



---

Leonardo Da Vinci and the Art of the Renaissance in Its Relations to Geography

Author(s): Eugen Oberhummer

Source: *The Geographical Journal*, Vol. 33, No. 5 (May, 1909), pp. 540-569

Published by: [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1777084>

Accessed: 17/12/2014 00:45

---

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at  
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



*The Royal Geographical Society (with the Institute of British Geographers)* is collaborating with JSTOR to digitize, preserve and extend access to *The Geographical Journal*.

<http://www.jstor.org>

teaching is of a peculiar stimulating nature, and that amongst his pupils there are many who have already won considerable distinction in geography. I may perhaps mention the name of Dr. Ellsworth Huntington, who wrote the 'Pulse of Asia,' and who has lectured to us here. We owe to the system of exchanges of Chairs between Harvard University and Berlin the pleasure of the visit to-night of Prof. Davis, because he is on his way back from having fulfilled his duties in Berlin, having made such an exchange with a German professor. I cannot help hoping that this system of exchanges of Chairs which exists between Harvard and Prussia may find an echo in this country, and that at some future time we may frequently welcome American professors, not only as our guests, but as our teachers.

The PRESIDENT (after the paper): I think we shall all carry away a considerable number of vivid memories of to-night's lecture. We shall all retain recollections of the extraordinary beauty of the scenery of this Colorado valley, and of the admirable way it has been illustrated. But I believe there are other and more permanent memories which will remain in our minds. Every one who has ever looked at a bit of scenery and had in his mind at the time a knowledge of the geological formation of the country, must have been struck with the way the interest of the scene is thus enhanced. I take it that our lecturer to-night has wished to indicate to us that by teaching the origin of land-formation we arrive at far the best method of geographical description. He has, in fact, without our knowing it, been giving us a lecture on the best form of geographical teaching; and I am sure I may express your wishes that many other such lectures may be given us, affording educational instruction in such a pleasing manner.

---

## LEONARDO DA VINCI AND THE ART OF THE RENAISSANCE IN ITS RELATIONS TO GEOGRAPHY.\*

By Prof. Dr. EUGEN OBERHUMMER (Vienna).

### I.—INTRODUCTION.

TWICE before the development of modern science commenced has geography made an immense stride which threw all earlier investigations into the shade and far surpassed the following age in the extent of its achievements. The first period of progress is marked by the geography of the Greeks, which, starting from the part of the Earth's surface then known, determined with wonderful ingenuity the form and dimensions of our planet, gained an insight into its position in the solar system, and established for all time the outlines of mathematical geography. The second period was when Europeans, throwing off the fetters of the mediæval conception of the world, boldly stretched their hands over the ocean, and in a victorious career of one century (about 1420–1520) closed a ring around the world, the surface of which had hitherto been revealed slowly and step by step. While now for the first time the continents and oceans were exhibited in their actual forms, and their graphic representation was soon completed, the flood of new facts led to an extension of the knowledge of the Earth which supplemented

\* Map, p. 628. Fig. 1 is copied from *Archæologia*, vol. 40, p. 1, by permission of the Society of Antiquaries; figs. 2 to 6 from Richter's 'Leonardo da Vinci,' by permission of Messrs. Sampson Low & Co.

in the happiest manner the acquisitions of the Greeks, and bore fruit in the brilliant researches of Copernicus, Mercator, Galileo, Kepler, Varenius, and Newton. That unique epoch, standing out conspicuously in the history of human culture, which we call the Renaissance, began with the sprouting out anew of the seeds of old Greek thought; it inspired imitative art with new life and, developing harmoniously all its branches, raised it to a height it has never subsequently attained; in the New Learning it handed over the intellectual treasures of the ancient world to the modern, and in the art of printing provided the nations with the most ample means for the exchange of their ideas; in the Reformation it broke through the bonds that had hampered thought and research for a thousand years, and introduced a new era in all departments of human science.

Except archæology and astronomy, no branch of knowledge was so promoted and revolutionized by the Renaissance as Earth knowledge. Not a few modern geographers, whose names are among the most noted in our profession, have therefore rightly devoted a large, nay, the largest part of their life's work to the investigation of that period of geography. I need only mention the names of Alexander von Humboldt, Oskar Peschel, Sophus Ruge, Baron Nordenskiöld, Henry Harrisse, Franz von Wieser, Hermann Wagner, Konrad Kretschmer, Gabriel Marcel, Lucien Gallois, etc., or refer to the services of the Hakluyt Society and similar institutions, in bringing to light the geographical achievements of the Renaissance period.

Our colleague, Siegmund Günther, in a valuable lecture before the Geographical Congress in Berlin, illustrated the influence of learning on the development of geography.\* In this connection I should like to refer, rather in general terms than in a special disquisition, to the manifold relations connecting Earth knowledge with the art and artists of the Renaissance. In that time not only the most diverse branches of research in history and natural science were often studied by the same person, but also were with structural and imitative art combined in a harmony impossible under present conditions. I place in the forefront a personality, known to the general public only as one of the great Italian masters of painting and the plastic arts, because hardly any other represents the wonderful versatility of the leading minds of that age as Leonardo da Vinci does, and because several recent publications have made known to us Leonardo's life-work from our standpoint as geographers, though the influence of the great Italian on our science is not yet fully known to the friends of geography. For as Leonardo's artistic remains reveal to us only a fraction of his learning and achievements, on which art criticism has not by any means uttered the last word, so his literary works have come to light by degrees and not completely

\* *Verhandl. d. VII. intern. Geographenkongresses*, vol. 2, pp. 845 *et seq.*

even yet. The manuscripts of his works are scattered through the various libraries of Europe, especially in Italy, France, and England, and are, moreover, hard to decipher, for Leonardo wrote from right to left. They are mostly hasty memoranda for personal use and not for publication. Like many of his artistic studies and designs, these notes are of an aphoristic character, and seldom form a connected



FIG. 1.—NORTHERN HEMISPHERE OF THE MAPPEMONDE.

(After R. H. Major.)

composition of any length. The character of this irregular sequence of ideas, draughts, and sketches may be observed in the 'Codice Atlantico' in the Biblioteca Ambrosiana, Milan, now to be obtained in facsimile,\* as well as in the voluminous collection of the Paris manuscripts published by Ravaisson-Mollien.†

\* 'Il Codice Atlantico di Leonardo da Vinci nella Biblioteca Ambrosiana riprodotto e pubblicato dalla R. Accademia dei Lincei,' 4 vols., fol. Milano: 1894-1904.

† Paris, 1880 *et seq.* A new edition of the London and Windsor manuscripts published since 1901 in Paris, and calculated to form a collection of forty-one volumes, is not accessible to me in Vienna.

## II.—LEONARDO AS CARTOGRAPHER.

Some parts of Leonardo's writings have long been known, and their valuable contents soon attracted the attention of scientific circles. As early as the end of the eighteenth century the Italian physicist, T. B. Venturi, published an essay on the studies of the artist in mathematical physics,\* which caused Peschel to assign to Leonardo a prominent place in the history of geography.† Historians of the physical sciences have made many further contributions to the subject; but they deal chiefly with details only, and do not exhibit the versatility of the master even in this domain.‡ The sketch of a map of the world in a collection of manuscript notes of Leonardo now in Windsor Castle excited especial notice in geographical circles. It is a rough sketch for a globe, not in the usual form of gores, but in sectors, four for each of the northern and southern hemispheres. Particularly noticeable is a southern land corresponding to our Antarctic continent, which is separated from Africa and America by broad belts of sea. The first editor, R. H. Major,§ assigned the map to the years 1513–14, and believed it to be the oldest map containing the name America. After him A. E. Nordenskiöld|| issued a reduced facsimile, and F. von Wieser¶ the western hemisphere within the usual border of a planisphere, in which form K. Kretschmer\*\* also has reproduced the map. Wieser, who dates the map somewhat later (1515–16), recognizes it as the type of the maps of the world on which Magellan based his plans for a south-western passage. The southern continent being placed at a considerable distance from Africa and America, this sketch has no little interest in spite of its roughness and lack of detail, though the use of the name America has lost its importance since the discovery of Waldseemüller's great map of 1507 and its later imitations. Another question is whether Leonardo was its real author. Italian experts, as the Marchese Girolamo d'Adda†† and G. Giovi,‡‡ have decided in the negative, likewise the best authority on early American maps, H. Harrisse,§§ while M. Fiorini||| maintains its authenticity, and even if the actual drawing is Leonardo's, the map

\* 'Essai sur les Ouvrages physico-mathématiques de Léonard de Vinci.' Paris: 1797.

† *Geschichte der Erdkunde*, 2 Aufl., 1877, s. 427, 438.

‡ See S. Günther, *Geschichte der Erdkunde*, 1904, pp. 113, 118 *et seq.*, and the works referred to there.

§ "Memoir on a Mappemonde by Leonardo da Vinci," *Archæologia* (1866), vol. 40, pp. 1–40, pl. i. and ii.

|| 'Facsimile Atlas,' p. 77.

¶ 'Magalhãesstrasse u. Australcontinent' (1881), pp. 52–58, pl. iii.

\*\* 'Die Entdeckung Amerikas' (1892), pp. 389 *et seq.*, pl. xi.

†† 'Leonardo da Vinci e la Cosmografia.' La Perseveranza, Milano: 1870.

‡‡ 'Saggio delle opere di Leonardo da Vinci,' p. 12. Milano: 1872.

§§ See E. Müntz, 'Léonard de Vinci,' pp. 353 *et seq.*

||| "Il Mappamondo di Leonardo da Vinci," *Riv. geogr. ital.* (1894), vol. 1, pp. 213–23.



may, in Wieser's opinion, be only a copy at third or fourth hand and not an original design of the master.\*



FIG. 2.—MAP OF NORTH-WESTERN TUSCANY.  
(After T. P. Richter.)

\* The map is also reproduced by Winsor, 'Hist. of America,' vol. 2, 126, and is discussed by H. Harrisse, 'Disc. of N. America,' p. 504, and S. Ruge, 'Entwicklung der Kartographie von Amerika,' pp. 43 *et seq.*

Fortunately our knowledge of Leonardo's geographical work is not confined to this sorry sketch of doubtful origin. Jean Paul Richter \*

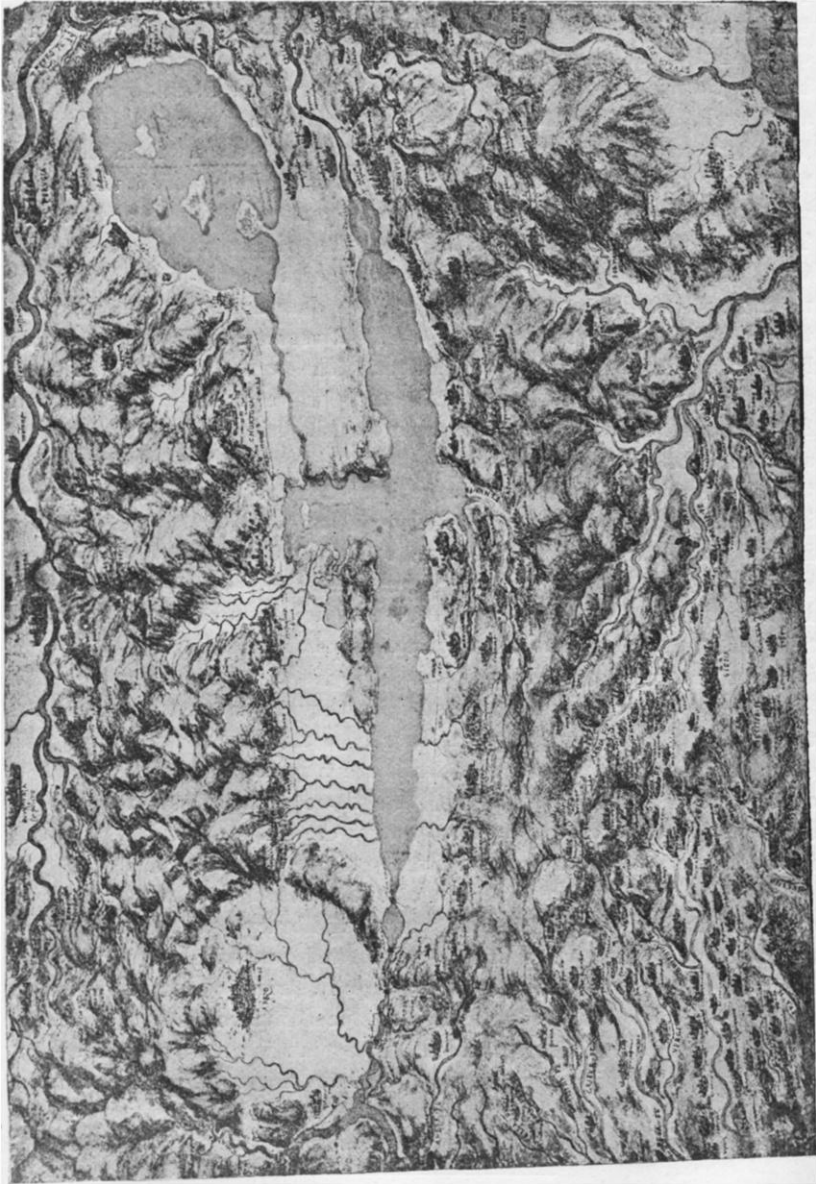


FIG. 3.—MAP OF EASTERN TUSCANY.  
(After T. P. Richter.)

has brought within our reach a large number of map drawings preserved

\* 'The Literary Works of Leonardo da Vinci,' vol. 2. London, 1883.

in manuscript, which, however, are hardly known in geographical circles. Other material is contained in the monumental work of the Accademia dei Lincei, edited with exemplary care and recently published, the 'Codice Atlantico.' Most of these maps owe their origin to a tour of the artist through central Italy in 1502. They are not copies but detailed surveys freely traced on the spot; some sketches hastily thrown together; others carefully executed in colour with pen and brush. To the latter belong three maps in the royal library at Windsor, one of which represents north-western Tuscany from the coast near Leghorn to Lucca and Volterra, a country with which the artist, who was born at Vinci near Empoli, was particularly well acquainted. The scale is approximately 1 : 300,000, the orientation is towards the west. The sea is blue, the land is coloured in sepia-brown, and the mountains, mostly crowned by towns, are drawn in perspective, with the light falling from the left (south). Rivers are indicated by double lines, towns and villages by vignettes. The second map is similarly executed and embraces eastern Tuscany between Arezzo, Siena, and Perugia. The scale is about the same, but the orientation is to the east, and the light falls from the right (south). Besides the blue expanse of the lake Trasimeno with its three rather exaggerated islands, we notice in the Valle di Chiana a large and long sheet of water, no longer existing, which drains both to the Arno and the Tiber. The third of the maps made known by Richter\* represents the southern part of the Pontine marshes with Monte Circeo and the mountains of Terracina. The scale is at least double that of the maps already mentioned, but, as in them, not uniform throughout. The curves of flexure in the low flood-land coast are too much rounded, as they appear to the naked eye, the mountains (with the light falling from the left), the swamps, and especially the thickets on the sandhills are very naturally drawn. The orientation is to the north-east. All three maps afford remarkable examples of detailed surveys as they were known in Italy in the fifteenth century, but are seldom found elsewhere at that time.

Not less worthy of remark is a carefully executed plan of the town of Imola in the Romagna, also in the royal library at Windsor.† The representation of the walls, streets, wards, and even single buildings, as, for instance, the cathedral and the castle, is in strict geometrical outline; outside the town the roads, fields, and the Santerno flowing between banks of detritus, are recognizable. The plan is exactly oriented by a windrose, and on its eight radii one reads in mirror-writing *septentrio*, *grecho*, *levante*, *scirocho*, *libeccio*, *ponente*, *maestro*. The position of the town with respect to neighbouring places is set down in a note,‡ "Imola

\* *L.c.*, pl. cxii.-cxiv. The first of these three maps has also been reproduced in colours in the splendid work of Eug. Müntz, 'Léonard de Vinci,' p. 352. Paris: 1899.

† Richter, pl. cxi.

‡ *Ibid.*, pp. 243 n., 1051.



*vede Bologna a  $\frac{5}{8}$  di ponente inverso maestro* (five points from the west towards the north-west) *con distantia di miglia 20,*" etc. Similarly, the position with respect to Castel S. Pietro, Faenza, Forlì, Forlimpopoli, and Bertinoro, is fixed by direction and distance—an interesting specimen from the childhood of cartographical survey.

The survey of Imola is only one of a series of works which Leonardo executed for Cesare Borgia. In 1499 Cesare had conquered the Romagna and taken the principality of Urbino. In 1502 Leonardo entered his service as a constructor of fortresses and military engineer. It is proved that after July, 1502, he was in Urbino, Pesaro, Rimini, Cesena, and other places, everywhere drawing plans and instituting surveys.\* Probably the three maps of Tuscany were also intended for Cesare's personal use, and therefore the text is not in mirror writing. The careful style of execution based on studies and sketches still preserved in manuscript also points to the same conclusion. The death of Pope Alexander VI. (1503), and the consequent fall of the Borgias, may have prevented the maps from reaching their original destination.

The rest of the maps and plans left by Leonardo in manuscript bear generally the character of hastily drawn sketches for his own use, as that of Milan † (ground plan and elevation), maps of the lakes of Lecco, Annone, and Pusiano, ‡ various river courses, particularly of the Loire, near Amboise above Tours, with the large islands which curb the current, § and lastly perspective drawings of the Armenian mountains. || That the last were not drawn, as Richter ¶ assumes, during a tour of the artist in the East, but are based on information derived from others, has been demonstrated by Douglas Freshfield, \*\* G. Uzielli, †† and others. ‡‡ On the other hand, the notes and observations on the Loire are explained by his appointment as court painter to Louis XII. (1503), and his sojourn in a chateau near Amboise (1516–19), which Francis I. assigned to him as a place of residence. §§

Neither the frequently discussed map of the world, of which probably we should reject him as the author, nor the hastily drawn outlines of the eastern hemisphere, put together in the geographical style of the

\* A. Rosenberg, 'Leonardo da Vinci,' 2 Aufl., 1907, p. 88; Richter, *l.c.*, p. 224.

† Richter, *l.c.*, pl. cix. (from the 'Cod. Atl.').

‡ 'Codice Atlantico,' vol. 2, fol. 275: "*Il lago di Pusian versa nel lago di Serio, ed Annon e di Sala.*"

§ Richter, *l.c.*, pl. cxv., p. 251 (Arundel MS. in the British Museum). Other hydrographical sketches, *ib.* p. 254, and 'Codice Atl.,' vol. 2, pp. 334–336.

|| Richter, *l.c.*, pl. cxii.–cxix.

¶ *Zeitschr. f. bild. Kunst* (1881), vol. 16.

\*\* *Proc. Royal Geogr. Society* (1884), pp. 323 *et seq.*

†† 'Ricerche intorno a Leonardo da Vinci,' vol. 1, 2nd ed. (Torino, 1896), pp. 70–84.

‡‡ The question has been discussed at last by E. Müntz, *l.c.*, pp. 82–86.

§§ Rosenberg, pp. 110, 130 *et seq.*

fifteenth century, which are found among his papers, \* are the works which gain for him an important place in the history of cartography,

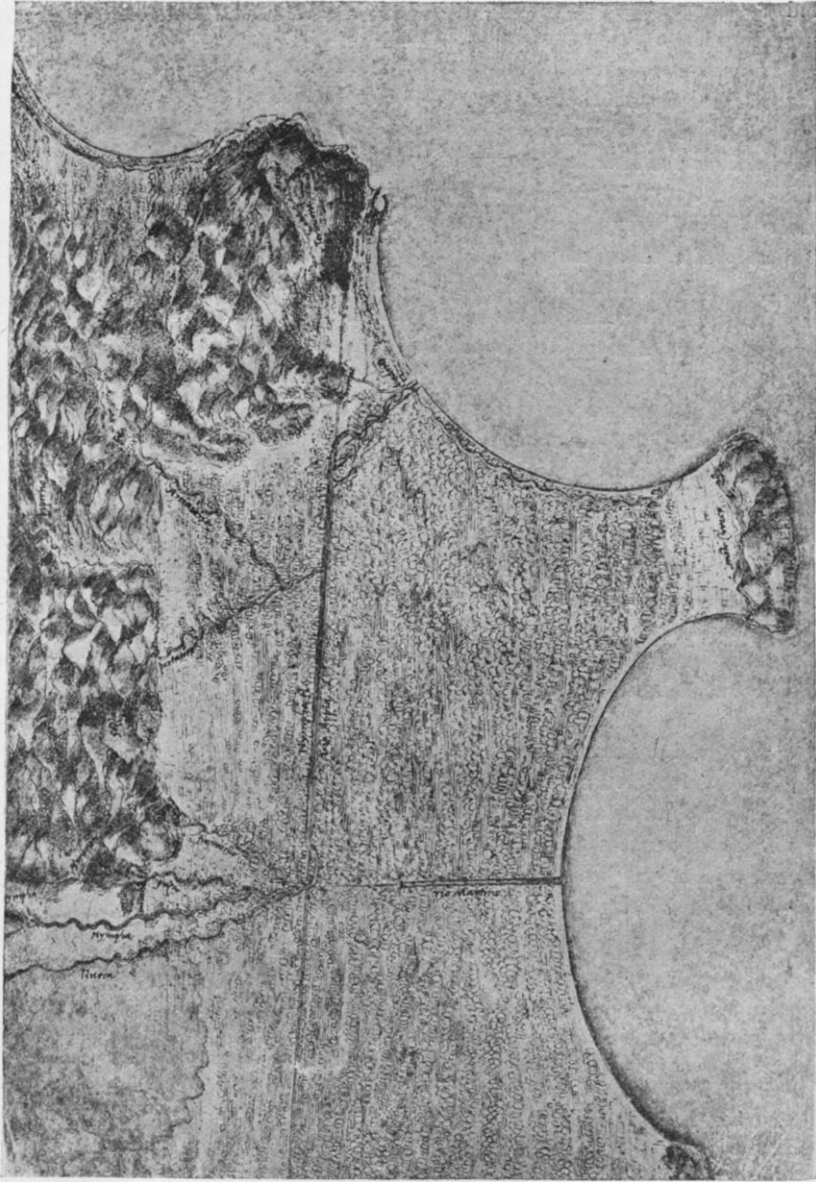


FIG. 4.—MAP OF PONTINE MARSHES.  
(After T. P. Richter.)

\* Richter reproduces on pl. cxi. a sketch which shows the outlines of the Mediterranean and Africa with Mount Atlas, the Nile, and the Red sea, according to the world maps of the fifteenth century. A similar sketch of Europe is contained in the 'Codice Atl.,' vol. 2, fol. 361.

but the special maps and town plans based on his own surveys, and far in advance of the time in technique. Of the latter, town plans, there are very few of earlier date than the sixteenth century, and down to the seventeenth, and even the eighteenth, centuries perspective views of towns without a strict geometrical foundation predominate. This is true for plans of Rome,\* as well as for those of Paris and London. As



FIG. 5.—PLAN OF IMOLA.

(After T. P. Richter.)

L. Gomme † shows, in a very interesting study of the question, the oldest existing plan of London appeared at the same time (1530-40) as the oldest one of Paris, that of Seb. Münster. Both give only a perspective representation of the town to suit the popular intelligence of the time. That architects and engineers had different ideas and

\* E. Oberhummer, 'Der Stadtplan' (Berlin, 1907), p. 86 *et seq.* (from the *Verhandl. d. XVI. deutschen Geographentages*).

† *Geogr. Journal*, vol. 31, p. 616 *et seq.*

No. V.—MAY, 1909.]

knew from early times how to draw real ground plans, we see, not only from the two great Vienna plans of 1547,\* but also from the Capitoline town plans, as well as the building plans of Egyptian, Assyrian, and mediæval architects. Leonardo's plan of Imola is a further proof.

### III.—LEONARDO AS A PHYSICAL GEOGRAPHER.

I have dwelt the longer on Leonardo's cartographical work because, it seems to me, it has hitherto been the least valued. His contributions to physical geography, not to mention the older expositions of Venturi, Libri,† and others, have of late been so excellently worked up that I may confine myself to short references. J. P. Richter, in his often-quoted work,‡ has arranged in systematic order Leonardo's pronouncements on astronomy, physical geography, and topography, and recently Mario Baratta,§ in a comprehensive book, has dealt with the attitude of the artist to questions of physical geography, but this publication seems to be little known in geographical circles outside Italy. Though this exposition, as the author himself emphatically declares, can have no claim to finality, since Leonardo's literary remains are by no means fully accessible as yet, still it permanently determines the essential outlines of his conception of the nature of our planet. I shall now endeavour to bring out the most important points, referring German readers also to the book of Marie Herzfeld.||

Passing over his remarks about the sun and moon and other celestial bodies, I shall first notice that Leonardo regards the Earth as a planet and as a star among the other stars, and decidedly rejects the notion that it occupies a privileged position in the universe, but places it only in the centre of the heavenly bodies accompanying the sun (*"la terra non è nel mezzo del cerchio del sole, nè nel mezzo del mondo, ma è ben nel mezzo de' sui elementi, compagni e uniti con lei"*). The conception of a movement of the Earth round its own axis and round the sun, which, of course, was not unknown in ancient times, is certainly not distinctly expressed by Leonardo, but it evidently occupied his thoughts, so that, with Nicolaus Cusanus, we must count him among the forerunners of Copernicus.¶ He was firmly convinced of the spherical form of the

\* Oberhummer, *l.c.*, p. 27 *et seq.*

† Libri, 'Hist. des sciences mathématiques en Italie,' vol. 3 (Paris, 1840), p. 10. For Venturi, see above. Just in reading the proof, I am referred by Mr. D. Freshfield to an article of G. Séailles, "Léonard de Vinci Savant, sa méthode et sa conception de la science," *Rev. d. deux mondes*, September 1, 1892.

‡ *L.c.*, ch. xv., "Astronomy," pp. 135-72; ch. xvi., "Physical Geography," pp. 173-221; ch. xvii., "Topographical Notes," pp. 223-70.

§ 'Leonardo da Vinci ed i Problemi della Terra' (Torino, 1903), ch. xiv. p. 318 (*Biblioteca Vinciana*, No. 1).

|| 'Leonardo da Vinci, der Denker, Forscher u. Poet.' Leipzig: 1904. 2 Aufl. 1906.

¶ Further information on these questions will be found in Richter's work, pp. 137 *et seq.*, and Baratta, cap. ii., "La forma e la posizione della Terra;" cap. iii., "La rotazione della Terra."







uncertain.\* The former would, according to Baratta,† amount to 7763½ English miles, the latter to 7192½, or 67¾ and 62¾ miles respectively to a degree of latitude.

The form of the globe is most fully stated in connection with the surface of the ocean (*la sfera dell' acqua è perfettamente tonda*); this is the normal surface to which the elevations of the land are referred.‡ No part of the solid land lies below the level of the sea, to which all flowing water directs its course; no water surface can be lower than the sea.§

The salinity of the sea is not ascribed, as in Pliny's work, to the evaporation of the water by the sun's heat, but to the transport of salt particles by the rivers which lixiviate the saline deposits of the land; therefore the saline contents are constantly increasing. Notwithstanding the important observation that salt water is heavier than fresh, Leonardo assumes that only the upper layers of sea water contain salt, while at great depths the water is fresh.||

By far the most important are the investigations into the movements of the sea. Leonardo, as A. Cialdi ¶ first showed, must be regarded as the founder of the modern theory of wave motion; he was the first to clearly perceive the orbital motion of water particles in waves, and to compare the progression of waves with the undulations of a wind-swept corn-field.\*\* He also concerned himself with the phenomenon of tides. Although Posidonius †† had recognized the influence of the moon on ebb and flood, and Brunetto Latini, Dante,‡‡ and others had expressed the same views, Leonardo did not feel satisfied with this explanation, and propounded in opposition his own theory of a circulation of the water in the interior of the Earth, whereby the water of the ocean was sometimes sucked in and again let out. He acknowledges, however, a subordinate

\* I had occasion recently to raise this question, and was told that Italian critics consider Leonardo uses the Milanese mile.

† Cap. iv., "Le dimensioni della Terra."

‡ On the height of mountains, see below.

§ Baratta, cap. v., "Il livello del mare e l'altezza delle montagne." It need scarcely be remarked that the knowledge of depressions dates only from the nineteenth century. The Jordan trough was first recognized as a depression in 1837-38 by G. H. Schubert and J. Russeger, and Alderson and Symond confirmed the fact in 1842. See O. Peschel, *Gesch. d. Erdk.*, 2 Aufl., p. 545.

|| Richter, pp. 188 *et seq.*; Baratta, cap. xii., 'Il mare;' Herzfeld, p. 61.

¶ "Leonardo da Vinci fondatore della doctrina sul moto ondoso del Mare," *Rivista marittima*, 1873, vol. 6.

\*\* Baratta, cap. xiii., 'I moti del mare;' S. Günther, 'Handbuch der Geophysik,' 2 Aufl., vol. 2, pp. 439 *et seq.*; A. Penck, 'Morphologie,' vol. 2, p. 463.

†† F. Schühlein, 'Untersuchungen über des Posidonius Schrift *περὶ ὠκεανῶν*,' vol. 2, pp. 83-99 (Freising: 1901). Further details of the tidal theory of the ancients are given by H. Berger, *Gesch. d. wiss. Erdkunde d. Griechen*, 2 Aufl. pp. 289 and 560 *et seq.*, who, however, has overlooked the important researches of Schühlein.

‡‡ 'Paradiso,' canto 16, verso 82: "Il volger del ciel della luna scopre ed iscopre i liti senza posa."

action of the moon when he says that on the coast of Flanders the flood of 20 ells may rise to 22 ells when the moon is favourably situated (“*quando la luna è in suo favore*”). The differences in the height of flood tide are well known to him, but he overestimates them in some cases—at Genoa, 0, at Venice, 2, in the North sea, 18, in the Loire, 20, in the Garonne, 40 (!) ells.\*

He studied with no less care the problem of currents. The local currents in narrow seas first drew his attention, especially the current in the straits of Gibraltar, which, however, he erroneously assumed to set principally towards the west. This is the case sometimes at high tide, and with an east wind,† but Leonardo's theory is bound up with the notion of a general flow from the Nile and Black sea towards the ocean; the surface current of the Bosphorus and the Dardanelles naturally falls in with this theory. The large rivers discharging into the Mediterranean and Black seas, with a subterranean drainage from the Caspian, are the sources of this excess of water.‡ The ocean currents, of which little certain was known at that time, are accounted for by Leonardo by the warming of the sea in the equatorial regions and the flow towards the lower-lying polar seas, which agrees with recent views of atmospheric circulation.§

Leonardo's investigations on the movements of water are the main feature of his geographical work. They are connected with his technical studies on hydraulics, which projects for the construction of canals and mills led him to pursue. These studies were embodied in a work composed in 1500, ‘*Del Moto e della Misura dell' acqua*,’ which was printed in 1826, and which contains an admirable exposition of the laws of hydromechanics.|| His views on hydrostatics explain his theory that water traverses the earth in channels and veins, branching out in all directions, and even penetrates into the higher mountains. This theory is most fully set forth in a manuscript in the library of the Earl of Leicester in Norfolk.¶ The Earth is, like the bodies of living beings (*animali*), a network of branching veins which are all connected with one another, and serve to vitalize and sustain the earth and its creatures. Water starts from the depths of the sea, and after long, circuitous wanderings returns through the rivers, which spring up from the clefts of the veins. He tried to bring the ascent of the water under physical laws by comparing it with the syphon and the circulation of the blood,

\* Richter, *l.c.*, pp. 192 *et seq.*; Baratta, pp. 172 *et seq.*

† Boguslawski-Krümmel, ‘*Handbuch der Ozeanographie*,’ vol. 2, p. 296; ‘*The Mediterranean Pilot*,’ vol. 1, 3rd edit., pp. 19 *et seq.*

‡ Richter, pp. 258, 268; Baratta, p. 184.

§ Baratta, p. 188; Günther, *l.c.*, vol. 2, p. 573.

|| Richter, p. 173; Baratta, pp. 126, 313.

¶ A splendid edition of this important manuscript just now is coming out by G. Calvi, ‘*Il Codice di Leon. da Vinci (Idraulica e Cosmografia) della Biblioteca di Lord Leicester in Holkham Hall.*’ Milano: 1909. Fol.

just as William Harvey, a century later, supported his noted discovery by reference to the circulation of water on the Earth.\* Though Leonardo's explanation was wrong, it rests partly on correct observations, to which we must add a certain acquaintance with the Karst phenomenon, and deserves the greatest respect as an ingenious attempt to bring the circulation of water into causal connection. Leonardo appears afterwards to have modified his theory, as is shown by a passage in the 'Codice Atlantico,'† and to have acknowledged the meteoric origin of flowing water. Such contradictions occur in some of his other notes, which date from widely separated years of his life, and are often the outcome of momentary impressions.

He took great interest in the mechanical action of flowing water, both at the confluence of streams and where islands obstruct the water, to which the drawing above mentioned refers, and also as regards the solid matter with which rivers are loaded. He follows the course of large stones from the upper reaches of the river within the mountains, where their edges are not yet worn down, then considers the deposition of large and small pebbles, and then of sand, which becomes finer and finer until it passes into suspended mud. He notices the consolidation of these deposits into stone and tuff in some of the north Italian rivers (Adige, Adda, Ticino, Arno), and the damming up of lakes by river alluvium. In this process he recognizes the essential cause of lake formation, and illustrates it by examples from the lakes of upper Italy.‡ As the alluvium alters the course of rivers and causes the formation of lakes, so also it displaces the coast-line towards the sea and gradually silts up enclosed sea-basins (*"Muovonsi al continuo i liti marittimi inverso il mezzo del mare e lo scaccian dal suo primo sito"*). Thus the bay between the Apennines and the German Alps has been filled in by the Po and its tributaries, and the same fate is in store for the Adriatic sea.§ Still more extensive is the alteration in the basin of the Danube, where once the Euxine spread over the plain of Hungary to Austria and Bavaria, as proved by the fossils on the mountain flanks; it covered the South Russian plain (*pianura del Tanai*) to the Rhipæan mountains, and was confined on the south by a great range, in which the Alps (Monte Adula) from the west and the Taurus from the east met together. The discharge through the Propontis to the Ægean sea gradually broke down the continuity of the mountains, and lowered the surface of the Pontic sea by about 1000 ells, whereby the plains were left dry and the Danube took possession of its present bed.|| One is naturally reminded by this

---

Baratta, cap. ix. : "L'interna Circolazione delle acque."

† "L'acqua delli fiumi non dal mare ma dalli nuvoli à origine," fol. 160; Baratta, p. 132.

‡ Baratta, cap. xi., 'I Laghi.'

§ Richter, p. 192; Baratta, pp. 252 *et seq.*

|| Leicester MS., pl. i.; Baratta, p. 252.

exposition of modern geological researches concerning the "Sarmatic" and "Pontic" sea, and one is astonished at the intellect which, four hundred years ago, far in advance of the times, could arrive at similar conclusions.

The predominating rôle in the morphological changes in the Earth's surface which Leonardo assigns to water makes him seem a predecessor of the Neptunists. He declares absolutely that rocks are of sedimentary origin, and conceives mountains to be accumulations of river alluvium; \* that mountains rise to a considerable height above the water-level is due to the fall of the surface of the sea and the irruption of masses of water into the interior of the earth. But he underestimates the height of mountains when he assumes that the highest mountains of Europe, which he rightly takes to be the French Alps, do not rise to a mile (about 5200 feet) above sea-level.† Though this estimate is far behind the truth, it is yet in agreement with a much later statement by Galileo,‡ and avoids the enormous exaggerations into which men even in the seventeenth century, as Snellius and Riccioli, strayed in reckoning the height of mountains.§ The folding of strata (*li piegamenti delle falde*) escaped his sharp observation as little as the fossils enclosed. His opinions on the latter are the more worthy of remark that even down to the eighteenth century the most contradictory assertions were made about the nature of fossils. They were regarded as freaks of Nature or purely mineral formations, at best as organisms which had grown in the ground, or, if their aqueous origin was conceded, as evidence of the Deluge. The latter view especially had zealous champions in the eighteenth century both in England and in Germany, and contrary opinions were condemned as irreligious. Leonardo was, it appears, the first to declare confidently that fossils were the remains of marine animals which had been covered with river sediment, and on the retreat of the sea had been left on dry land. He opposes with some sarcasm the then prevalent belief in the influence of the stars on the formation of fossils, which, he says, could only be shared by persons of little discrimination (*di non troppo discorso*), and likewise rejects all connection with the Deluge, as also did Fracastoro somewhat later.||

About the Deluge itself he speaks with remarkable freedom.¶ The

---

\* 'Cod. Atl.,' fol. 160: "*Li sassi si compongono e falde, o vero a gradi, secondo lo scaricamento della turbulenze portate dal corso, de' fiumi*"—*li monti son fatti dalli corsi de' fiumi*;" Baratta, cap. xvi., 'L'Orogenesi e la Stratigrafia.'

† "*Le Alpi galliche son la piu alte parte dell' Europeanessum de' monti d'Europa n' leva un miglio sopra la pelle delli nostri mari*," Baratta, p. 69.

‡ Opere, vol. 3 (Firenze, 1843), p. 70: "*In tellure nulli exstant montes qui vix ad unius milliariis altitudinem perpendicularem accedant*."

§ Peschel, 'Gesch. d. Erdk.' 2 Aufl., pp. 62, 426.

|| Zittel, 'Gesch. d. Geol. u. Palæont,' pp. 15 *et seq.*; Baratta, cap. xvii. 'I. fossili.'

¶ The chief sentences of the passage, the sense of which is reproduced in the free translation above, run in the 'Codice Atl.,' fol. 155, as follows: "*e se cosi la pioggia*

question whether Noah's flood was universal must be answered in the negative. Had the water, as the Biblical narrative asserts, risen above the highest summits, it must have formed a spherical envelope everywhere equidistant from the centre, and therefore could not flow off anywhere, as only gravity could lend it motion. How could this inert mass pass away? All natural explanations fail, and one must resort to miraculous aid or assume that the sun effected the evaporation of such a volume of water. The independence with which Leonardo maintains his scientific judgment in opposition to Biblical tradition is surprising in that age, but it finds its counterpart in many bold views of the Italian Renaissance on ecclesiastical matters and questions of faith from Dante down to Leo X.\* The Reformation and the counter-reformation which set in with the Council of Trent perfected slavish subjection to the very letter of the Scriptures. What Copernicus could still dare became fatal to a Galileo, and encountered the opposition even of Protestant orthodoxy.

As Leonardo regarded the constructive activity of water as the chief factor in moulding the relief of the Earth's surface, so he attributed the greatest effects to erosion; nay, in this direction he may be said to have anticipated much of the modern doctrine of valley formation. Almost all details of the action of erosion are alluded to in a passage contained in his famous book on painting.† "The sculpture of the mountains is effected by rivers which are formed from rain, snow, hail, and ice melted by the summer sun. When melted, the water is collected in many small brooks, which gather from all sides into large streams and grow larger as they advance, until they meet in a great ocean. During their course they undermine the one bank and deposit their load on the other, until they have traversed the whole breadth of the valley. But this is not all; they tear away the bases of the valley slopes (*dei monti laterali*), which then fall into the rivers and dam up the valley. As though in revenge they close the way to the river and convert it into a lake, where the hemmed-in water moves exceedingly slowly, until the obstruction formed by the landslip is again demolished by the water."

Of the numerous other passages where the process of erosion is

---

*fusti universale, ella vesti di se la nostra terra di figura spherica e la superfizie spherica ad ogni sua parte egualmente distante al centro della sua sfera, onde la sfera dell' acqua, trovandosi nel modo della detta condizione, ella è impossibile che l'acqua sopra di lei si mova, perchè l'acqua in se non si move, s'ella non discende; addunque l'acqua di tanto diluvio come si parti, se qui è provato non aver moto? E qui mancano le ragion naturali onde bisogna per soccorso di tal dobitazione, chiamare il miracolo per aiuto o dire che tale acqua fu vaporata dal calor del sole."* Further extracts in Herzfeld, *l.c.*, pp. 69-79.

\* Examples are given by Ludwig Geiger, 'Renaissance u. Humanismus,' p. 103 (Poggio); p. 108 (Gemisthos Plethon); p. 129 (Laur. Valla); p. 200 (Pulci); p. 289 (Pomponazzi); and others.

† Lionardo da Vinci, *Das Buch von der Malerei*. Nach dem 'Cod. Vat. Urb.,' 1270, herausg. von H. Ludwig; II. Band (Wien, 1882), p. 209 (*Quellenschriften für Kunstgeschichte* Bd., 15-18).



described, another may be cited from the Leicester MS.\* "The rivers have sawn through (*segati*) the members of the high Alps and separated one from another. One can perceive this in the arrangement of the stratified rocks (*pietre faldate*), for one can trace the corresponding strata on both sides of the valley from the river up to the summits." The sentence quoted above on the carving out of the mountains by rivers, Leonardo completes by the addition "*li monti son disfatti dalle pioggie e dalli fiumi.*" He is convinced that the goal to which erosion tends is the complete degradation of the continents; the constant transport of solid matter into the sea must, however, have the effect of raising the level of the sea, which will at length overflow the levelled land and form a perfectly spherical surface.†

Erosion works also in the interior of the Earth, in the channels traversed by the water; the subsidence of the Earth's crust is a consequence, and the flooding of subsided blocks, as in the case of Sodom and Gomorrah.‡ It has already been pointed out that the subterranean cavities in the stream-courses of the Karst have a bearing on this theory. Furthermore, the masses of rock loosened by erosion in the interior of the Earth are carried out by the water and deposited on the sea-bottom in the form of detritus cones, which gradually rise, and finally emerge as islands above the sea-surface.§ Also connected with the same subject is the theory, propounded in the essay "*Della natura, moto, e peso dell' acqua,*" of the origin of earthquakes in the tension produced by water converted into steam by the natural heat in the interior of the Earth. Afterwards, when Leonardo abandoned his theory of internal water circulation and acknowledged meteoric precipitation as the source of springs and rivers, he modified also his doctrine of earthquakes, attributing them to the compression of air produced by the falling in of subterranean cavities. He appears never to have observed volcanic phenomena personally, and speaks of them casually only.||

Leonardo's meteorological conceptions need much elucidation. He inquires chiefly into the cause and effect of winds, which on the sea produce waves, on the land sand dunes,¶ as in Libya and the plain of the Po, and also into the humidity of the air and precipitation. Much of this is to be found in his book on painting, where a separate

\* Richter, fol. 10, p. 205; Baratta, p. 211. A similar passage from a manuscript in the British Museum is given by Richter, p. 95, and Herzfeld, p. 64.

† Passages from the 'Cod. Atl.' etc., in Baratta, pp. 208, 263.

‡ "*Profondamento di paesi come nel Mare Morto di Soria, cioè Sodoma e Gomorra,*" Leicester MS., fol. 36; Baratta, p. 215.

§ Paris MS. G., fol. 44, from Ch. Ravaisson-Mollien, 'Les manuscrits de Leonardo da Vinci' (Paris: 1890). The passage is also quoted by Herzfeld, p. 60.

|| Baratta, cap. xiv., 'I Vulcani ed i Terremoti'; Herzfeld, p. 67.

¶ Baratta, cap. vii., 'L'Atmosfera.'

chapter deals with clouds.\* These are formed of the moisture dispersed through the atmosphere, which is condensed by cold. Air flows into the empty space caused by condensation, for Nature abhors a vacuum (*perchè non si da vacuo in natura*), and thus arise winds, as also when the sun again disperses the mist. "A cloud is lighter than the air below it and heavier than the air above it." Clouds are mist raised by the sun to a height where their weight balances the elevating force. The particles of vapour (*particole dell' umido vaporate*) compressed by the movement congregate into drops, which, owing to their weight, fall to the Earth as rain. That rain exerts a destructive action on the Earth's crust is stated in the sentence quoted above, "*li monti son disfatti dalle pioggie*." Purely theoretic is the conclusion that the foot of the mountains is affected more than the summits, since the acceleration of the raindrops must also increase their force.† That Leonardo also constructed a hygrometer, by which he determined the humidity of the air, and could predict rain, has been frequently pointed out. The idea, indeed, was not a new one, but had been conceived already by Nicolaus Cusanus (1464) and Leon Battista Alberti (1485). Leonardo developed it further, and suggested several methods of construction.‡

Many other remarks of Leonardo relating to physical geography might be cited here, as, for instance, on the formation of soil,§ on the origin of waterspouts and wind vortices,|| on the transparency and blue colour of the air,¶ on the twinkling of stars and the light of the moon,\*\* etc.; but enough has been said to show that Leonardo was one of the greatest pioneers of the school of physical geography, which bases its knowledge chiefly on observation and experience. A. von Humboldt †† most justly calls him the greatest physicist of the fifteenth century, who combined exceptional mathematical knowledge with the most

\* H. Ludwig, *l.c.*, vol. 2, pp. 320-29.

† 'Cod. Atl.', fol. 162 and 160; Baratta, cap. viii., 'Le Acque meteoriche.'

‡ Venturi, *l.c.*, p. 28; C. Amoretti, 'Memorie su Leon. da Vinci' (Milano: 1804), pp. 143 *et seq.*; Humboldt, 'Kosmos,' vol. 2, pp. 381, 517; Richter, *l.c.*, vol. 1, p. 297; Baratta, pp. 92 *et seq.*

§ Baratta, pp. 204 *et seq.*

|| The remarkable passage in the Leicester MS., fol. 22, is here given from Richter, vol. 2, p. 219: "The eddies of wind at the mouth of certain valleys strike upon the waters and scoop them out in a great hollow, and whirl the water into the air in the form of a column and of the colour of a cloud. And I saw this thing happen on a sandbank in the Arno, where the sand was hollowed out to a greater depth than the stature of a man, and with it the gravel was whirled round and flung about over a great space; it appeared in the air in the form of a great bell-tower, and the top spread like the branches of a pine-tree, and then it bent at the contact of the direct wind which passed over from the mountains."

¶ Leicester MS., fol. 20; Richter, p. 219.

\*\* Humboldt, 'Kosmos,' vol. 2, p. 356; vol. 3, p. 499; Günther, 'Geophysik,' 2 Aufl., vol. 1, p. 118; Richter, pp. 154-168, 'The Moon;' pp. 169-172, 'The Stars;' Baratta pp. 270 *et seq.*, 274 *et seq.*

†† 'Kosmos,' vol. 2, pp. 324, 484; vol. 3, p. 10.

astonishing penetration into the secrets of Nature. Like Francis Bacon, quite a century later, he considered induction to be the only reliable method in science, "*dobbiamo cominciare dall' esperienza, e per mezzo di questa scoprirne la ragione.*"

Leonardo's opinion that nature knowledge must always be based on experience is quite in keeping with the principles he laid down for the practice of art. As he himself from earliest youth found the most exact study of natural forms an indispensable duty, and preserved in his drawing the structure of leaves, trees, and wood in its finest ramifications, while he paved the way for the portrayal of the human body by a careful study of anatomy, so also he demanded of other painters direct imitation of Nature. "I say to the painters," he writes in his 'Book on Painting,' p. 81, "that one should never imitate the style of another, for he will then be called, as far as art is concerned, not a son, but a grandson of Nature." "Great inspiration," he affirms in another place, "springs only from much knowledge of inspired objects."

#### IV.—LEONARDO AS ALPINIST AND LANDSCAPE PAINTER.

It was a warm, lively sympathy with Nature in all her forms which made Leonardo a great artist, and at the same time a pioneer in research.\* This sympathy with Nature reveals itself especially in his affection for the Alps and their artistic reproduction. Recently there has been a desire to class him as an Alpinist, but this is true only in a very limited sense. The following noteworthy passage occurs in the Leicester MS., fol. 4.† "And this may be seen, as I saw it, by any one going up Monboso, a ridge (? *giogo*) of the Alps which divide France from Italy. The base of this mountain gives birth to the four rivers which flow in four different directions through the whole of Europe. And no mountain has its summit at so great a height as this, which lifts itself above almost all the clouds, and snow seldom falls there, but only hail in the summer, when the clouds are highest. And this hail lies there, so that if it were not for the absorption (? *retà*, probably *rarietà*) of the rising and falling clouds, which does not happen twice in an age (? *età*, probably *estate*, summer), an enormous mass of ice would be piled up there by the layers of hail, and in the middle of July I found it very considerable; and I saw the sky above me quite dark, and the sun as it fell on the mountain was far brighter here than in the plains below because a smaller extent of atmosphere lay between the summit of the mountain and the sun." This shows that Leonardo

---

\* Compare herewith the excellent article of A. Farinelli, "Sentimento e Concetto della Natura in Leonardo da Vinci," in 'Miscellanea di Studi critici edita in onore di Arturo Graf' (Bergamo: 1903), pp. 285-365.

† From Richter, p. 246.

once ascended as high as 3000 metres at least somewhere in the western Alps of Italy, and observed snowfields and glaciers, the colour of the firmament, the purity of the air, and the radiation peculiar to such heights. The position is only vaguely indicated by the name Monboso. By the four rivers only the Po, the Rhone, the Rhine, and the Danube can be meant; and this is confirmed by another passage of the same manuscript,\* where these rivers are mentioned. Their sources cannot be localized in a single mountain group; a comparison of both passages rather tends to show that the Alps in general are referred to as the water-parting of the four great river-basins. The indication "on the boundary of France and Italy" gives little help. It can only mean a language boundary,† and distinguishes the Alps as separating countries, as is fully apparent in the second passage, where the words "*che dividono la Magnia (Germany) e la Francia dalla Italia*" occur. There remains only the name Monboso, which is unknown in the modern nomenclature of the Alps. Richter suggested Monte Rosa, while Douglas W. Freshfield, in his critical study 'The Alpine Notes of Leonardo da Vinci,' had proposed Monte Viso,‡ but rejected later this opinion in favour of Monte Rosa.§ He rightly points out that the word *giogo* means a pass or ridge rather than a summit. Certainly the terms applied to these natural features were often used loosely; but, considering the structure of the Alps, it seems incredible that Leonardo climbed one of the culminating peaks of the western Alps. At the most he probably reached the region of snow. G. Uzielli|| has investigated the question the most thoroughly. From evidence he brings forward from the fifteenth to the eighteenth century there can be no doubt that the name Monboso (= Mons Silvius) was then actually in use to distinguish Monte Rosa, and M. Jacobi¶ has no reason to treat the identification as still uncertain. Even in modern maps the name M. Bô is found on the spur stretching south-east of Monte Rosa between Val Sesia and Biella. At any rate, this episode of Leonardo's life is as interesting as a contribution to the history of mountain climbing as it is characteristic of him as a friend and observer of nature.

His studies of Alpine scenery were not confined to the western Alps, as is shown by his geographical observations in the Adige basin and the artistic reproduction of mountain forms evidently taken from the

\* Leicester MS., fol. 10; Richter, p. 247.

† This is more likely than the political boundary of France, which then extended to the main crest of the Alps only in the Briançonnais. See Spruner-Menke, 'Hist. Handatlas,' No. 54.

‡ *Proc. R. Geogr. Soc.*, 1884, pp. 335-40.

§ See his critical account on Uzielli's paper in *Proc. R. Geogr. Soc.*, 1892, pp. 345 *et seq.*

|| 'Leonardo da Vinci e le Alpi.' Torino: 1890 (from *Boll. Club Alp.*, vol. 23). For further evidence see E. Oberhummer, "Die ältesten Karten der Westalpen," *Zeitschrift d. D. u. Oe. Alpenver.*, 1909.

¶ "Leonardo da Vinci als Alpinist" (*Beilage zur Allgem. Zeitung*, 1904, No. 155).

Dolomites, and partly, perhaps, from the Karst. His preference for steep and rugged rocks and grottoes is seen in his treatment of the background of several of his most famous pictures. Among these are one of his greatest masterpieces, the portrait of Mona Lisa in the Louvre, and also the Madonna of the Rocks ("La Vierge aux Rochers"), which exists in two versions, one in the Louvre, the other in the National Gallery in London, of which the relationship has not been definitely explained; the Madonna with St. Anna and with the scales ("La Vierge aux Balances") in the Louvre, another in Munich, the Resurrection in Berlin, the female portrait in the Hermitage at St. Petersburg,\* etc.

#### V.—ALBRECHT DÜRER AND OTHER ARTISTS OF THE RENAISSANCE IN RELATION TO GEOGRAPHY.

We have now arrived at a point whence we may pass on to some general consideration of the art and artists of the Renaissance to landscape painting. Without plunging into a discussion of the history of art, we must point out that the awakening of the mind to understand Nature, an appreciation of what is real, and the gradual undermining of traditional beliefs, are characteristic of the culture development of the Renaissance, and towards the end of the Middle Ages come to light in imitative art, as in all other spheres of intellectual life. One of the most attractive sections in A. von Humboldt's† description of the universe deals with the reaction of the outer world on the imagination, the history of the poetical description of Nature, and landscape painting. That the latter rose from the position of a subordinate and often fantastic addition to figure painting to an independent representation and artistic reproduction of Nature, is an effect of the new spirit, the beat of whose wing was first felt by the contemporaries of Dante. As in the thirteenth century maps first appeared, in the place of the distorted map-sketches of antiquity and the diagrammatic drawings of mediæval monks, and showed with astonishing correctness the outlines of the Mediterranean, so at the same time we see the Florentine Cimabue casting off the bonds of Byzantine tradition in painting, and the dawn of a new art break forth under his great successor, Giotto. "With the advent of Giotto mountain scenery first became a subject for art" (Bredt). The feeling for Nature which prompted Petrarch's famous description of the ascent of Mont Ventoux, meets us also in the first beginnings of Tuscan painting.‡ Only a little later the delight in

\* Rosenberg, *l. c.*, pp. 113-123; E. W. Bredt in *Zeitschrift d. D. u. Oe. Alpenver*, 1906, pp. 87 *et seq.*

† 'Kosmos,' vol. 2, pp. 1-134.

‡ See W. Kallab, "Die toskanische Landschaftsmalerei im 14 u. 15 Jahrhundert" (*Jahrbuch der kunsth. Samml. d. allerh. Kaiserhauses*, 1900, pp. 1-90); Guthmann, "Die Landschaft in der toskanischen u. umbrischen Kunst von Giotto bis Rafael." Strassburg: 1903.



scenery also appeared on German soil, and precisely in those provinces where, after the invention of the compass, the oldest intercourse with Italy by sea had grown up, in Flanders and Brabant. The altar-piece of the artists Hubert and Jan van Eyck at Ghent had the effect of a revelation, and marked the victory of the naturalistic tendency in the school of Flanders, and the Brabant school, with Rogier van der Weyden and Hans Memling, soon followed on the same lines. By slow degrees the

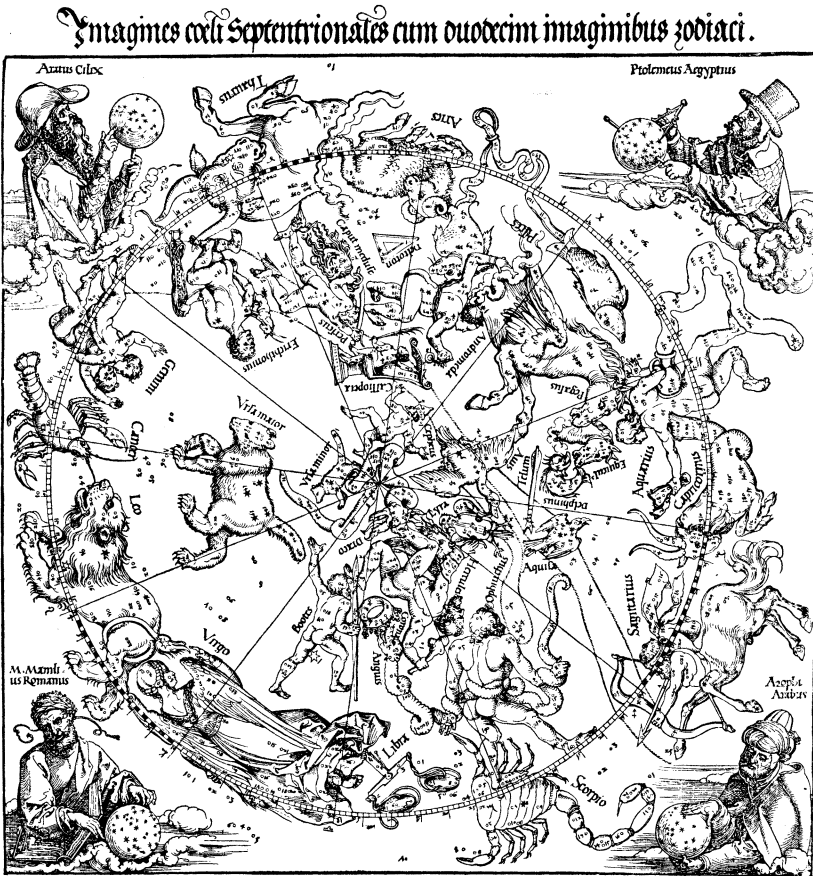


FIG. 7.—NORTHERN FIRMAMENT, BY A. DÜRER.

(From a Copy in the British Museum.)

artists of the lower Rhine and Cologne joined themselves to these; Martin Schongauer turned the art of Upper Germany into the new direction, and with Albrecht Dürer the new school attained full sway. With him L. Kaemmerer\* concludes his welcome studies on "Die Landschaft

\* In *Beitr. z. Kunstgesch.*, N.F. 4. Leipzig: 1886.

in der deutschen Kunst." E. W. Bredt, who has recently treated of Alpine landscape painting in a series of suggestive articles,\* actually styles Dürer the *Entdecker der künstlerischen Alpenlandschaft*. The view of Klausen in Tyrol,† cited by him as an example, seems to me so far remarkable that it has almost the effect of a prospective map like many

### Imagines coeli Meridionales.

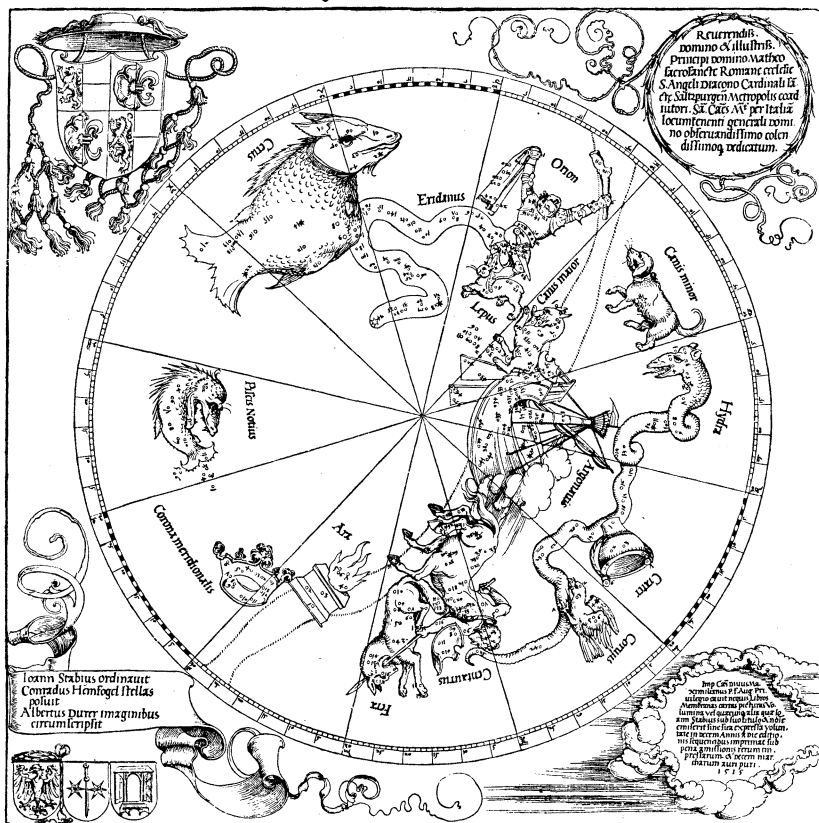


FIG. 8.—SOUTHERN FIRMAMENT, BY A. DÜRER.

(From a Copy in the British Museum.)

of the productions of the *barocco* time in which the distinction between a map and a landscape almost vanishes;‡ they correspond to the

\* "Wie die Künstler die Alpen dargestellt." (*Zeitschrift d. D. u. Oe. Alpenver*, 1906–1908.)

† *L.c.*, 1906, pp. 70 *et seq.*

‡ See, for instance, Phil. Gretter's 'Landtaffel der schönen Gelegenheit umb Boll,' 1602, published by C. Regelmann (Tübingen: 1902). Also *Geogr. Zeitschr.*, 1904, pp. 55 *et seq.* Oberhummer in *Zeitschrift d. D. u. Oe. Alpenver*, 1907, p. 13 *et seq.* (Map of Berchtesgaden A.D. 1628.)

numerous town drawings of the sixteenth and seventeenth centuries, which leave us in doubt whether to call them plans or views.\*

It is impossible to dwell more fully here on Dürer's landscape art, nor must the further development of landscape painting which attained its culmination in Italy in the hands of Tizian,† but found its proper home in the Netherlands (Ruisdael, Hobbema, etc.), detain us; the literature of art history may be consulted.‡ But Albrecht Dürer merits our interest in other respects. Though he has not, like Leonardo, attacked the problems of physical geography, still in his 'Underweysung der messung mit dem zirkel und richtscheyd' (Nürnberg, 1525), 'Underricht zur Befestigung der Stett' (Nürnberg, 1527), and in his practical work as fortress engineer, he has approached the subject of mathematical geography, more especially, however, in his personal relations with the excellent cartographer, Johannes Stabius. To these we owe two star maps, ingeniously executed by the hand of Dürer, and a world map, which no less a person than Carl Ritter has rescued from oblivion. During his stay in Vienna in 1847 he found the wooden blocks of the map in the Court library and caused a fresh impression to be taken, from which a reduced lithographic copy was published, with a full description by Sotzmann.§ An original print of the map is not known, but a copy of 1781, which A. Bartsch had made, is preserved in the Albertina at Vienna. Both star maps seem to have been distributed in several copies. Lately they have been issued in reduced form and described by the astronomer E. Weiss,|| as well as a new impression of the map of the world. The co-operation of Dürer in the star maps is made certain by the annotation, *Joann Stabius ordinavit, Conradus Heinfogel stellas posuit. Albertus Durer imaginibus circumscriptit.* Thus the projection is the work of Stabius; it differs from that of our star maps in that the hemispheres are bounded by the ecliptic and not by the equator, and the pole of the ecliptic is the centre of projection. Heinfogel, a Nuremberg mathematician, placed the stars in position, from the *Almagest* of Ptolemy, and Dürer drew the figures of the constellations,

\* Oberhummer, 'Der Stadtplan,' *l.c.*, p. 94. Striking examples are the plan-views of Florence (1490) and Venice (1500), in L. Geiger's 'Renaissance,' pp. 190, 264; of Paris, by Seb. Münster (1550); of Vienna, by J. Houfnagel (1609). For London plans see the article of L. Gomme in *Geogr. Journ.*, vol. 31 (1908), p. 616.

† Ernst Zimmermann, "Die Landschaft in der venezianischen Malerei bis zum Tode Tizians," Leipzig: 1893 (*Beitr. z. Kunstgesch.*, N.F. 20).

‡ In addition to the writings already mentioned, particular reference may be made to J. Gilbert, 'Landscape in Art' (London: 1885); and K. von Lichtenberg, "Zur Entwicklungsgeschichte der Landschaftsmalerei" (Leipzig: 1892) (*Beitr. zur Kunstgesch.*, 18).

§ *Monatsber. üb. d. Verhandl. d. Ges. f. Erdkunde. z. Berlin*, N.F., vol. 5 (1848), pp. 230-56, Tafel IV.

|| "Albrecht Dürer's geographische, astronomische und astrologische Tafeln" (*Jahrbuch d. Kunsthist. Samml.*, 1888, pp. 207-20). On the star maps Sotzmann also, *l.c.*, pp. 247 *et seq.* R. Wolf, 'Gesch. d. Astron.,' p. 422 *et seq.*

also according to Ptolemy's directions. Though Arabic and even ancient celestial globes\* are known to us, no older star maps of the whole heaven than that of Stabius and Dürer seem to have been preserved. That Dürer also took an interest in the construction of globes appears from his direction to divide the surface into sixteen gores.† Concerning the map of the world, I am glad to join here (p. 628) a reduced copy of the impression A.D. 1847, preserved in the British Museum.‡

Dürer's map of the world, a large double sheet of 65 by 86 centimetres, embraces only the eastern hemisphere. The pole of projection lies at the intersection of the meridian of  $90^\circ$  with the tropic of Cancer, so that northwards the map extends beyond the pole, but southwards only to  $50^\circ$  S. lat. From west to east it reaches in the middle only over  $160^\circ$ , and about the same from north to south. It cannot therefore be described as an *orthogonale Horizontalprojektion* (Weiss), but is an external azimuthal projection. Practically, however, it differs little from the orthographic. It represents the globe as it would appear to an observer placed in the zenith of the tropic of Cancer at  $90^\circ$  of latitude east of Ferro, and at a distance of six times the earth's radius from the centre of the earth.§ The globular appearance is emphasized by the inclusion of the whole north polar calotte down to  $75^\circ$  N. lat. On the other hand the map suffers, as in all orthogonal projections, from a contraction of the peripheral parts, which distorts Europe especially; in the case of Asia ignorance of the north-eastern part, and in Africa the narrowing of the continent towards the south, contributed to minimize this difficulty. As far as the drawing of the Ptolemaic maps could be utilized they were followed throughout; only the north (*Engroneland*), South Africa, and Madagascar, are added from contemporary maps. But the actual form of Africa, then fairly well known, is not preserved; the gulf of Guinea is not shown at all, and the southern extremity is bent round to the east.

For the contents of the map Stabius is alone responsible; his arms adorn the lower left-hand corner, and he only is set down on the map as the author, both in the dedication to the Archbishop of Salzburg, Cardinal Mathias Lang (whose arms are above on the left), and in the imperial license (dated 1515). Now, though Dürer's co-operation is not vouched for by his name or monogram, the artistic decoration generally passes for his work. Bartsch showed the harmony of the ornamental accessories with those of the star maps and the copy of 1781 was

\* Further information in M. Fiorini's 'Erd. u. Himmelsgloben,' revised by S. Günther. Leipzig: 1895.

† Fiorini-Günther, pp. 71 *et seq.*

‡ See C. Dodgson, 'Catalogue of Early German and Flemish Woodcuts in the British Museum,' 1 (1903).

§ Penck, *Geogr. Abhandlungen.*, vol. 5, p. 9.

No. V.—MAY, 1909.]

inscribed, "*Editum ex tabula lignea ab Alberto Durer incisa.*" The most prominent students of Dürer, as M. Thausig,\* agree with him. It is quite in accordance with the close relations in which Stabius, one of the first geographers of his time, stood to Dürer; he had, moreover, worked at the design of the triumphal arch of the Emperor Maximilian, Dürer's greatest wood-carving, and studiously availed himself of the opportunity afforded by his sojourn in Nuremberg to frequent the society of artists, and enlist them for the publication of his astronomical and geographical sheets. The spirited heads which symbolize the twelve principal winds are genuine Dürer work, and are decorated with sharp or peacock's feathers according as the winds are rude or mild. A quite similar treatment of the winds is seen in the 'Carta Marina' of Martin Waldseemüller of 1516, which betrays in its artistic decoration the influence of Dürer's school.†

Dürer's connections with geography are not exhausted. Apart from perspective plans and suchlike drawings derived from his studies in fortification (see above),‡ his 'Tagebuch der Reise in die Niederlande' § is not without interest. While it consists chiefly of notes on stages, expenses, and works of arts, it also contains a noteworthy passage on the Aztec works of art which Cortez sent to the Emperor, and Dürer had an opportunity of seeing at Brussels (1520). The delight caused by these products of an unknown and strange civilization expresses itself in the words of Dürer || just as in the impression they made on Cortez himself. ¶

Carl Ritter \*\* goes too far when he sums up his judgment of Dürer in the words, "*So dürften wir denn den grossen deutschen Meister auch zu unsern ersten deutschen Geographen und Landkartenzeichnern rechnen, deren Reigen er anführt mit Meisterschaft.*" For the map, as such, is not his work, as we have seen, and, moreover, we are now acquainted with older and far more important German cartographical work than the hemisphere of Stabius. His services to geography are rather due to his artistic labours, in the influence he brought to bear on the understanding of natural forms and scenery, and in advancing the arts of

\* 'Dürer,' 2 Aufl., vol. 2, pp. 114 *et seq.*

† Jos. Fischer u. F. von Wieser, 'Die älteste Karte mit dem Namen Amerika,' p. 19.

‡ Val. Scherer, 'Dürer' (Stuttg.: 1904), pp. 326 *et seq.*

§ Published by F. Leitschuh, Leipzig, 1884.

|| *Loc. cit.*, p. 58. "*Auch hab' ich gesehen die dinge die man dem könig aus dem neuen guldten land hat gebracht, ein gross gulden sonnen, eines ganzen klasten breith, dgl. ein ganz silbern mond, auch also gross, u.s.w. Hab aber all mein Lebtag nichts gesehen, das mein herz also erfreut hat als diese ding.*"

¶ He writes in his letter (1520), "The ornaments are invaluable owing to their novelty and singular form, apart from their value as metal; no prince in the world can possess such," Cf. the description of S. Ruge, 'Gesch. d. Zeitalt. d. Entdeck.', p. 367 from Bernal Diaz and Torquemada.

\*\* *Loc. cit.*, p. 231.



stamp-cutting and copper-engraving, which first came into general use for maps in Germany after Dürer's time.\*

Other artists of that time besides Dürer were closely connected with book decoration and the illustration of maps. The school of Martin Schongauer and then Hans Burgkmair and Hans Baldung Grien should first be mentioned.† Hans Holbein was one of the foremost artists in the work of illustrating books and drawing marginal decorations. Among others the marginal decorations to the map of the world in the 'Novus Orbis' of Grypæus (1532),‡ to several maps in S. Münster's 'Ptolemæus' of 1542,§ and by some also the beautiful border to the Swiss map of Æg. Tschudi of 1538 (1560),|| are attributed to him.

The custom of adorning maps with artistic work goes back far into the Middle Ages. The monkish maps, as those of Beatus, and at Ebstorf and Hereford, are notable examples. The maps of the world evolved from Portulans adopted the practice, and passed from the fanciful imaginations of the Middle Ages to drawings of foreign peoples, animals, etc., more true to nature. The Catalan maps, the globes of Behaim and Schöner, the world maps of Juan de la Cosa, Sebastian Cabot, and Pierre Descelliers mark the stages of this development.¶ Often this decoration served only to conceal a lack of geographical knowledge, especially in maps of Africa, of which Swift jeeringly wrote—

“Geographers in Afric maps  
With savage pictures fill their gaps,  
And over inhabitable downs  
Place elephants for want of towns.”

In the sixteenth century, however, a general tendency is observable towards removing the decoration from the body of the map into the artistic margin. Aventin's map of Bavaria\*\* (1525) is a good example. An endeavour was often made by combining the great possible elegance and neatness in the drawing with a beautifully designed margin to turn

\* Isolated specimens of German copper-engraving are found still earlier, as, for instance, the map of Nicol. Cusanus of 1491, but in general, wood-engraving prevailed on German maps till past the middle of the sixteenth century.

† Fischer-Wieser, *l.c.*, p. 17.

‡ Thus Passavant, p. 37; but A. Woltmann, 'Holbein,' vol. 2, pp. 215 *et seq.*, is doubtful.

§ Nordenskiöld, 'Facsimile Atlas,' p. 25.

|| Reproduced by J. F. Hofer and Burger in Zürich.

¶ Particularly fine and elegant are the maps of the Provençal geographer Guillaume le Testu (1555), studded with numerous figures, in Santarem's 'Atlas,' Abt. iv., and those of the Portuguese Vaz Dourado in the 'Atlas zur Entdeckungsgeschichte Amerikas' (1859). To these may be added the maps of Pero Fernandez, Nicolas Desliens and Diogo Homem published by V. Hantzsch and L. Schmidt, 'Kartographische Denkmäler' (1903).

\*\* Published for the Geogr. Gesellschaft in Munich by T. Hartmann and E. Oberhummer (1899); also in the *Jahresber. d. Geogr. Ges. in München*, 1898-99 (Heft 18), pp. 83 *et seq.*, Tafel iv. (2nd edition of the Aventin map of 1533).

out a work of art worthy of the acceptance of a prince. Herein the Genoese cartographer, Giov. Batt. Agnese,\* distinguished himself, who from 1517 to 1564 presided over a cartographical institution in Venice. Among his numerous Portulan atlases, of which most of the great libraries of Europe possess copies, the atlas intended for Philip II. of Spain is conspicuous by the fineness of the drawing and the beauty of its equipment.† Sometimes, however, the tendency to subordinate the map to a marginal figure degenerates into mere trifling, to the detriment of the map itself, as when, for instance, Wolfgang Lazius‡ fitted his maps of the Austrian provinces into the shield of the Austrian eagle, or Mathias Burgklehner§ forced his map of the Tyrol into the heraldic form of the Tyrolean eagle. His large map of the Tyrol in twelve sheets shows, on the other hand, the heavy ostentatious decoration of the *barocco* period, which we also meet with in the Dutch atlases of the seventeenth century, those of Jansson, Blaeu, and others. Such is also the fine world map of Jodocus Hondius (1611), which P. Jos. Fischer discovered in Wolfegg, and has lately been published by E. L. Stevenson in an excellent facsimile edition.||

The equipment of works on regional geography, with plans and illustrations, frequently of considerable artistic merit, as was so successfully accomplished by Sebastian Münster and Matthæus Merian, is still another link in the chain connecting the art of the Renaissance with the expansion of geographical knowledge and ideas. Through it form won importance, and is now an indispensable part of geographical delineation. Eminent artists vied with one another in depicting towns, and were often surveying cartographers. Thus the versatile Nuremberg artist, Augustin Hirschvogel, about 1547 executed a ground plan and elevation of Vienna,¶ and Melchior Lorichs, of Flensburg, drew, in 1559, a view of Constantinople,\*\* with painstaking care, and in 1568 published a map of the lower Elbe, with a view of Hamburg. A perspective plan of Constantinople, circulated from Venice, probably owes its original design to Gentile Bellini,†† and in the history of plans of Rome we come across the name of Raphael.‡‡

\* E. Oberhummer, 'Die Insel Cypern' (1903), vol. 1, p. 406, Tafel iii. and iv.

† F. Spitzer and Ch. Wiener, 'Portulan de Charles-Quint' (Paris: 1875); F. Wieser, 'Der Portulan Philipp II. von Spanien' (Wien: 1876); *Sitzungsber. d. phil.-hist. Kl. d. Kais. Ak. d. Wiss.*, Bd. 82.

‡ 'Karten der österreichischen Lande u. des Königreichs Ungarn, 1543-63,' published by E. Oberhummer and F. von Wieser (Wien: 1906).

§ 'Tirolische Landtafeln, 1608, 1611, 1620. Mit Text von E. Richter' (Wien: 1902).

|| Map of the World by Jodocus Hondius, 1611. New York: 1907.

¶ Oberhummer, 'Der Stadtplan,' pp. 90 *et seq.*; Wollfg. Lazius, pp. 18, 23.

\*\* E. Oberhummer, 'Konstantinopel unter Sultan Suleiman dem Grossen' (München: 1902), pp. 1 *et seq.*, Tafel i.-xxi.

†† Oberhummer, *l.c.*, pp. 21 *et seq.*

‡‡ Otto Richter, 'Topogr. der Stadt Rom,' 2 Aufl. (1901), p. 23.

The industrial arts of that period, which united a sense of beauty to the purely practical, also did not hold themselves aloof from our science. I need only refer to the artistic embellishment with which astronomical and surveying instruments were provided down to the eighteenth century, and mention that goldsmiths also took part in the execution of town pictures. In the museum at Augsburg I saw a carefully worked plan of the town in perspective, with the inscription "*Georg. Seld civis et aurif. Aug. 1521,*" and in the museum at Bern plans of Lucerne (1597) and Fribourg (1606), by the "*aurifaber Martinus Martini.*"

I cannot close this review, perhaps already too long, without drawing attention to a peculiar work of the Renaissance which, though placed in one of the most frequently visited spots in the world, is yet known to few—the Galleria geografica of the Vatican. The maps of individual parts of Italy and of other lands here, executed in fresco by Father Ignazio Danti from Perugia, the excellent mathematician and cartographer of Gregory XIII. (1572–85), have never, as far as I know, been copied or described.\* Unfortunately, the gallery is closed to the public, and is accessible only with a special permit hard to procure. A hurried glance round in the year 1904, and some photographs I possess, have convinced me that the maps have probably no intrinsic value, but that a reproduction, especially of the detailed maps of Italy, would be of great interest.

I here conclude this excursion through a period which was no less fruitful for geography than for art, and exhibits both in a more intimate connection than the contrast between the exact investigator and the freely creating artist would lead us to expect.

---

## LIEUTENANT SHACKLETON'S ACHIEVEMENT.

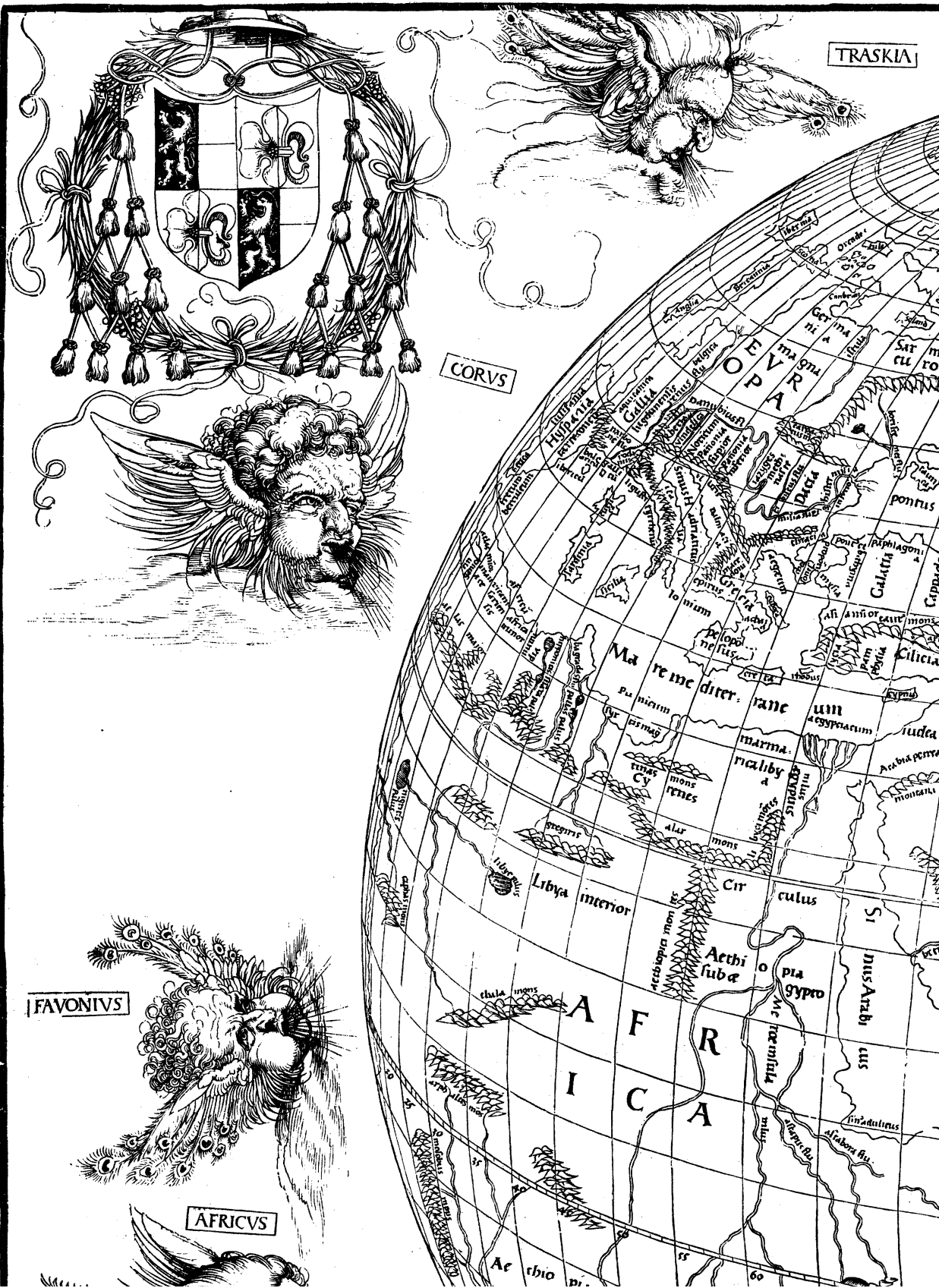
By HUGH ROBERT MILL, D.Sc.

WHILE the preliminary notice of Lieut. Shackleton's brilliant expedition in the last issue of this *Journal* has not yet been supplemented by any additional information, and remains a sketch which can only be completed and made to glow with the colours of life when the explorer returns to tell the completed tale, there are one or two considerations which may be brought forward at this stage as to the magnitude of the step which has been made towards the solution of the Antarctic problem.

It is interesting to notice how the recent expeditions to Ross sea have been connected by personal relations between members of the

---

\* Another series of maps by the same author may be seen in the Sala delle carte geografiche of the Palazzo Vecchio in Florence, from which the map of Switzerland has been published by A. Züricher, *Jahrbuch d. Schweiz. Alpenclub*, 76 (1890–91).

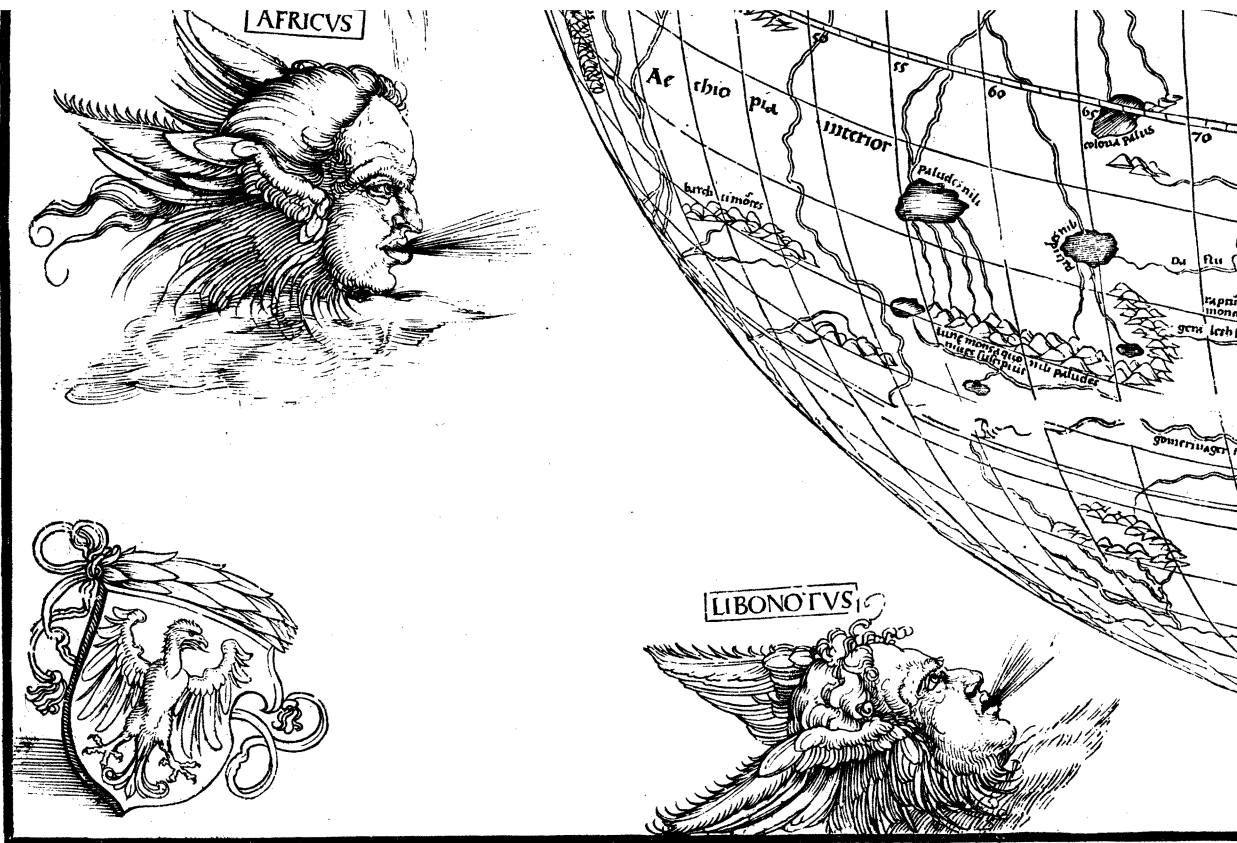




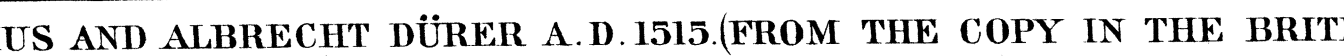




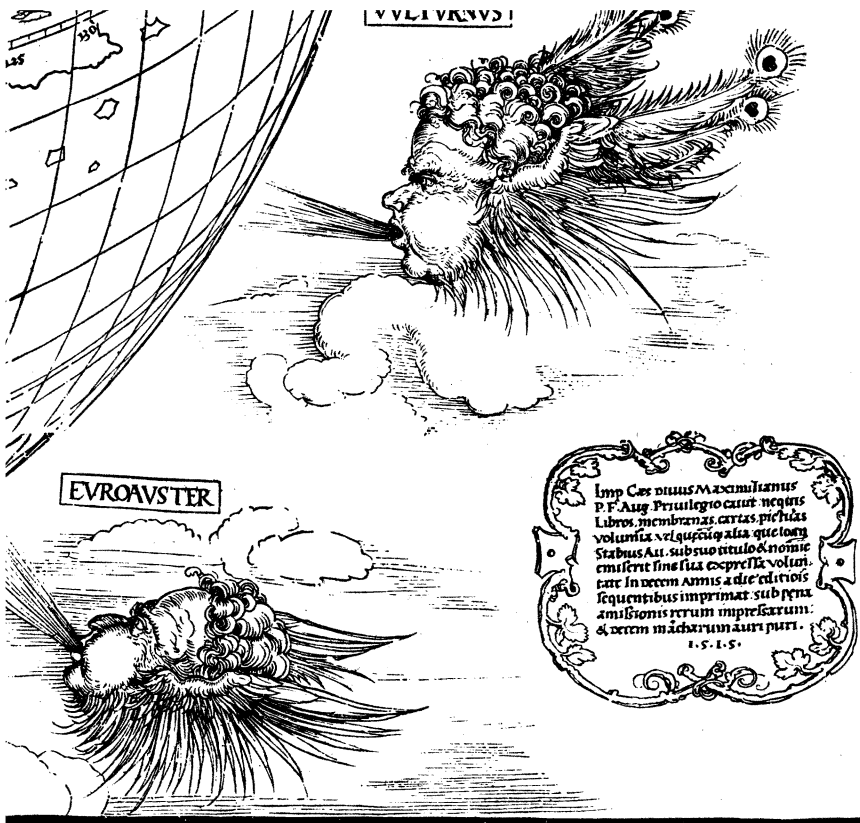




WORLD MAP BY JOHANNES STABIUS A



This content downloaded from 128.235.251.160 on Wed, 17 Dec 2014 00:45:49 AM  
All use subject to [JSTOR Terms and Conditions](#)



BRITISH MUSEUM.)