strips of leather, and other occupations which combine play with work, are carried on with advantage. A good manager of Kindergarten can do them great good, and gymnastics give them the power of controlling their limbs; but every exercise must be first taught singly

Object lessons must be given by means of models, stuffed animals, birds, fish, &c., to bring out the powers of memory and reason. Simple hymns and ballads are practised.

Very little technical work can be taught, except making rush baskets, &c., as the children are all under ten. This school has been carried on for eleven years, and the benefits of teaching blind children so early are plainly seen by all who watch the progress which they make when removed to the Blind Institution; they are fit for independent work at an age three years less than the average of those who do not go through it.

As the children pass through the institution more rapidly, there is also more room for those who become blind as adults."

Of the *National Blind Institution* at Dresden, Dr Reinhard, the director, said—"It is organized so that the working school forms an essential part of it, and when children enter it, consideration is at once given, not only to their physical, religious, and intellectual education, but also to their instruction in work. Whilst between the ages of six and eleven they remain in the preparatory school, and find inexhaustible occupation in Frobel's system of play and exercise

'Playwork' is given them as they become fit for it; for the feeling that they can make something useful rejoices the little workers and excites their activity; it is important that they should learn early to aim at real work. They learn to plait reed mats, which is an excellent means of strengthening the muscles of the arm and hand, and they also make little rush baskets.

The range of their work is extended when they are transferred to the higher class, which is usually during their eleventh year; and from that time till their confirmation, which is generally at the end of their fourteenth year, they have at least three hours' work every day in the shops.

The work of the girls is, unfortunately, much restricted, and it is doubtful whether their learning to make baskets and rope is without injury to their constitution. Besides, we must not lose sight of the evils arising from their working with male overseers and workmen.

Hence, girls learn in general only knitting, plaiting counterpanes, chair-caning, hair-working, and sewing—as much as is required for mending their linen.

Hair-work has already been adopted in another institution, and is the most profitable work for blind girls, as a clever one can earn 7 or 8 groschen (about 9d.) a day by it, whilst the quickest knitter can scarcely make 2 groschen a day.

The boys learn either basket-making or rope-making; they learn in the rope factory various kinds of light work, and, when they have been confirmed, choose for themselves between these two trades, their muscles being strengthened by alternately being employed at both.

It is important to consider the grounds of fitness for these trades. Rope-making requires strength and health of body, for much of the work must be carried on in places exposed to the weather; and besides this it requires a great deal of dexterity which is not indispensable in basket-making. It is also of great importance that each should learn the trade in which he is most likely to succeed after leaving the institution; for the great object is that pupils should be fitted for independent work eventually.

All those who understand the subject are now convinced that the blind cannot be really helped by building asylums. If there were three times as many asylums as there are schools, there would not be room for all, and the inmates would never be satisfied with their condition. Even women prefer an independent life full of care to the sameness of an asylum, where one quarrelsome person often embitters the whole life of the institution.

If there is any possibility of establishing pupils of either sex without exposing them to the risk of losing their health, there can be no doubt that it is to be preferred to placing them in asylums.

"The Dresden Blind Institution is managed on the principle that the pupils, on commencing independent work, require much assistance before they can support themselves by it, and that the institution must give the necessary help. The director of the institution makes known to the manufacturers that a blind worker is coming to settle near them, and induces some of the families around to take an interest in him, and recommend him for employment. He also inserts in the newspapers short notices describing his capacity for work, and his difficulty in finding customers, &c., and requesting people to employ him.

The outfit required for pupils on leaving the institution consists of tools and clothing, and materials must also be provided at first. The cost of these is partly defrayed by the fund established for the purpose, partly by the savings of the pupils, and partly, if necessary, by a grant from the parish.

It is indispensable that the blind worker should have some person near in whom he can fully confide, and from whom he can get advice and help in any time of temporary difficulty, whilst the manager of the institution can rely on his taking an interest in the worker, and seeing that he obeys the rules.

The purchase of raw material causes the greatest difficulty; the blind man has not the means of buying much at a time, and must, consequently, pay highly for it; therefore the institution helps him by buying it at wholesale prices and letting him have it at the same price in small quantities. The number of his applications for materials shows the managers whether the man is industrious.

More than 200 blind support themselves in Saxony by means of the aid afforded by the fund and their own exertions. The fund amounted, in 1873, to 85,000 dollars, subscribed in all parts of the country."

Previous to the Franco-German War, Mr Liebreich, a celebrated oculist and practical friend of the blind, by order of the empress of the French, prepared a report in regard to the *Institution Impériale des jeunes Aveugles* of Paris, in which he says that the institution—

"Is an establishment of the State, in which children of both sexes deprived of sight receive an intellectual, musical, and industrial training. Children are received at the age of 13 years. They remain in the institution 8 years, and are made professors, musicians, tuners of pianos, workmen and workwomen.

During the last ten years 110 male pupils have left the institution, concerning whom we have received satisfactory information. The workwomen, on the contrary, earn but very little; among 166 blind, 108 have received a very good education, which ensures to them an easy and independent living; 56 have received an elementary training, and have not been put entirely beyond the charge of public charity.

The annual expense for 200 pupils is very nearly 240,000 francs (of which 146,000 francs are given by the State), making an average of 1200 fr. (£48) per pupil,—the workman costing a little less, the artist a little more. This sum it not excessive for the education of a tuner, a professor, or an organist, but it certainly is for the education of a workman, who only receives an elementary training, and is not even qualified to earn his own living.

M. Gaudet, chief instructor of the institution, expresses disapproval of the simultaneous education of artists and workmen. He says, 'Realizing from the first the great difference which exists between the future of an organist or a piano tuner on one side, and of a blind workman on the other, the apprentices regard themselves as sacrificed; therefore they do all they can to become tuners, and thus often lose much time in fruitless efforts before they resign themselves to become workmen, and even then toil reluctantly. On quitting the establishment to follow their occupations, they are not habituated to assiduous toil; returning to their indigent families they regret the comfortable life of the institution, and finally become discouraged.'

Tuners begin ordinarily to work with piano manufacturers, and earn easily 1500 francs per year. If a little later they succeed in obtaining a town connection, they have no difficulty in earning double that or more. Some have even succeeded in uniting manufacture with tuning. The organists, by obtaining places in churches and by giving music lessons, very soon earn a good livelihood.

In short, the tuners, organists, and teachers have, in spite of their infirmity, become independent men, exercising honourable and lucrative professions; some have married and reared families, others have come to the aid of their indigent relatives.

Very different is the lot of the blind workmen, who by toiling without relaxation many more hours than sighted workmen, barely succeed in gaining a part of what they need to support themselves. By perfecting as far as possible the industrial training of the institution, a greater number of the male pupils might be enabled to earn 300 or 400 francs, but none far exceed this sum. The workwomen seldom earn more than 100 or 150 francs per year."

The institutions of America are not asylums, but in the truest sense of the word educational establishments, in which the blind, without regard to their future, receive a thorough education. The blind in the United States are socially far above those of any other country; large numbers of them become eminent scholars and musicians, and even their blind workmen enjoy a degree of comfort unknown in England or on the Continent.

The results achieved by the Perkins Institution at Boston, U.S., are particularly instructive. High-class musical training appears to have been commenced there about 13 years ago, previous to which time the results in this respect were far from being satisfactory. The report of 1867 states that music is now taught to all of both sexes whose natural abilities make it probable that under proper

instruction, they will succeed as organists, teachers of music, or piano tuners, and goes on to say—"The teaching of music and playing is now the largest single field open to the blind as a means of support, and it seems to be growing larger. People are becoming more disposed to employ them; and as they go forth from the school they have more and more ground of hope that they will find opportunities to earn their living in this way." The whole tone of mind among the musical pupils has been changed, for instead of looking forward to the future with fear and anxiety, they now feel a well-grounded confidence in themselves. It seems that in Boston, and in America generally, the blind are able to earn more as teachers of music than as tuners, which is exactly the reverse of the state of things existing in Paris, and may arise either from differences in the condition of the two countries, or from the training for teachers being more thorough at Boston than at Paris; but their expérience is identical in one respect, which is, that the blind who have the requisite amount of talent are almost certain to make a good income out of music; but to attain this end they must aim high. It will not do to be equal to the average seeing teacher or tuner; they must be superior; and this involves a good musical notation with first-rate masters, instruments, and appliances, and above all, a determination on the part of managers and teachers to overcome all obstacles.

A few paragraphs from American reports will sufficiently illustrate the enlightened views held in that country in regard to the education of the blind.

"A school for the higher education of the blind should be specially adapted to the condition and wants of the persons to be trained. In it the course of study should be the same as in our best colleges. All instruction should be oral, and the apparatus and modes of illustration be addressed to the touch. It should be supplied with text-books, maps, diagrams, and the like, in raised characters. It should have large collections of models of various kinds, such as weights, measures, tools, machinery, and the like; mannikins and models showing the anatomy of plants and animals, as well as their outward form. It should have collections of shells, crystals, minerals, and the like; models and sections showing geological strata; philosophical apparatus adapted to the touch; in short, everything that can be represented by tangible forms.

It would amaze those who have not reflected upon it to know how much can be done in this way. Saunderson, the blind professor of mathematics in Cambridge, not only knew ordinary money well, but he was an expert numismatist, and could detect counterfeits in a collection of antique coins better than ordinary persons could do by the sight.

Such an institute should have able professors and teachers, with special aptness for adapting their lessons to the condition of their scholars. It should furnish special facilities for the study of languages, ancient and modern, of mathematics, of pedagogy, and especially of music. It should also be well provided with everything necessary in a good conservatory of music, and have funds for the payment of competent teachers.

It is evident that there are a large number of persons to whom such an institute would be a source of great happiness, and a means of preparation for great usefulness.

A little reflection will show what a great advantage generous culture would be to a blind man, even if he were to be only a musician. Let him be ever so accomplished in his immediate art, he is under great disadvantages as compared with his competitors who can see. But if he has generous culture in other branches of knowledge, he will have advantages which few of them possess, and of course he will be more nearly on a level with them, and more capable of earning a living and enjoying it. Human effort will in such a case be successful in counteracting the principal evil which flows from the infirmity of blindness."

"The careful observer will see a marked difference between a hundred youths in a blind institution and the same number of boys in an ordinary school. This is especially true of the male sex. He will find among the blind a larger proportion of scrofulous, narrow-chested, angular, pallid, and feeble boys, who move sluggishly and soon fire; and a smaller proportion of those full-chested, chubby, rosy, elastic creatures, whom nothing can keep still, and nothing tire out.

Now, if the blind, as a class, have a much smaller *quantum* of life than ordinary persons, it must be either on account of some flaw in the stock whence they sprung, or of some peculiarity in their mode of life, induced by their infirmity, such as bodily inactivity; but it probably results from both causes. At any rate, it is a matter worth considering.

The following tables have been calculated from data furnished by Vitality *seven* American State Institutions for the Blind—namely, those of of the New York, Ohio, Pennsylvania, Illinois, Missouri, Tennessee, and Blind. Massachusetts, and are the results of careful discussion of data, by far the most extensive and trustworthy, it is believed, yet published in any country.

In each of these tables the number of the blind actually surviving in 1859 are compared with the numbers that *should* then be surviving, according to two different Life Tables—first, the Massachusetts Life Table, prepared by Mr Elliott, from the State Census and Registration Returns for the year 1855; and secondly, the English Life Table, prepared by Dr Farr of London, from the returns for the year 1841:—

TABLE I.—*Comparing the relative vitality (or ability to resist destructive influences) of the Blind, at divers ages of life, according to the combined experience of seven American State Institutions for the Blind, with that of the populations of Massachusetts and of England respectively. Calculated by Mr E. B. Elliott, Consulting Actuary, Boston.*

Ages on Admission.	Number of Persons Admitted (known whether Surviving or Deceased).	Average Age on Admission.	Average Years elapsed, to middle of 1859.	Number Deceased (before the end of 1859).	Number Surviving (in 1859).	According to Elliott's Massachusetts Life Table.			According to Farr's English Life Table.		
						Number that should be Surviving (in 1859).	*Deficiency* of Actual Survivors, relative to the Number that should be Surviving.		Number that should be Surviving (in 1859).	*Deficiency* of Actual Survivors, relative to the Number that should be Surviving	
							Number.	Per cent.		Number.	Per cent.
0–6	14	4·4	19·1	1	13	12·0	−1·0[2]	...	12·0	−1·0[2]	...
6–10	210	7·7	14·3	39	171	189·2	18·2	9·6	189·8	18·8	9·9
10–14	287	11·5	13·2	52	235	257·2	22·2	8·6	259·5	24·5	9·4
14–18	209	15·5	13·3	38	171	182·0	11·0	6·1	186·6	15·6	8·4
18–22	177	19·3	14·3	50	127	149·6	22·8	15·1	154·0	27·0	17·5
22–26	101	23·3	14·6	19	82	84·8	2·8	3·4	86·9	4·9	5·6
26–30	47	27·4	12·6	10	37	40·3	3·3	8·1	40·8	3·8	9·4
30 and over	38	37·2	12·7	11	27	31·9	4·9	15·4	31·8	4·8	15·2
Age not specified	19	...	12·4	4	15	16·7[1]	1·7	10·4	17·1[1]	2·1	12·4
All ages...	1102	15·4	13·8	224	878	963·7	85·7	8·9	978·5	100·5	10·3

Note.—This table may be read thus:—Between the ages of 6 and 10 the number of persons admitted to the above-mentioned Institutions, of whom it is known whether they were living in 1859 or had previously deceased, was 210; their average age on admission was 7·7 years; the average period elapsed since admission, and previous to the middle of the year 1859, was 14·3 years; the number of those who died before the end of the year 1859 was 39,—the number surviving in 1859 being 171. The number that should be surviving, according to the *Massachusetts* Life Table, is 189·2. Hence the number of actual survivors was 18·2 *less* than the number demanded by the Massachusetts Table, which deficiency is 9·6 per cent. of (189·2) the number so demanded. The number that should be surviving, according to the *English* Life Table, is 189·8. Hence the number of actual survivors was 18·8 *less* than the number demanded by the English Table, which deficiency is 9·9 per cent. of (189·8) the number so demanded.

[1] Calculated on the assumption that the average age on admission of the persons whose ages were not specified was the same as the average age of those whose ages were specified, to wit, 15·4 years.

[2] Excess.

TABLE II.—*Comparing the relative vitality (or ability to resist destructive influences) of the Blind, at different periods after admission, according to the combined experience of seven American State Institutions for the Blind, with that of the population of Massachusetts and England respectively. Calculated by Mr E. B. Elliott, Consulting Actuary, Boston.*

Years.	Number of Persons Admitted (known as Surviving or Deceased).	Number Deceased (previous to the middle of 1859).	Number Surviving in 1859.	Average Age on Admission.	Average Number of Years Elapsed (to middle of 1859).	According to Elliott's Massachusetts Life Table.				According to Farr's English Life Table.			
						Number that should be Surviving (in 1859.)	Deficiency of Actual Survivors, relative to the Number that should Survive.			Number that should be Surviving (in 1859).	Deficiency of Actual Survivors, relative to the Number that should Survive.		
							Number.	Per cent.			Number.	Per cent	
								3 Year Group.	7 Year Group.			3 Year Group.	7 Year Group.
1832	13	4	9	12·7	27	9·7	0·7	7·1	12·5	10·1	1·1	10·4	15·6
1833	49	17	32	16·4	26	36·3	4·3			37·6	5·6		
1834	29	7	22	15·9	25	21·8	0·2[1]			22·6	0·6		
1835	26	8	18	17·1	24	19·7	1·7			20·4	2·4		
1836	33	12	21	15·5	23	25·5	4·5	17·8		26·5	5·5	20·7	
1837	45	18	27	16·3	22	35·1	8·1			36·3	9·3		
1838	41	12	29	14·9	21	32·6	3·6			33·8	4·8		
1839	30	12	18	14·5	20	24·2	6·2	12·3		25·0	7·0	15·4	
1840	37	8	29	16·6	19	29·9	0·9			31·0	2·0		
1841	47	7	40	14·2	18	39·0	1·0[1]			40·2	0·2		
1842	56	16	40	16·5	17	46·5	6·5	6·0	8·7	47·9	7·9	8·4	11·1
1843	70	13	57	12·7	16	60·2	3·2			61·6	4·5		
1844	68	14	54	13·9	15	58·6	4·6			59·9	5·9		
1845	43	11	32	14·6	14	37·3	5·3	8·9		38·3	6·3	11·0	
1846	51	9	42	15·3	13	44·6	2·6			45·6	3·6		
1847	35	8	27	14·2	12	31·2	4·2			31·7	4·7		
1848	43	12	31	16·3	11	38·3	7·3	11·1		39·1	8·1	12·6	
1849	60	8	52	16·8	10	54·2	2·2		7·6	55·1	3·1		9·1
1850	54	9	45	18·5	9	49·0	4·0			49·9	4·9		
1851	38	4	34	15·3	8	35·2	1·2	4·4		35·6	1·6	5·5	
1852	28	1	27	11·5	7	26·7	0·3[1]			26·7	0·3[1]		
1853	40	0	40	12·6	6	38·4	1·6[1]			38·3	1·7[1]		
1854	30	5	25	14·5	5	28·8	3·8	5·0		28·9	3·9	5·2	
1855	34	4	30	15·7	4	32·8	2·8			33·0	3·0		
1856	23	5	18	16·8	3	22·4	4·4		4·4	22·5	4·5		4·6
1857	16	0	16	17·6	2	15·7	0·3[1]	6·4		15·8	0·2[1]	6·7	
1858	23	0	23	18·0	1	22·8	0·2[1]			22·8	0·2[1]		
1859	40	0	40	16·2	0	40·0	0·0			40·0	0·0		

Note.—This table may be read thus:—Of the 68 persons admitted to the before-mentioned institutions during the year 1844, 14 died previous to the middle of the year 1859, and 54 were surviving in that year. The average age on admission of the 68 persons was 13·9 years, and the average number of years elapsed between the time of admission and the middle of the year 1859 was about 15 years. According to the Massachusetts Life Table, the number that should be surviving in 1859 was 58·6, showing the number of actual survivors to have been 4·6 less than the number demanded by such table. The deficiency (4·6 + 5·3 + 2·6 = 12·5) of actual survivors relative to the number that should survive of those admitted during the three years 1844, 1845, and 1846, was, according to the Massachusetts Table, 8·9 per cent. of (58·6 + 37·3 + 44·6 = 140·5) the number demanded; and the deficiency of actual survivors relative to the number that should survive of those admitted during the seven years 1839 to 1845 inclusive, was, according to the same life table, 8·7 per cent. of the number demanded. In like manner may be read the results derived from comparison with the English Life Table.

TABLE III.—*Summary of the results presented in the two preceding Tables, comparing the relative vitality (or ability to resist destructive influences) of the Blind, at divers ages of life, and also at divers periods after admission, according to the combined experience of seven American State Institutions for the Blind, with that of the population of Massachusetts and England respectively. Calculated by Mr E. B. Elliott, Consulting Actuary, Boston.*

Deficiency in the number of the Blind that survived in 1859, relative to the number that should then be surviving.

Ages on Admission.	According to the Massachusetts Life Table. Elliott.	According to the English Life Table. Farr.	Date of Admission (in Periods of *Three* Years).	Average Years Elapsed (to middle of 1859).	According to the Massachusetts Life Table. Elliott.	According to the English Life Table. Farr.	Date of Admission (in Periods of *Seven* Years).	Average Years Elapsed (to middle of 1859).	According to the Massachusetts Life Table. Elliott.	According to the English Life Table. Farr.
	Per cent.	Per cent.			Per cent.	Per cent.			Per cent.	Per cent.
0–6	...	...	1832–34	25·8	7·1	10·4	1832–38	23·6	12·5	15·6
6–10	9·6	9·9	1835–37	22·8	17·8	20·7	1839–45	16·6	8·7	11·1
10–14	8·6	9·4	1838–40	20·0	12·3	15·4	1846–52	10·2	7·6	9·1
14–18	6·1	8·4	1841–43	16·9	6·0	8·4	1853–59	3·2	4·4	4·6
18–22	15·1	17·5	1844–46	14·1	8·9	11·0				
22–26	3·4	5·6	1847–49	10·8	11·1	12·6				
26–30	8·1	9·4	1850–52	8·2	4·4	5·5				
30 and over	15·4	15·2	1853–55	5·1	5·0	5·2				
Age not specified	10·4	12·4	1856–58	2·0	6·4	6·7				
All ages...	8·9	10·3								

Note.—This table may be read thus:—Of the number of persons admitted to the above-mentioned institutions, between the ages of 10 and 14, the number that was surviving in 1859 was 8·6 per cent. *less* according to the Massachusetts Life Table, and 9·4 per cent. *less* according to the English Life Table, than the number that should then be surviving. Of the number of persons admitted during the *three* years 1838–40, from which the average time elapsing to the middle of 1859 was 20·0 years, the number that survived in 1859 was 12·3 per cent. *less* according to the Massachusetts Table, and 15·4 per cent. *less* according to the English Table, than the number that should then have been surviving. Of the number of persons admitted during the *seven* years 1839–45, from which the average time elapsing to the middle of 1859 was 16·6 years, the number that survived in 1859 was 8·7 per cent. *less* according to the Massachusetts Table, and 11·1 per cent. *less* according to the English Table, than the number that should then have been surviving.

[1] Excess.

According to the first table, it appears that, of the entire 1102 persons admitted whose after-history is known, 878 now survive, whereas the Life Table of Massachusetts calls for about 979 survivors, thereby indicating that the power of the blind, represented by the returns of these institutions, to resist destructive influences is about 9 per cent. (10·2) *less* than that of the population of all England, and that the number of deaths is from 60 to 80 per cent. *greater*, according to the tables employed for the comparison, than the number required by such tables.

If we could draw our statistics from the blind as a whole, and not from the favoured few who have been taught in schools, the average duration of life would be much less. We should probably find the average amount of vital force, or power to resist destructive agencies, to be nearly one-fifth less than that of ordinary persons.

It is well known that the blind as a class are happy, contented, and cheerful. There are exceptions, of course, and it is unfortunate that Milton should have been one of them, because his eminence as a poet and scholar makes his example conspicuous, and his words to be taken as the natural language of a class of unfortunates. There have been others more admirable in this respect, for they set forth in their lives and conversation the sublime moral height to which men may attain by grasping courageously the nettle misfortune, and 'plucking thence the flower' happiness." (F. J. C.)

BLOCH, MARK ELIEZER, a German naturalist, born at Ansbach, of very poor Jewish parents, about the year 1730. Having entered the employment of a surgeon at Hamburg, he was enabled by his own exertions to supply the want of early education, and made great progress in the study of anatomy, as well as in the other departments of medical science. After taking his degree as doctor at Frankfort-on-the-Oder he established himself as a physician at Berlin, and found means to collect there a valuable museum of objects from all the three kingdoms of nature, as well as an extensive library. His first work of importance was an essay on the different species of worms found in the bodies of other animals, which gained the prize offered by the Academy of Copenhagen. Many of his papers on different subjects of natural history, comparative anatomy, and physiology, were published in the collections of the various academies of Germany, Holland, and Russia, particularly in that of the Friendly Society of Naturalists at Berlin. But his greatest work was his *Allgemeine Naturgeschichte der Fische* (12 vols., 1782–95), which occupied the labour of a considerable portion of his life, and is considered to have laid the foundations of the science of ichthyology. The publication was encouraged by a large subscription, and it passed rapidly through five editions in German and in French. Bloch made little or no alteration in the systematic arrangement of Artedi and Linnæus, although he was disposed to introduce into the classification some modifications depending on the structure of the gills, especially on the presence or absence of a fifth gill, without a bony arch. To the number of genera before established he found it necessary to add nineteen new ones; and he described 176 new species, many of them inhabitants of the remotest parts of the ocean, and by the brilliancy of their colours, or the singularity of their forms, as much objects of popular admiration as of scientific curiosity. In 1797 he paid a visit to Paris, in order to examine the large collections of such subjects of natural history as had been inaccessible to him on the shores of the Baltic; and he returned to Berlin by way of Holland. His health, which had hitherto been unimpaired, began now to decline. He went to Carlsbad for its recovery, but his constitution was exhausted, and he died there on the 6th of August 1799.

BLOCK MACHINERY. A block is a case with its contained pulley or pulleys, by means of which weighty objects are hoisted or lowered with facility. There is nothing in the appearance of a block which, to an unpractised eye, would seem to require any stretch of mental ingenuity or of manual dexterity to manufacture. It is a machine apparently so rude in its structure, and so simple in its contrivance, that the name was probably given to it from its general resemblance to a log of wood, as is obviously the case with a butcher's block, a barber's block, the block of the executioner, &c. Of the two constituent parts of a ship's block, the external *shell* and the internal *sheave*, every carpenter might make the one, and every turner the other; but still block-making is a separate branch of trade, and it is necessary that it should be, for the whole efficiency of the block depends upon the proper proportions being observed between the various parts and the accuracy with which they are adjusted.

Mr Walter Taylor of Southampton took out a patent in the year 1781, to secure the benefit of some improvement he had made in the construction of the sheaves. He also shaped the shells, cut the timber, &c., by machinery driven by water, and carried on so extensive a manufacture of blocks as to be able to contract for nearly the whole supply of blocks and blockmakers' wares required for the use of the Royal Navy. Mr Dunsterville of Plymouth had a similar set of machines wrought by horse-power. Both his blocks and Taylor's were said to be superior to those constructed by the hand, though still deficient in many respects.

It would appear that it was the enormous quantity of blocks consumed in the course of a long protracted war that first called the attention of the Admiralty or Navy Board to the possibility of some reduction being made in the expense of so important an article, and to the imprudence of depending entirely on a single contractor. On these considerations, it seems to have been the intention of Government to introduce, among other improvements in Portsmouth Dockyard about 1801, a set of machines for making blocks there. About this time, too, Mr Brunel had completed a working model of certain machines for constructing, by an improved method, the shells and sheaves of blocks. This model was submitted to the inspection of the lords commissioners of the Admiralty, and it was decided to adopt Mr Brunel's more ingenious machinery.

The advantages to be gained were those common to all cases in which machine work supersedes hand labour, and consisted in the fact that, after the proper sizes of each part had been determined by careful calculation and experience, the machine could be made to observe these sizes with unerring accuracy, and so avoid all variations due to the carelessness or ignorance of the workman; these considerations are in blocks, perhaps more than in most things, of the utmost importance. Another advantage was, that the blocks could be made by Brunel's machinery about 30 per cent. cheaper than hand-made blocks had been previously obtained by contract, and the importance of this to the Admiralty in those days, when all ships were so heavily rigged, having no steam to supplement their sail power, will be sufficiently seen when it is stated that the remuneration which Brunel was to receive for his invention was agreed to be the savings of one year, and that these savings were estimated at £16,621; in addition to this he received an allowance of a guinea a day for about six years while engaged on the work, and was paid £1000 for his working model—the total amount paid to Brunel for the invention amounting to about £20,000.

The process may be described as follows:—Pieces of wood are cut roughly to the size of the block, and the first operation is then performed by the *boring-machine*, which bores a hole for the pin, and one, two, or three holes, as the case may be, for single, double, or treble blocks, to receive the first stroke of the mortising chisel; the block is next taken to the *mortising-machine*, where the mortise or mortises for the sheaves are cut; after this, to a *circular saw*, conveniently arranged for cutting off the corners and so preparing the block for the *shaping-machine*, which consists principally of two equal and parallel circular wheels