and Denderah *a* Ursæ Majoris was used before it became circumpolar. We deal with 5000 B.C.

Since undoubtedly *new* temples with nearly similar amplitudes (such as that denoted by M at Karnak) were built in late times, we find so long a range of time indicated that the utility of the stellar observations *from the yearly point of view* could scarcely have been in question.

It may be suggested therefore that the observations made in them had to do with the determination of the hours of the night; this seems probable, for in Nubia at the present day time at night is thus determined.

It may be that such stars as Canopus were used by the southern peoples for the same purpose as *a* Ursæ Majoris first and then γ Draconis were used by the northerners. In other words, the question arises whether the extreme north and south stars were not both used as warners of the dawn all the year round.

It is well known that in quite early times means had been found of dividing the day and night into 12 hours. In the day shadows cast by the sun, or sundials, might have been used, but how about the night?

We have seen that the Egyptians chiefly, if not exclusively, observed a heavenly body and the position of other bodies in relation to it, when it was rising or setting, so that it was absolutely essential that the body which they were to observe should rise and set. Everybody knows that as seen in England there are many stars which neither rise nor set. The latitude of London being 51°, the elevation of the pole therefore is 51°.

Hence, any star which lies within that distance from the pole cannot set, but sweeps round without touching the horizon at all. The latitude of Thebes being 25°, the distance from the pole to the horizon is much smaller, and so the number of stars which do not rise and set is much smaller. The stars which do not rise or set are stars near the pole, and therefore stars which move very slowly, and the stars which rise most to the north and most to the south are those bodies which are moving most slowly while they yet rise or set. Can this slow rate of motion have had anything to do with such stars being selected for observation, the brightest star to the north, most slowly moving, the brightest star to the south most slowly moving? It is possible that observations of these stars might have been made in such a way that at the beginning of the evening the particular position of γ Draconis, for instance, might have been noted with regard to the pole star: and seeing that the Egyptians thoroughly knew the length of the night and of the day in the different portions of the year, they could at once the moment they got the starting point afforded by the position of this star practically use the circle of the stars round the north pole as the dial of a sort of celestial clock. May not this really have been the clock with which they have been credited? However long or short the day, the star which was at first above the pole star, after it had got round so that it was on a level with it, would have gone through a quarter of its revolution.

In low northern latitudes, however, the southern stars would serve better for this purpose, since the circle of northern circumpolar stars would be much restricted. Hence there was a reason in such latitudes for preferring southern stars. With regard both to high north and south stars then, we may in both cases be in presence of observations made to determine the time at night. So that the worship of Set, the determination of the time at night by means of northern stars, might have been little popular with those who at Gebel Barkal and elsewhere in the south had used the southern ones for the same purpose, and this may be one reason why the Theban priests, representing Nubian astronomical culture and methods, were pledged to drive the cult of Sutech out of the land.

Since then the observations of γ Draconis might be used to herald the sunrise almost all the year round, and since the modern constellation Draco is the old Hippopotamus, we can readily understand Plutarch's statement that "Taurt presides over the birth of the sun," and why Taurt or Maut should be called the Mistress of Darkness.[1]

It does not seem too much to hope that the continuation of such inquiries may ultimately enable us to solve several points connected with early Egyptian history. We read in Brugsch :—[2]

"According to Greek tradition, the primitive abode of the Egyptian people is to be sought in Ethiopia, and the honour of founding their civilisation should be given to a band of priests from Meroë. Descending the Nile, they are supposed to have settled near the later city of Thebes, and to have established the first state with a theocratic form of government."

"But it is not to Ethiopian priests that the Egyptian Empire owes its origin, its form of government, and its high civilisation; much rather was it the Egyptians themselves that first ascended the river to found in Ethiopia temples, cities, and fortified places, and to diffuse the blessings of a civilised state among the rude dark-coloured population."

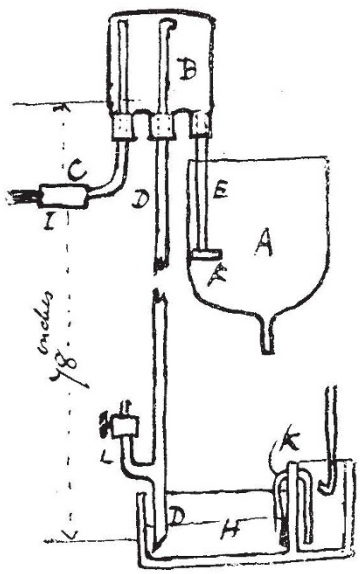
. . . "Strange to say, the whole number of the buildings in stone, as yet known and examined, which were erected on both sides of the river by Egyptian and Ethiopian kings, furnish the incontrovertible proof that the long series of temples, cities, sepulchres, and monuments in general, exhibit a distinct chronological order, of which the starting point is found in the pyramids, at the apex of the Delta."

J. NORMAN LOCKYER.

(*To be continued.*)

A PERIODIC MERCURY PUMP.

I HAVE designed and constructed the instrument described in the following lines to reduce the labour of working pumps of the Sprengel class. It has proved itself to be so serviceable in our laboratory that I believe a short descripion of it may be useful to those who



are engaged in work in which the mercurial pump is employed.

A is the cistern of the Sprengel pump (not shown), B is a bottle having three necks: it is furnished with three tubes, C, DD, EF; C, which has a valve at I, is attached

[1] Rawlinson, i. 337.
[2] "Egypt under the Pharaohs," ed. 1891, p. 3.

to an ordinary water-pump through a wash bottle containing sulphuric acid (I find that which is known as the University College pump the best); EF dips into the cistern A, and is closed at its end F by a small glass ball fitting the ground out end of the tube which acts as a valve. The tube DD dips in the cistern H into which the mercury from the Sprengel pump is discharged. The siphon K causes the supply of mercury to be periodic; upon this the action of the pump depends. By means of a stop-cock L air is admitted to the tube DD. The mercury is raised thus: A partial vacuum is formed in B by the water-pump; this raises the mercury to the point where L joins DD; a piston of mercury is then formed, and it is at once carried up into B; this goes on till all the mercury in H is raised to B, then air is drawn through DD and the vacuum ceases in B, and the mercury falls through EF; in a short time H refills, and the operation is repeated.

The instrument at work in my laboratory raises 90 lbs. of mercury 6·5 feet high in one hour. The pump requires no attention after it has been started. The valve I stops the tube C, should the supply of water to the water-pump be accidentally cut off when the pump is lifting. I have made many experiments with mercury elevators, and from these it appears that the periodic supply of mercury to the cistern from whence it is drawn greatly contributes to the certainty of the action of the instrument.

FREDERICK J. SMITH.

THE LATE DR. JOHN RAE.

DR. JOHN RAE, F.R.S., whose death we announced last week, was perhaps the most persevering and successful of the Arctic travellers by land whose journeys called forth the admiration of the world forty years ago. He was a native of Orkney, born in 1813, and studied medicine at Edinburgh, where he qualified in 1833. Rae was early brought face to face with his life-work, his first engagement on leaving college being as surgeon to the Hudson Bay Company's ship which carried supplies to the fur-forts in Hudson Bay. He entered the service of the company, and for ten years lived at Moose Factory, gaining familiarity with Arctic life during the severe winters. In 1845 his true career as an Arctic explorer began in his undertaking the leadership of a small expedition to explore a considerable extent of the coast-line of the Arctic Sea. In June, 1846, he set out on this expedition from York Factory, coasted along the west side of Hudson Bay, and wintered on the shore of Repulse Bay. Early in 1847 he made an extensive land journey to the north and west, with the result that 700 miles of new coast were surveyed, almost filling the gap between Ross's work in Boothia and Parry's at Fury and Hecla strait. In 1850 Dr. Rae published an account of this expedition in the form of a book of 250 pages. This was, curiously enough, his only permanent contribution to geographical literature, his subsequent journeys being recorded merely in formal reports published in the *Journal* of the Royal Geographical Society. After this journey Rae came to London, but was almost immediately induced to join the first land expedition sent to seek for Sir John Franklin, under the leadership of Sir John Richardson. The expedition was unsuccessful as to its primary purpose of finding traces of Franklin, but it effected a satisfactory survey of the whole coast between the Mackenzie and Coppermine rivers. In 1851 Rae received the command of another boat expedition for the Hudson Bay Company, in the course of which he thoroughly explored and mapped the south coast of Wollaston Land and Victoria Land, still searching vainly for traces of Franklin's party. On his return from this arduous undertaking, which he conducted throughout with conspicuous daring and sagacity, he had to travel on snow-shoes, and himself dragging a sledge, across the whole length of Canada from the Arctic Sea, through Fort Garry (now Winnipeg) until he reached United States territory. His total walking on this expedition was over 5000 miles, of which 700 miles were traversed for the first time. On returning to England in 1852 the gold medal of the Royal Geographical Society was presented to him by Sir Roderick Murchison in a speech, the cordial terms of which showed how fully Dr. Rae's genius for Arctic travel with the minimum of equipment and at infinitesimal expense was appreciated by the highest authorities. In no wise deterred by the hardships of his earlier campaigns, Rae left England early in 1853 to continue his work in the far north; the Hudson Bay Company equipping an expedition on condition that he would lead it personally. He completed the survey of King William's Land on this occasion, proving it to be an island; 1100 miles of sledging were accomplished in the process, of which 400 miles were new discovery. But the really important result of this expedition was Dr. Rae's meeting with the first evidence of Sir John Franklin's fate, from the story of a party of wandering Eskimo. The tribe encountered were in possession of many personal relics of members of that ill-fated expedition, which Rae secured and brought home. When he returned to England with the news so long searched for and so anxiously awaited, the Admiralty, which had spent large sums in fitting out successive expeditions, concluded that the fate of Franklin was decided beyond a doubt, and accordingly awarded to Dr. Rae the sum of £10,000 offered by Government to the first who brought back decisive information. The justice of this award was at the time strongly objected to by Lady Franklin, and although no further action was taken by Government she continued to organise private expeditions, which, while proving in effect the correctness of Dr. Rae's information from the Eskimo, served in no small degree to advance the geographical survey of the polar area.

In all his expeditions, Dr. Rae made collections of characteristic plants and animals as well as physical and meteorological observations. The material, described by other workers, went to swell the sum of our knowledge of the general conditions of climate and life in the Arctic basin.

In 1860 and subsequent years Dr. Rae made a series of interesting journeys in Iceland, Greenland, and in North America with the object of exploring and arranging routes for telegraph lines. His later years were spent in this country, where he made himself conspicuous by his zeal in forwarding the volunteer movement, being himself an excellent shot. The feeling which grew upon him to a painful extent as he became older, that his brilliant explorations were not adequately recognised and acknowledged on the Admiralty charts, unfortunately somewhat embittered his last years. But to the end he took the keenest interest in Arctic travel and was ever ready to take part in discussions bearing on the region in which he had lived so long and suffered so much. He was a regular attendant at meetings of the Royal Geographical Society and Colonial Institute, and for many years attended the gatherings of the British Association.

NOTES.

THE Senate of Edinburgh University has conferred the honorary degree of Doctor of Laws upon Prof. Arthur Auwers, in recognition of his astronomical labours. The same honour has been given to Dr. Littlejohn, the President of the British Institute of Public Health.

A Reuter's telegram states that a cloud-burst occurred at Pueblo, Colorado, on July 28, and destroyed property to the