of this globe, this manner of accounting for the obſerved change of variation has all the probability that we can deſire. Nay, we apprehend that very conſiderable changes may be produced in the direction oſ the compaſs needle even with­out the ſuppoſition of any internal motion. If the great mag­net reſembles many loadſtones we are acquainted with, having more than two poles, we know that theſe poles will act on each other, and gradually change each other’s force, and conſequently the direction of the compaſs. This proceſs, to be ſure, tends to a ſtate of things which will change no more. — But the period of human hiſtory, or of the hiſtory of the race of Adam, may make but a ſmall part of the hiſtory of this globe ; and therefore this objection is of little force.

There can be no doubt of the operation of the general terreſtrial magnetiſm on every thing ſuſceptible of magnetic properties ; and we cannot hesitate to explain in this way many changes of magnetic direction which have been ob­ſerved. Thus, in Italy, Father de la Torré obſerved, that during a great eruption of Vesuvius the variation was 16⁰ in the morning, at noon it was 14⁰, and in the evening it was 10⁰, and that it continued in that ſtate till the lava grew ſo dark as no longer to be viſible in the night ; after which it ſlowly increaſed to 13½, where it remained. Daniel Bernoulli found the needle change its poſition 45' by an earthquake. Profeſſor Muller at Manheim obſerved that the declination of the needle in that place was greatly af­fected by the earthquake in Calabria. Such ſtreams of lava as flowed from Hekla in the laſt dreadful eruption muſt have made a transference of magnetic matter that would conſiderably affect the needle. But no obſervations ſeem to have been made on the occaſion ; for *we* know that com­mon iron-ſtone, which has no effect on the needle, will, by mere cementation with any inflammable ſubſtance, become magnetic. In this way Dr Knight ſometimes made artificial loadſtones.—But theſe are partial things, and not connected with the general change of variation now under conſideration.

We have ſaid ſo much on this subject, chiefly with the view of cautioning our readers againſt too ſanguine expecta­tions from any pretentions to the ſolution of this great pro­biert. We may certainly gather from theſe obſervations, that even although the theory of the variation ſhould be completed, we muſt expect (by what we already know of mag­netiſm in general) that the diſturbances of the needle, by local cauſes intervening between it and the great influence by which it is chiefly directed, may be ſo conſiderable as to affect the poſition of the compaſs needle in a very ſenſible manner : for we know that the metallic ſubſtances in the bowels of the earth are in a ſtate of continual change, and this to an extent altogether unknown.

There is another irregularly of the mariner’s needle that we have taken no notice of, namely, the daily variation. This was firſt obſerved by Mr George Graham in 1722 (*Philosophical Tranſactions,* n⁰ 383), and reported to the Royal Society of London. It uſually moves (at leaſt in Europe) to the westward from 8 morning till 2 P. Μ. and then gradually returns to its former ſituation. The diur­nal variations are ſeldom leſs than 0⁰ 5', and often much greater Mr Graham mentions (*Philoſophical Transactiοns, n⁰* 428) ſome obſervations by a Captain Hume, in a voyage to America, where he found the variation greateſt in the afternoon. This being a general phenomenon, has alſo attracted the attention of philosophers. The moſt detailed accounts of it to be met with are thoſe of Mr Canton, in *Philoſophical Transactiοns,* Vol LI. Part I. p. 399, and those of Van Swinden, in his *Treatiſe on Electricity and Magnetiſm.*

It appears from Canton’s obſervations, that although there be great irregularities in this diurnal change of poſition of the mariner’s needle, there is a certain average, which is kept up with conſiderable ſteadineſs. The following table ſhows the average of greateſt daily change of poſition in the different months of the year, obſerved in Mr Canton’s houſe, Spital Square, in 1759.

|  |  |  |  |
| --- | --- | --- | --- |
| January | 7'. 8'' |  |  |
| Feburary 8 .58 | |  |  |
| March | 11 .27 |  |  |
| April | 12 .26 |  |  |
| May | 13 — |  |  |
| June | 13 .21 |  |  |

Mr Canton attempts to account for theſe changes of poſi­tion, by obſerving that the force of a magnet is weakened by heat. A ſmall magnet being placed near a compaſs needle, ENE from it, ſo as to make it deflect 45⁰ from the natural poſition, the magnet was covered with a braſs vessel, into which hot water was poured. The needle gradual­ly receded from the magnet ¾ths of a degree, and returned gradually to its place as the water cooled. This is confirm­ed by uniform experience.

The parts of the earth to the eaſtward are firſt heated in the morning, and therefore the force of the earth is weaken­ed, and the needle is made to move to the weſtward. But as the ſun warms the weſtern side of the earth in the after­noon, the motion of the needle muſt take the contrary di­rection.

But this way of explaining by a change in the force of the earth ſuppoſes that the changing cauſe is acting in oppoſition to ſome other force. We do not know of any ſuch. The force, whatever it is, ſeems ſimply to produce its own effect, in deranging the needle from the direction of terreſtrial magnetiſm. If Æpinus’s theory of magnetic action be admitted, its that a bar of ſteel has magnetism induced on it by propelling the quieſcent and mutually repelling particles of magnetic fluid to one end, or attracting them to the other, we may ſuppoſe that the ſun acts on the earth as a magnet acts on a piece of ſoft iron, and in the morning propels the fluid in the north-weſt parts. The needle directs itſelf to this conſtipated fluid, and therefore it points to the eaſtward of the magnetic north in the afternoon. And (to abide by the same theory) this induced magnetiſm will be ſomewhat greater when the earth is warmer ; and therefore the diurnal variation will be greateſt in ſummer. This change of poſition of the conſtipated fluid muſt be ſuppoſed to bear a very ſmall ratio to the whole fluid, which is naturally ſuppoſed to be con­ſtipated in one pole of the great magnet in order to give it magnetiſm. Thus we ſhall have the diurnal variation a very ſmall quantity. This is departing, however, from the prin­ciple of Mr Canton’s explanation ; and indeed we cannot ſee how the weakening the general force of the terreſtrial mag­net ſhould make any change in the needle in reſpect to its direction ; nor does it appear probable that the change of temperature produced by the ſun will penetrate deep enough to produce any ſenſible effect on the magnetiſm. And if this be the cauſe, we think that the derangements of the needle ſhould vary as the thermometer varies, which is not true. The other method of explaining is much better, if Æpinus’s theory of magnetic attraction and repulſion be just ; and we may ſuppoſe that it is only the ſecondary magnetiſm (i. *e.* that of the magnetiſable menerals) that is ſenſibly affected by the heat ; this will account very well for the greater mobility of the fluid in ſummer than in winter.

A great objection to either of theſe explanations is the prodigious diverſity of the diurnal variations in differ­ent places. This is ſo very great, that we can hardly aſcribe the diurnal variation to any change in the magnetiſm of the