DESCRIPTION OF THE PLATES AND MAP.

FRONTISPIECE.

View of part of the Valley del Bove, on the East side of the great Cone of Etna.

THIS valley is a cavity of immense depth, commencing at a short distance below the summit of Etna, and descending through that zone of the mountain where lateral eruptions are frequent. The general dip of the volcanic beds in the precipices surrounding this valley is towards the sea, but exceptions occur where lateral cones have been buried in the manner described in the first volume (p. 363). The stupendous precipices surrounding this great amphitheatre vary from 600 to nearly 3000 feet in height, and they are traversed on all sides by innumerable vertical walls or dikes of compact lava, which cut through the sloping beds of lava, sand, and scoriæ, of which the great cone is formed. These dikes, which will be described in the next volume, seem all to have been produced by ancient lateral eruptions on the flanks of Etna.

The causes which have produced this great depression in the otherwise symmetrical cone of the volcano will be discussed in the third volume, and we shall merely state here, that we consider the conformation of the rocky barrier encircling the cavity, as entirely at variance with an hypothesis recently proposed, that the hollow was a crater of eruption from whence the scoriæ of the surrounding heights have proceeded.

We have introduced two colours into the plate, the grey to express that part of the mountain which may have been formed before the origin of the "Val del Bove," the red to indicate the part which has resulted from eruptions subsequent to the

formation of the valley. The great lava currents of 1819 and 1811, described in the first volume (p. 367), are seen pouring down from the higher parts of the valley, overrunning the forests of the great plain, and rising up in the foreground on the left with a rugged surface, on which small hillocks and depressions are seen, such as often characterize a lava-current immediately after its consolidation.

The small cone, No. 7, was formed in 1811, and was still smoking when I saw it in 1828. Immediately in front of it is seen another cone, formed during the same eruption. The other small volcano to the left, from which vapour is issuing, was formed, I believe, in 1819.

This sketch, which forms part of a panoramic drawing which I made in November 1828, is merely intended to assist the reader, in comprehending some geological details into which we shall hereafter enter, on the structure of the older portion of Etna, but it will give no idea of the extraordinary geological interest, still less of the picturesque grandeur of this magnificent scene of desolation. Nor is the view sufficiently extensive to exhibit the entire form of the vast amphitheatre, part only of the northern, and scarcely any of the southern boundary of which is included.

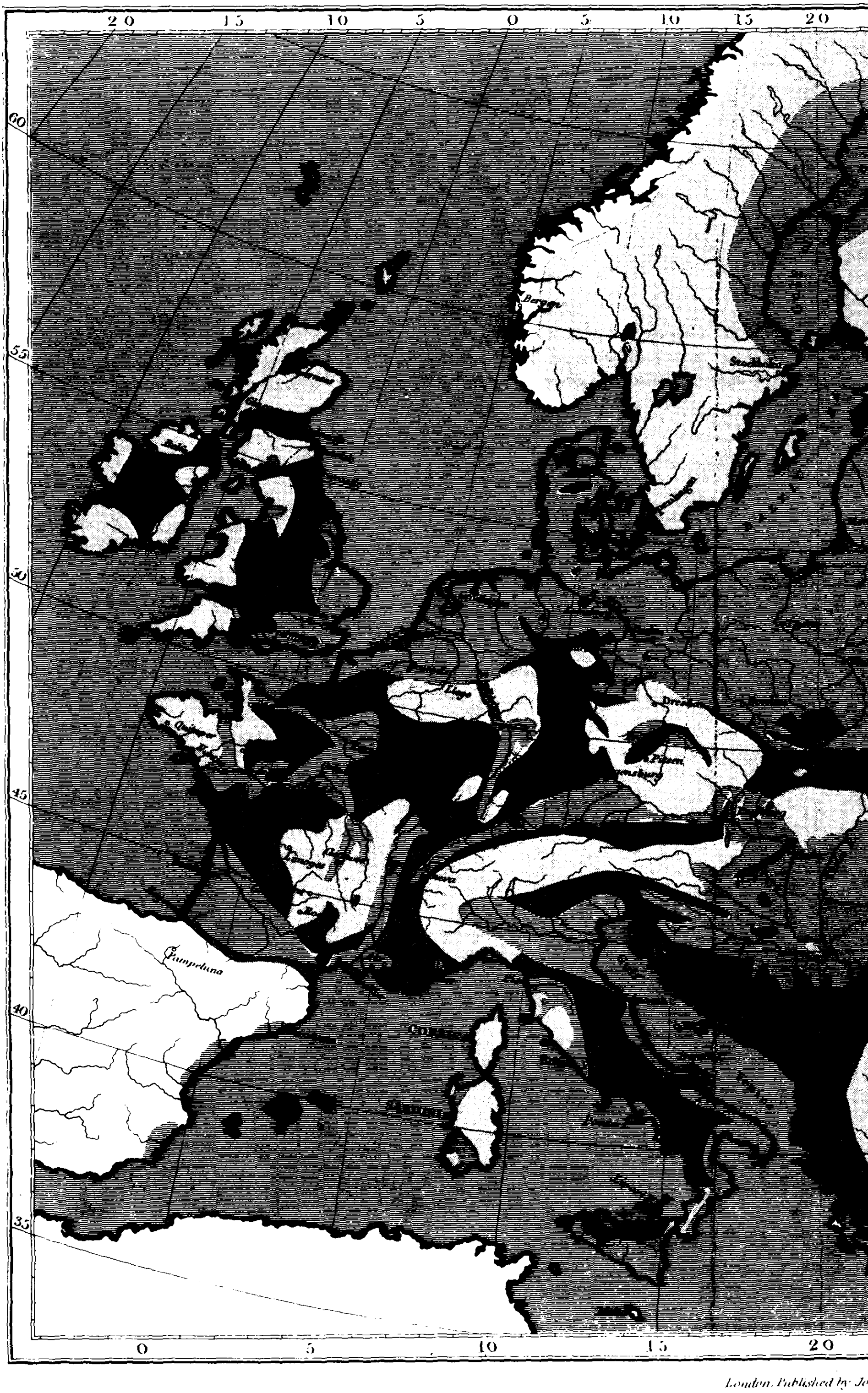
MAP

Shewing the extent of Surface in Europe which has been covered by Water since the Deposition of the older Tertiary Strata. (*Strata of the Paris and London Basins, &c.*)

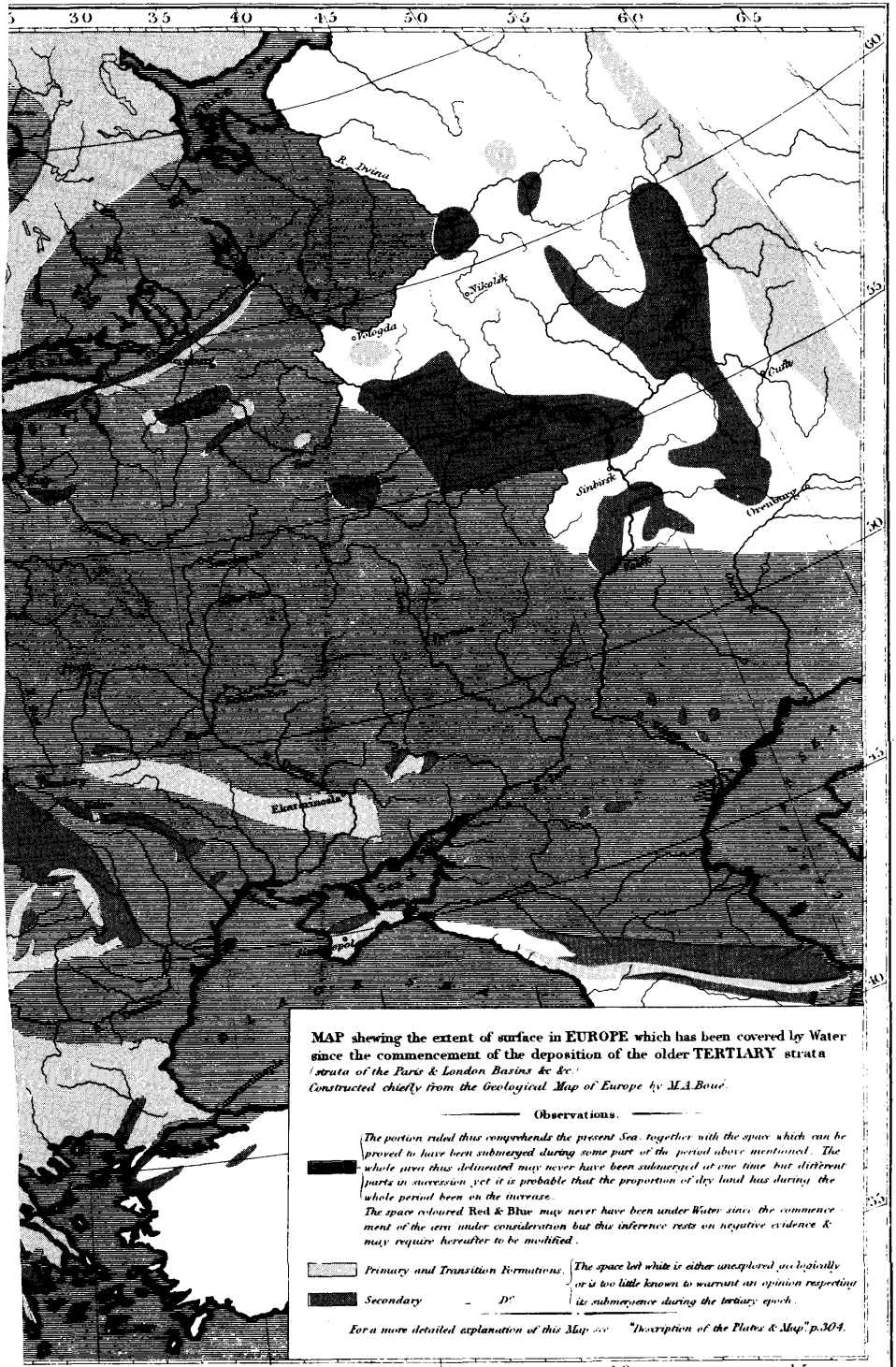
[Constructed chiefly from M. Amie Boué's Geological Map of Europe.]

This map will enable the reader to perceive at a glance the great extent of change in the physical geography of Europe, which can be proved to have taken place since some of the older tertiary strata were deposited. The most ancient part of the period to which the map refers cannot be deemed

[In the original publication, the map on the following two pages was printed as a fold-out and hand painted in two colors. We have adapted the colors to shading in order to print the map in black and white.]



London, Published by Jo



MAP shewing the extent of surface in EUROPE which has been covered by Water since the commencement of the deposition of the older TERTIARY strata

(strata of the Paris & London Basins &c &c)

Constructed chiefly from the Geological Map of Europe by M.A.Boué.

Observations.

The portion ruled thus comprehends the present Sea, together with the space which can be proved to have been submerged during some part of the period above mentioned. The whole area thus delineated may never have been submerged at one time, but different parts in succession, yet it is probable that the proportion of dry land has during the whole period been on the increase.

The space coloured Red & Blue *may never have been under Water since the commencement of the era under consideration but this inference rests on negative evidence & may require hereafter to be modified.*

Primary and Transition Formations. — *Secondary* — *D°*

The space left white is either unexplored geologically or is too little known to warrant an opinion respecting its submergence during the tertiary epoch.

For a more detailed explanation of this Map see "Description of the Plates & Map" p.304.

Engraved by J.Gardner.

Albemarle Street.

very remote, considered geologically, because the deposits of the Paris and London basins, of Auvergne, and many other districts belonging to the older tertiary epoch, are newer than the greater part of the sedimentary rocks of which the crust of the globe is composed. The species, moreover, of marine and fresh-water testacea, of which the remains are found in these formations, are not entirely distinct from such as now live; a proportion of about three in a hundred of the fossil species having been identified with species now living. Yet, notwithstanding the comparatively recent epoch to which the retrospect is carried, the variations in the distribution of land and sea depicted on the map, form only a part of those which must have taken place during the period under consideration. Some approximation has merely been made to a correct estimate of the amount of *sea converted into land* in that part of Europe best known to geologists, but we cannot determine how much land has become sea during the same period; and there may have been repeated interchanges of land and water in the same places, mutations of which no account is taken in the map, and respecting the amount of which little accurate information can ever be obtained by geologists.

The proofs of submergence, during some part of the tertiary period, throughout the districts distinguished by ruled lines, are of a most unequivocal character; for the area thus described is now covered by deposits, containing the remains of aquatic animals belonging to tertiary species. We have, indeed, extended the sea in two or three instances beyond these limits, because other geological data have been obtained for inferring the submergence of these tracts subsequently to the commencement of the deposition of the tertiary strata. Thus we shall explain, in the next volume, our reasons for concluding that part of the chalk of England, (the north and south downs, for example, together with some other adjoining secondary tracts,) continued beneath the sea until the older tertiary beds had begun to accumulate.

It is possible also that a considerable part of Caernarvon-

shire might with propriety have been represented as sea, if our information respecting the geology of that country had been more full and accurate; for marine shells have been found in sand and gravel at the height of one thousand feet above the level of the sea, on the summit of Moel Tryfane, between Snowdon and the Menai Straits. The species are apparently recent, but certainly are newer than the older tertiary epoch *.

The introduction of a small bay where the river Ribble enters into the sea in Lancashire, is warranted by the newly discovered deposit of tertiary shells covering an area of about thirty miles square in that region †.

A portion also of the primary district in Brittany is divided into islands, because it has been long known to be covered with patches of marine tertiary strata; and when I examined the disposition of these, in company with my friend Captain S. E. Cook, R.N., in 1830, I was convinced that the sea must have covered much larger areas than are now occupied by these small and detached deposits.

The former connexion of the White Sea and the Gulf of Finland is proved by the fact that a broad band of tertiary strata extends throughout part of the intervening space. We have represented the channel as somewhat broader than the tract now occupied by the tertiary formation, because the latter is bordered on the north-west by a part of Finland, which is extremely low, and so thickly interspersed with lakes as to be nearly half covered with fresh-water.

Certain portions of the north-western shores of Norway have been left blank, because the discovery by Von Buch, Brongniart, and others, of deposits of recent shells along the coast of Norway and Sweden, at several places and at various heights above the level of the sea, attest the comparatively

* Joshua Trimmer, Esq., Proceedings of the Geological Society of London, No. 22, 1831. The shells were exhibited at the Geological Society when the memoir was read.

† See an abstract of a memoir read by Mr. Murchison, Pres. Geol. Soc., Proceedings of York meeting, 1831.

recent date of the elevation of part of the gneiss and other primary rocks in that country, although we are unable as yet to determine how far the sea may have extended.

On the other hand, a considerable space of low land along the shores of the Gulf of Bothnia, in the Baltic, is represented as sea, because the growth of deltas on that coast, and the shallowing of the water by sedimentary deposits during the historical era, leave no room for doubt that the extent of the gulf must have been very much greater at some periods since the older tertiary epoch.

The low granitic steppe coloured red, to the north of the Black Sea has *not* been represented as having been under water during the tertiary period, although, from the quantity of marine tertiary strata in the surrounding districts, it is far from improbable that it has recently emerged.

We were anxious, in the observations annexed to the title of this map, to guard the reader against the supposition that it was intended to represent the state of the physical geography of part of Europe at any one period. It is not a restoration of a former condition of things, but a view of the change which a certain amount of surface has undergone within a given period, an alteration so complete, that not one of the species of organic beings which now inhabit the large space designated by ruled lines, beyond the borders of the existing seas, can have lived there during some other period subsequent to the commencement of the tertiary era.

We have stated, in the first volume *, that the movements of earthquakes occasion the subsidence as well as the upraising of the surface; and that, by the alternate rising and sinking of particular spaces, at successive periods, a great area may have been entirely covered with marine deposits, although the whole may never have been beneath the waters at one time; nay, even though the relative proportion of land and sea may have continued unaltered throughout the whole period. We believe, however, that since the commencement of the tertiary

* Page 126.

period, the dry land in the northern hemisphere has been continually on the increase, not only because it is now greatly in excess beyond the average proportion which land generally bears to water on the globe, but because the comparison of the secondary and tertiary strata implies a passage throughout the space now occupied by Europe, from the condition of an ocean interspersed with islands to that of a large continent.

But if it were possible to represent all the vicissitudes in the distribution of land and sea that have occurred during the tertiary period, and to exhibit not only the actual existence of land where there was once sea, but also the extent of surface now submerged, which may once have been land, the map would still fail to express all the important revolutions in physical geography, which have taken place within the epoch under consideration. The oscillations of level have not merely been such as to lift up the land from below the waters to a small height above them, but in some cases a rise of several thousand feet has been effected. Thus the Alps have acquired an additional altitude of from 2000 to 4000 feet, and even in some places still more; and the Apennines owe a great part of their height (from 1000 to 2000 feet and upwards) to subterranean convulsions which have happened within the tertiary epoch.

On the other hand, some mountain chains may have been lowered, during the same series of ages, in an equal degree, and shoals may have been converted into deep abysses.

It would be superfluous to point out in detail the bearing of the facts exhibited in this map, on the theories proposed in a former part of this volume, respecting the migrations of animals and plants, and the extinction of species; and it would be equally unnecessary to enlarge on the variations in *local* climate, which must have accompanied such vicissitudes in physical geography.

But the general temperature, also, of the habitable surface of the globe, as well as the local climates, may have been considerably modified by such extraordinary revolutions. The

alteration in climate, implied by a comparison of the organic remains of the older tertiary strata, and the species of living animals and plants, does not appear to be so great as would be produced if the temperature of our tropics were now transferred to the temperate zone, and the temperature of the latter to the arctic. We do not, therefore, anticipate that the reader, who has duly studied the arguments explained by us in the 6th, 7th, and 8th chapters of the first volume, will object to the *adequacy* of the cause proposed, on the score of the small quantity of geographical change during the time in question.

But if there be good reason to conclude that the change would be fully adequate, in point of the magnitude of its effects, this cause, we conceive, ought to supersede every other of a purely speculative nature, until some argument can be adduced to prove that the change has not acted in the right direction *.

Some persons, but slightly acquainted with the present state of geology, have objected, that the lands in high northern latitudes have *not* been recently elevated. If they had reflected that every year we are making some new discoveries respecting the periods when tracts in the immediate neighbourhood of the great European capitals emerged from the deep, and had they sufficiently considered that the antiquity of a group of rocks has no necessary connexion with the date of its elevation, they would probably have seen the futility of such arguments. As far as we can conjecture, from the very scanty information which we possess of the geology of the arctic region, there is no want of proofs of comparatively recent alterations of level.

In conclusion, we may remark that the portion of Europe distinguished in this map by colours and ruled lines, comprises the greater part of the globe now known to geologists—almost all at least that is known in such a manner as to entitle any one to speculate on the mutations in physical geography which have taken place during the tertiary period.

* See Mr. Herschell's remarks on a change of climate.—Disc. on the Study of Nat. Phil., pp. 146 and 148.

In regard to other parts of the world, we have no reason for inferring, from any data hitherto obtained, that during an equal lapse of the ages which immediately preceded our times, an equal amount of alteration of surface may not have taken place.

LIST OF WOOD-CUTS.