A splendid series of these mounds along the lower Palouse River in the vicinity of Winona would seem, however, to point clearly to their mode of origin. No feature of the Columbia Basalt is more conspicuous than the isolated castle-like towers and crags that persist wherever there has been surface erosion. On the walls of canyons these are especially striking. One scarcely needs more than ocular evidence to know that these persisting crags have remained because formed of harder material. Actual experience in blasting ditches through the top of such a persisting crag demonstrated it to be many times harder than ordinary basalt, and of a somewhat different structure.

In the old bed of the river near Winona the series of mounds shows every gradation from rock caps to mounds of basalt boulders; and from these to ordinary basaltic soil. The conclusion seems unavoidable, therefore, that these mounds are the result of decaying basalt caps, from about which flowing water had previously worn the softer surrounding rock.

The cause of these harder basalt centers may be analogous to that of nodules. Be that as it may, they seem to be quite evenly distributed through the rock, as evidenced not only by their fairly regular occurrence on canyon walls, but especially by the distribution of the mounds in old shallow stream beds.

It was mentioned above that along canyons the mounds were discernible mainly on the north walls. This is due to the prevailing winds of the region being southwesterly, a fact that has led to the deposition of a considerable layer of fine soil on the south walls, and, therefore, the mounds are buried. The occurrence of the mounds only on the crests is doubtless owing to the much greater effect of erosion on the slopes.

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SPECIAL ARTICLES.

LEVELING WITHOUT BASELEVELING.

SINCE the widespread adoption of Powell's views regarding baseleveling, whereby the earlier views regarding marine planation have been so generally displaced, truncated uplands—that is, uplands whose deformed structure is truncated by their surface—have come to be very generally interpreted as uplifted and more or less dissected peneplains. Doubt has been thrown, properly enough, on this interpretation in cases where the dissection of a supposed upland has progressed so far as to transform it into a series of discontinuous and uneven hills; but the interpretation has usually and deservedly had full acceptance in those cases where the dissection of the upland was but little advanced and where the inter-valley upland areas still preserved nearly plain surfaces, whose previous continuity across the valleys could not be reasonably questioned. It is evident, however, that the correctness of this interpretation depends on the impossibility of the production of similarly truncated uplands independent of normal baselevel; and those physiographers who have inferred crustal elevation on the evidence of truncated uplands have doubtless been convinced that this impossibility was demonstrated. True, it has long been understood that the processes of erosion and deposition in desert interior basins might result in leveling above baselevel, the waste from the highlands going to fill up the original depressions; but it does not appear that this process has been regarded as possibly accounting, after a change to a humid or normal climate and without any uplift, for the occurrence of truncated uplands in non-desert regions.

A recent article by Dr. Siegfried Passarge, of Steglitz, Germany, opens new possibilities in this direction. After extended observation on the desert plains of southern Africa, fully described in his book, 'Die Kalahari' (Berlin, 1904), Passarge concludes that these plains are the result of leveling without baseleveling, through the combined action of wind and water erosion; and that such plains, nearly everywhere showing a rock surface independent of structure and interrupted only here and there by residual hills or mountains—which he calls by Bornhardt's term 'Inselberge'—may be produced over large areas at any altitude above baselevel. His article, Rumpfflächen und Inselberg (*Zeitschr. deut. geol. Gesellsch.*, LVI., 1904, Protokol., 193–209), in which this

conclusion is announced, is well worthy of attention from American physiographers.

The principle of leveling without baseleveling, or Passarge's law, as it may be called, in contrast to Powell's law of leveling by baseleveling, suggests that the scheme of the normal cycle of erosion, so generally applicable in regions of ordinary or normal climate, should be systematically modified in such ways as will adapt it to the conditions of an abnormally dry or arid climate. This modification I have lately attempted in an article that will soon be published in the *Journal of Geology;* it is here presented in outline.

An extensive region of any structure uplifted in an arid zone to any altitude and with any form will, in the youthful stage of its cycle of erosion, be characterized by as many independent and incomplete centripetal drainage systems as there are depressed areas or basins within its limits: independent systems, because in an arid climate the basins can not be filled with overflowing lakes; incomplete systems, because many of the intermittent centripetal streams will wither away on the slopes and fail to join forces in trunk streams on the basin floors. The early stage of a normal cycle, where all basins are filled to overflowing and where all streams are continued until they unite in trunk rivers which reach the sea, is characterized by a rapid increase of relief, due to the incision of valleys. The early stage of the arid cycle is, on the other hand, characterized by a decrease of relief, due to the aggradation of the basins with the waste washed down from the enclosing highlands. As youth advances towards maturity, the initially independent basins will become more and more completely confluent, either by headward erosion on the slopes of the lower basins, or by the overflow of waste across depressions in the borders of the higher basins; thus from original independence will be developed a maturely integrated and interdependent system of drainage slopes, although trunk rivers will still be wanting. Maturity may be said to be fully established when large areas are thus brought into systematic correlation. At this stage, there may still be some unreduced uplands, but there will also be increasing piedmont areas of degraded, rock-floored plains, inclined gently towards the greatly enlarged central aggraded basin floor; and the composite plain thus produced will have no definite relation to normal baselevel. In so far as the erosion of arid regions has previously been discussed, it would appear that this stage, here called maturity, has been regarded as the old age of a desert, and that it has been taken to mark the end of the changes to which an interior basin is subject, unless it is attacked by the headward extension of exterior streams and thus dissected and reduced to normal baselevel; but as Passarge clearly shows, the old age is yet to come, and with a systematic sequence and grouping of features essentially unlike those just described. The action of the wind is yet to be considered.

In the earlier stages of the cycle, while the slopes are still varied and strong, transportation and trituration by the wind is probably of small value in proportion to that of the occasional streams and floods. But as the barren surface becomes more and more even, the relative importance of wind action increases; for unlike running water, the wind does not depend on local slopes for its activity; it is about equally strong everywhere on a surface of moderate relief, and has no subdivision into subordinate parts that correspond to small headwater streams, whose slopes must be steeper than that of their trunk river. The wind may sweep sand along a level floor, or even up a moderate slope; and whirlwinds may raise dust high into the air, and there give it to the upper currents; both of these processes may carry desert waste outside of the desert region under consideration, and thus the mean level of the desert may be very slowly reduced. The surface may, indeed, in this way eventually be worn below sealevel, as several writers have suggested; but the form that the surface will exhibit during its slow reduction has not, to my knowledge, been especially considered until in the recent statement of this aspect of the question by Passarge.

It might at first sight appear that when the winds gain the upper hand in the processes of transportation, they would tend to excavate extensive basins wherever the weathering of

the rocks resulted in the production of fine dusty waste; and that, inasmuch as the winds know no baselevel, there would be no definitely assignable limit to the unevenness of the surface thus produced. This might be true in absolutely rainless regions; but such regions are not known. The most desert regions of the world have occasional rainfall, and are from time to time visited by showers heavy enough to cause floods; and the intermittent action of such floods will put an effectual stop to the development of deep basins by wind action. As soon as the winds succeed in sweeping out a shallow depression, that part of the integrated drainage slopes which leads toward the depression will, when rain falls and floods are formed, provide a supply of waste with which the depression will be aggraded. Further deepening of the depression below its surroundings is thus effectually hindered. The wind may then begin the excavation of another depression elsewhere, only again to be defeated by the local inwash of a waste cover. Not an uneven surface of many hills and hollows, but a remarkably even plain must result from the long continuance of these antagonistic processes.

During the development of such a plain, a series of systematically irregular changes will run their course. As the exportation of desert waste by the winds continues, the area of the central aggraded basin floor must diminish, while that of the surrounding degraded rock plains must increase. At the same time, the integrated drainage system of maturity will be more and more completely disintegrated and replaced by many local and variable systems of extremely indefinite separation. Eventually all the central accumulation of waste will have been exported by the winds; the rock-floored plain will have been worn down lower than the bottom of the deepest initial depression, so that it will then extend throughout the region, except for residual mountains of rocks most resistant to dry weathering. Thin veneers of gravelly waste will remain, swept hither and yon by the intermittent fluctuating disintegrated drainage; shallow 'saltpans' may occur from place to place and from time to time; but large areas of rock plains carrying only scattered stony waste, will abound; this is the condition of true old age in such a region. Once attained, it persists, slowly worn lower and lower, possibly sinking below sealevel, until disturbed by crustal movements or climatic change. It is old rock-floored desert plains of this character and apparently of this origin that Passarge describes as occupying thousands of square miles in South Africa.

Two interesting consequences of this scheme should be pointed out.

Every truncated upland that has been described as an uplifted and more or less dissected peneplain should now be reexamined with the object of learning whether it may not have originated as a desert plain at its present altitude above sealevel, and afterwards suffered dissection as a result of climatic change. True, we are to-day more accustomed to movements of the earth crust, in the way of elevations and depressions, than to climatic changes, in the way of transforming arid regions to humid regions and *vice versa;* but perhaps this habit of thought is only a fashion of our time. A century ago, movements of the earth's crust indicated by the discovery of marine fossils on the higher peaks of the Alps were regarded with astonishment, not to say incredulity. A century hence, variations of climate may be accepted as freely as changes of level are now. The way towards such an opinion is opened by the discovery of glacial periods in various geological ages, and it is not hindered so much as it was once by supposed evidence of the correspondence of earlier climatic zones with those of to-day. We should, therefore, open our minds widely to the possibility of explaining truncated uplands as ancient desert plains not changed in elevation, but only in climate; and this possibility should not be set aside because it seems improbable, but only because it may be shown on good and sufficient grounds to be inappropriate to the case under consideration. It may be added that, as far as I have undertaken a revision of the origin of truncated uplands, as is suggested above, nearly all the familiar cases seem to possess characteristics that accord with their origin as uplifted peneplains and not as desert plains; and that there

is therefore less ground for change of generally accepted opinions than the suggestion of the need of revision might for the moment indicate.

The second consideration concerns the processes of combined induction and deduction by which the complete or logical method of scientific investigation is constituted. In view of the possible change of interpretation now open for truncated uplands according to Passarge's law, it might be said by one who prefers to work on more purely inductive lines: "Behold, here is another case in which deduction has led the investigator astray! He thought that he could deduce the sole conditions under which truncated uplands could be formed, and that these conditions necessitated uplift after degradation; now he finds a new series of conditions under which such uplands may be formed and all his previous conclusions are uncertain. Let us, therefore, beware of deductive or imaginative methods, and hold fast to the safer methods of observation and induction." In reply to such a warning, one might say—besides pointing out that all problems which deal with unseen processes necessarily involve deduction and that the deductive side of the work should be conscious and systematic —that the fault in the method by which truncated uplands have heretofore been discussed lies not in the too free use of deductive methods, but in their too limited use. The mistake lies in our not having years ago set forth, by purely deductive methods, just such an analysis of the geographical cycle in an arid climate as has now been provoked by the discovery of rock-floored desert plains. Such an analysis does not involve any new or difficult problems; it might have been successfully attempted long ago; the difficulty that stood in the way lay not in the problem itself, but rather in the habit among physical geographers of trusting too largely to observational methods and of neglecting the aid that deductive methods furnish. The lesson of the problem is, therefore, that deduction should be pushed forward more energetically and systematically than ever; always checking its results as far as possible by confronting them with the appropriate facts of observation, but never halting in the reasonable extension of deductive conclusions because the corresponding facts of observation have not been detected; never lessening the activity with which exploration and observation are pursued, but always using the spur of deduction along the paths suggested by 'multiple working hypotheses.' The problem of the erosion of mountain valleys of Alpine glaciers teaches the same lesson: if physiographers had, thirty years ago, been well practised in deductive methods, they might have easily extended Playfair's law regarding the accordant junction of branch and trunk streams from the case of stream surfaces to the contrasted case of stream beds, and from the case of water streams to the analogous case of ice streams; thus they might have predicted that, if Alpine glaciers were effective eroding agents, glaciated mountain valleys ought to show discordant or hanging side valleys; and in going to the mountains they would have found the prediction correct, and the basis of the prediction—that glaciers are effective eroding agents—would have thus been verified. So with the geographical cycle in an arid climate: there is nothing difficult in the series of deductions that lead to the expectation of rock-floored desert plains, independent of baselevel, as the product of arid erosion; the only obstacle to the development of these deductions has been the habit of not making them. This is a habit that should be broken.

W. M. Davis.

NOMENCLATORIAL TYPE SPECIMENS OF PLANT SPECIES.

The recent 'Code of Botanical Nomenclature' now usually known as the Philadelphia Code, states as the fourth fundamental principle, 'The application of a name is determined by reference to its nomenclatorial type.' This means that a specific (or subspecific) name stands or falls according to the disposition of the type specimen. It is not proposed here to discuss the advantages or disadvantages of this method of determining the application of names, although to the writer this method seems much more likely to secure 'stability, uniformity and convenience in the