

This line to be prolonged from Alhama to the Sierra de Moncayo. A line to be carried from the widest range of secondary and tertiary formations in lower La Mancha, from the neighbourhood of Ciudad Real, until the primary of Estremadura shows the beginning of the section, quite through the Valdepeñas chain to Almanza, where the beds of secondary limestone are thrown up perpendicular, and have the appearance of an axis, to be continued through Alcoy, where the nummulite formation must be examined, and from thence to Cape St.-Martin.

### IN VALENCIA.

The relations of the chain through which the Ebro breaks to be traced from that of the Sierra de Cuenca and thence to be followed through Catalonia, and its connection, if any, with the limestone and sandstone of Mont. Perdu made out. A section from the Cape Palos through Murcia by the defile of the village of Cañarejo across the secondary chain to the Sierra de Segura or until the central axis of it be found in the line of bearing from Almanza, or where ever it be discovered. From thence by the Sierra de Segura to Alcaraz. The important point of the nummulite limestone at Velez Rubio to be made clear, and sections to be taken, especially from that place to the Sierra de Filabres and Lomo de Vaca, or Sierra de Almagro and Sierra de Huescar. The volcanic formations of Almazarron and Cape de Gatt to be examined in detail.

### ANDALUSIA.

The limestone of the Sierra de Gador to be examined

and its junction with the formations of granular limestone and other undoubted primary rocks at the head of the valley of Derines on the route to Cadiar. Near Granada the real position of the great classes of recent formations, the conglomerate of the city and the diluvions of the Vega, the clay and gypsum, the marine formation of Escuzar and the lacustrine basin of Alhama to be positively fixed, whether they stand in the relations supposed in these sketches. A section carefully carried across the Sierra de Elvira, and the secondary chain to the Guadalquivir and the bed of the river examined in all its length, from Andujar to Carmona, to trace the connection supposed to exist through that line, especially between Cordova and Andujar.

The Sierra Morena behind Cordova to be examined. A line to be carried from the recent marine formations of Xeres across the Serrania de Ronda to Marbella and a section from St.-Cristobal to the marles of the plain of Antequera on the flanks of that elevated range.

These are the outlines of what it appears advisable should be done in order to have a general knowledge of this almost terra incognita of geology and the designation of it will facilitate the operations of those who may have leisure for a part only. The whole of course will require time and much labour. Of details it is needless to say they must suggest themselves every where, in collecting local notices and especially fossile remains wherever they are to be obtained.

It remains to notice the soils of Spain, which are, as may be supposed extremely varied under their geological bearings. The alluvial soil of old Castile is fertile; apparently in the middle degree, but much of it is sandy and not sufficiently retentive of water. Near Villal

pando it is excellent, being a tenacious loam, whilst near Valladolid it is a white and unproductive clay, the formation in that vicinity giving only in different soil. Towards the primary chain it improves. In new Castile there is every variety. The dismal country of Madrid and Ocaña is of the gypseous marle, which gives the dreary look to the country scarcely differing in May or in December, whilst the limestone of Arganda; etc. is a light and productive soil and the red marle of Guadalaxara and the Alcarria, is about the best in Spain for every purpose. The Sierra Morena which is formed of primary detritus cannot be excelled in beauty and natural fertility, being capable of every kind of culture. The country of Valdepeñas is decomposed limestone and of excellent quality for all purposes.

The soil of Estremadura especially near Merida is primary detritus, and in the world there is not a more beautiful country, which is now almost a desert. The rich plain of Talavera and the country near Toledo appear to be of the same quality, but near Toledo in some parts there is an excellent red marle. In upper Andalusia the country of Ubeda formerly so celebrated and of Jaen is of clay, whilst Linares and the country below Orcera and Segura de la Sierra, are red marle. The rich vale of Andujar appears to be of transported materials and the dreary country from thence to Granada, excepting some hoyas or basins, as that of Archidona which is decomposed limestone forming a mass of great thickness is chiefly of the unfertile gypseous marles.

The celebrated Vega of Granada is a sandy and gravelly marle passing into clay and is an unfertile, ungrateful soil, as is the vast district of Guadix and of Baza, to

the sea. All this soil can only be made productive by irrigation.

Lower Andalusia is chiefly clay and bad marle only to be forced by irrigation, none of it being really good soil, until the red sandstone marles of the Serrania of Ronda appear, which give the fertility to that beautiful region. The Tierra Caliente or strip along the mediterranean varies exceedingly. In the Vega of Malaga now a desert it is naturally of surprising fertility, and west of Marbella is an excellent small tract upon the sandstone, now quite uncultivated. Along the coast near Veléz Malaga there is red marle like that of Malaga and it is equally fertile. The beautiful sugar and cotton grounds are chiefly the deltas of the torrents and all around them is bare rock. Almeria and the campo de Dalias are bare rocks only to be managed by irrigation and the establishment of pantanos or reservoirs, as is all the country to Murcia. This vale owes its fertility to the Moors by the establishment of irrigation. It is probably better soil than Valencia and like that, alluvial or transported materials. Alicante resembles the country further west and requires only additional pantanos to make it a garden.

Valencia is a poor and ungrateful soil which is constantly exhausted and yields its crops only by forced cultivation and especially the use of water. Most of the country to the Ebro is the detritus of limestone which it thinly covers. Catalonia contains beautiful red marles and tracts of white gypseous marle as dreary as any in Castile. Aragon has both unproductive gypseous marles and rich red marles as in the valley of the Xalon. The bed of the Ebro is of sand and gravel, which with the irrigation from the canal

prove what may be done, the produce in a very imperfect state of agriculture being seven times the consumption in good years. The northern provinces have the soil principally from the red sandstone as is that of the upper part of old Castile. If steps were to be taken seriously to revive the agriculture and people the *despeblados*, care should be taken in selecting as commencements those parts where the return will be most rapid and certain. The Sierra Morena, the Alcarria, the province of Toledo, and of Guadalaxara, the Vega of Malaga, and the country between Gibraltar and Cadiz would probably repay exertion more than any others in Spain. In a vast proportion of soils, it is a mere calculation of the quantity of water which can be bestowed on them. The gypseous marles give the white and dreary appearance so striking in many parts of the country and so distressing to the traveller when the glare of their brilliant sun induces the wearied eye to court repose on verdure, which is sought in vain in these districts. These clays give the peculiar state called *barro* which is frequently mentioned in travelling. In the important branch of springs, this arid country possesses certainly the most beautiful waters in the world, and in the greatest abundance. Attempts have been made to increase the supply in some peaces by the introduction of the Artesian system, unfortunately without success, as it may deter others from making the attempt.

The foot of the limestone ranges are the most promising localities, but in general in these it is not wanted, as nature affords it in abundance, without the troubling of boring. The mining districts are mentioned under that head, and do not require repetition under the geological notice. The Sierra Morena and range

of the Sierra Nevada are beyond question the best, and most likely to repay the examination now going on in almost all parts. The veins in the Sierra Morena are generally in a direction from north to south and are perpendicular in most parts. Those which are sterile are filled, at least at Guadalcanal, with quartz.

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## ERRATUM.

Page 105, line 26, for San Pauls, read St.-Pauls.

*Note to page 244.* In the ascending series of the Pines, the p. pinea is placed above the Hispanica, on account of the *latitude* and elevation of the plateau of old Castile, but it is not meant to be asserted as positively higher. Experiments will soon prove, in England, their relative hardiness. It is probable that in actual level above the sea, the Hispanica in the forests yet remaining, will, when the levels are taken, be found the highest of these two species.