HYDRAULIC MACHINERY, PAST AND PRESENT. A LECTURE DELIVERED TO THE LONDON AND SUBURBAN RAILWAY OFFICIALS' ASSOCIATION, ON THE 10TH JANUARY, 1880

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Hydraulic machinery, past and present. A lecture delivered to the London and Suburban Railway Officials' Association, on the 10th January, 1880 by Henry Adams

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HENRY ADAMS

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LONDON AND SUBURBAN

RAILWAY OFFICIALS' ASSOCIATION,

On the 10th January, 1880,

BY

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and

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London and Suburban Railway Officials' Association.

ESTABLISHED 1873.

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London and Suburban Railway Officials' Association.

PROSPECTUS.

The progress of railways of late years has been such as far to exceed the most sanguine expectations. If we take a glance at the railways in and near London, we find tunnels made, bridges, viaducts and signals erected, permanent ways, with all their points and crossings laid down, stations, warehouses, and workshops built, engines, carriages, waggons, turntables, and almost every description of machine constructed to meet the demand and to futher develope the railway traffic. We also find every class of Officers and Men employed and actively engaged in the various departments to meet the requirements and conduct the business of a dozen railway companies. It is remarkable, with so many railways within the London District, that the officials engaged on one line have hitherto had scarcely any knowledge of those holding similar positions on others, and with these facts before us, we consider the time has arrived when the officials of the London and Suburban Railways should become acquainted, and with that view this Association has been formed. We are aware that many railway officials (especially in the mechanical branches) are already enabled to become members of societies according to their profession, while many others equally valuable, holding positions of great responsibility in the service, are not eligible to join them. It is therefore the intention of this Association to admit any railway official to be a member within the London and Suburban District (in accordance with the rules), irrespective of trade or calling, and as far as possible to unite in fellowship and good will, and assist each other in the maintenance of position and respectability, which we feel assured will establish that confidence among railway officials requisite for the good management of every department, and benefit of railway service generally. We have also something more to add, and although last, we think it not least in importance, viz.:—To provide a fund to assist members when out of situations, or when age or infirmity have incapacitated them, and at their decease to meet the claims as set forth in the rules, and to render such other assistance as may be deemed advisable.

In establishing this Association, we would much prefer to subscribe than receive, yet at the same time we consider it our duty to be prepared to assist, or be able to obtain assistance if needed. We therefore kindly ask the co-operation and assistance of those gentlemen who are connected with or may feel interested in the progress of railways, by adding their names as Honorary Members or Donors to the "London and Suburban Railway Officials' Association."

London and Suburban Railway Officials' Association.

Meeting of Association, held at the Mansion House Station on Saturday, 10th January, 1880.

The PRESIDENT, WILLIAM ADAMS, ESQ., in the Chair.

The President introduced Mr. HENRY ADAMS, who then delivered the following Lecture on

HYDRAULIC MACHINERY—PAST AND PRESENT.

MR. PRESIDENT AND GENTLEMEN,

In preparing the following notes, I have assumed that a majority of your members are unacquainted with the details of the application of hydraulic power, and I have therefore confined my illustrations to simple outlines, which indicate the principles, but do not show the exact detail employed.

Hydraulic machinery may be defined as mechanism actuated by water for the purpose of raising a load or doing any other mechanical work.

Long before the appearance of man on the earth, water was the great transporting medium which carried trees and stones down from the hills to the ocean, and it was also the first source of inanimate motive power controlled and directed by the ingenuity of mankind. Water alone might form the subject of many discourses. In the dawn of civilization it was reverenced by philosophers as the life-giving principle of the universe; and even in the present day shoals of pilgrims are to be seen travelling to the Ganges, the sacred river of

India, to worship the self-same substance. With these people it is deemed a virtue to think of the river, while to bathe in its waters washes away all sin, and to expire on its brink, or be suffocated in its embrace, is the climax of human felicity.

We are, however, concerned only with the practical application of the good qualities resident in the water. We shall find three of these very useful in their bearing upon the question before us, viz., its gravity or weight, its momentum or moving force as in a running stream, and its mobility combined with resistance to compression, which render it so valuable in transmitting power to long distances.

The subject is a large and important one, and is destined to become of still greater importance. Its rapid progress in recent times is apt to lead one to suppose that machines actuated by water are of modern origin, but ancient writers tell us that Archytas, of Tarentum, invented hydraulic machinery about the year 400 B.C.; no description of his inventions has reached our times, but we have records extending nearly as far back. Hero, a celebrated mechanician of Alexandria, who lived over 2,000 years ago, among other works wrote a treatise on Pneumatics, in which he described several curious devices handed down by former writers, whom he at that time called "ancient philosophers." Among these devices is one in which water is caused, by its weight, to effect the opening of a temple door.

Although the method is clumsy, it is certainly ingenious, and I shall endeavour to describe it to you, with the aid of a diagram (Fig. 1).

In the upper portion of the sketch we have the interior of a temple, with a door on the right and an altar on the left. The altar contains an air-tight receptacle in such a position that it will be subject to great heat as soon as a fire is lighted. This receptacle communicates by a pipe with a larger receiver partly filled with water, and placed in the basement, or any excavation below the temple floor. A syphon pipe leads from this receiver into a bucket hanging to a cord, which passes over a pulley, and is wound round a

shaft firmly secured to the door above, and pivoted at the bottom. Attached to this shaft is another cord wound in the opposite direction, passing over another pulley and supporting a weight. The action of the apparatus is this:—When a fire is kindled on the altar, the air-receiver under it is heated, the air expands, and passing down the pipe, presses on the water in the large receiver, forcing it through the syphon pipe into the bucket. As soon as sufficient water has entered the bucket to overcome the resistance of the suspended weight and the friction of the door, the bucket begins to lower, and, pulling on the cord wound round the upright shaft, opens the door and raises the weight. The apparatus is so proportioned that as the water pours into the bucket and the bucket lowers, the mouth of the syphon pipe keeps just below the level of the water, and the bucket reaches the ground before the pipe is quite withdrawn. When the temple services are concluded and the fire extinguished, the air-receiver cools down, the air in it contracts and causes a partial vacuum in the large receiver, and the water flows back into it from the bucket. The weight has more power than the empty bucket, and now lowers, turning the shaft round and closing the door. Of course this piece of mechanism below the floor, if ever used, formed part of the esoteric religion, and no vulgar eyes were allowed to see by what earthly means the gods signified their approval of the burning sacrifice by mysteriously opening to them the temple door.

Wheels, partly immersed in a running stream, and receiving motion from it, formed so ancient a device for obtaining power, that we have no record of their origin, but it is not generally known that force pumps worked by water wheels date back nearly so far as they unquestionably do. The following anecdote, for which I am indebted to Thomas Ewbank's admirable book on raising water, will show you how and when this force pump arrangement received its last and most important addition—that of an air vessel:—

About the year 200 B.C., during the reign of Ptolemy Philadelphus over Egypt, an Egyptian barber pursued his vocation in the city of Alexandria. Like all professors of that ancient

mystery, he possessed, besides the inferior apparatus, the two most essential implements of all—a razor and a looking-glass or mirror, probably a metallic one. This mirror, we are informed, was suspended from the ceiling of his shop, and balanced by a weight, which moved in a concealed case in one corner of the room. Thus, when a customer had undergone the usual purifying operations, he drew down the mirror that he might witness the improvement the artist had wrought on his outer man, after which he returned it to its former position for the use of the next customer. It would seem that the case, in which the weight moved, was enclosed at the bottom, or pretty accurately made, for as the weight moved in it, and displaced the air, a certain sound was produced, either by its expulsion through some small orifice, or by its escape between the sides of the case and the weight. This sound had probably remained unnoticed, like the ordinary creaking of a door, perhaps for many years, until one day, as the barber's son was amusing himself in his father's shop, his attention was arrested by it. This boy's subsequent reflections induced him to investigate its cause, and from this simple circumstance he was led eventually either to invent or greatly to improve the hydraulic organ, the force pump, the air gun, fire engine, &c. Now this barber's son was Ctesibius, of Alexandria, one of the most eminent mathematicians and mechanicians of antiquity, and the teacher of Hero, of Alexandria, of whom I have previously spoken. No illustration of the pump of Ctesibius has survived, but from the descriptions handed down it is supposed to have been constructed as shown in our next diagram (Fig. 2.) A wheel having projections or float boards on its rim is placed in a stream; fixed upon the same shaft with the wheel, and therefore revolving with it is a piece called a cam, which stands out more on one side of the shaft than the other. At each revolution this pushes down one end of a lever, to the other end of which is connected the pump rod, carrying a solid piston closely fitting the barrel of the pump. In the bottom of the pump is a suction-valve and a pipe leading to the water, and in the side another