

# SCIENCE

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## EXPERIMENTS IN GEOGRAPHICAL DESCRIPTION<sup>1</sup>

### THE PRESENT CONDITION OF OUR ASSOCIATION

THE exploration of unknown lands and seas has, to my regret, seldom been the subject of essays presented before our association. It would appear that most of those who are active or bold enough to make their way far from the beaten track do not care for the more thorough study of geography to which we are pledged; or perhaps that we, with our interest in the more scientific and analytical aspects of geography, have not been sufficiently cordial to those explorers who go far from home and bring back narratives in which personal adventure almost necessarily has a large place. Nevertheless, we have not been altogether wanting in this respect. We have heard in earlier meetings something of the desert basins of inner Asia, of the lofty plateaus of the Andes, and of the great territory of Alaska; and I trust that we shall again from time to time have reports on distant parts of the world, particularly when they can be presented with such technical geographical skill as characterized the papers just referred to. Some such papers are listed in our program for this meeting, but if I thus call especial attention to the recent studious travels of Messrs. Woodworth, Huntington and Martin, it would be unfitting not to add at least a few words on the extraordinary geographical achievements of the

<sup>1</sup> Presidential address at the meeting of the Association of American Geographers, held in Cambridge, Mass., December 30, 1909, modified and extended in certain parts.

year now closing; a year that has brought us the news of the most remarkable advances in polar exploration ever made. Although our own work is mostly performed in well-known lands, we must recognize and admire the brave strength of purpose, the persistence in the face of exhausting hardships, which enabled Peary to reach one pole and Shackleton so very nearly to reach the other.

The work of our members has naturally been limited for the most part to our own country. It was at first feared that it might also be limited too closely to the physiography of the lands, because so many of us had been more concerned with that division of geography than with any other; but if we have at any time deserved that reproach, the meeting last winter at Baltimore merited and indeed received altogether different comment; for Professor Penck, who was then our guest, described it as giving a well-distributed attention to various phases of our subject; and Dr. Gilbert, our president at that time, considered the meeting to be a thoroughly serious and scientific assembly. These two opinions are surely most encouraging; yet we still have work to do in the way of broadening our relations. We would willingly see oceanography and climatology more fully represented on the inorganic side of geography, and on the organic side there is pressing need of more attention to the geography of plants, animals and man than has yet been given. We therefore have abundant room for expansion, and I beg each and all of you to use all appropriate efforts to make our needs known in these several directions. As a practical step in this direction, I suggest that we invite representatives of allied subjects, such as history, economics and biology, to address us from time to time on their conception and use of geography.

We have, I believe, still the distinction of being the only geographical society in the world in which some definite geographical accomplishment is required for membership. I trust that such a qualification will be carefully maintained. We have probably the further distinction of being the smallest geographical society in the world; we are indeed so small that it is difficult and disappointing to believe that all the trained and productive geographers in North America are included in our list of some eighty names. Let me, therefore, commend the discreet nomination of new names to the council, always provided that the nominees have reached the stage of studious and original geographical production; and let me even more particularly advise that personal invitation be given to earnest younger students of geography to attend our meetings as guests of the association, in the hope that what they see and hear among us will encourage them to secure serious professional equipment and to reach active production in geographical science. In due time, they having become members, it will be their turn to maintain our simple organization and to foster its fuller development.

#### EXAMPLES OF UNSYSTEMATIC DESCRIPTION

The particular subject on which I wish to address you to-day concerns, as you might expect, the study of land forms, and more especially the manner in which land forms may be effectively described by mature observers, so that they may be appreciated by mature readers. Let me consider with you whether it is desirable and practicable to make at least some approach to systematic methods in describing the landscapes with which every geographer has to deal in the narrative of his travels, or in the account that he gives of particular areas in his regional studies. My own

answer to this question is decidedly in the affirmative, and I propose to illustrate at once the need and the value of some sort of systematic method by the rather invidious device of giving an example of unsystematic description, taken from the first geographical journal on which my hand happened to fall after the intention to cite such an example was formed. The following abstract, therefore, presents all the statements concerning the structure and form of a certain mountain range, in the order in which they are presented in the essay referred to; but distances, directions and other details are changed so that the source of the abstract can hardly be identified, and a considerable amount of general description that is aside from my purpose is omitted.

The mountain mass, entirely isolated and having a very remarkable geological constitution, is a high range, which rises abruptly at its northern end in the form of a great escarpment, surmounting the plain by some 3,000 or 4,000 feet; the range continues in an almost direct course to the south for about 40 miles. The summit is of very difficult access, the rocky wall being nearly vertical and mostly bare for the uppermost 1,500 feet. There is said to be no deep pass through the range. At an elevation of 2,000 or 3,000 feet there are grassy benches. On all sides the crests are very steep, with altitudes of from 4,500 to 6,000 feet; the culminating point rising to 6,300 feet. The crest is not continuous. Erosion has dissected the top of the mountain into a multitude of knobs and small plateaus. The entire range is formed of sandstones, inclined in general at an angle of  $45^{\circ}$ , and trending like the range from north to south. The sandstones rest on granite, which reaches an altitude of 1,900 feet at the village of Blank; while near River So-and-so the sandstones are seen at an altitude of 1,200 feet. On certain lower terraces, horizontal sandstones are deposited. The range has the appearance of constituting the eastern limb of an anticline, but it is difficult to explain in what way erosion has removed the sandstones of the western limb from the plain, since they form a heavy body in the range. Deep V-shaped valleys, parallel to one another, veritable torrent beds, are seen in large

number on the eastern flank. After reaching the foot of the range, at an altitude of 1,000 feet, the torrents become quiet streams.

Part of this description is rather baffling. For example, what is the general form of the top of the mountain, in which erosion has produced a multitude of knobs and small plateaus? On reaching this statement, after having previously read that the summit is of difficult access, the upper rocky walls being nearly vertical and the crest very steep on all sides, one might make the provisional inference that the mass was of horizontal structure, like a lava-capped mesa; but this inference is not consistent with the earlier statement regarding the well-defined north-south trend of the range, and it is explicitly contradicted by reading, a little farther on, that the mountain is formed of inclined sandstones. One must feel rather vexed not to be told at once in which direction the sandstones dip; for until such information is given, the reader has to keep two pictures floating in his mind; one of an east-dipping monoclinal range, the other of a west-dipping monoclinal range. But he may throw away the second picture after reading a little farther and coming to the comparison of the range with the eastern limb of an anticline, of which the western limb is lost. This is the only indication given by the observer that the dip of the sandstones is to the east. The absence of the western limb of the postulated anticline tempts the reader to suppose that the range, instead of being part of an anticline, is really an east-tilted and dissected fault-block; even though the observer, after he has himself discredited the suggestion of anticlinal structure, says nothing about this manifest possibility. Theoretical discussion is therefore as fragmentary as the record of observation. In fine, the more carefully one reads the

article, the more one is impelled to say that certain important items are omitted; that such items as are mentioned are introduced in no apparent order; and that the method of treatment is uneven, arbitrary and accidental, being explanatory in one part and empirical in another.

By rearranging the facts presented, the reader may form a more systematic description. In the absence of explicit statement to the contrary, normal erosion is naturally assumed to have caused whatever changes have been produced during the development of the existing form from the initial form. The systematic description may then proceed as follows: The range, trending north and south, with altitudes of from 4,500 to 6,000 feet, is a monocline of heavy sandstones which dip eastward, and which are underlaid by granite along the western flank. The northern termination is a high cliff; the southern end is left undescribed. (Whether the initial form of the mass was a tilted block or not must be left undecided, because no sufficient account is given by the observer either of the constitution or of the form of the lower ground from which the range rises.) The crest is somewhat dissected but not deeply notched; the eastern flank is well dissected by consequent streams; the western flank is presumably more or less ravined by obsequent streams. On the whole, the stage of erosional development may be provisionally regarded as submature or mature.

It is tantalizing to read of the grassy benches at altitudes of 2,000 or 3,000 feet, and not to be told on which side of the range they occur, or how they are related to the structure of the mass; possibly they are granite benches on the western flank. One must discount the statement regarding the nearly vertical slope of the upper rocky walls, because vertical walls are al-

together improbable if not impossible on the back slope, and are hardly possible even on the front slope of a monocline. Uncertainty must also remain regarding the piedmont terraces; perhaps they are remnants of a sandstone formation that once had a greater horizontal extension; but this can not be determined because of the vagueness of the phrase: "On certain lower terraces, horizontal sandstones are deposited." Inasmuch as erosion is explicitly mentioned as having affected the crest of the range and implicitly suggested as having ravined the eastern flank, it is unfortunate that its effects on the western escarpment and around the base of the range are passed over in silence. Uneven description of this kind is disappointing.

The point to be emphasized is that the description prepared by the observer would be much more easily apprehended by the reader if it had been orderly instead of disorderly, and thorough instead of fragmentary. Immediately following the introductory statement concerning the occurrence of a high and isolated range, trending north to south, one must wish to know its general structure; namely, that it is a monocline of heavy sandstones, dipping eastward, with a foundation of granite exposed in the western flank. After exploration is finished, the preparation of brief and explicit statement of this kind surely imposes no great burden on the observer; and as surely it gives great aid to the reader. Brief suggestion as to the initial form of the mass and as to the amount of change that it has suffered since its uplift would be helpful, because the reader could then, as it were, accompany the observer in his attempt to give an explanatory account of the present form. If erosion has gone so far that the initial form is altogether uncertain, an explicit

statement to that effect should be made. Normal erosion being understood to be the process engaged in carving the mass to its present form, various details regarding the dissection of the crest, the steepness of the upper slopes, and the ravining of the flanks, may be easily added in the latter part of the description in orderly fashion; and as easily apprehended. If the observer, on seeing the ravines in the eastern flank, hesitates to call them "consequent," because of the vague possibility of some other origin, he may immediately solve this difficulty by calling them "apparently consequent"; and the reader will at once catch his meaning, and also his uncertainty regarding it. If the observer hesitates to assert definitely that the mass was initially a tilted block, he may say it looks "as if" it had been uplifted as a tilted block, provided that that is really his best interpretation of the facts; and then the reader will find in this guarded statement the clue that he needs in order to gain the observer's point of view, to follow the rest of the description, and to form a good mental picture of the landscape. The essential principles here are, first, that the reader's mental picture can not be well formed, unless the observer describes what he has seen in terms that are susceptible of definite interpretation; and, second, that the mental picture can not be easily formed, unless the observer presents the results of his observations in a reasonable order.

Only after a definite description of the landscape has been presented, is it fitting to mention by name subordinate items, such as single villages and individual streams. It is altogether inappropriate to use unknown local names of villages and streams as a means of locating unknown structures and forms. This is a general principle that is too often

overlooked. In the absence of all diagrams and maps in the article here considered, the reader gains nothing on being told, before the direction of monoclinical dip is stated, that the foundation granite outcrops near the village of Blank. He profits nothing on reading that the sandstones are seen on the banks of River So-and-so, the relation of the river to the range being unexplained, and even the direction of river flow being unmentioned. Such items may be useful hints to a second traveler on the ground, but they are distractingly irrelevant to a reader at a distance. On the other hand, after a general statement has been given, from which the reader may form a fairly definite conception of the structure and form of the range, it may well be added that at the western base, about so far from the well-defined northern end of the range, and near a large exposure of the foundation granite, lies the village of Blank; or that at the head of a certain obsequent ravine, located in such and such a way and drained by the headwaters of River So-and-so, the sandstones are reached at such and such an altitude.

#### THE NEED OF SYSTEMATIC METHODS

The article from which these extracts are taken affords a fair sample of the treatment accorded to land forms in most of the leading geographical journals of the world and in most of the books of travel, from which we must learn nearly all that we know about distant lands. If the article here abstracted departs from the average treatment of land forms, it is rather on the side of greater than of lesser fulness of statement; but here, as well as in the great majority of geographical books and essays, the method of treatment is really no method at all, as far as this division of our subject is concerned.

Such articles as those by Bowman on the Bolivian Andes<sup>2</sup> are altogether exceptional in the clearness and fulness of their explanatory treatment. There is very seldom any indication that explorers have had in mind any well-matured plan or standard, in view of which a mountain range or any other form that they come upon should be treated. Geographical essays seldom give us reason for thinking that their authors have had any thorough training in the analysis or the description of land forms; or for thinking that they are aware of the systematic association of parts that is so generally characteristic of the elements of a landscape, or of the reasonable origin of the associated parts by the action of ordinary processes. There is not even any clear indication that the observers are consciously experimenting with any definite method for the better presentation of the facts that they have seen. The random accounts of item after item are usually arranged in indiscriminate order, as if any accidental manner of presentation were all sufficient. This is truly one of the most disappointing features of the present status of geography. The very sources from which we ought to expect the best material—namely, original narratives in books of travel, and essays in the journals of the great geographical societies—give us records of the kind just cited, in which so important a part of our subject as land forms is, as a rule, treated in an utterly unscientific manner.

The prevailing absence of scientific method for the treatment of land forms may be, on the one hand, taken as a discouragement by those who believe that a systematic method would be helpful; for if disorderly, unscientific methods prevail at so late a time as the present, it must be,

one may be tempted to say, because no other can be invented. But, on the other hand, the absence of method may be regarded as an encouragement, because it shows that the field is practically clear for the introduction of any method that will generally commend itself to practical geographers. The latter point of view is to be preferred. Let me, therefore, confidently urge upon all our members who are interested in this aspect of geographical progress to give a share of their time to the invention and development of a thorough-going method for the description of land forms, a method that may find general acceptance through being generally applicable; and to make experimental trial of the method for themselves, and explain it as well as exemplify it in their publications.

As an earnest of my conviction of the importance of this work, allow me to say that I have already made some experiments of this kind myself. You may remember that, two years ago, when we met at Chicago, I had the pleasure of conducting a conference in which the discussion centered chiefly on the possibility of developing and adopting a systematic method for the description of the lands, and in which I advocated the general use of what has been called the method of "structure, process and stage" for this purpose. It is my desire to-day to carry the subject of that conference somewhat farther; partly by reviewing what was then accomplished, partly by describing to you an experiment in the same direction that I made in Europe in the summer of 1908.

One of my objects at the Chicago conference was to bring forward various other systematic methods of treating land forms, besides the one with which I was experimenting myself; but no success was reached in this direction. Several members who

<sup>2</sup> *American Journal of Science*, XXVIII., 1909, 197-217, 375-402.

were present, and several absent members to whom I afterwards wrote, expressed themselves as unprepared to adopt the method of structure, process and stage in their work; but what impressed me more was that they did not propose any alternative method. Perhaps no sufficient opportunity was given for the presentation of such an alternative; but certainly none was forthcoming, either in discussion or in correspondence. Some members stated explicitly that they preferred to remain free from any limitations; and with a preference for full freedom I have the warmest sympathy. Indeed a wish to profit from the more general introduction of a systematic method does not, to my mind, unwisely interfere with such freedom. Improvements are always in order, and every one must of course feel free to introduce them. There are occasions, however, when some definite method of treatment has to be adopted for a time at least, as when one writes a geographical description of a tract of country, or when one presents the principles of geography to a class of students; and still more when one attempts to teach young geographers the art of geographical description. It was particularly with regard to such needs that I was interested to learn the opinions and the practise of my associates. Perhaps the title of the Chicago conference, namely, "Uniformity of Method in Geographical Investigation and Instruction," went too far; and as I am now minded, my object would be better expressed under such a title as "Experiments in the Systematic Description of Land Forms." It is especially that aspect of the subject which I wish to pursue further to-day.

#### A GEOGRAPHICAL EXCURSION IN ITALY

A good test of a method of description is found in its application to new fields.

It was, therefore, with much interest that I looked forward two years ago to a journey to Italy in the summer of 1908, when it would be possible to revisit certain districts of which I had had passing glances in the spring of 1899, and to determine how far they could be described according to the method under experiment. But it occurred to me that an adequate and impartial experiment with a method could hardly be secured if the person who had developed it should also be the person who had to apply it. Others of different training ought to make the test. Hence a circular letter was sent to a number of correspondents at home and abroad, indicating a route and a plan of work, and inviting them or such of their advanced students as they could recommend to join me in Italy on June first. The success of this plan passed all my anticipations. We were favored by special permission from the Italian Ministry of War, secured through the kind offices of the American Embassy at Rome, to make field studies even near fortifications and along the frontier. We were allowed to purchase all sorts of maps, not usually on sale, at the Military Geographical Institute in Florence. We were cordially welcomed by scientific colleagues at various points. The members of the party all entered heartily into the spirit of the work proposed, and made a most harmonious even if a variegated troop. The numbers varied from four to forty or more in different parts of the route. The cosmopolitan character of the gathering was its greatest value; for under what conditions could one secure livelier incentive to geographical investigation or make a better test of a proposed method of work, than by visiting choice fields in the company of earnest students of different nationalities and different training, and discussing together the varied landscapes

that opened before us. Members who accompanied the party for a week or more included teachers from the universities of Paris, Lyons, Marburg, Genoa, Michigan, Cincinnati and North Carolina, Williams College and the Lycum of Oran (Algiers), as well as graduates or students from Berlin, Lille, Vienna, Bern and Cambridge (England); those who were with us for shorter periods represented the universities of Grenoble, Fribourg and Harvard, the military school of Fontainebleau and the state normal schools of Salem, Mass. and Cheney, Wash.

Our work began on June 1, 1908, at Ancona on the Adriatic (A, Fig. 1), where we studied a late mature coastal plain; and ended on July 18 at Le Puy en Velay in central France; and between times we saw the valley of the Lamone above Faenza (Fa), in the northeast flank of the Apennines, the basins of Florence (F) and of Val d'Arno within the Apennines; the

the Dora Baltea above them to Aosta (A); the pass of the Little St. Bernard, by which some of us crossed into France; the French Alps in the vicinity of Grenoble; and west of the Rhone the mountain belt of the Cévennes, formed by the dissection of the southeastern slope of the central plateau. It may well be imagined that we had much entertainment that was not strictly geographical; yet on the whole we held rather closely to the object of the excursion. One of the most amusing features of the journey was the necessity of using several languages in our daily intercourse; and here the European members of the party had great advantage over the Americans by their fluency in other tongues than their own. The determination taken by some of the American members to learn at least one foreign language before making another visit to Europe was not the least valuable lesson of our cooperative efforts.

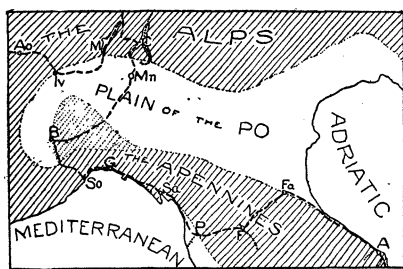


FIG. 1. Route of the Italian Excursion, 1908.

plain of Pisa (P); the beautiful coastal forms of the Riviera Levante between Spezia (Sa) and Genoa (G); the elbow of the Tanaro valley at Bra (B), where the river has been diverted from a former northward to its present eastward course; the lakes of Como (C), Lugano and Maggiore (M), and their associated Alpine valleys, where we discussed the problem of glacial erosion; the huge terminal moraines of Ivrea (Iv), and the glaciated valley of

#### THE METHOD OF STRUCTURE, PROCESS AND STAGE

As in the case of the Chicago conference, the most significant result of the Italian excursion for me was again the prevailing absence among the members of the party of any conscious and matured method for the description of land forms. That the method with which I had been experimenting was not familiar to my European companions was surely not due to any recondite elements in it, for there are none; all its elements are taken from the common experience of geologists and physical geographers. In so far as the method has any novelty, it is to be found in the systematic treatment of well-known elements; and even in this respect it is not so novel as some have seemed to suppose. Its fundamental principles are to be found, for example, in the third edition of



Sir Archibald Geikie's "Scenery of Scotland" (1901), where one may read:

The problem of the origin of the scenery of any part of the earth's surface must obviously include a consideration of the following questions: (1) the nature of the materials out of which the scenery has been produced; (2) the influence which subterranean movements have had on these materials, as, for instance, in their fracture, displacement, plication and metamorphism, and whether any evidence can be recovered as to the probable form which they assumed at the surface when they were first raised into land; (3) the nature and effect of the erosion which they have undergone since their upheaval; and (4) the geological periods within which the various processes have been at work, to the conjoint operation of which the origin of the scenery is to be ascribed (pp. 9, 10).

Here we have the very essence of what is implied under the terms "structure, process and stage"; and I fully agree that "obviously," as used in the first sentence, is precisely the word with which to introduce what follows. Yet, obvious as these considerations are as regards the origin of scenery, it is seldom that they are completely and systematically employed by geographers in the description of scenery. Their helpful use is furthered by their systematic treatment according to a definite method; and therefore method has here a practical value. Each member of my party knew well enough the various structures and processes involved in the production of natural landscapes, and could explain them item by item; nevertheless, hardly any one had consciously adopted a particular method for presenting the results of his observations regarding the natural combinations of the items, such as occurred in the landscapes that were repeatedly spread before us.

A generally favorable consideration was given to the method of structure, process and stage, during the excursion, but this must not be taken as counting altogether

in its favor. A definite method naturally makes headway as against indefinite, unformulated methods; and moreover, as I was the leader and oldest member of the party, my views probably received a greater consideration than they would have gained if I had been a junior and a follower. Still, all allowances made, the excursion gave me great encouragement, and I resolved to persevere in carrying the development and the application of the method as far as possible; but always in the hopes of meeting other methods, developed by my colleagues; and always with the promise, to myself at least, to make careful trial of other methods as far as I could learn them.

#### THE DISSECTED COASTAL PLAIN NEAR ANCONA

Let me give a few examples of our work, beginning with two excursions in the neighborhood of Ancona, where sheets 117, 118, 124, 125 of the Grande Carta topografica del Regno d'Italia, 1:100,000, served as local guides. Here the earliest members of the party, a Frenchman, a German Swiss and an Austro-Galician, were present. The results may be briefly summarized as follows: The northeastern Apennines serve as the oldland to a dissected coastal plain, some 20 or 30 kilometers in breadth, composed of unconsolidated strata of clay and sand. The dissection has been carried to a stage of late maturity by prevailingly consequent streams with short insequent branches, the largest consequents being those which have been extended across the plain from the Apennine oldland to the sea. The oldland, although not sharply separated from the coastal plain, has a more deformed structure, a greater altitude, and a tendency to a longitudinal rather than to a transverse arrangement of its ridges. The relief of the district is moderate or small, with altitudes of 200

or 250 meters along its inner border, and of from 50 to 120 meters near the coast, where the sea has developed a fully mature line of cliffs which truncate all the sea-board hills in even alignment. The texture of dissection is rather coarse. In consequence of a slight and recent elevation,

mediately infer the total initial structure and form of the district concerned; second, that it proceeds, tacitly implying the action of normal and of marine processes of erosion, to state the stage that each of these processes has reached in the regular progress of its work; and third, that it adds in

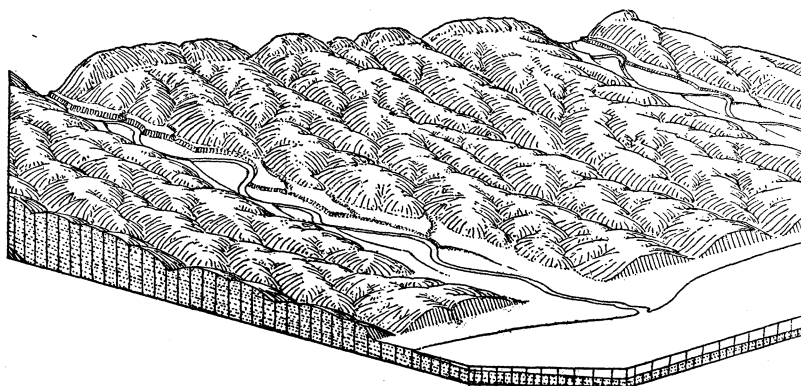


FIG. 2. Diagram of the Late Mature Coastal Plain, South of Ancona, Italy; looking West.

increasing from zero at the coast to 10 or 20 meters at the inland border of the district, the larger consequent streams have excavated mature flood plains below the remnant terraces of their earlier valley floors; and during about the same recent period the sea has withdrawn from the maturely aligned cliffs of its former attack and prograded a strand-plain from 200 to 300 meters in breadth, which at the river mouths is broadened in faintly convex deltas of about double this measure. Hence it seems as if the recently revived rivers had rapidly washed so much waste to the sea, that the waves could not immediately dispose of all of it, and therefore deposited a part of it along the shore, thus prograding the strand plain. These features are graphically summarized in Fig. 2, an imagined bird's-eye view, looking north-west.

The essentials of the above description are, first, that it begins with a general statement from which the reader may im-

closing a brief account of the result of a slight interruption of the first cycle of erosion due to a slanting uplift of small amount, and with the cautionary words, *as if*, provisionally suggests the correlated origin of two new features, the terraced valley floors and the prograded strand plain, concerning which our brief excursions did not suffice to provide full proof.

Let us consider these points in more detail. From the term, coastal plain, which is given in the first sentence of the description, the initiated reader immediately understands a simple structural mass composed of stratified sediments, deposited on a sea floor when the region formerly stood lower than now, and when the sea had its shore on the flanks of the Apennine oldland; but now revealed as a land area, sloping gently seaward, in virtue of a broad uplift without significant deformation. Even if all this had been explicitly stated, instead of having been only implied in the term, coastal plain, the description

would not have been too geological, for every point of the structural statement bears helpfully on the appreciative understanding of the existing landscape, and hence on its proper description. Nothing is introduced simply for the sake of its geological interest, however great that may be; even the geological date of the strata concerned is left unmentioned, because this is geographically irrelevant.

It may be noted in passing that the terms coastal plain and coast plain have been used by some geographers to designate platforms of marine abrasion, now uplifted so as to form a littoral lowland. Geographical terminology is so little developed and systematized that no agreement as to the limitation of these and various other terms has yet been reached.

Although a marine coastal plain is in its earliest youth a smooth surface, gently inclining from the oldland to the sea, the first sentence of the description given above includes the significant word, dissected; and with this the reader must immediately pass from the conception of the initial stage of a smooth coastal plain to the later stage of a surface made uneven by the erosion of many valleys. The strata that form the plain are said to be unconsolidated, and this suffices to exclude all outcropping ledges from the present landscape, particularly as the dissection of the plain is said, in the second sentence, to have reached a late mature stage. All the hill slopes must therefore be conceived as cloaked with a creeping soil. The former shore line, marking the original inner border of the plain, must have lost whatever distinctness it may have had at the time of uplift; and it is indeed to-day hardly to be detected.

For similar reasons, all the streams must be conceived as having thoroughly well-graded courses, and all but the smallest

valleys must be pictured as having flood plains of gentle fall. The general pattern of the streams and their valleys is sufficiently indicated by the words, prevailingly consequent and short insequent. These must be taken to mean that the larger streams flow almost directly to the sea in sub-parallel courses about at right angles to the general trend of the plain as a whole; while many small valley-heads branch in various directions from the trunk valleys. The hilly interfluves between the chief valleys must, in a late mature stage, be pictured as having lost something of their initial altitude, and hence, when looked over in the direction of the length of the plain, as no longer rising to a perfectly smooth and gently sloping skyline, but nevertheless as approximating to this form; while the spurs that branch from the axes of the interfluves must be pictured as generally pointing toward the sea and as descending by gentle, graceful and well-graded slopes into the open valleys. The texture of dissection being described as rather coarse, the hills and spurs must be conceived as having contour lines in flowing curves of rather large radius; and all close-set, sharp-cut ravines must be excluded.

At a late mature stage, the larger extended rivers must of course be pictured as having broad valley floors; and the sea must be imagined as having cut back or retrograded the front border of the plain, so that the sea-board hills are evenly truncated in a long succession of sea cliffs, all standing in accordant line over a well-developed beach. Deltas must be absent. The general picture thus sketched must then be slightly modified by terracing the main valleys and by widening or prograding the beach into a well-developed strandplain.

The technical terms here employed are

few; most of them are almost self-explanatory, but they are all highly significant. Consequent and insequent streams and valleys present elementary and fundamental conceptions in rational physiography. Retrogradation and progradation of a shore line by marine action correspond to degradation and aggradation of a valley floor by a stream; in both cases, the steady action of balanced forces is implied. Surely there can be no sufficient reason that the newly recognized ideas represented by these newly introduced terms should be neglected by modern geographers who employ, whenever they can, such innovations as motor cars, film cameras and daylight developers. Nor need there be any fear that the mere use of such technical terms as are here suggested will necessarily result in enforcing an unattractive, non-literary style upon geographical descriptions. Attractiveness of style is a matter to be cultivated for and by itself; it is as well worth cultivating in geography as in history; but in neither subject should it involve a sacrifice of truth and efficiency to form and sound. The degree of technicality appropriate in a geographical description will depend largely on the condition of the readers for whom it is written. As the description presented above is intended for mature geographers, it does not seem to be either unduly technical or unattractively awkward.

It is assumed at the beginning of the description that Apennines and Adriatic are names that every mature geographical reader will know without explanation. No other local names are used in the general physiographic description. But now that the general features of the district have been presented, local names and all sorts of details may be conveniently added, and ontographic relations may be effectively introduced. For example, agricultural vil-

lages are found on the broader hills of the dissected interfluves, one of these being Loreto with its famous shrine, standing on a full-bodied spur-crest some four kilometers back from the coast; here pilgrims would appear to yield a larger revenue than farms. Fishing villages lie on the harborless strand plain, especially near the mouths of the larger valleys; in bad weather the boats are hauled up on the beach or towed into the little rivers. An important trunk railroad and a main wagon road follow the level strandplain for a long distance; branch railroads enter some of the larger valleys, and wagon roads turn up all of them; while roads of less importance enter certain smaller valleys and sidle in zigzags up the spurs to the farming villages on the interfluve hills, or follow the hill crests in passing from one upland village to another. It may be pointed out that Ancona does not belong to the coastal plain; it lies on the northern side of a cliffed promontory of altogether different constitution.

#### THE VALLEY OF THE LAMONE

Our second stop was at Faenza, where the valley of the Lamone was examined. It is the work of one of the many streams that extend in apparently consequent fashion from the northeastern flanks of the Apennines across a piedmont lower land, to the fluviatile plain of the Po, which here replaces the Adriatic sea. This late mature valley, enclosed by well-dissected uplands of moderate relief, is of particular interest in having an early mature valley of small depth eroded in its floor: that is, we have here the late mature work of an earlier cycle followed by the early mature work of a later cycle; the earlier cycle having been interrupted and the later one introduced by a gentle uplift. I was greatly impressed by the distinctness of

these combined features during a trip by rail from Faenza to Florence in 1899, and then resolved to examine them more at leisure at some later season. On going there in 1908 we were well rewarded by a delightful prospect over the valley from a favorable view point up on its western side, where our small party of four spent some profitable and memorable hours in the shade of a group of tall cypresses alongside of a little chapel, sketching, drawing maps and diagrams, and discussing our efforts at systematic description. Then we walked over some of the neighboring hills, and in the afternoon went by train a short dis-

outer belt was apparently a continuation of the dissected coastal plain that we had seen by Ancona, here descending by straggling hills to the plain of the Po, instead of ending in an evenly retrograded line of sea cliffs. We noted first that in the inner belt of stronger strata the new, early mature valley, incised in the gravel-covered floor of the former, late mature valley, has a well-defined meandering course, with steep-walled amphitheaters in which the inclined strata of the district are well exposed, with sloping spurs sharply trimmed on their up-valley side, and with graceful flood-plain scrolls, systematically placed

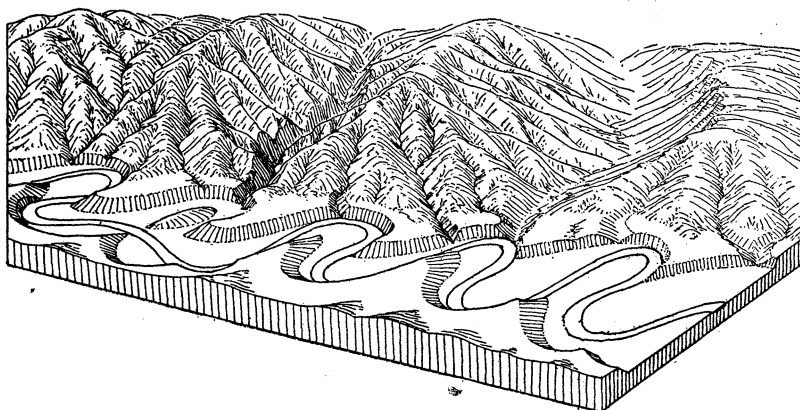


FIG. 3. Diagram of the Compound Valley of the Lamone, Italy; looking West.

tance farther up the valley for new observations. The results are summarized in Fig. 3, an imagined bird's-eye view, looking northwest.

We thus learned that the valley traverses two piedmont belts of unlike constitution; an inner belt of deformed and somewhat resistant strata, which trend in general parallel to the extension of the mountains in the background; and an outer belt of weak, bedded clays, dipping gently northeastward. The inner belt seemed to represent the well degraded border of the Apennine oldland, with respect to which the outer belt had been deposited; and the

along the down-valley side of the trimmed spurs. The depth and breadth of the new valley both decrease up-stream, as if the work of the new cycle were less and less advanced as the mountains are entered. As might be expected, the lateral streams that here come down from the dissected uplands have as yet eroded only narrow, young, steep-walled gorges, with abundant outcrops, beneath the soil-covered slopes of the mature lateral valleys of the earlier cycle; but the lateral gorges are already worn deep enough to mouthe at grade in the main valley. We noted secondly that, in the outer belt of weaker strata, all the

features are farther advanced in erosional development, and that at the same time the depth of erosion decreases down-stream. The main valley of the first cycle was here widely opened; the main valley of the second cycle, originally a narrow, incised meandering valley, has now reached the stage of nearly consumed, blunted spurs, so that in this stretch the Lamone wanders freely on a flood plain of greater breadth than that of its meander belt. The valley sides of the lateral streams are here in large part already regraded with respect to the new depth that the valleys have gained; but in consequence of the faint northeastward dip of the weak clays, the higher part of the lateral valley sides are often incompletely graded on the northeastern or outcrop slope, and there exhibit a minute, bad-land dissection; while the southwestern or basset slope of the valley sides is smoothly sloping. As the hills decrease in height towards the plain of the Po, the height of the terrace remnants of the earlier valley floor over the newer valley also decreases; and the hills and the terraces vanish together at the border of the fluviatile plain. All this permits one to make a somewhat more definite statement regarding the uplift by which the first cycle of erosion was interrupted and the second introduced; namely, that the uplift seems to have been greater toward the mountains in the background than toward the plain in the foreground; hence, that it apparently involved a gentle northeastward tilting, such as had been inferred near Ancona. But let it be added at once that the geographer's interest in these inferences as to past uplifts of the Apennines does not spring from any concern on his part as to past events as such, but goes only so far as past events may aid him in the appreciative observation and the effective description of existing land forms.

A railroad and a main highway follow the western terrace remnant of the earlier valley floor; hence they have to cross the newly incised side-valleys on embankments and bridges. I believe a few small villages lie on the broad floor of the newer valley in the outer belt of weak clays; but in the inner belt of stronger structures, all the villages are on the terrace; the newer valley being too narrow for occupation. On the western terrace near the junction of the two belts lies the village of Brisighella; it was by the chapel just above this village that we spent our morning hours, sketching and writing; and I can strongly recommend this spot as the goal of a physiographic pilgrimage for all who choose to follow.

Thus I might go on describing the smooth-floored basin of Florence, in contrast to the maturely dissected basin of the Val d'Arno; the young lowland and its simple shoreline of elevation and progradation north of Leghorn, in contrast to the complicated mountainous shoreline of the Riviera Levante, with its interesting features due to slight and recent uplift towards Genoa, and corresponding depression towards Spezia; an account of this delightful district was presented to the research department of the Royal Geographical Society in March, 1909; it has since then been published in a paper on "The Systematic Description of Land Forms."<sup>3</sup> Much might be said of the maturely established elbow of capture of the Tanaro at Bra; of the superb exhibitions of glacial erosion in the overdeepened troughs of the Alpine valleys, whose terminal basins hold Lakes Como and Maggiore, and of the remarkable pair of glacial distributaries by which the irregular intermediate basin of Lake Lugano was excavated; and so on. It was

<sup>3</sup> *Geographical Journal*, September, 1909, 300-318.

much to our regret that while the excursion was in the district of the sub-Alpine lakes, where the party had reached nearly a dozen, no member could from conviction present the arguments of the anti-glacial erosionists. We did the best we could in their absence, but found it impossible to explain the over-steepened trough walls and the numerous hanging lateral valleys of most typical development without accepting a strong measure for glacial erosion. After crossing into France, two professors from the universities of Grenoble and Fribourg presented their views against wholesale glacial erosion during a visit to the strongly glaciated valley of the Romanche; but it seemed to most of us that their discussion was incomplete and unconvincing.

What with the variety of landscape that we studied and with the variety of training represented in our cosmopolitan party, it will, I think, be agreed that our discussions as to methods of describing land forms must have been profitably extended by the time the excursion closed in the volcanic district of central France. Without giving further account of our results, let me next present certain underlying principles, which appear to be of much importance in this connection.

#### DESCRIPTION IN TERMS OF TYPE FORMS

Whenever an observer attempts to tell what he has seen, so that a landscape or a region may be conceived by his readers, he must describe the observed forms in terms of certain similar forms previously known to him, and hopefully known also to those for whom he writes. It must always be in terms of something previously known that a verbal description is phrased. Hence the most accurate verbal description will be made by that observer who is equipped with the largest variety of previously

known type forms. It is important to consider how a young geographer is to obtain such an equipment. The ideally perfect method would be for him to travel about the world and see with his own eyes a great variety of actual forms, from which he might gradually develop a complete series of type forms. Then all other forms could afterwards be described in terms of these types. But this method is manifestly impossible to general application. Some equipment of types may be secured by observation of actual forms; and this beginning may be significantly enlarged by the study of descriptions, pictures, models and maps of actual forms, as prepared by other observers.

The geographer who follows the empirical method stops here. The geographer who follows the explanatory method goes much farther. He extends and systematizes the equipment, thus far gained, by deducing many related forms; and thus fills his mind with a series of more or less ideal forms. It will then be chiefly in terms of the ideal types, largely developed by deduction, familiarized by diagrams, and confirmed or corrected by experience, that his explanatory descriptions of actual landscapes will be phrased. But whether the geographer follow the empirical or the rational method, it will be only in proportion to the completeness with which his series of ideal forms provides him with counterparts of actual forms, that his descriptions of actual landscapes can be true to nature. Only in proportion to the compactness of the terminology in which the ideal forms are verbally expressed, can the observer's descriptions be tersely stated. Only in proportion to the correspondence existing between the ideal forms as conceived and named by the observer and by his reader, will the reader be able to apprehend the observer's meaning.

Imagine, for a moment, that the observer had no mental conception corresponding to what is commonly understood by the word, hill. He would then have to fall back on geometrical terms, such as apex, slope, base, and so on, in order to give an account of a hill when he sees one; and his account would involve awkwardly long paraphrases. Or imagine that when the observer writes down the term, hill, the reader conceives the form that we usually mean by the term, hollow. The reader might mentally conceive a very definite landscape; but it would have little relation to the landscape that the observer had seen.

#### CONTRASTS OF EMPIRICAL AND EXPLANATORY METHODS

Let me contrast somewhat further the empirical and the rational use of type forms. In so far as ideal forms of types, with their corresponding terms, are learned partly from direct observation, partly from books and maps and pictures, they may be treated either empirically or rationally. If treated empirically, each type form, however learned by the student, must have been derived from some one's observational experience, without explanatory interpretation. If treated in the explanatory fashion, all the members of the series that are based on induction should be rationally or genetically accounted for as far as possible; while many other members, developed by deduction, will be perfectly understood, even though they are purely imaginary. Under the empirical method, diagrams are unsafe if they depart from the forms of nature, for their departures can hardly be reasonable under a method from which reason is excluded. In support of this strong statement, one need only turn to those fanciful not to say fantastic landscapes, which have

so often defaced the pages of empirical text-books, and which bring together in the most absurd manner all sorts of incongruous land forms. Under the rational method, diagrams and especially block-diagrams, of which more will be said below, are of immense service; they present the graphic equivalent of deduced forms, whereby another person than the deducer may easily apprehend the intended meaning; and they serve at the same time as graphic definitions of a systematic terminology.

Furthermore, each member of the empirical series has to be learned without consideration of its origin and without explanation of its relation to other forms. Hence to the geographer who employs the empirical series, the corresponding actual forms in a landscape will seem to stand in purely arbitrary association with one another; the occurrence of one element of form can not be logically taken to indicate the associated occurrence of another element; the use of empirical types in the description of actual landscapes or regions requires that every part must be described for itself. On the other hand, all the types in an explanatory series, and particularly the deduced types, are learned in view of their origin by the action of some reasonable process on some specified structure through some limited period of time; and hence type-forms of this kind are necessarily considered in relation to their natural associates. The association may be regional, as in the case of the different parts of an ideal landscape produced by the imaginary action of process on structure to a given stage of development; or the association may be sequential, as in the case of a single element of form followed in imagination along its successive stages of erosional change, from the initial, through the sequential to the ultimate.



As a further contrast, all the many members of an extended empirical series of ideal types must be learned arbitrarily and separately, for no mnemonic aid from explanation attaches to any of them. All the members of an extended explanatory series may be divided into groups, so that the groups themselves shall have certain highly suggestive general relationships, and so that the members of each group shall be treated as systematically interdependent and easily remembered. The development of the explanatory series is immensely aided by the mental process of deduction, which may be carried on by a trained student anywhere and at any time at his convenience; but deduction has no significant place in the preparation of the empirical series, each member of which must originally be learned by some observer, traveling about in the actual world.

Having now pointed out the strong contrasts between these two kinds of type forms, in terms of which the descriptions of natural landscapes and regions must be made, let me hasten to state that no one to-day uses either kind in its purity. The most conservative empiricist will introduce some explanatory types and terms in connection with forms of which the origin is manifest, such as sand dunes, deltas, volcanoes and sea cliffs; while the most determined rationalist will not infrequently find certain actual features which he can not explain, and for which he can therefore establish no corresponding explanatory types. The difference between the empiricist and the rationalist is therefore not so much in their practise as in their intention. The empiricist introduces explanatory terms as it were by accident; he makes no conscious effort to substitute explanatory types for empirical types, and he has no definite intention of introducing

explanation as the most effective means of description. The rationalist, on the other hand, consciously and intentionally strives to find out the origin of every form that he observes, and then tries to describe every observed form systematically in terms of deductively developed type forms. The conservative empiricist condemns the rash rationalist as using a dangerous method, in that it must often be unsafe to describe what one sees in terms of what one does not and can not see; and in that it is unwisely venturesome to introduce theoretical considerations, which are in many cases necessarily more or less doubtful, instead of holding to direct observation which is essentially safe. The sanguine rationalist criticizes the hesitating empiricist as using a blind method, in that it is short-sighted to describe only those things which can be seen with the outer eyes, and unreasonable to omit all those illuminating explanatory considerations, theoretical though they be, by which so much light is thrown on empirical facts, and by which the way is indicated to many facts which the empiricist overlooks.

My own preference for the explanatory method is so strong that the preceding paragraphs have probably done some injustice to the empirical method. Be this as it may, it seems to me a plain duty to use to the utmost every explanatory relation that we can discover, in so far as it aids us in describing existing landscapes. If the explanation seems assured, it may be used without qualification; if it appears somewhat venturesome, explicit notice may be given of its insecurity by introducing warning words; for example, "as if." The extraordinary advances made in the understanding of the evolution of land forms in the last half century, particularly those advances made by the government geological surveyors in the arid southwest-

ern part of the country, can not be neglected by the geographers of this new century. The only matter that is questionable is the manner in which the advances shall be practically applied in geographical investigation.

#### GEOLOGY, AS SUCH, TO BE AVOIDED IN GEOGRAPHICAL DESCRIPTIONS

The influence of geology upon geography has indeed been so great that it has come to be a common practise to introduce some statement of geological history, as if in explanation of the origin of land forms, so as to aid in their description; but if geological history is introduced in a more or less haphazard way, it often goes too far in taking the attention away from the geographical present and holding it too long on the irrelevant past; and it often does not go far enough in the way of emphasizing the origin of visible forms. The accidental geological explanation is moreover especially deficient in not developing a carefully extended series of deductive types, in terms of which existing forms may be presented. In some way or other such a series of types certainly ought to be developed and carried in the mind as an indispensable equipment for outdoor observation and description. The way that has been most convenient, effective and helpful in my experience is the one embodied in the method to which I have given the name "structure, process and stage," and of which some illustration has been afforded by the examples presented above from my Italian excursion.

#### THE SCALE OF VERBAL DESCRIPTION

There are certain supplementary considerations regarding the description of land forms to which brief attention may be given. The first concerns what may be called the scale of verbal description, and

corresponds to what we familiarly understand by the scale of a map. The well-trained cartographer has had conscious practise in reducing large-scale maps to small scale, and knows that in so doing he must intelligently and critically select the major features for retention and the minor features for omission; he knows also that a really good small-scale map can be made only by reducing it from a well-prepared map of larger scale. What I wish to point out here is that the principle of large and small scales may be applied not only to maps, but to verbal descriptions as well. The kind of maps here considered are not those sketch maps of hasty route surveys, in which large spaces are necessarily left blanks; these would correspond to the verbal reports of hurried excursions in which the writer is well aware that his records are deficient in many respects. It is here a question of more thorough work; that is, of maps for which all necessary surveys have been made, and of descriptions for which all necessary studies have been completed. Then, just as a cartographer must intelligently select certain features to be retained in reducing a large-scale map to a smaller scale, so a geographer, who has already gained sufficient information about a district to complete an elaborate or large-scale description of it, must critically select the major features for retention and the minor features for omission, in compressing his account to the space of small-scale presentation.

In view of this principle, the geographer who wishes to make a well-considered, brief statement concerning a district or region must first learn a good deal more about it than can be contained in a little space. He must then intelligently and critically select the major features for retention and the minor features for omission. He must

furthermore carefully study the capacity and the limitations of verbal description, and thus come to perceive that his task in setting forth the features of a district in words is altogether different from that of the cartographer in setting forth the facts graphically. Cartographic representation permits, and indeed requires, the indication of every element of form that is reached by its scale, and gives to each element a definite location and dimension. Hence the cartographic representation of geographical features is very definite. The eye, when first looking over a map, glances from part to part, and apprehends chiefly those elements which by repeated occurrence give character to the district, and those which by reason of exceptional peculiarities stand forth from the others; afterwards, special parts of the map may be more closely examined. On the other hand, verbal description can hardly be understood unless the reader follows the order of presentation chosen by the writer. The description will be fatiguing if it attempts to state the location and size of every element of form; it is therefore best employed to state the generalized characteristics which the eye would perceive in looking over a map, thus giving first emphasis to prevailing features, and only secondary emphasis to less important special features. After the leading facts are thus presented, more elaborate description may well follow, with due attention to what may be called "local color."

Inasmuch as verbal presentation is necessarily linear, one item following another, emphasis is automatically given to those items which come first; subordinate rank is indicated for such items as are assigned a later place; but on a map there is no beginning or end; the whole surface is presented simultaneously, and the student may first take up any part he pleases. If any

one wishes to learn minute details as to the length or direction of certain small streams, the location and altitude of hills, and so on, he can best find them on a map; but if he wants a well-phrased characterization of a district, he will be best helped by a verbal description, on a scale appropriate to the occasion. Hence the importance of giving conscious practise to the preparation of verbal descriptions of a given district or region on different scales; one might be ten lines long; another might fill a page; a third, a chapter; a fourth, a volume. A geographer who proposes to make himself proficient in his science ought to practise himself as thoroughly in writing descriptions on different verbal scales as in drawing maps on different graphic scales.

#### THE STYLE OF VERBAL DESCRIPTION

Maps differ in style as well as in scale. A wall map on a given scale is coarse-textured, so that certain leading features may be seen across a room. A map of the same region, and on the same scale, divided into sheets and bound in an atlas for library use, is crowded with minute details of fine texture. Verbal descriptions also may vary in style as well as in scale. For example: the first account of the dissected coastal plain on the Adriatic border of Italy may be regarded as of medium scale and of technical style; the several following paragraphs, in which the same ideas are presented in more general language, is on larger scale, so far as space is concerned, but as it is of popular rather than of technical style, it really adds no new facts, nothing but ease of apprehension to the smaller scale description; hence it may be compared to a wall map, in being offered to ready understanding. On the other hand, if the increased space had been given to a continuation of the technical descrip-

tion for the purpose of bringing in many details, the larger scale of description might then be compared to a larger scale of a map for library use, in which many small features are indicated. Hence style as well as scale requires consideration; and in acquiring the art of geographical description, conscious experiment and practise should be given to various styles as well as to various scales.

From all this it must appear clearly enough that the preparation of an effective verbal description, after all necessary field studies have been made, will require the careful consideration of several different points. The style to be adopted should be first determined according to whether the description shall be technical, for trained geographers; or popular, for intelligent, mature, non-technical readers; elementary, for young beginners. Second, consideration must be given to the scale or space permissible, according to the opportunity for publication and to the relation which the description bears to the rest of the volume in which it may be only a part. In view of the style and the scale as thus determined, the critical selection of certain items to be included and of others to be excluded may come next; and with this should go the careful determination of the order in which the included items shall be presented. It has already been shown that various items concerning location, dimension, attitude and direction of subordinate features had best be omitted from verbal descriptions, because they have their better place on a map; if included even in a large-scale verbal description of technical style, they will make it unreadable. It is chiefly the generalized treatment of dominant or of recurrent elements that deserve verbal statement, with subordinate place for the more significant exceptional features.

#### THE ORDER OF PRESENTATION

As to order of presentation, a whole essay might be written. I shall here emphasize only certain leading principles. The first is, to present the main idea in the first sentence; to give at once, at the very outset, a general block-statement for the district concerned. The reader will then most promptly apprehend its general nature, most easily follow the explanatory paragraphs as they are expanded, and most readily appreciate subordinate features, item by item, as they are introduced in orderly advance. The case is utterly different from that of a novel or a play, in which it is appropriate enough to conceal the plot till the end is approached; here the reader or listener enjoys being kept in the dark while the story is developed. But in a scientific essay, the reader ought, contrary to common practise, to be made aware of the end at the beginning, particularly if the explanatory method of description is employed; so that as the description advances, the leading explanatory ideas as stated in the first paragraph may be constantly confronted with the evidence that bears upon them, and so that the smaller features may be immediately placed in their proper position with respect to the general scheme. Narrative descriptions, in which items are presented in the order of encounter in the field, may be appropriate as a means of recording the work of hasty reconnoissances, but when the narrative method is employed in the presentation of more careful studies, the most that can be said of it is that, as far as scientific geography is concerned, it is a very easily acquired and unambitious method.

It has already been pointed out that the location of natural features should not be indicated by means of their relation to small artificial features, such as little villages, which must be unknown to most

readers; but, on the contrary, that small artificial features, such as little villages, ought to be located in relation to the previously described natural features, to which they stand in some reasonable relation. This principle should surely be carried out by those who believe that the location of artificial features exhibits some response to physiographic environment. Likewise, an individual hill or stream should not be first indicated by its name, which is the least natural thing about it, and which is unknown to the reader and therefore of no assistance to him in his reading. Such features should be introduced in general terms, by first describing the whole group of features to which they belong, and then singling out such members of the group for location and name as may be desired.

It is of prime importance to the writer to test his own description as he prepares it; to determine whether his manner of announcing the most general features is thoroughly effective; whether the order in which he introduces secondary and tertiary items is the most appropriate. Practise added to close scrutiny can alone develop proficiency. On the other hand, when a carefully prepared description reaches the reader, he must exercise a considerable degree of attention and skill, in order to apprehend the full significance of the writer's terse phrases; and he must use a skilful imagination in the process of visualizing the forms, large and small, as they are introduced by the writer. Here again, nothing but practise can produce proficiency; and all this suggests that the training of a would-be geographer ought to include conscious, well-planned exercises in all these processes of observing, generalizing, writing, reading and visualizing, just as surely as it should include exercises in surveying and map-drawing.

#### GRAPHIC AIDS IN GEOGRAPHICAL DESCRIPTION

The best geographical descriptions fall short of satisfying the reader if they are purely verbal; they ought to be supplemented by graphic devices wherever possible. A small scale map may be introduced to great advantage on an early page, in order to exhibit general locations; hence, well known as Italy may be, the places above mentioned in connection with my Italian excursion are probably identified more easily and more promptly than they would be otherwise, by means of the outline map, Fig. 1, prepared in an hour, here reduced to small scale, on which our route may be followed and on which the Ancona district and the valley of the Lamone above Faenza may be quickly found. A larger-scale map may, if available, be appropriately provided to accompany more detailed descriptions; a good purpose is served in this respect by the elaborate sheets of the Italian topographical map, 1:100,000, already mentioned, which clearly exhibit the mature dissection and the even truncation of the coastal plain, south of Ancona, and the strand plain by which the former sea cliffs are now separated from the shore line. Photographs and sketches serve to illuminate the text; but in recent years photographs have been rather recklessly used, particularly when they are printed in a very blurred condition on rough paper. Sketches are in many cases more serviceable, even though less accurate, than photographs, because they show what the observer wishes them to show. As a subordinate matter, let me add in this connection certain details that are often overlooked, if one may judge by many illustrations in scientific journals. First, the size of the page on which a figure is to be printed ought to be learned before the figure is drawn. Decision should then be made as to whether the figure shall occupy the

whole breadth of the page or only half-breadth; and to do this it is worth while to sketch the figure roughly on the scale that it will have in the text. When this is settled, the figure should be redrawn on double scale with really black ink in smooth firm lines, so that it may be effectively reduced in making a black and white "process" cut. If any lettering is included, let it be plain and unshaded. The number and title of the figure ought not to be drawn on it or below it; both can be set up in type, when the figure is printed in its proper place in the text, thus saving in time and gaining in appearance. These are trifles: but trifles ought to be properly attended to, and not neglected.

In addition to the various cartographic and pictorial aids thus far mentioned, let me call special attention to the device known as block diagrams, or bird's-eye views, such as Figs. 2 and 3, which may be designed so as to form useful supplements to descriptions that open with condensed block statements. Both tell the plot of the whole story at the beginning, and thus allow the reader to place all details where they belong, when they are met in later paragraphs. Just as block diagrams aid in giving graphic illustration to the members of series of deduced type forms, as has already been mentioned, so they aid in the understanding, the description of actual regions, because they serve so immediately to present the generalized type forms with which the observer compares the actual forms. When seen cornerwise, block diagrams have the advantage of presenting two structural sections, if desired, in immediate association with the surface forms that have been carved on the structural mass. When drawn in groups, they have the further advantage of compressing into a single view the several successive stages of development, which are

verbally presented or implied in the statement of the text.

Diagrams of this kind are not and are not meant to be mere pictures of observed landscapes, for they must always be simplified by the judicious omission of much unessential detail, and greatly compressed by the omission of many repetitions of similar elements. They may indeed be rather fanciful, in being designs rather than copies of nature, as is the case with Figs. 2 and 3, above. They should be simply drawn so as not to demand too much time in preparation, yet they may still be vivid and effective in aiding the reader to grasp the meaning of the writer.

No one may be more conscious of the defects of diagrams than the one who has drawn them. In the imaginary view of the dissected coastal plain south of Ancona, here given in Fig. 2, the hill shading is very rough; all the slopes are drawn convex, and hence fail to show the graceful concave lower sweep down to the valley floors. The terraces in the main valleys and the narrow belt of oldland included in the background are too definite and distinct. The absence of all indications of forests and fields, of villages and roads, gives an impression of barrenness and vacancy that does no justice to the pleasing reality. Moreover, the dissected hills and the broad valleys of two consequent streams extended from the oldland do not correspond to any particular hills and valleys of the district concerned; they merely show the observer's generalized idea of the kinds of hills and valleys that characterize the district. Nevertheless, the drawing has a value in immediately presenting the essential features of a late maturely dissected plain, in which the streams and valleys are prevailing consequent, with some insequent branches; in which the hill sides are all reduced to gently graded slopes;

and in which the spurs in the foreground are all evenly truncated by the former sea cliff, in front of which the strand plain is now prograded.

Similarly, the invented sketch given in Fig. 3 shows only the kinds of features that were noted in the valley of the Lamone, and not the actual features themselves. The maturely dissected hills developed on the more resistant structures occupy the middle and left of the view; the incised meandering valley of the second cycle, is maturely opened beneath the floor of the broader, late mature valley of the first cycle; the sharp-cut side gorge through the hills of harder structure in the left-center contrasts with the wider side valley on the right, where the weaker clays of the dissected coastal plain replace the more resistant strata of the Apennine foothills; and in immediate association therewith is seen the broadened floor of the main stream after it passes from the more resistant into the less resistant structures. The diagram would surely be much more faithful, if it had been drawn from a hilltop on the near side of the valley instead of from the imagination of what such a hilltop view would be. Many of the lines would be smoother and steadier, if they had been drawn by a professional draftsman; but diagrams prepared by some one else than the observer are hardly more satisfactory than lectures prepared by an expert typewriter instead of by the lecturer himself.

Block diagrams are more immediately understood than maps are; they are vastly superior to mere profiles, which of all graphic devices are of least value to the geographer; for he is concerned with surfaces, not with lines; yet if profiles are wanted, they are found along the side of block diagrams, in their proper position with respect to the adjoining surface. For the purpose here indicated—that of giving

an immediate introduction to the whole story—block diagrams are as much more serviceable than photographs, as photographs are more serviceable than block diagrams when it comes, later, to the presentation of details. One of the chief values of block diagrams remains to be mentioned; they can be drawn from any desired point of view, as in the case of Figs. 2 and 3, so as to show the features represented in the best possible relation to each other. Some ingenuity in the way of inventing and designing is here called for; and it is well expended if the final diagram is thereby drawn in the most effective manner.

An objection that is often raised against the use of block diagrams—that their preparation demands a knowledge of drawing—ought to have small weight among practical geographers, especially among the younger ones. To object to an effective kind of diagrams because their preparation demands a moderate skill in drawing, is like objecting to horseback riding during a geographical excursion in the West because it involves a little skill in the saddle; or to the use of original photographs as illustrations, because their preparation requires a little acquaintance with cameras and films; or to the consultation of European journals, because this calls for a moderate knowledge of foreign languages; or to map-making, because it depends on an elementary understanding of cartography; or to preparing a written report, because it involves a knowledge of composition. There must, of course, always be a great difference in the proficiency that different geographers will reach in these several associated arts; but any one who is in earnest in his work may soon acquire a profitable reading knowledge of a foreign language or two, or a sufficient comfort in horseback travel, or a simple proficiency in

photography, or a reasonable expertness in writing reports on various scales and in various styles, and also a helpful handiness in drawing diagrams. The only serious point here to be settled by a practical geographer is: are diagrams, foreign languages, photography, and riding, and so on, really helpful in the kind of work that he proposes to undertake; if they are, then he will as a matter of course set about acquiring some degree of skill in each and all of them.

#### OBJECTIONS TO THE METHOD OF STRUCTURE, PROCESS AND STAGE

Allow me briefly to consider some of the objections that have been urged against the method of structure, process and stage in the description of land forms. A German geographer has regarded that part of the method which involves the scheme of the cycle of erosion as too rigid, and has likened its use in the description of natural landscapes to the cramping of nature in a strait-jacket. Such a criticism only indicates the complete failure of the critic to apprehend the method; for it is essentially elastic and adaptable; much more so, I believe, than any other method of description that has been formulated.

Some other critics have regarded the method as too geological, because it requires the consideration of underground structures and of past processes. This it certainly does require; nevertheless, it introduces underground structures only so far as they aid in the appreciation of visible surface forms; and it introduces past processes only in so far as they aid in the explanatory description of actual surface features. In this respect, it is interesting to note that, judging by my experience in Germany a year ago (1908-09), the method of structure, process and stage is much less geological than the method of geographical

description commonly employed by the younger geographers at the University of Berlin; for they habitually present past geological conditions and processes as such, and treat them as characteristic parts of geographical reports, even though the events thus brought in from the past bear in no direct or helpful way on the features of the present. Many interesting discussions were held on this point, always with the object of trying to emphasize the existing visible landscape as the object of a geographer's work, and hence with the wish to exclude every geological item, however interesting in itself, if it had no helpful bearing on the observable facts of to-day. For example, I questioned the value of the geological term, Triassic, in the account of a certain district in Hesse; my contention being that all a geographer's needs were satisfied when the composition, structure, thickness and attitude of the formation concerned were stated, without regard to its date; but German geographers seemed to be in favor of including the names of geological formations in geographical descriptions. The geologist of course wishes to know the date of origin, as well as the present structure and attitude of the formations that make up a district; but the geographer has little or no need of such historical information, although it is extremely important for him to know to what stage of erosion the district concerned has advanced in one or in several successive partial cycles. However, this is a subordinate matter.

An English geographer has expressed some doubt as to whether the method of structure, process and stage, which he recognizes to be of value for the description of small districts, will prove serviceable for the description of large regions. My own opinion on this point is that its value for large regions can only be deter-



mined by experiment, which I should like very much to see tried. In any case, we can gain no comprehension of large regions save by gathering and by generalizing observations of small visible landscapes. It is fair to expect that the better our understanding of detailed morphology, the better we can summarize general features. My own experience in describing the larger subdivisions of the United States and of Europe would encourage me to say that the explanatory method can be well used for the treatment of such areas; but I have made few systematic experiments with any other method of description.

Another geographer has expressed his fear that an explanatory method of description for land forms will prove dangerous in the hands of untrained students, and that young disciples may apply it in a way that will cause anxiety at first and horror afterwards. Horror is rather a strong word to use in this connection; but I can instance several examples that have caused me some anxiety, and others which have, I am sorry to admit, shocked me, to say the least. There is the case, for example, of a geographer who, inasmuch as he submitted an article to me for criticism, and accepted the criticisms that I made, may perhaps be regarded as a disciple to that extent; but surely he caused me some anxiety by stating in essence that "granitic districts are of rugged form." His evident error here was the failure to consider the erosional process and the time element, or stage of erosional development, in his partly explanatory treatment; for resistant as granite is, rugged as its forms may be in a youthful stage of normal erosion, and sharp as they may be in a mature stage of glacial erosion, granite must have subdued and rounded forms in late maturity; and like every other kind of rock, even the hardest granite must be worn

down to low relief of very tame expression in old age, as abundant examples testify.

In another case a geographer who explicitly declared himself to be my disciple shocked me by the additional declaration that the scheme of the cycle of erosion, which is essentially involved in the method of structure, process and stage, must be inapplicable to districts in which frequent movements have taken place, because forsooth he thought that the scheme of the cycle could be used only where complete cycles ran their course! In both these cases and in various others of a similar kind, criticism ought not to be directed against the explanatory method of description, but against its wrong use. It is proverbial that "a little learning is a dangerous thing"; the proper guard against such danger is better found by decreasing the careless use of an explanatory method than by discouraging its careful development.

And finally, to close these comments with one that suggests a most peculiar attitude on the part of the critic, it has been objected that the method of structure, process and stage can not be applied until one knows all about the district that he is describing. In so far as the use of the method may require an observer to make a serious study of a district before he attempts to tell about it, the method is thereby recommended; but as a matter of actual experience, the explanatory method has proved useful even in the most hasty reconnoissance, because it aids so greatly in directing observation to significant points, which might as likely as not escape the attention of a blind empiricist.

The kind of criticism that the method of structure, process and stage really needs is, as has already been intimated, criticism based on the experimental and comparative use of various methods, each method being

first carefully thought out, and then all the methods being thoroughly and impartially applied to one and the same district. Experiment of this kind should of course be made by various observers of different trainings and preferences, and in different localities. Precisely this sort of experimental criticism was attempted during the Italian excursion of 1908, but under conditions, as already pointed out, that predisposed the jurors to a verdict in favor of a particular method. It would be a good thing for geographical progress if a larger experiment of the same kind could be made. I trust that our association may some day actively engage in such an enterprise.

W. M. DAVIS

CAMBRIDGE, MASS.

#### THE GRADUATE SCHOOL OF PRINCETON UNIVERSITY

MR. W. C. PROCTER has renewed his gift of \$500,000 for the Graduate College of Princeton University on the same conditions on which it was originally made, except that in view of the bequest of Mr. Wyman for the graduate school, which it is thought will amount to \$3,000,000, the \$500,000 to be collected to secure Mr. Procter's gift is to be used for the endowment of the preceptorial system in the college. After the meeting of the trustees on June 9, President Wilson gave out the following statement:

By the will of the late Isaac C. Wyman, of the class of 1848, a great bequest has been left to the university in terms which must be acceptable to every friend of Princeton and of the higher learning. Its amount is expected to be sufficient to enable us to form a great graduate faculty and equip graduate teaching upon as liberal a scale as we should desire.

William Cooper Procter, of the class of 1883, has, with admirable generosity, offered \$500,000 to the university for the equipment and endowment of the Graduate College upon terms which will, I feel confident, commend themselves to every member of the board.

Mrs. Russell Sage has completed our great

obligation to her by offering to extend the beautiful building she recently presented to the university and to add to it the great tower which is likely to be the chief architectural ornament of the university.

Mr. Procter makes it a condition of his gift that the buildings of the Graduate College shall be placed upon the golf links. Strongly as my own judgment would dictate a different choice of site, the expectations of immediate large development created by Mr. Wyman's bequest so alter the relative importance of the question of the position of the graduate college of residence that I feel it to be my duty no longer to oppose in that matter what I now know to be the judgment of a majority of colleagues in the board.

The recent discussion of the many questions connected with the development and administration of the graduate school has fortunately called forth from all parties expressions of opinion which show practical unanimity of judgment and purpose upon the questions upon which agreement was most important; inasmuch as it has developed common consent that the life of the Graduate College should be organized upon the simplest and most natural lines possible, and that the college should be of common use and benefit to all members of the graduate school.

I, therefore, very heartily congratulate the board upon a combination of circumstances which gives so bright a promise of a successful and harmonious development of the university along lines which may command our common enthusiasm.

#### SCIENTIFIC NOTES AND NEWS

SIR DAVID GILL, K.C.B., F.R.S., has been appointed a knight of the Prussian Order of Merit.

DR. WILHELM ROUX, professor of anatomy at Halle and eminent for his contributions to embryology, celebrated his sixtieth birthday on June 9, when a *Festschrift* in two volumes was presented to him.

DR. E. A. SCHAEFER, professor of physiology in the University of Edinburgh, has received an honorary doctorate of medicine at the University of Berne, after lecturing at the University on "The Functions of the Pituitary Body."

THE council of the Royal Society of Arts has elected Mr. Theodore Roosevelt a life member of the society under the terms of the