ON THE

WORKING OF PUNKAHS IN INDIA,

AS AT PRESENT

CARRIED OUT BY COOLIE LABOUR,

AND THE SAME OPERATION

EFFECTED BY MACHINERY.

BY

HON. R. C. PARSONS, B.A., B.C.E. DUBLIN, A.I.C.E.



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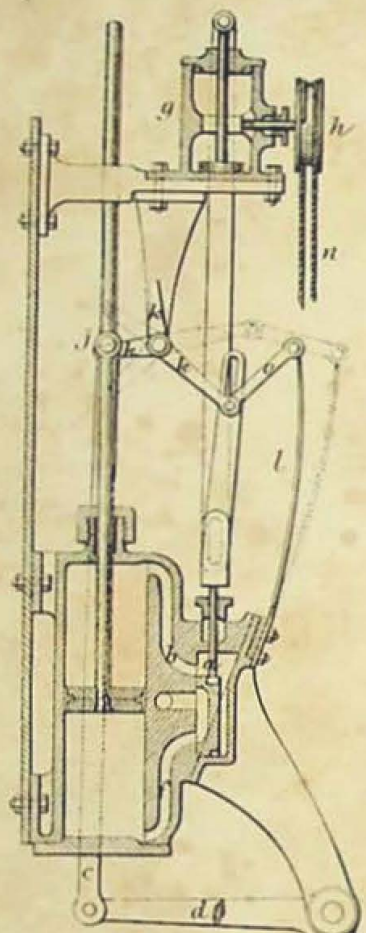

Fig. 1.

PNEUMATIC PUNKAH MACHINE.

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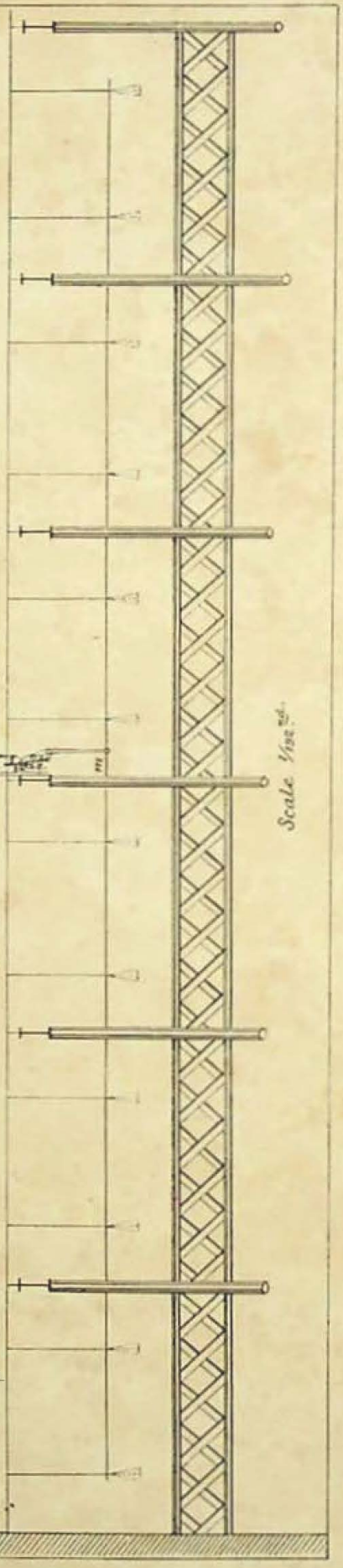
Fig. 2.

PNEUMATIC PUNKAH MACHINE AND PUNKAKS
as erected in the
Royal Westminster Aquarium.



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ON THE

WORKING OF PUNKAHS IN INDIA.

Most persons are no doubt aware that in all parts of the plains of India during the hot season, punkahs are one of the necessaries of life, not only to Europeans but also to the native gentry and merchants.

This season (speaking generally) extends from the months of March to October inclusive, during which time punkahs are kept constantly swinging at night in the sleeping apartments, and during the day in the sitting and dining rooms, as well as in the churches and other large buildings.

Before proceeding farther, as some of my readers may not be acquainted with the punkah, I propose to describe the various forms of this contrivance which are at present in use.

The form most extensively used in India, and universally in barracks and hospitals, is that known as the "frame punkah."

This punkah is a rectangular wooden frame, which is usually 10 feet by 1 foot 6 inches, to both sides of which is attached canvas, which then receives two or three coats of whitewash. Below this framework hangs a fringe of cloth or sacking, in depth about 12 inches. This frame, with the fringe hanging below it, is suspended by three or more ropes or wires from the ceiling of the room.

Another, and perhaps one of the simplest forms, is that known as the "pole punkah."

This consists of a heavy wooden pole about 10 feet long, which is suspended by two or more cords or wires from the ceiling of the apartment in which it is required. Attached to this pole, and hanging below it, is a curtain or flounce made of coarse heavy canvas, and with an outer cover of white calico trimmed according to fancy. Some of these curtains are weighted with shot or sand on their lower sides, the object of which will be presently explained.

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The methods of working these two forms of punkah are exactly similar, and as the "pole punkah" is generally considered the most modern, effective, and simple form, I shall describe its general mode of action more particularly.

We will suppose, for example, a set of six punkahs is required in an hospital ward. These punkahs would be suspended from the ceiling in a line parallel and connected with each other by two or more ropes. The coolie who is engaged in pulling these punkahs is placed upon the top of a high stool at the end of the room, and by means of a light cord attached to the centre of the first punkah pole of the set, is able to keep up a swinging motion in the whole six punkahs. When the coolie commences to work the punkahs he gives a pull to the cord as far as he can, and then allows it to run back to the full extent of his arm, thus causing the six punkahs to swing back in the opposite direction. As soon as they have reached the full extent of their backward swing, he again repeats the pull, and this monotonous movement is continued, without intermission, throughout the hot season.

The object of placing the coolie upon the high stool which I mentioned just now is, that in the event of his falling asleep, which is an occurrence by no means rare, he may have a severe fall, thus inspiring him with a wholesome dread of committing an offence which we in this country should consider very trivial, but which there entails upon the unfortunate culprit a shower of boots, brushes, &c., until he resumes his seat and the punkahs are again in motion.

To a casual observer the punkah appears a very barbarous and primitive device, and one which, to all appearance, might have been invented by the aborigines of India; but even down to the present day, in spite of a century of English occupation, no machine has been invented to supersede the old-fashioned contrivance. The essential requirements of a "pole punkah" are: first, that the pole from which the curtain or fringe hangs should be tolerably heavy, and secondly, that the preponderance of weight should be at its lower edge. Now, when the punkah coolie gives a pull to the machine, the pole from which the curtain hangs quickly obeys the impulse; but, on the other hand, the curtain being heavy, especially towards its lower edge, its motion is retarded, and it assumes a position more or less horizontal. This position of the curtain only lasts for a moment, and as soon as the pull of the coolie comes to an end, the curtain

falls again into a vertical position, and in doing so produces a movement of air in the apartment to be cooled. This flapping action, in an ordinary punkah, is produced far more effectively in the forward stroke, and it is very remarkable how much less the cooling effect is felt in the return swing, owing to the want of this sudden impulse.

As a practical proof of this, whenever a punkah is swung over a dining table in India, on the company proceeding to take their places, it is invariably found that the seats facing the forward swing of the punkahs are occupied first, and this is due to the fact that persons prefer to be fanned on their faces rather than to have their necks cooled.

Having now briefly explained the forms of punkah used in India, and their modes of action, I propose to enumerate the disadvantages of the system as at present used, and then to point out how these disadvantages may be remedied by the substitution of machinery judiciously designed.

1st. The coolie, frequently at night, when most needed, is found to have fallen asleep, and the punkahs under his charge have ceased to swing.

2nd. As a consequence of this cessation in the action of the punkahs, the persons who have been cooled during their sleep wake up conscious of a feeling of suffocation, and, as a matter of course, in a state of violent perspiration. The "punkah walla" is then assailed by a shower of boots and strong language, and the punkahs are again set in motion. But this does not repair the evil; as soon as the draught caused by the swing of the punkahs reaches the heated sleeper, a feeling of chill is experienced, and this is a notorious cause of fever and diseases of the chest and lungs.

3rd. The disadvantage that the coolie can but produce at the best a single flap of the curtain at each stroke, consequently, only about half the cooling effect which would be procured provided a double flap could be imparted to the curtain.

4th. In the event of there being contagious diseases among the natives, the danger of these diseases being conveyed to the inmates of the houses in which the punkahs are required.

I propose now to describe some of the attempts which, from time to time, have been made to substitute for coolie labour a system which would be more certain and effective in its action, and at the same time less expensive.

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The first great defect which inventors seem to have seized upon and have sought to overcome, was the fact of the coolie going to sleep at night when most required, and in order to remedy this, an invention was brought out in the year 1868, which consisted of a clockwork apparatus wound up periodically, and which, by means of a revolving arm, kept the punkahs swinging backwards and forwards until it ran down. This, although it answered the purpose on a small scale, was exceedingly wasteful of power, in consequence of so large a percentage of the energy stored in the clockwork being lost in friction, before it was again used to work the punkahs. This machine was also defective in this respect, that it failed to produce the required jerk at one or both ends of the stroke, which has been shown to be so essential to the effective working of the punkah.

Another machine, which was patented about the same time and practically tried in India, consisted of a heavy fly-wheel, the circumference of which was weighted on one side. The rope attached to the punkahs was fastened to a point on the circumference of the wheel, which was rotated by a coolie. The object of the weight attached to the circumference of the wheel was to produce a sudden jerk as the punkahs were pulled forward, similar to that produced by the arm of the coolie. This contrivance certainly did produce a fair imitation, but at the same time, as it was worked by a coolie, it possessed all the defects consequent upon the employment of this form of labour, besides many inherent mechanical defects which were soon brought to light upon trial.

Another form of machine, which has been tried and is now in constant use in the general hospital, Madras, is that in which the punkahs are worked by a steam engine situated in the basement of the house in which the punkahs are required. In order to distribute the power of the engine over the various parts of the house, vertical shafting is carried up one corner of the house, and from thence horizontally along the walls of the rooms in which the punkahs are required. Attached to this horizontal shafting at various intervals are cranks, which, as the shafting revolves, swing the punkahs to and fro.

The defects of this method of punkah pulling, and those which have militated seriously against its introduction more generally, are: First, the disadvantage of having the steam engine which supplies the power situated in or near the house where the

punkahs are required, thus causing a rise in the temperature which the punkahs are intended to reduce; secondly, the length and necessary cost of the shafting which would be required in a large building or system of buildings, consisting of a number of small detached bungalows, which is generally the case in India; and thirdly, the absence of the required jerk imparted to the punkahs at each end of the stroke.

In addition to these defects, the Government of India has decided that no system involving the introduction of steam into barrack rooms will be considered.

The last form of machine for cooling houses that I shall mention, and one which is extensively used in Upper India or wherever hot winds prevail, is that known as the "Thermantidote"; or, as its name implies, a machine which is intended to correct the extreme heat of the atmosphere.

This machine consists merely of a fan, similar to that used for winnowing corn, which drives air through a moistened mat hung in the doorway of the room to be cooled. As its action depends upon evaporation, it is quite ineffective when the air contains moisture.

The mats, or "tattees," used with the thermantidote are made from the roots of a sweet-scented grass, called "khus-khus," and are very costly.

The chief disadvantage of the thermantidote is the chilling effect which is invariably experienced when it has been in action for a short time. I need hardly say that this is attended with many evils, principally due to its producing colds, neuralgia, rheumatism, and similar diseases.

Having duly weighed and carefully considered the various defects in the systems of working punkahs by means of coolies, and also through the agency of such machinery as had hitherto been tried, Col. Osborne in the year 1874 informed Captain Palliser, of the firm of Sir William Palliser and Co., of his plan of working punkahs by compressed air laid on to the various parts of a building or system of buildings, similar to the gas and water supply in this country.

This compressed air was then to be admitted into small cylinders, fitted with pistons and with a suitable valve gear which admitted the compressed air successively above and below the piston, and by this means the punkahs were to be continually drawn backwards and forwards. A machine which

effected these requirements was exhibited by Captain Palliser at the Loan Exhibition at South Kensington in the summer of 1874.

This machine was worked by air, compressed by means of a hand-pump, and although the valve gear was in some respects not as satisfactory as might have been desired, still the punkahs attached to this machine were effectively worked, and the required jerk, similar to that produced by the coolie, was given to the punkahs at the beginning of each stroke.

But although this machine worked very effectively and economically, it possessed one defect which had not then been overcome. This consisted in the fact that if anyone touched the punkahs when they were in action, there was a danger of their ceasing to swing, and also when the compressed air was admitted to the machine, it was often necessary to start it by hand before it would begin to oscillate. Since the year 1874, the system of working punkahs by compressed air has received a good deal of attention from Captain Palliser, but the financial circumstances of India, owing to the recent famine, rendered it unadvisable to undertake any enterprise of this description. Since the machine was exhibited, a good many experiments have been made with a view to overcome the defects which have been alluded to, and to obtain an apparatus which should possess the following qualifications: Firstly, a machine which should have the power of giving a jerk to the punkah at both ends of the stroke; secondly, a machine which should have the property of varying the number of strokes per minute according to the heat of the weather; and lastly, a machine which would be incapable of ceasing to act, although the pressure of the compressed air might vary to a considerable degree.

In June, 1877, the author was consulted on the subject, and after some experiments in order to determine the exact motion which was required for the effective working of punkahs, he designed the machines which are now in use for this purpose in the Royal Westminster Aquarium.

As the general idea involved in this machine is so exceedingly simple, and as it may render the consideration of the subject more interesting, I propose to describe its internal structure, and the manner in which the compressed air acts within the cylinder in order to produce the required oscillation.

Referring to Fig. 1, the air is admitted through the pipe *a*,

which communicates with the cover of the slide-valve, and from thence is admitted through the passage *b* at the upper end of the cylinder. The pressure of air then acts upon the piston, forcing it downwards, also producing a downward motion in the piston-rod. The piston-rod being attached to the arm *d* by means of the two side links *c*, a corresponding motion is produced in the arm *e*, which being rigidly connected to the punkahs by means of a rod *m*, Fig. 2, imparts a similar motion to them.

As soon as the piston has travelled down to the end of the cylinder, the valve opens in the upward direction, and air is then admitted through the passage *f* to the lower side of the piston, which is then forced up, and a contrary swing is imparted to the punkahs.

I shall now describe the action of the contrivance which is the essential feature of the machine, and which affords the attendant the power of regulating the frequency of the strokes, and also removes all possibility of the machine ceasing in its action.

Attached to the base-plate of the machine is the small cylinder *g*, filled with oil. This cylinder is so constructed that the piston, which works within it, only fits at its centre, and at each end there is a considerable space between it and the sides of the cylinder, which allows the piston to move up and down freely at those points. Through the narrow part of this cylinder is cut a slot or passage, which is capable of being closed by means of the screw *h*. In the event of the machine being situated high up on the wall of a room, this screw is turned by the cord *n*. When the passage is closed the piston is pushed slowly past the narrow part, in consequence of the oil contained in the cylinder finding a difficulty in flowing in, to fill up the space vacated by the piston; but on the other hand, when the screw is withdrawn and the passage has been opened, the piston is easily forced past this narrow part of the cylinder.

It is this simple contrivance which renders it possible to vary the number of strokes made by the machine per minute.

As the piston is moving in a downward direction, the piston-rod crosshead *j* touches the lever *k*, which is attached to the valve-rod and also to the piston of the oil cylinder; the spring *l*, which is also attached by means of the link *o* to the lever *k*, in virtue of its tension, exerts a force inwards, and at the same time produces a force downwards upon the valve.

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The crosshead *j*, which I have just mentioned, when it touches the lever *k* throws it into the position indicated by the dotted lines, and at the same time the piston is carried to the narrow part of the oil cylinder.

The spring now, instead of acting upon the valve in a downward direction as it did previously, acts in an upward direction, and would, if not hindered by the piston in the oil cylinder, open the valve so as to admit the air on the under side of the piston; but the action of the valve being retarded in this way, the piston is allowed time to travel to the end of the cylinder before the valve is moved upwards, and the action is reversed. Thus, according as the retardation in the action of the valve caused by the oil cylinder is increased, the number of strokes made by the punkahs per minute is diminished, and *vice versâ*; so that the number of strokes can be varied within very considerable limits.

But the most important feature in this valve gear remains yet to be explained, and that is its inability to allow the punkahs to come to rest. The spring *l*, which, whether the lever *k* happens to be in an upward or in a downward position, exerts a force on the valve either upward or downward, and consequently the valve is of necessity either open so as to admit the air upon the upper or lower side of the piston, so that a backward or forward movement in the punkahs is produced, provided any air is admitted into the machine. The author, whilst explaining the action of this valve gear to a friend conversant with commercial transactions, suggested that its mode of operation was very similar to a person investing in merchandise for which he paid ready money, but the goods, by the terms of contract, were not required to be delivered until at a stated time; it may be asked why did he pay for the goods immediately? the reason was, because he had the ready money in his possession, and the bargain could be arranged more advantageously upon those terms.

Exactly the same principle applies to this valve gear. When the punkahs are hanging vertically, and when the piston is in the middle of the cylinder, then there being no force on the machine due to the weight of the punkahs, it possesses a large surplus of power to open the valve, and the labour of doing so is effected at that time; but the act of opening the valve does not take place until the completion of the stroke by the piston.

Now that the method of working punkahs by manual labour,

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and also the machine which has been designed to effect this object more satisfactorily has been discussed, the author proposes to consider briefly the financial aspects of the question, and hopes to show that in large public buildings, such as barracks, churches, hotels, &c., where punkahs are used extensively, the method which has now been explained will meet the requirements of the case more efficiently and at the same time at a considerably reduced annual outlay. The general idea of the scheme, which has long been under consideration, is of the following nature.

In this country everyone is aware that in order to supply drinking water and that used for domestic purposes upon reasonable terms to the consumers, they must of necessity combine together in order to draw their supply from some one source, or, in other words, that they must be supplied by means of a company. Just in the same way, towns are supplied with gas through the agency of a gas company. It is clear that in a financial point of view, it would never answer for each individual householder in the town to pump the water used in his house from a well beneath it, or to produce the gas used in it by means of a gas apparatus.

The same principle manifestly applies to the working of punkahs in India. Under the present system the manual labour is scattered throughout the building in a most wasteful manner, a coolie being needed for every punkah or set of punkahs.

Under the system which has been proposed, the air compressed at a central pumping station would be conveyed under the streets in cast or wrought iron pipes, as the case may be, to the different parts of the town. These pipes are then placed in connection with the machines, which have been described, and by simply turning a cock and admitting the compressed air the punkahs can be started at a moment's notice.

Thus the punkahs throughout a town, such as Calcutta, could be worked by means of an engine situated in any central position.

A practical instance of compressed air being carried in this way is the Post Office system of pneumatic despatch tubes, laid throughout our metropolis and other large towns.

Many of my readers are no doubt aware that in the General Post Office in St. Martin's-le-Grand, there are three air-compressing engines, working more or less constantly day and night. The telegraphic messages which arrive from the various parts of the country are all received at the central office, and from thence

are transmitted by means of the pneumatic tubes to the various district offices. In the case of messages received at the district offices for transmission to the country, the pneumatic system is also used. In order to effect this, the engines at the central office produce a vacuum instead of a pressure in the tubes, and draw the messages from the outlying district offices to the central office, from which they are transmitted to the country by means of the electric telegraph. For want of space, I have only given a very brief account of this pneumatic system which is found to work so admirably, and which at the present time in London has attained to an aggregate distance exceeding 19 miles.

Those of my readers who are interested in the working of this system, will find a detailed account in a paper read before the Institution of Civil Engineers, in November, 1875, by Mr. Richard Culley and Mr. Robert Sabine.

In Liverpool, Manchester, and Dublin, where similar systems are in operation, the mains are laid for distances which, in 1875, amounted respectively to 1 mile 1237 yards, 1 mile 266 yards, 1 mile 940 yards.

A parallel system has also been introduced into Paris, where the air mains have attained a length of over 15 miles.

Before drawing a comparison between the pneumatic system of transmission as used in London and a corresponding system for working punkahs in India, I shall say a few words with reference to the power which will be required to swing a system of punkahs by compressed air.

The machine which is illustrated in Fig. 1 is capable of swinging eight large punkahs attached to each other by a pressure of air of about 8 lbs. per square inch, as has been proved by actual experiment.

Assuming that the punkahs make fifteen double strokes per minute, which is on the average the case in India, the engine power which would be required through the agency of compressed air to maintain the eight punkahs in operation will be one-ninth of a horse-power.

Supposing that in a large building or group of buildings there were 600 punkahs which required to be worked, then, upon the above estimate, 75 machines would be required to swing the punkahs, and an engine of about 10 horse-power would be required to compress the air.

The above facts having been obtained from actual experiment, it is possible to approach very near to the annual expenditure necessary to maintain a system of punkahs in operation by machinery during the hot season of the year.

The following estimate of the annual expenses for maintaining 600 punkahs in constant operation during 180 days assumes that the hot season lasts on an average for about six months.

Cost of the various parts of the machinery:—

	£	s.	d.
Two 10 horse-power engines, air-pumps, and boilers ..	1200	0	0
Seventy-five punkah machines, at 30*l*.	2250	0	0
Air-pipes and fixing	300	0	0
Carriage, &c., to India	150	0	0
Total Expenditure	£3900	0	0

Upon the foregoing expenditure of capital in consequence of the machinery being in operation during six months of the year, 10 per cent. per annum is a fair rate to set aside for renewals; this amounts to:—

	£	s.	d.
	390	0	0
Coal for 180 days, at 1*l*. per ton	100	0	0
Two engine-drivers and two stokers	180	0	0
Oil, waste, &c.	30	0	0
Total Working Expenses	£700	0	0

Taking 5 per cent. upon the capital expended, or 195*l*., then the net annual sum for the maintenance of the above machinery will be 895*l*.

It may be urged that the various items in this estimate are placed rather high, but in a new scheme this will be admitted to be a fault on the right side.

I now propose to consider the comparative expenditure in the case where coolie labour is used instead of machinery.

The daily labour of a coolie is generally considered to be the continued swinging of four large punkahs, or six small ones, for a period of twelve hours, not necessarily consecutive. The daily pay of a coolie for this work is 6*d*., consequently the daily expenditure for keeping four punkahs continually swinging will be 1*s*. per day. And for 600 punkahs for 180 days the expenditure would amount to 1350*l*.

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Comparing this annual expenditure upon coolie labour with that which represents an equivalent amount of work as per-

formed by the machine, it is seen that a saving of 455*l.* is effected by the use of machinery, which is at the rate of 33 per cent. upon the annual expenditure in coolie labour.

The above estimate is made out for a system of punkahs upon a small scale, and it will readily be understood that the larger the system the greater will be the saving.

But there is another point, and one which seriously affects the economy of the machine as compared with the coolie.

In the case of only one punkah being required, two or three coolies must necessarily be hired for this purpose, although the maintenance in action of one punkah represents a fractional part of the work of one coolie. But if worked by compressed air, a small machine the size of a hat-box might be used, and the consequent expenditure reduced nearly in proportion to the size of the machine.

Some of those who read these pages may not be aware of the enormous sums which are annually expended by the Indian Government upon labour for the purpose of procuring this necessary of life. The following estimate is that given by Col. Osborne (in the paper already referred to), as the monthly expenditure for a regiment stationed in the church lines at "Rawul Pindee."

Establishment.			No.	Rate of Pay.	Amount.
Barracks.					
Punkah Pulling		Mates	9	6	54 0 0
		Coolies	483	5	2215 0 0
Tattee Watering Establishment	Bullocks,	Pairs	3	15	45 0 0
	Bheestees	Mates	2	6	12 0 0
		Bheestees	91	5–10	511 14 0
	Coolies	Mates	3	6	18 0 0
		Coolies	132	5	660 0 0
		For Barracks, total Rs.			3515 14 0
Hospital.					
Punkah Pulling		Mates	1	6	6 0 0
		Coolies	60	5	300 0 0
Tattee Watering	Bheestees	Mates	1	6	6 0 0
		Bheestees	8	5–10	45 0 0
	Coolies	Mates	1	6	6 0 0
		Coolies	12	5	60 0 0
		For Hospital, total Rs.			423 0 0
		Required for Barracks and Hospital, total Rs.			3938 14 0

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And in the same paper, Col. Osborne goes on to say: "If this be taken as the average monthly expenditure of a regiment in India, and considering on the one hand the cost of the tattees not included in the above estimate, and on the other the number of European regiments located in climates where punkahs are not required, it may be estimated that the Imperial expenditure in cooling barracks falls very little short of a lac and a half of rupees, or at 15,000*l.* per month during the hot weather; an expenditure, be it remembered, which has a constant tendency to increase year by year, owing to the inevitable rise in the price of labour in India as in the rest of the world."

Assuming that the hot season averages five months throughout India, then the annual expenditure by the Imperial Government amounts to 75,000*l.*

In Calcutta, where the heat is more excessive than in most parts of India, the expenditure upon labour for punkah pulling in Fort William, as obtained (by Captain Palliser in 1874) from the official reports, amounted to 1440*l.* per annum.

Fort William consists of two parts, the Dalhousie and the South Barracks; in the former there are 600 punkahs, and in the latter 100.

From the official returns the Imperial expenditure for punkah pulling throughout India last year amounted to 470,000 Rs., distributed as follows:—

Bengal	350,000
Madras	60,000
Bombay	60,000

This return shows rather a falling off when compared with that given by Col. Osborne, but this I find is due to a larger number of regiments being draughted to cooler districts during the hot season.

In conclusion, I would wish to accord my most sincere thanks to my numerous friends (especially to Col. Osborne) for practical information connected with the present system of punkah pulling in India, and also for many valuable suggestions with regard to the practical adaptation of machinery to supersede this form of labour.

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