

These experiments were repeated with bars of other dimensions, which were loaded till they broke; and from them the author also infers that the elastic force of steel is not altered by temper, and that the force which produces permanent alteration is to that which causes fracture in hard steel, as 1 : 1.66; and in the same steel of a straw yellow temper, as 1 : 2.56. From comparisons of the strain required to cause permanent alteration in different kinds of steel, the author concludes, that in the process of hardening, the particles are put into a state of tension among themselves, which lessens their power to resist extraneous force; and the phenomena of hardening may be referred to the more rapid abstraction of heat from the surface of the metal than can be supplied from the internal parts, whence a contraction of the superficial parts round the expanded central ones, and a subsequent shrinking of the latter, by which the state of tension is produced.

A short Account of some Observations made with Chronometers, in two Expeditions sent out by the Admiralty, at the recommendation of the Board of Longitude, for ascertaining the Longitude of Madeira and of Falmouth. In a Letter to Thomas Young, M.D. For. Sec. R.S. and Secretary to the Board of Longitude. By Dr. John Lewis Tiarks. Read April 29, 1824. [Phil. Trans. 1824, p. 360.]

Dr. Tiarks was sent to Madeira in the year 1822 with 15 chronometers, of which the rates had principally been ascertained in the Royal Observatory of Greenwich; he touched at Falmouth both in going out and returning; and having again ascertained the rates of his time-keepers, he was thus enabled to obtain two distinct determinations of the longitude of Falmouth, which differed about four seconds of time from that which had been inferred from the Trigonometrical Survey of Great Britain. It became therefore desirable that some further operations should be undertaken for the removal or elucidation of this discordance; and the following year a similar method was adopted with 25 chronometers, for determining the difference of longitude between Falmouth and Dover; this latter station having been chosen as easy of access, and as being perfectly determined; and the computations were made by interpolation, without employing any other rates for the chronometers than those which were observed in the different trips while they were actually on board the ship; and latterly, when Dover Roads became unsafe, the operations were limited to the distance from Portsmouth to Falmouth: thus, between the months of July and September, the observations were made three times at Dover, four times at Falmouth, and three times at Portsmouth; and the comparison of their results affords a correction of five seconds of time for the difference of longitude of Dover and Falmouth, and of three for the difference of Falmouth and Portsmouth, agreeing completely with the error of four seconds, attributed from the observations of the preceding year to the difference of longitude of Falmouth and Greenwich.

Hence Dr. Tiarks thinks it fair to conclude that the diameter of the parallel circle, in which the longitude is measured, has in the survey been taken somewhat too great, and consequently the earth's ellipticity greater than the truth. He remarks that the measurement of the spheroidal triangle concerned, determines only the actual flatness of the part of the earth's surface on which it is situated, and not the actual magnitude of the whole parallel, unless its curvature be supposed perfectly uniform, which we cannot assume with confidence; while on the other hand, if we compute the ellipticity from the result of the chronometrical determination, it becomes one 314th instead of one 150th, and agrees with the most accurate measurements obtained from different principles. The longitude of Falmouth is finally determined to be $20^m 11^s.1$ of time, and that of the British Consul's garden at Funchal, $1^h 7^m 39^s$ W. of Greenwich.

Of the Effects of the Density of Air on the Rates of Chronometers.

By George Harvey, *F.R.S.E. &c.* Communicated by Davies Gilbert, *Esq. V.P.R.S.* Read May 13, 1824. [*Phil. Trans.* 1824, p. 372.]

Among the sources of error to which chronometers are liable, the effect of the variable density of the medium in which the balance vibrates has been overlooked; the author therefore proposes to investigate the effects of diminished and increased pressure of transference from one to the other, and of the ordinary variations of atmospheric density upon the rates of chronometers. In respect to diminished pressure, he found that chronometers gained by being placed in air of less density than that of the ordinary state of the atmosphere, and that, on the other hand, they lost when subjected to air of greater than ordinary density. These experiments were made with a variety of chronometers, placed in the receiver of an air-pump, or in that of a condensing apparatus.

In respect to the influence of ordinary changes in the density of the air, the author remarks that pocket chronometers are more readily affected than box chronometers, but that they all exhibit an increased rate under diminished density, and *vice versâ*. The author shows that these changes in the rates, as observed in the air-pump and condensing apparatus, are independent of the changes of temperature, resulting from changes in the density of the air thus rapidly effected, and therefore proceeds to inquire into the actual cause of the changes which his experiments indicate; he refers them to an increase in the arc of vibration when the density is diminished, and to a diminution in the arc under increased density.