

trices and epicycles, as we have already said; and the motions in latitude by certain *librations*, or alternate elevations and depressions of epicycles. If a mathematician had obtained a collection of true positions of a planet, the form of the orbit and the motion of the star would have been determined with reference to the sun as well as to the earth; but this was not possible, for though the *geocentric* position, or the direction in which the planet was seen, could be observed, its distance from the earth was not known. Hence, when Kepler attempted to determine the orbit of a planet, he combined the observed geocentric places with successive modifications of the theory of epicycles, till at last he was led, by one step after another, to change the epicyclical into the elliptical theory. We may observe, moreover, that at every step he endeavored to support his new suppositions by what he called, in his fanciful phraseology, "sending into the field a reserve of new physical reasonings on the rout and dispersion of the veterans;"<sup>6</sup> that is, by connecting his astronomical hypotheses with new imaginations, when the old ones became untenable. We find, indeed, that this is the spirit in which the pursuit of knowledge is generally carried on with success; those men arrive at truth who eagerly endeavor to connect remote points of their knowledge, not those who stop cautiously at each point till something compels them to go beyond it.

Kepler joined Tycho Brahe at Prague in 1600, and found him and Longomontanus busily employed in correcting the theory of Mars; and he also then entered upon that train of researches which he published in 1609 in his extraordinary work *On the Motions of Mars*. In this work, as in others, he gives an account, not only of his success, but of his failures, explaining, at length, the various suppositions which he had made, the notions by which he had been led to invent or to entertain them, the processes by which he had proved their

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<sup>6</sup> I will insert this passage, as a specimen of Kepler's fanciful mode of narrating the defeats which he received in the war which he carried on with Mars. "Dum in hunc modum de Martis motibus triumpho, eique ut planè devicto tabularum carceres et equationum compedes necto, diversis nuntiatum locis, futilem victoriam ut bellum totâ mole recrudescente. Nam domi quidem hostis ut captivus contemptus, rupit omnia equationum vincula, carceresque tabularum effregit. Foris speculatores profigerunt meas causarum physicarum arcessitas copias earumque jugum excusserant resumtâ libertate. Jamque parum abfuit quia hostis fugitivus sese cum rebellibus suis conjungeret meque in desperationem adigeret: nisi raptim, nova rationum physicarum subsidia, fuis et palantibus veteribus, submissem, et qua se captivus proripuisset, omni diligentia, edoctus vestigiis ipsius nullâ morâ interpositâ inhæsissem."