east to west, which will show the position of the artificial branches, is thus; the Pelusian, the Mendesian, the Bucolic, the Sebennitic, the Saitic, the Bolbitine, and the Canopic.

One of the earliest hydraulic operations to which we find allusion made, was the recovery of the site of Memphis from the water by which it was overflowed. This is attributed to Menes, respecting the date of whose reign some diversity of opinion exists, Herodotus calling him the first sovereign of Egypt, while by Diodorus Siculus, he is styled the first king of Memphis, a view which is supported by many leading moderns. According to Herodotus the river before that time flowed entirely along the sandy mountain on the side of Libya, but by Menes its course was diverted. A hundred stadia from Memphis a bank was constructed, while a canal was led between the mountains, or according to some cut through them, to receive the stream. Of the ancient bed the site is still to be traced; Savary observes that it may be found west of the lakes of Natroun, extending for a considerable distance. Menes is also said to have sunk a lake to the north and west of Memphis, communicating with the river, which from the situation of the Nile, it was impossible to effect towards the east. On the spot thus rescued from the water was built the city of Memphis, by which Thebes was afterwards supplanted. We have here an instance at an early period of the diversion of a large river, and the recovery of a considerable space of ground, operations requiring a degree of skill in the plan, and energy in the execution which must give us a favourable idea of the engineer-king, who thus founded a city and a dynasty. It might at this place be a speculation whether it was not to the success of this work that Menes and his followers owed their kingdom and their authority, an hypothesis which if substantiated would be a unique addition to the claims of the profession. Cultivated as it has been by kings and warriors, it shares this honour with the law, with which the establishment of this new fact would give another step towards an equality of privileges—many owing their kingdoms to their legislation, and acquiring the exercise of authority by showing the necessity for it. Homer mentions the practice of medicine by powerful chiefs, but this art although it may have saved crowns, never seems to have gained them. We have however another subject of interest to the profession to lay before them—suggested also by the works of Menes. Our author informs us that even in his time, when Egypt was under the dominion of the Persians, the artificial channel was annually repaired, and regularly preserved; for he says had the river once broken its banks, the town of Memphis would have been greatly endangered. The necessity for the regular preservation of these works would undoubtedly require their being placed under the care of duly appointed officers, the exercise of whose functions being specially devoted to one object would lead to the formation of a particular class, essentially civil engineers. The same class of officers would also be required in other parts of the country, and thus we may conceive the organization at the distance of two milleniums and a half of a regular *water staat*. We have here a dawning of the system of a government corps of engineers, such as exists in most countries abroad at this moment, for there must have been in Egypt little opportunity for private practice when so much depended on the government. Private practitioners of engineering, although employed by governments, we shall perhaps hereafter find to have sprung up in Greece—so much split up in petty states, many of which would have no demand for permanent officers.

A princess, whom Herodotus calls Nitocris, is said by him to have floated to death a number of Egyptians. Having been appointed sovereign on the death of her brother, who had been murdered by the Egyptians, to be revenged on them she had a large subterranean apartment constructed, to which she invited a great number of those, whom she knew to be the principal instruments of her brother's death, and then by a private channel introduced the water of the river among them, and so destroyed them.

To Sesostris is attributed the execution of the general system of canals with which Egypt is provided, the number of which still existing is estimated by Savary at eighty, several of which are fifty, eighty, or a hundred miles long, and like rivers. On the return of Sesostris from his foreign conquests about three thousand two hundred years ago, he employed the captives of the different nations in collecting the immense stones which were employed in the temple of Vulcan. They were also, says our author, compelled to make the vast and numerous canals, with which Egypt is intersected. In consequence of their involuntary labours, continues the historian, Egypt which was before conveniently adapted to those who travelled on horseback or in carriages, became unfit for both; the canals occurring so often, and in so many winding directions, that to travel on horseback was disagreeable, but in carriages impossible. The inhabitants of the inland parts however benefited by obtaining a more regular supply of water for domestic and agricultural purposes.

In his next paragraph Herodotus informs us of the well known origin of surveying. Sesostris made a regular distribution of the lands, and assigned to each Egyptian a square piece of ground. Whoever was a sufferer by the inundation of the Nile, was permitted to make the king acquainted with his loss, and certain officers were appointed to inquire into the particulars, that no man might be taxed beyond his means. To this circumstance the historian assigns the origin of geometry, and from Egypt it was afterwards communicated to Greece. Here we have the origin of surveying, and of distinct officers engaged in its pursuit at a period according to received chronology, about 1350-60 years before Christ, now three thousand two hundred years, an antiquity, of which few professions are able to boast the equal, and one of the many circumstances in the history of civil engineering which show its early progress. Thebes was then the great school of Egyptian learning, and where geometry and surveying are supposed particularly to have flourished. It was perhaps to the government surveyors that the care of the canals of Memphis and other places was intrusted, so that then as it frequently is now, the surveyor might have been the probationer to the civil engineer. We do not apologize for troubling our readers with these observations, for we know that they like ourselves must feel the same interest in remembering that our's is no profession of to-day, but one which centuries ago, as now, was a powerful contributor to the progress of civilization, and the well being of the human race.

FOUR AND SIX-WHEELED ENGINES.

SIR—There is a subject connected with the question of four and six-wheeled engines as to their relative advantages when traversing curves, which has not, I believe, been sufficiently examined into; will you allow me, therefore, through the medium of your valuable journal, to call attention to it.

It has generally been assumed, because the distance between the fore and hind wheels is greater in six than in four-wheeled engines, that there must of necessity be greater danger of the former running off the rails when traversing curves.

If the engines moved with mathematical precision in the path laid out for them, this would undoubtedly be the case; but in consequence of the irregularities and inequalities of the rails, and the play which it is necessary to allow on this account between the wheels and the rails, the motion of the engine is varied from its true direction. Any person who has observed the action of a locomotive when passing rapidly along the rails, will have noticed that its track is not straight, but partakes of a serpentine movement, the fore wheels going from side to side in tolerably regular vibrations, and the greater the velocity the greater this effect, also the less the distance between the fore and hind wheels the greater this effect; for as the play is the same in all cases, the angle formed between the direction of the rails and the engine during these vibrations, will depend on the distance of the points of bearing; and it is probably in some measure attributable to this effect that four-wheeled engines have been found to go off the rails when travelling over straight parts, while such an accident was never, I believe, known to occur to a six-wheeled engine, unless from some foreign cause.

The distance between the centres of the wheels in the one case is about 7 feet, and in the other about 10 feet, and the play given to the wheels is half an inch. The greatest obliquity, therefore, that the six-wheeled engine can take up is ·5 of an inch in 10 feet, or 1 in 240, while in the four-wheeled engine it is ·5 of an inch in 7 feet, or 1 in 168. It would, perhaps, be too much to assume that the engine vibrated to the whole of this amount, but, to be quite on the safe side, we will take half of it, in which case the sine of the angle of obliquity between the direction of the engine and that of the rails will be expressed by $\frac{1}{480}$ in the six-wheeled engine, and $\frac{1}{336}$ in the four-wheeled engine, when travelling on the straight parts; and it will be seen that this apparently slight difference gives the advantage to the six-wheeled engine in all curves used in ordinary practice.

The sine of the angle at which an engine meets the rails on a curve supposing the engine to be moving mathematically true, will be $\frac{l}{2\,r}$, l being the distance between the centres of the fore and hind wheels, and r the radius of the curve in feet. The advantage in favour of the four-wheeled engine in this respect, on curves of the same radius, would therefore be as $\frac{7}{2\,r}$ to $\frac{10}{2\,r}$; but to this must be added in practice the angle of obliquity due to the vibratory motion of the engine;