off the crop in a shorter time, when the grinding may be continued until 8 or 9 P.M.

On many plantations with a small mill and large crop work might advantageously be carried on day and night, as mature cane generally begins to deteriorate standing in the field after July.

Of the five mills in this district bagasse furnishes the only fuel, and often one-fourth, at least, is not consumed; but the question of bagasse burning deserves separate consideration, so I will not deal with it here.

These remarks on sugar making are intended to apply only to the sugar houses on this island (Hawaii). Where irrigation is practicable, the quality of the juice is, I think, generally of poorer quality than here, where we depend on the rainfall entirely.

EDMUND C. SHOREY,
Chemist Kohala Sugar Co.

Kohala, Hawaii, September, 1893.

"AMEN" MUMMY COFFINS IN THE BRITISH MUSEUM.

THE Khedive has presented the British Museum with four mummy coffins of great interest. Egypt has given us many surprises, but none more striking than the discoveries made in 1887 and 1891. In the former year the royal mummies, including those of Thothmes III., the conqueror of Asia, and Rameses II., were discovered. In 1891 the still more wonderful find was made of the mummies of the priests and priestesses of the order of Amen. Scholars at once associated these two results of research with each other. The mummies were found in vast excavated hiding-places, showing that there must have been a reason for the concealment. Round these coffins one of the most remarkable chapters of the religious and secular history of the world centers, the order of Amen having been probably the most powerful and perfectly organized ancient sacerdotal order. The discovery of 1891 was made by M. Grebaut in the immediate neighborhood of Deir-el-Bahari, where he found a well giving access to an immense tomb, in which were 163 coffins of members of the confraternity of Amen. There were also a number of *ushabti* figures and statues of Isis and Nephtys, the latter being hollow and containing papyrus rolls. All these objects were removed to the museum at Ghizeh, where the larger portion are now on exhibition. But the Khedive and the museum authorities decided to present the surplus coffins to the European powers which had shown such great interest in Egyptian exploration. Accordingly a few months ago a raffle was held at Ghizeh, and four of the coffins and some other objects fell to the lot of the British Museum. The coffin of a priestess in the museum is that of Tenthsanf, and is very large and "double," presenting a fine specimen of Egyptian work, probably of the twenty-second dynasty. The paintings which decorate it are taken chiefly from the "Book of the Dead." Another coffin is that of a priest whose name is unknown, but who seems to have been an incense burner in the temple. Like that of the priestess, it is richly decorated. The coffin is probably of the time of the twenty-first or twenty-second dynasty. Along with the objects presented to the museum are a pair of sepulchral boxes belonging to a priestess Huit. These probably contained toilet and other necessities for the deceased, and are adorned with mythological scenes. These coffins and objects are a most valuable contribution to the collection of the British Museum; it would, indeed, be matter of regret if this collection did not contain some specimens of the work of this great order of Amen.

MICROSCOPICAL NOTES.

Carminum.—This is the name given to the most recent carmine stain for histological purposes. It has been devised by Dr. Paul Mayer, and is very easily prepared. One gramme of carminic acid is placed in a suitable vessel, together with ten grammes of ammonia alum and 200 c. c. of distilled water. The mixture is then heated nearly to boiling point, until solution is effected, and, after cooling, carefully decanted or filtered, when it is ready for use. The addition of a small crystal of thymol keeps the solution free from organic growths. It is a dark red liquid of great staining power and, like picocarmine, will stain objects satisfactorily that have been fixed in osmic acid. It is said to tinge the protoplasm slightly as well as the nucleus (*Nat. Science*, iii., 113).

Aniline Stains.—A general recipe for these stains, recommended by Hermann and said to serve equally well for safranin, gentian violet, eosine, fuchsine, fuchsine S, dahlia, and orange G, is as follows: Staining substance (dry), 1 gramme; absolute alcohol, 10 c. c.; aniline water, 90 c. c. As thus prepared anilines are said to stain very intensely and sharply. Washing out should be done in absolute alcohol, though with safranin acid alcohol may be used. The solutions require to be used fresh, as they do not keep very long (*Nat. Science*, iii., 121).

Staining Connective Tissue.—Pharmacists who are called upon by medical practitioners and others to prepare animal tissues for microscopic examination may find Beneke's process for staining connective tissue a useful one. It is a modification of Weigert's method for staining fibrin, and by means of it Beneke claims that the connective tissues of the most diverse organs can be consistently stained. Portions of tissue that has been fixed in alcohol, having been embedded in paraffin and cut, the sections are attached to slides in the usual way and stained for ten to twenty minutes with aniline gentian violet (aniline oil, 10 parts, well shaken with water, 100 parts, then filtered, and concentrated alcoholic gentian violet solution, 5 to 10 parts, added to the filtrate). Afterward treat for one minute with lugol solution of a port wine tint, dry with filter paper, and decolorize with aniline xylol (aniline oil, 2 parts, xylol, 3 parts). Decolorization having been stopped at the right point, which must be judged from experience, mount the sections in xylol balsam. The fibers of the connective tissue should appear stained various shades of violet (*Centrab. f. allgem. Path.*, through B. M. J. *Epit.*, p. 40).

Bleaching Sections.—An ingenious method of bleaching histological sections before staining is described by E. A. Minchin, and consists in placing the sections in a bottle of 80 per cent. alcohol, having a layer of po-

tassium chlorate crystals at the bottom. A few drops of concentrated hydrochloric acid are then cautiously added and the bottle is subjected to a gentle heat. The chlorine evolved is said to bleach sections in about an hour (*Nat. Science*, iii., 121).

Fixing Microscopic Objects on Slides.—To fix minute objects in a definite position on a glass slide J. Tempere applies to the particular part of the surface of the latter, after warming (at about 40° to 50°), to remove all traces of moisture, a drop of a medium prepared by dissolving on a water bath 15 grammes of white lac in 100 grammes of absolute alcohol, and decanting off the clear liquid after standing awhile. As the alcohol evaporates from the warmed surface of the glass a hard transparent coating is left. This may be slightly softened at any time by means of a drop of oil of lavender, and after arranging the objects the heat of a spirit lamp will cause the oil to evaporate, leaving them firmly attached. Objects may be mounted on cover glasses in a similar way. A resinous mounting medium may then be employed in the usual manner. If glycerin or glycerin jelly be the mounting medium used, collodion diluted with two or three times its volume of oil of lavender may be found preferable as the fixing agent. The sections, etc., should be placed in position before the preparation dries and the oil evaporated at a temperature of about 50° (*Micrographie prepareur*, i., 81).

A WIREWORM TRAP.

THE wireworm is one of the most troublesome pests of the garden, and of all the nostrums recommended

WIREWORM TRAP.

for its destruction none is really effectual. Gas lime, if used sufficiently strong to kill the wireworm, kills the plants. The only effectual way of dealing with them is to catch them. Messrs. Osman & Co., 132 and 134 Commercial Road, E., have introduced a most effectual trap in the form of a perforated cone, made of sheet iron, into which a carrot is inserted, and the cone thrust into the ground, as in the accompanying illustration. I have tried a dozen of the traps during the past six weeks, and find that they quickly clear the ground of this enemy of carnations. I am putting down two dozen more on some new ground I have broken up for carnations. I saw the traps exhibited at the Agricultural Hall flower show recently, and bought a dozen for trial; and I believe I am doing a public benefit in drawing attention to this little known and useful article.—J. Douglas, in the *Gardeners' Chronicle*.

TOBACCO SMOKE FLOATED UPON CARBONIC ACID.

COAL, on burning incompletely in the air, yields oxide of carbon, a gas which is a very violent poison,

TOBACCO SMOKE FLOATED UPON CARBONIC ACID.

and so much the more dangerous in that there is no odor to announce its presence; when, on the contrary, the combustion is complete, the gas produced is carbonic acid. Although less poisonous than oxide of carbon, it announces its presence by a slight pricking sensation in the nose and mouth; and, although it now and then causes an accident, it must not be forgotten that it is what gives seltzer water its so

agreeable, refreshing and sharpish taste in summer, and that makes beer and champagne foam.

The preparation of carbonic acid is very simple. Let us put a few pieces of chalk and some kind of acid (vinegar, for example) into a bottle, and close the latter with a cork provided with a tube to lead the disengaged gas to a receiver.

It may also be prepared by pouring water upon a mixture of equal weights of powdered bicarbonate of soda and tartaric acid. This process is employed in families for the preparation of artificial seltzer water.

Upon uncorking a bottle of carbonic water and quickly closing it with a cork provided with a bent tube, a small quantity of carbonic acid gas, quite sufficient for a few experiments, may easily be procured.

By means of one of the producing apparatus mentioned above, let us introduce some carbonic acid into a large jar, but in such a way as not to fill the latter completely. Although the level of the gas cannot be perceived, since it is as colorless as air, it may be recognized approximately by means of a candle attached to a wire and lowered slowly until it is extinguished. This is the point of separation of the acid and air. Let us then blow the smoke of a cigarette gently upon the surface of the gas, and we shall see it form waves and float, so to speak, upon the carbonic acid, and, upon shaking the jar, we shall plainly see its level oscillate like that of a liquid, thanks to the smoke blown upon it. In an instant we shall witness a curious phenomenon: the gas will diffuse itself in very visible wreaths upon a black ground, each of which terminates in a toadstool-like appendage. These vortices will descend slowly to the bottom of the jar.—*L'Illustration*.

THE MAKING OF MOUNTAIN CHAINS.

By H. G. WELLS, B.Sc.

WITHIN the past decade speculation upon the process of mountain formation has attracted a considerable amount of attention from geologists. With increased stratigraphical knowledge it has been possible to trace the successive stages in the life of an elevated region with increased certainty, and a great and growing quantity of collateral information has been collected upon volcanic phenomena, earthquakes, the microscopic structure of rocks and the behavior of viscous bodies under pressure.

The history of every mountain range seems to resolve itself into the story of an incessant struggle between hypogene and solar energy. From the moment the land emerges from the sea the forces of denudation begin to act upon it; as the upheaving powers win for a time and the land gradients increase, erosive action becomes more and more efficient, the wedges of the frost come to aid the wear of the rain as the snow line is approached, and at last the Titanic forces of elevation, the strength of the caryatid giant, old Seismos, becomes exhausted and the record of his efforts is slowly erased by the at last triumphant forces of the air. This, in brief, is the life history of every mountain chain, the common plot of all the stories at which we are now to glance.

Somewhere in Swedenborg's writings there is an account of the examination by angels of one of the risen dead. They did not ask the man questions or subject him to cross-examination. They simply took his body, and methodically from that infallible document read out to him all the things he had done. If I remember rightly, they began by "unrolling his fingers." Whatever act his fingers had performed had left its record in their structure, and whatever thought had passed through his brain had made its infinitesimal difference there. This is precisely the way the scientific man hopes at last to build up the history of the past. Every hill, every pebble, every microscopic patch in a weathered feldspar, every cleavage crack in a needle of hornblende, rightly interpreted, bears its witness to the cosmic forces that have been at work upon them; and at present we must read the story of the mountains in this way, so far as our light permits. We may best begin by remarking upon a few of the most significant features of existing mountain masses.

Perhaps in the order of their importance one should first notice the fact that almost all our great mountain chains have, high up upon their flanks, rocks of comparatively recent origin, and that we often find great thicknesses of such rocks. The very summit of Mont Blanc, for instance, was once surmounted by Jurassic rocks. Cretaceous rocks crown the Rocky Mountains, and tertiary masses lie at great elevations upon their sides. Nummulitic limestone, a foraminiferal rock of early tertiary age, is found at heights of nineteen and twenty thousand feet on the Himalayas, and still younger pliocene formations lie high on their slopes. The elevated *molasse* of the Alps is a middle tertiary rock. Not one of the really great mountain chains of the globe appears to have been elevated, or, indeed, above water during the mesozoic period. At that time each was an area of deposition, and further, of subsidence, as the accumulated thickness of mesozoic strata, witnesses. So that we must figure for the beginning of our story a sea, near land indeed, or strata would not accumulate, and with a sinking bottom, or its silting up must have occurred in the place of continuous deposition.

Of course, when we state that the early tertiary and upper mesozoic rocks are *recent*, the non-geological reader must understand we mean recent relatively to the length of geological periods. The date of accumulation of these sediments is certainly a matter of hundreds of thousands if not of millions of years.

Mr. Mellard Reade has insisted particularly upon the importance of this fact of the comparatively modern sedimentary structure of mountain masses. He has, indeed, propounded a theory of the origin of mountain elevation largely based upon this. As everybody knows, there is within the earth an enormous store of heat; for instance, near the surface for every fifty feet or so we go down the temperature rises 1°. The temperature of the surface—disregarding solar radiation—is the net result of two processes; heat must be continually arriving from the hotter interior by conduction, and heat must be continually escaping by radiation into space.

Mr. Reade asks us to consider the result of a continually increasing thickness of strata over any part of the earth's surface. It will act, just as a blanket

does, by preventing the escape of heat. The rocks below will in time grow warmer, since they are no longer superficial, and the growing accumulation of strata will also be heated. The whole mass will expand horizontally and vertically, the movement of subsidence will finally cease, and at last, as a consequence of the lateral strain, the horizontal strata will bulge and be ridged upward into the form of mountain masses.

More striking, perhaps, than the recent age of their constituent strata, and almost equally significant, is the folding that mountainous regions have undergone. We cannot do better than call attention here to the accompanying figure of that classical example, Mont Blanc. The strata, the reader will see here, have been folded and folded again, and their ridges have been denuded. If one takes the edges of a sufficiently flexible book and approximates the ends, one may imitate these foldings roughly, but they may be imitated still better by compressing layers of cloth laterally beneath a weight.

Now, unless all the elementary presumptions of geology are wrong, these folded strata must originally have been deposited horizontally. Since their deposition, therefore, their extremes have been brought nearer together. This puckering points unmistakably to a squeezing in from the sides. It has been calculated, in the case of the Alps, that points on either side of this mountain mass have been brought closer to one another by as much as seventy-two miles. In the case of the Appalachian Mountains the estimate is eighty-eight miles. We seem to have here, then, the clear record of the successive stages in such a process as is indicated in a simplified fashion by our Fig. 2 (A, B, C, D), in which A, B and C represent phases in a steady lateral compression and D repeats C, with some allowance for the action of sub-aerial denudation.

It is upon this aspect of mountain structure that Prof. Lapworth laid particular stress in his memorable address to the Geological Section of the British Association. He insisted upon the horizontal pressure and upon the strata giving to this strain at their weakest points, bulging up into ridges and furrows, and with further compression folding over, so that we get at last "over-folds" (Fig. 1), with an upthrust or arch limb, a middle portion, and a down thrust or trough limb. The middle portion must especially be under great pressure, and it may undergo crushing, or the fold may rupture and the arch slide forward over the fault to form a reversed fault or over-fault or thrust plane as in Fig. 5. The final result of this folding will be to strengthen the crust at the original weak point by more than doubling its thickness, and adjacent portions of the strata will then begin to pucker. So that in the flanks of the original fold fresh folding will arise until we get either a fan-like series (as in Mont Blanc) or a one-sided arrangement (Fig. 3) such as is displayed in the Appalachian and Jura Mountains.

The causes of these mountain foldings may possibly be the lateral stress due to local horizontal expansion, if the theory of Mr. Mellard Reade is correct. But a great number of geologists consider that the prime cause of these foldings, and indeed of mountain upheavals, is the contraction of the earth due to its secular cooling. As this contraction goes on, the cold crust has to accommodate itself to the shrinking interior, and in doing this it is necessarily crumpled and wrinkled. The great land masses and the great oceanic troughs of our earth, moreover, lie along lines of longitude. Winchell has attributed this north and south trend of the chief lines of crumpling to the directive influence of the tidal stress.

Prof. Lapworth, in his address, stated the case for the contraction theory of mountain origin in a remarkably vivid way. He called attention to the manner in which trough and ridge everywhere corresponded. For the upthrust of America, with its Mississippi Valley and its unilateral ridges of the Rockies and Appalachians, we have the Atlantic with its division by the Dolphin ridge into two parallel troughs; and corresponding to the broad uprise of the older continents we have the great depression of the Pacific. Coming to the shorter transverse foldings, the Alpine mass had for its trough the Mediterranean; and Central Asia the southward deep of the Indian Ocean. This "undulation" of the surface of the solid earth is far more in agreement with the theory of secular cooling than the theory of Mr. Mellard Reade.

On the other hand, there are those who consider the amount of folding we find in mountain masses, which must amount altogether to a diminution of the earth's circumference by many hundred miles, too great for their conception of the amount of contraction the world has undergone since the rocks in question were solidified. Moreover, in certain localities in Sweden and elsewhere, crumpled rocks are found lying on an undisturbed base. Prof. Reyer has recently propounded some novel and remarkably suggestive views in this matter.

He has conducted a series of experiments upon the behavior of artificial strata made of muddy material or plaster of Paris mixed with glue and variously tinted. These before complete consolidation were placed on boards slightly tilted (5° to 15°), and the arrangement was occasionally tapped to imitate earthquake shocks. There was a general sliding down and crumpling of the mass, such as might conceivably happen in the case of sedimentary rocks, and sections taken after hardening showed, in consequence of this sliding, beautiful imitations of folding, contortion and faulting such as are seen in mountain chains. Such experiments as this might very easily be repeated by teachers of geology or physiography. They certainly aid the imagination very greatly in thinking out these physiographic problems.

Prof. Reyer's conception of the development of a series of mountain folds, based on experiments of this kind, may be illustrated by the three figures given. While it harmonizes with Mr. Mellard Reade's hypothesis, it seems perhaps a little better adapted to explain complex crumpling of strata than does that supposition. A represents a continental mass, from which the sediments, C, D, E, accumulating in the sea, B, are derived. For manifest reasons, these will be thickest and coarsest near land, where the carrying power of water is at its greatest. Now, on the reasoning already given, this accumulation will finally

lead to upheaval, the uprise of strata being greatest in the region where the "blanket" is thickest. That is to say, the base is tilted. The strata consequently glide seaward and pucker up upon the tilted base (Fig. 7). Meanwhile the continental mass (A) is continually undergoing denudation, and the rocks immediately beneath, therefore, are cooling. We may say that the young land to the right is pulling the blanket off its older neighbor, the area, A. The cooling of A causes a subsidence and faulting, and the faulting, weakened, and sinking crust is there least able to resist eruptive material, so that at last (Fig. 8) a volcanic chain, F F F, may grow up behind the fold chain.

This, briefly, is the story suggested by Prof. Reyer.

SECTION OF MONT BLANC.

a story also fairly consistent with existing mountain structures. But it need not be regarded as a theory absolutely opposed to that so clearly propounded to the English student by Prof. Lapworth. The heating effect of deposition suggested by Mr. Mellard Reade, the crust contraction to which Prof. Lapworth gives prominence, the "gliding" of Prof. Reyer, are all causes that must operate. Prof. Reyer's theory may explain many cases of folding, Mr. Mellard Reade's many cases of upheaval, and yet the great wrinkles on the face of Mother Earth may be due to her withering as the warmth of her youth departs from her.

Clearly, from what has been said, volcanic phenomena are a mere incident in the growth of a mountain chain. They do not, for instance, appear to have played a leading part in Alpine history, and the Rocky Mountains were already elevated before the great trachytic and basaltic outflows of that region occurred. Volcanic forces cannot, therefore, for one moment be regarded as standing in a causative relation to mountain building. Nevertheless, in the

Andes and the Himalayas the abundant presence of volcanoes is food for thought. However, the question of the causes of volcanic action scarcely belongs to this paper.

Here we may allude to a third feature of mountain structure. It emphasizes the enormous pressures to which the folded rocks were subjected. It is the alteration of the microscopic structure of these rocks.

We find, for instance, clays, with all their once highly-pigged particles, twisted round into a direction at right angles to the force of compression, so that they can be split up into laminae, and are no longer clays but slates. Limestones lose the traces of their organic relics and become recrystallized as marble. Some rocks are seen with their constituent minerals literally crushed and rolled over and into one another, as though they had been through a colossal crushing mill (mylonitic structure). The quartz of granite, for instance, is powdered, the feldspar cracked and reduced to cloudy particles, the mica twisted and shredded. The rock has also been, as it were, masticated in the presence of in-soaking water. Old minerals have been dissolved out, fresh ones formed.

In some cases a parallel order of the minerals has been induced. It is as if the rock had become plastic under these stupendous stresses, and that we had here its lines of flow. Nothing could be more eloquent of the irresistible nature of the mountain-making forces. It is interesting too to notice how we have thus repeated, in a thin flake of rock that would scarcely weigh a grain, the same story of enormous lateral pressure that we find in considering the stratigraphical structure of an Alpine massif.

To summarize our deductions, we have in the history of every great mountain chain the following phases. We can do without any appeal to "old Seismos" now to account for the elevation. A long

period of quiet subsidence and deposition of sediment is followed by upheaval. There is a process of lateral compression relieved by a bulging, the formation of a ridge or ridges, with troughs on either side. Probably there are no great paroxysms; the steady squeezing and upward creep goes on day by day, year by year, age by age. Strata are imperceptibly thrown into bends, into loops, the foldings are heaped up one above the other, overfolds are formed. The rising mass slowly becomes a prominent terrestrial feature. Stresses, culminating day by day, are at last relieved by the formation of faults and thrust planes, and as the ruptured strata slip there are earthquakes. Rocks are crushed and metamorphosed, softened, moulded, possibly even liquefied. There may be volcanic outbursts along the axis or upon the margins of the rising area.

The emerging mass becomes subjected to denudation. In the main troughs which will be sinking beside the rising ridge, forming seas or lakes, sediments will accumulate. Presently these areas cease to subside and become involved in a greater movement of elevation, as is shown by the Swiss *molasse* and the Siwalik rocks on the Himalaya flanks. So the vast growth continues. Strata tilted on its rising shoulders slide and are crumpled. Above, the snow and glacier are soon at work—unequal heating by day and frost by night, rain and wind splinter the metamorphosed upturned rock masses into peak and pinnacle, cirque and precipice. Thus in the course of ages the mountain chain attains its prime, and a brief equilibrium follows.

But the forces of lateral pressure and upheaval are dying away or they have found a weaker area elsewhere. The volcanoes become extinct, the earthquakes less violent and less frequent. Every moment a hundred streams carry away their quota of material suspended or dissolved. So the period of decay sets in. From the still eruptive Himalayas we may turn to the more quiescent Alps, from there again to the worn-down masses of Scandinavia and Scotland, from there to the still more ancient mountain range half buried beneath the strata of Wales and central England; and so the story ends at last as it began, in sedimentation in the sea.

In conclusion, attention may be called to the rather remarkable fact that in the moon no great meridional mountain ridges, such as one might expect from the analogy of the earth, are to be traced. Neither have the mountains of the moon so distinctly the linear ridge-like arrangement characteristic of terrestrial mountain axes. One might have anticipated, on the contrary, in the absence of an atmosphere and atmospheric denudation and with feeble gravitational attraction, that broad regions of crust folding would have been more conspicuous than on the earth. It may be that these features have been masked by the subsequent precipitation of the lunar atmosphere; but the volcanic character of lunar scenery is hardly consistent with this hypothesis. This, however, is a question for the astronomer to consider.—*Knowledge*.

THE NEW PHYSICAL GEOGRAPHY.

By RALPH S. TARR.

AMONG the many instructive lessons which the study of the geology of the far West has taught, perhaps the most important is the fact that physical geography and geology are inter-related sciences. If one examine a text book of physical geography, he finds that it deals in the main with descriptions and statistics. A river is described as of three parts, the torrential, valley and flood plain portions; it has a divide, perhaps a delta, certain tributaries which rise here or there; it flows in this or that direction, and empties into a certain sea or ocean; and it has a given length and drains so many thousand square miles of surface. A mountain has a certain position, height and trend. In other words, the geographical side is fully presented; but the physical side is practically neglected.

Turning now to the monographs of Powell, Gilbert, Dutton, Russell and others, one finds that land form is regarded from the standpoint of origin and history, and that certain laws are stated by which these forms are derived. This is the nucleus about which much progress has been made toward the foundation of a science of physiography, or, if one prefers, of physical geography. While some Germans and Frenchmen and a few English writers have aided in the establishment of this science, it may, I think, be called essentially an American science, as it now stands. The writers named above, with Chamberlain, Salisbury, McGee, Davis and a few others, have shown how intimately land form is dependent upon structure and physical conditions, and that mountains, valleys, lakes and shore lines have all had a history which is readable, in part at least, by a study of their form and position. By them geology is made to serve in the explanation of land form, and land form is used to interpret geological history, so that the two sciences are made interdependent.

To each of these several writers much credit belongs for his part in the work, and it would be a task of much difficulty to award to each his full share of credit; but to Prof. Davis we owe much, not only for his original researches in the subject, but also formulation of a systematic statement of the history and development of geographical forms. This new science of physical geography he has been developing for years, with the aid of the other physiographers, and has established at Harvard a school of physical geography which is serving as a model for similar schools in some of the large colleges of the country. It is my purpose to state in outline some of the principles of this science, as I interpret them, though in a short article such a presentation must of necessity be incomplete.

Until recently river valleys have been looked upon as definite forms and in a measure unchangeable. Men who are still active in science, Prof. Dana, for instance, took part in the controversy which resulted in the now fully accepted view that river valleys were formed not by faults or cracks in the earth, or by floods, but by the streams themselves, and the general agents of denudation. When this view became firmly established, it was of necessity recognized that such valleys changed in form, but the exact nature of