9th century, in such a manner as to leave no doubt that his state­ments really refer to that extensive but remote island. See Letronne, Recherches sur Dicuil, Paris, 1814.

THÜMMEL, Moritz August von (1738-1817), Ger­man writer in prose and verse, one of the imitators of Wieland (see vol. x. p. 541), was born May 27, 1738, in the neighbourhood of Leipsic, was educated at Rossleben and the university of Leipsic, and from 1761 till 1783 held various offices in the ducal court of Saxe-Coburg. He died at Coburg on October 26, 1817. He wrote a comic prose epic, *Wilhelmine, oder der vermählte Pedant* (1764) ; *Die Inoculation der Liebe* (1771), a tale in verse; *Reise in die mittäglichen Provinzen von Frankreich* (1791— 1805), a romance in 10 vols. ; and *Der heilige Kilian, oder das Liebespaar* (1818). An edition of his works was published at Leipsic in 8 vols. in 1854-55.

THUNBERG, Carl Peter (1743-1828), an eminent traveller, and one of the most distinguished botanists of the school of Linnæus, was born in 1743. He became a pupil of Linnæus at the university of Upsala, where he graduated in medicine in 1770. Obtaining a travelling scholarship, he visited Holland, whence he embarked on a voyage of exploration to Java, in quest of vegetable treasures. He sailed as far as the Cape of Good Hope in 1771, and three years afterwards went to Japan, remain­ing five years, engaged in making collections of plants, and in observing the habits, manners, and language of the people. On his return in 1779 he visited England, and made the acquaintance of Sir Joseph Banks. In 1777 he was made demonstrator of botany at Upsala, and he succeeded Linnæus as professor of botany in 1784. Thunberg published in 1784 his *Flora Japonica ;* in 1788 he began to publish his travels. He completed his *Prodromus Plantarum* in 1800, in 1805 his *Icones Plant­arum,* and in 1813 his *Flora Capensis.* Thunberg pub­lished numerous memoirs in the *Transactions* of many Swedish and foreign scientific societies, of sixty-six of which he was an honorary member. He died in 1828.

THUNDERSTORM. All the more ordinary pheno­mena of thunderstorms had, about 1750, been conclusively traced to electrical charges and discharges (Electricity, voL viii. p. 6), so that they could easily be reproduced on a small scale in the laboratory. To the article cited we therefore refer for their explanation. Some of the laws of relative frequency of thunderstorms, in different places at the same season or in the same place at different seasons, will be found in Meteorology (vol. xvi. p. 128). A discussion of the cause of thunder, and of the circum­stances which give rise to a crash, a roll, or a peal of thunder is given under Acoustics (vol. i. p. 107). In what follows, therefore, the rarer phenomena of thunder­storms, and the possible sources of the atmospheric elec­tricity, will be the chief points treated.

There can be little doubt that atmospheric electricity, at least in the great developments which characterize a thunderstorm, is due in some way to water. Before a great thunderstorm the lower air is usually at an abnor­mally high temperature, and fully saturated with water vapour, so that it is in a thoroughly unstable condition. Immense cloud masses, often miles in vertical thickness, which produce almost midnight darkness by day in the region of the storm, and which appear, when seen from a distance, as if boiling upwards, are always a notable feature of great thunderstorms. These are usually accom­panied by torrents of rain, or by violent hail-showers. And it is commonly observed that each flash of lightning is followed, after a brief interval, by a sudden but temporary increase in the rate of rainfall. At what stage of its transformations the electrification is developed by water­substance is, as yet, only guessed at,—though it seems most reasonable to conclude that it is anterior to the formation of cloud, *i.e.,* to the condensation of vapour. And, though the idea was at one time very generally held and still has many upholders, it seems unlikely to be the direct result of evaporation. For, were it due directly either to evaporation or to condensation, it is almost im­possible to doubt that proof would long since have been furnished by careful experiment, even if made on a scale so limited as that afforded by our laboratories. No trace of electrical effect has been found to attend the precipita­tion of moisture ; and the electrical effects, sometimes con­siderable, which have been found associated with evapora­tion have always been accompanied by relatively violent physical and mechanical actions which are not observed in conjunction with atmospheric electricity. It has been suggested by some authorities that the electricity of a thunderstorm is developed during the formation of hail, by others that it is due to the molecular actions which accompany the diminution of total surface when two or more drops of water coalesce into a single one. It has been ascribed to the friction of moist against dry air, and to the dust-particles which appear to be necessary for the condensation of vapour. Again, it has been suggested that it may be a mere phenomenon of contact electricity, due to the impact of uncondensed vapour particles on particles of air. It is almost unnecessary to observe that, whatever hypothesis we adopt, some explanation must be given of two important points :—(1) What becomes of the electricity equal and opposite to that in each drop, which must be produced simultaneously with it *Ί* (2) By what means is the attraction between the drops and the recipient of the opposite charge of electricity overcome so that the drops may be enabled to part with their charge ? It is to be presumed that gravity satisfies the second of these questions. As to the first, it seems to necessitate the presence of something besides water, in order that the electric separation may be commenced, and thus appears to be fatal to the capillary theory indicated above. Whatever be the true source of the charge, it is easy to see, by known properties of electricity, that even an exceedingly small charge on each vapour particle would lead to a very high potential as soon as a visible drop is formed, and that as a drop increases in size its potential is proportional to its surface. That drops of rain are often individually electrified to a very high potential is proved by the frequent occurrence of “ luminous rain,” when the ground is feebly lit up by the multitude of tiny sparks given out by the drops as they come near it. The flakes of falling snow, also, are often strongly electrified, so that smart sparks have been drawn from an umbrella on which the snow was falling. But the law of electric repulsion shows us at once that, as soon as the drops in a cloud are sufficiently electrified, at least the greater part of their charge must pass to the boundary of the cloud. When this occurs, the nature of the further behaviour of the charge presents no difficulty. The reason for our singu­larly complete ignorance of the source of atmospheric electricity seems to lie in the fact that it can only be discovered by means of experiments made on a scale very much larger than is attainable with the ordinary resources of a laboratory. The difficulties will probably be easily overcome by the first nation which will go to the expense of providing the necessary means.

Numberless other explanations of the origin of thunder­storms have been suggested ; but the more reasonable of these do little more than shift the difficulty, for they begin by assuming (without any hint as to its source) an elec­trification of the earth as a whole, or of the lower (some­times the upper) layers of the atmosphere. Induction, convection, &c., are then supposed to effect the rest.