fratin, France, Group of Eagles, in bronze
Fuchs, J. N. von, Bavaria, fresco, exhibited by J. Muhr
Galli, Antonio, Austria, statue in marble, Susannah
Geefs, G., Belgium, A Lion in Love, in plaster
Geerts, C., Belgium, carving in oak
Gérente, A., France, stained glass
Hamon, France, enamelled casket
Hanhart, M. and N. (Fine Arts Court), chromolithrography
Hardman, J., and Co., Class XXVI., painted glass window
Hogan, J. (Sculpture Court), Drunken Faun, in plaster
Hullmandel and Walton (Fine Arts Court), chromolithography
Jacobber, France, paintings of flowers, on china
Jacotot, Madame, France, head of Raphael
Jennings, B. (Sculpture Court), statue of Cupid, in marble
Jerichau, J. A., Denmark, a group in plaster, Hunter and Panther
Jones, Owen (Fine Arts Court), chromolithography
Kellner, S., Bavaria, glass painting of window in St. Lorenz Church, Nürnberg
Kornaloff, N., Russia, painting on porcelain
Laroche, E., France, designs for shawls, barèges, muslins, &c.
Laurent, Mdme. Pauline, France, three enamels, on copper
Lawlor, J. (Sculpture Court), marble statue of a Bather
Lechesne, Auguste (Main Avenue, East), France, two casts in plaster, Child protected from a Snake by a Dog
Lemercier, R. J., France, lithography and chromolithography
Lequesne, E. L. (Main Avenue, East), France, the Dancing Faun, in bronze
Limner, Luke, Class XVII., variety of designs
Liverpool Local Committee (Main Avenue, West), model of Liverpool
Macdonald, Lawrence, Rome, Iconic statue, in marble
Macdowell, P. (South Transept), Cupid, in marble, and Eve, in plaster; Girl at Prayer, in marble
Marechal and Guynon, France, painting on glass
Marshall, W. C. (Sculpture Court), Sabrina, in marble
Monti, Raffaelle, Austria, marble statue of Eve
Perez and Co., Spain, inlaid wood table
Powers, Hiram, United States, statue of the Greek Slave, in marble
Ramus, J. M., France, group in marble, Cephalis and Procris
Rietschel, Ernst, Saxony, plaster group, La Pieta; bas-reliefs, in marble
Rogers, W. G., cradle, carved in Turkey boxwood
Roucou, J., France, inlaid work
Salter, S., Class VII., model of St. Nicholas' Church, Hamburg
Schilt, France, painting on a vase
Sharp, T. (Sculpture Court), statue, in marble, of Boy and Lizard
Silbermann, G., France, chromo-typography
Simonis, Eugène, Belgium, plaster statue of Godfrey de Bouillon, and other works
Strazza, Giovanni, Austria, marble statue of Ishmael
Thrupp, F. (Sculpture Court), Boy and Butterfly, and Arethusa, both in marble
Tuerlinckx, Joseph, Belgium, marble statue of Giotto
Vienna, Imperial Printing Office of, Austria, "Paradisus Vindobonensis," in chromolithography
Wallis, T. W. (Fine Arts Court), carvings in wood
Watson, the late M. L. (Sculpture Court —Main Avenue, West), statue of J. Flaxman in marble; and Eldon and Stowell group, also in marble
Winkelmann and Sons, Prussia, colours and lithographic prints
Wolff, Albert, Prussia, marble group, Innocence
Wurtlich, O., Bavaria, portrait of Charles IX, on china
Wyatt, M. Digby (Fine Arts Court), good taste in designs generally
Wyon, L. C., medals and medallions of the Royal children

(In addition to the Medals awarded, 2037 Contributions received "Honourable Mention" by the several Juries.)

VISITORS TO THE EXHIBITION.

Return, showing for each day, from May 1st to October 11th, the estimated Daily Number of Visitors to the Exhibition, the Receipts at the Doors, and the largest number of Persons in the Building at any one time.

Date.	Day of the Week.	Number of Persons paying at the doors. Number.	Number of Persons paying at the doors. Entrance Fee.	Amount received at the doors.	Estimated Number of Persons entering with Season Tickets.	Total number who entered daily, including Staff and Exhibitors' Attendants, as estimated by the Police.		Largest Number of Persons in the Building at any one time.
			s. d.	£ s. d.				
May 1	Thursday ..				19,000	25,000		
2	Friday	560	20 0	560 0 0	15,000	15,560		
3	Saturday ..	482	20 0	482 0 0	15,000	15,482	56,042	
		1,042		1,042 0 0	49,000			
5	Monday	5,452	5 0	1,362 19 0	12,304	17,756		
6	Tuesday	5,834	5 0	1,458 10 0	12,321	18,155		
7	Wednesday .	7,163	5 0	1,790 15 0	12,314	19,477		
8	Thursday ..	8,072	5 0	2,018 0 0	13,000	21,072		
9	Friday	7,298	5 0	1,824 10 0	12,316	19,614		
10	Saturday ..	7,375	5 0	1,843 15 0	14,801	22,176	118,250	
		41,194		10,298 9 0	77,056		174,292	
12	Monday	6,390	5 0	1,597 10 0	12,932	21,322		
13	Tuesday	8,918	5 0	2,229 10 0	13,027	23,945		
14	Wednesday .	8,259	5 0	2,064 15 0	13,131	23,390		
15	Thursday ..	9,704	5 0	2,426 0 0	13,527	25,231		
16	Friday	10,226	5 0	2,556 10 0	13,804	26,030		
17	Saturday ..	9,889	5 0	2,472 5 0	13,700	25,589	145,507	
		53,386		13,346 10 0	80,121		319,799	
19	Monday	9,380	5 0	2,345 0 0	13,740	25,120		
20	Tuesday	13,443	5 0	3,360 15 0	13,800	29,243		
21	Wednesday .	14,049	5 0	3,512 5 0	14,200	30,249		
22	Thursday ..	15,892	5 0	3,797 11 0	13,500	31,393		
23	Friday	16,382	5 0	4,095 10 0	14,000	32,352		
24	Saturday ..	20,312	5 0	5,078 0 0	22,200	44,512	192,869	
		89,458		22,189 1 0	91,440		512,668	

Date.	Day of the Week.	Number of Persons paying at the doors. Number.	Entrance Fee.	Amount received at the doors. £	s.	d.	Estimated Number of Persons entering with Season Tickets.	Total Number who entered daily, including Staff and Exhibitors' Attendants, as estimated by the Police.		Largest Number of Persons in the Building at any one time.
			s. d.	£	s.	d.		Bt. forw.	512,668	
May 26	Monday....	18,402	1 0	920	2	0	7,000	25,402		
27	Tuesday....	27,957	1 0	1,347	17	0	2,043	30,000		
28	Wednesday.	37,184	1 0	1,869	4	0	3,421	40,605		
29	Thursday ..	47,518	1 0	2,375	18	0	4,370	51,888		
30	Friday	22,713	2 6	2,839	9	0	22,956	45,669		
31	Saturday ..	7,083	5 0	1,770	15	0	21,467	28,550		
									222,114	
		160,857		11,123	5	0	61,257			
									734,782	
June 2	Monday....	42,581	1 0	2,129	1	0	3,709	26,290		
3	Tuesday....	48,302	1 0	2,415	2	0	2,327	50,629		
4	Wednesday.	50,016	1 0	2,500	16	0	4,619	54,635		
5	Thursday ..	51,337	1 0	2,566	17	0	3,917	55,254		
6	Friday	20,468	2 6	2,558	11	0	5,666	26,134		21,606
7	Saturday ..	6,095	5 0	1,523	15	0	6,891	12,986		8,822
									245,928	
		218,799		13,694	2	0	27,129			
									980,710	
9	Monday....	48,714	1 0	2,436	4	0	5,480	54,194		46,167
10	Tuesday....	45,444	1 0	2,272	2	0	4,253	49,697		46,159
11	Wednesday.	43,219	1 0	2,160	19	0	4,535	47,754		37,823
12	Thursday ..	44,667	1 0	2,233	7	0	3,651	48,318		38,146
13	Friday	17,650	2 6	2,206	5	0	6,870	24,520		12,555
14	Saturday ..	6,539	5 0	1,634	15	0	7,563	14,102		10,025
									238,585	
		206,233		12,943	12	0	32,352			
									1,219,295	
16	Monday....	57,089	1 0	2,854	9	0	6,680	63,769		46,374
17	Tuesday....	63,821	1 0	3,191	1	0	4,333	68,154		54,422
18	Wednesday.	57,947	1 0	2,897	7	0	4,716	62,663		52,673
19	Thursday ..	59,692	1 0	2,984	12	0	4,171	63,863		46,792
20	Friday	22,553	2 6	2,819	4	6	9,281	31,834		19,405
21	Saturday ..	6,698	5 0	1,674	10	0	6,034	12,732		8,607
									303,015	
		267,800		16,421	3	6	35,215			
									1,522,310	
23	Monday....	60,331	1 0	3,016	11	0	7,224	67,555		55,379
24	Tuesday....	63,732	1 0	3,186	12	0	4,662	68,394		54,097
25	Wednesday.	53,834	1 0	2,661	14	0	4,611	58,445		45,731
26	Thursday ..	54,450	1 0	2,722	10	0	3,331	57,781		45,631
27	Friday	23,754	2 6	2,969	6	0	5,279	29,033		21,613
28	Saturday ..	6,363	5 0	1,590	15	0	5,138	11,501		10,645
									292,709	
		262,464		16,177	8	0	30,245			
									1,815,019	

Date.	Day of the Week.	Number of Persons paying at the doors. Number.	Entrance Fee.	Amount received at the doors.	Estimated Number of Persons entering with Season Tickets.	Total Number who entered daily, including Staff and Exhibitors' Attendants, as estimated by the Police.		Largest Number of Persons in the Building at any one time.
			s. d.	£ s. d.		Bt. for.	1,815,019	
June 30	Monday	49,396	1 0	2,469 16 0	3,483	52,879		46,090
July 1	Tuesday ..	48,590	1 0	2,429 10 0	2,479	51,069		42,717
2	Wednesday.	47,278	1 0	2,363 18 0	2,121	49,399		39,873
3	Thursday ..	53,039	1 0	2,651 19 0	2,599	55,638		44,890
4	Friday	20,737	2 6	2,592 2 6	5,270	26,007		20,945
5	Saturday ..	6,263	5 0	1,565 15 0	5,484	11,747		8,276
							246,739	
		225,303		14,073 0 6	21,436			
							2,061,758	
7	Monday	57,042	1 0	2,852 2 0	4,628	61,670		50,605
8	Tuesday	63,385	1 0	3,169 5 0	2,577	65,962		54,016
9	Wednesday .	54,206	1 0	2,710 6 0	3,849	58,055		48,512
10	Thursday ..	59,160	1 0	2,958 0 0	2,332	61,492		51,284
11	Friday	25,167	2 6	3,145 17 6	4,900	30,067		23,563
12	Saturday ..	6,359	5 0	1,589 15 0	4,822	11,181		8,433
							288,427	
		265,319		16,425 5 6	23,108			
							2,350,185	
14	Monday	59,148	1 0	2,957 8 0	3,546	62,694		52,128
15	Tuesday....	70,041	1 0	3,502 1 0	4,081	74,122		61,640
16	Wednesday.	58,204	1 0	2,910 4 0	2,422	60,626		50,553
17	Thursday ..	60,465	1 0	3,023 5 0	3,281	63,746		51,336
18	Friday	30,099	2 6	3,762 7 6	5,239	35,338		27,700
19	Saturday ..	5,443	5 0	1,360 15 0	3,884	9,327		7,121
							305,853	
		283,400		17,516 0 6	22,453			
							2,656,038	
21	Monday	66,767	1 0	3,338 7 6	3,873	70,640		58,541
22	Tuesday....	64,722	1 0	3,236 2 0	3,439	68,161		55,264
23	Wednesday.	48,774	1 0	2,438 14 0	1,825	50,599		42,390
24	Thursday ..	45,721	1 0	2,286 1 0	1,737	47,458		40,881
25	Friday	23,872	2 6	2,984 0 0	3,010	26,882		21,325
26	Saturday ..	5,912	5 0	1,478 0 0	4,487	10,399		7,946
							274,139	
		255,768		15,761 4 6	18,371			
							2,930,177	
28	Monday	63,893	1 0	3,194 13 6	3,277	67,170		54,933
29	Tuesday....	65,630	1 0	3,281 10 0	2,866	68,496		57,677
30	Wednesday.	56,706	1 0	2,835 6 0	1,676	58,382		47,499
31	Thursday ..	56,556	1 0	2,827 15 0	1,293	57,84		46,315
Aug. 1	Friday	22,817	2 6	2,852 2 6	4,080	26,897		21,198
2	Saturday ..	5,298	5 0	1,324 10 0	4,427	9,725		7,167
							288 ,519	
		270,980		16,315 18 0	17,619			
							3,218,696	

Date.	Day of the Week.	Number of Persons paying at the doors. Number.	Entrance Fee. s.	d.	Amount received at the doors. £	s.	d.	Estimated Number of Persons entering with Season Tickets.	Total Number who entered daily, including Staff and Exhibitors' Attendants, as estimated by the Police.		Largest Number of Persons in the Building at any one time.
									Bt. for.	3,216,696	
Aug. 4	Monday....	60,138	1	0	3,006	18	0	2,493	62,631		53,254
5	Tuesday....	64,729	1	0	3,236	9	0	3,340	68,069		56,931
6	Wednesday.	56,664	1	0	2,833	4	0	2,475	59,139		44,368
7	Thursday ..	57,196	1	0	2,859	16	0	2,922	60,118		48,385
8	Friday	15,365	2	6	1,920	12	6	3,101	18,466		14,630
9	Saturday ..	12,678	2	6	1,584	15	0	5,670	18,348		14,792
										286,771	
		266,770			15,441	14	6	20,001			
										3,505,467	
11	Monday....	56,599	1	0	2,829	19	0	2,035	58,634		49,038
12	Tuesday....	56,539	1	0	2,826	19	0	2,015	58,554		49,167
13	Wednesday.	45,290	1	0	2,264	10	6	2,527	47,817		39,343
14	Thursday ..	47,720	1	0	2,386	0	0	1,732	49,452		39,589
15	Friday	17,209	2	6	2,151	2	6	3,650	20,859		16,623
16	Saturday ..	12,739	2	6	1,592	7	6	4,002	16,741		13,646
										252,057	
		236,096			14,050	18	6	15,961			
										3,757,524	
18	Monday....	50,136	1	0	2,506	16	0	1,389	51,525		43,612
19	Tuesday....	55,476	1	0	2,773	16	0	1,603	57,079		47,695
20	Wednesday.	44,348	1	0	2,217	8	0	219	44,567		35,499
21	Thursday ..	49,402	1	0	2,470	2	6	1,080	50,482		41,633
22	Friday	15,661	2	6	1,957	12	6	2,317	17,978		13,927
23	Saturday ..	11,479	2	6	1,434	17	6	3,429	14,908		11,607
										236,539	
		226,502			13,360	12	6	10,037			
										3,994,063	
25	Monday....	48,734	1	0	2,436	14	0	287	49,021		41,414
26	Tuesday....	49,870	1	0	2,493	10	0	1,441	51,311		44,190
27	Wednesday.	37,921	1	0	1,896	1	0	307	38,228		31,618
28	Thursday ..	43,350	1	0	2,167	10	0	894	44,244		37,412
29	Friday	12,479	2	6	1,559	17	6	3,111	15,590		12,771
30	Saturday ..	10,454	2	6	1,306	15	0	2,598	13,052		10,855
										211,446	
		202,808			11,860	7	6	8,638			
										4,205,509	
	Monday....	49,309	1	0	2,465	9	0	924	50,233		43,170
Sept. 1	Tuesday....	48,155	1	0	2,407	15	0	1,711	49,866		42,115
2	Wednesday.	41,612	1	0	2,080	12	6	305	41,917		36,005
3	Thursday ..	42,758	1	0	2,137	18	0	1,451	44,209		37,209
4	Friday	12,747	2	6	1,593	7	6	2,979	15,726		12,753
5	Saturday ..	9,590	2	6	1,198	15	0	3,082	12,672		10,857
										214,623	
		204,171			11,883	17	0	10,452			
										[illegible]	

Date.	Day of the Week.	Number of Persons paying at the doors. Number.	Entrance Fee.	Amount received at the doors.			Estimated Number of Persons entering with Season Tickets.	Total Number who entered daily, including Staff and Exhibitors' Attendants, as estimated by the Police.		Largest Number of Persons in the Building at any one time.
			s. d.	£	s.	d.		Bt. for.	4,420,132	
Sept. 8	Monday....	55,357	1 0	2,767	17	0	1,495	56,852		48,843
9	Tuesday ...	55,901	1 0	2,795	1	0	2,114	58,0.5		50,651
10	Wednesday.	47,905	1 0	2,395	5	6	2,201	50,106		41,774
11	Thursday ..	52,759	1 0	2,637	19	6	2,068	54.827		46,050
12	Friday	15,120	2 6	1,890	0	0	2,839	17,959		14,528
13	Saturday ..	11,614	2 6	1,451	15	0	4,659	16,273		14,002
									254,032	
		238,656		13,937	18	0	15,376			
									4,674,164	
15	Monday....	58,670	1 0	2,933	10	6	1,827	60,497		52,268
16	Tuesday ...	60,169	1 0	3,008	9	0	2,453	62,622		54,127
17	Wednesday	50,021	1 0	2,501	1	0	2,736	52,757		44,427
18	Thursday ..	56,201	1 0	2,810	1	6	2,399	58,600		49,555
19	Friday	17,817	2 6	2,227	2	0	3,671	21,488		18,205
20	Saturday ..	12,837	2 6	1,604	13	0	4,529	17,366		14,802
									273,330	
		255,715		15,084	17	0	17,615			
									4,947,494	
22	Monday....	57,256	1 0	2,863	6	0	2,098	59,354		50,108
23	Tuesday ...	57,187	1 0	2,859	7	0	3,195	60,382		50,246
24	Wednesday.	51,452	1 0	2,572	12	0	3,088	54,540		46,662
25	Thursday ..	54,514	1 0	2,725	14	0	2,647	57,161		48,007
26	Friday	19,326	2 6	2,415	15	0	4,368	23,694		20,034
27	Saturday .	14,817	2 6	1,852	2	6	5,419	20,236		16,541
									275,367	
		254,552		15,288	16	6	20,815			
									5,222,861	
29	Monday....	65,915	1 0	3,295	15	0	2,627	68,542		59,089
30	Tuesday ...	66,064	1 0	3,303	4	0	3,282	69,346		60,039
Oct. 1	Wednesday.	56,611	1 0	2,830	11	0	2,460	59,071		51,570
2	Thursday ..	61,612	1 0	3,080	12	6	2,686	64,298		55,379
3	Friday	26,733	2 6	3,354	3	0	5,218	31,951		27,626
4	Saturday ..	21,902	2 6	2,862	14	0	7,738	29,640		26,074
									322,848	
		298,837		18,726	19	6	24,011			
									5,545,709	
6	Monday....	103,506	1 0	5,175	16	0	4,299	107,815		89,242
7	Tuesday ...	104,630	1 0	5,231	10	0	5,285	109,915		93,224
8	Wednesday.	105,663	1 0	5,283	3	0	4,097	109,760		87,275
9	Thursday ..	86,887	1 0	4,344	7	6	3,926	90,813		72,344
10	Friday	39,312	2 6	4,914	1	6	7,601	46,913		39,767
11	Saturday ..	38,765	2 6	4,845	13	6	14,296	53,061		45,067
									518,277	
		478,773		29,794	11	6	39,504			
									6,063,986	

JAMES WADE, *Registrar.*

FINANCIAL STATEMENT.

The pecuniary proceeds of the Exhibition up to its close, are stated as follow:—

Season Tickets	£67,610	14	0
Receipts at doors	356,808	1	0
Retiring rooms	2,427	19	9¼
Washing places	440	11	11½
Taking charge of umbrellas	831	3	3
Profit from medals struck in building	881	16	10
	£429,000	6	10
The other receipts were:—			
Subscriptions	67,399	3	10
Catalogue contract	3,200	0	0
Refreshment contract	5,500	0	0
Sale of weather charts	7	14	11
Grand total	£505,107	5	7

The liabilities incurred, so far as they have been at present ascertained, are as follow:

To Messrs. Fox and Henderson for the building	£79,800	0	0
To Messrs. Munday for rescinding of contract	5,000	0	0
Extra galleries, counters, and fittings	35,000	0	0
Management, including printing, &c., up to May 1	20,943	0	0
Police force	10,000	0	0
Prize fund	20,000	0	0
Management during the Exhibition	...		
Total	£170,743	0	0

The Official Catalogue.—Upwards of 250,000 copies of the Catalogue, about one-sixth of the estimated number of printed volumes that issued from the printing press within the three first centuries after the discovery of the art of printing, have been sold. The quantity of paper thus consumed amounted to 105 tons, and the duty paid thereon to the sum of £1460; 52,000 pounds weight of metal are employed in the type, which is kept constantly "set up," in order to make all needful alterations. These figures are so large, that we find it difficult to discover any middle term to bring the results they indicate home to our minds. But it may, perhaps, assist the imagination to reflect that if from any reason, or, indeed, many reasons, the whole of the earlier editions had been consigned in one vertical column to the bosom of the Pacific Ocean, the depth of the latter being generally estimated at 6,000 feet, the present improved and correct edition would still form a lonely peak rising to the height of Chimborazo or Cotopaxi, exactly 18,000 feet above the level or the censure of the ordinary inhabitants of this earth.—*Edinburgh Review.*

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