SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE VEGETATION OF THE HOT SPRINGS OF YELLOWSTONE PARK.

MUCH of the beauty of the so-called 'formations' of Yellowstone National Park lies in the brilliant tints of the mineral deposits, wet from the streams of hot water that issue from the thermal springs and geysers.

Formation is a general term employed to designate any mineral matter deposited by the geysers and hot springs. The amount of formation in the Park is extraordinarily large, but it is chiefly confined to four regions. At Mammoth Hot Springs there is an immense deposit of calcium carbonate, the sides of which are terraced with pulpit-like projecting basins, as is shown in figure 1.*

These interesting basins are formed by the activities of numerous hot springs upon the top and along the sides of the terraces. The entire pile of dazzling white mineral has been likened to the front of a glacier. The Norris Geyser Basin, the Lower Geyser Basin and the Upper Geyser Basin are similar to one another in certain respects. They are extensive expanses of formation chiefly silicious in composition. All of them are situated in the floor of a valley and cover acres on either side of the Firehole River, which flows between banks of snowy whiteness. Upon these formations are scattered the numerous mounds built up by the geysers, and here also are many clear pools of hot water. The latter are of various sizes, some mere shallow puddles which sizzle and sputter, but most of them deep basins with sloping sides, and one at least a pond a hundred yards wide. The water is almost always scalding hot, sometimes even boiling violently in the middle of the pool.

*Figures 1, 5 and 7 are taken from the Ninth Annual Report of the United States Geological Survey.

Dry formation is generally dazzling white, as pure and clear as any snow field of the Alps or Norway. Dry formation reflects the light from innumerable crystals and the rays all seem to focus upon the individual in the proximity. This is why the formation is so hot and blistering. This is why the kodak must be 'stopped down' to its smallest diaphragm if one desires to photograph the geysers, as many a tourist has learned to his sorrow when he viewed the dark brown, over-exposed film of some geyser in action, and then remembered the long wait in the glittering sunshine, the mad rush for favorable points of view and the supreme satisfaction that he felt when the exposure was indexed and described: 'Old Faithful from the west, sunshine upon the vapor clouds, fir forest in the background.'

Wet formation is usually colored. Wherever a stream of water flows from a hot spring the course is marked by streaks of green and yellow along its margin. Fringes and rims of green and gamboge border the boiling pools. Upon the sides of the pulpit basins (see Fig. 1) are flutings of red and orange, of green and brown. The sides and bottoms of the streams are lined with olive colored felts of a velvet-like consistency, and there may be green or brown stringy filaments waving to and fro in the hot currents of water. The sides of many of the pools are covered with green, leathery membranes, or smeared with a coating of structureless jelly. Even the hottest pools, those which are boiling violently in certain parts, are likely to have some of the colored fibrous or gelatinous deposits at their edges. The temperature of the water in these streams and basins is frequently above 80° C., and water boils in Yellowstone Park in the neighborhood of 92° C.

Almost all of this brilliant coloring is associated with growths of low forms of plant life. Some of these organisms it will be our purpose to describe, together with a discussion of certain activities manifested by them in connection with the structure and development of the formation. It is not difficult to see that the growth is various in character in different parts of the hot springs. One finds the most luxuriant masses in such portions of the streams as have cooled down to a relatively low temperature, that is where the water, instead of being scalding hot, may be simply unbearably warm.

Here, at a temperature of from 40°–50° C., flourish a variety of forms with the greatest display of color. The prevailing tints are green, but much of the growth is brown, red or frequently orange. The forms which the masses of vegetation assume depend upon the condition of the environment. If there is a rapid stream the bottom will be covered by a smooth, slippery, leathery felt, and perhaps occasional stringy masses attached at points along the sides and bottom will float out with the current. If water lies in a quiet pool one may find a thick growth of this felt-like character on the bottom and there will be numerous tufts perched upon projecting knobs of rocks. These tufts are made especially prominent by the bubbles of gas entangled in the network of filaments. The tufts are particularly interesting because they give rise to some of the most peculiar sculpturing of the shallow pools.

In warm water, at a temperature of from 55°–65° C. there is a preponderance of green growth, much of it a vivid emerald green. The color becomes less pronounced in warmer portions of the stream, fading to a yellowish brown, and finally becoming light yellow when the water approaches 80° C. in temperature. In the hottest water one finds only white filaments, which grow as long silky strings in the running streams or form a delicate cobweb upon the bottoms of quiet pools. This is the growth that marks

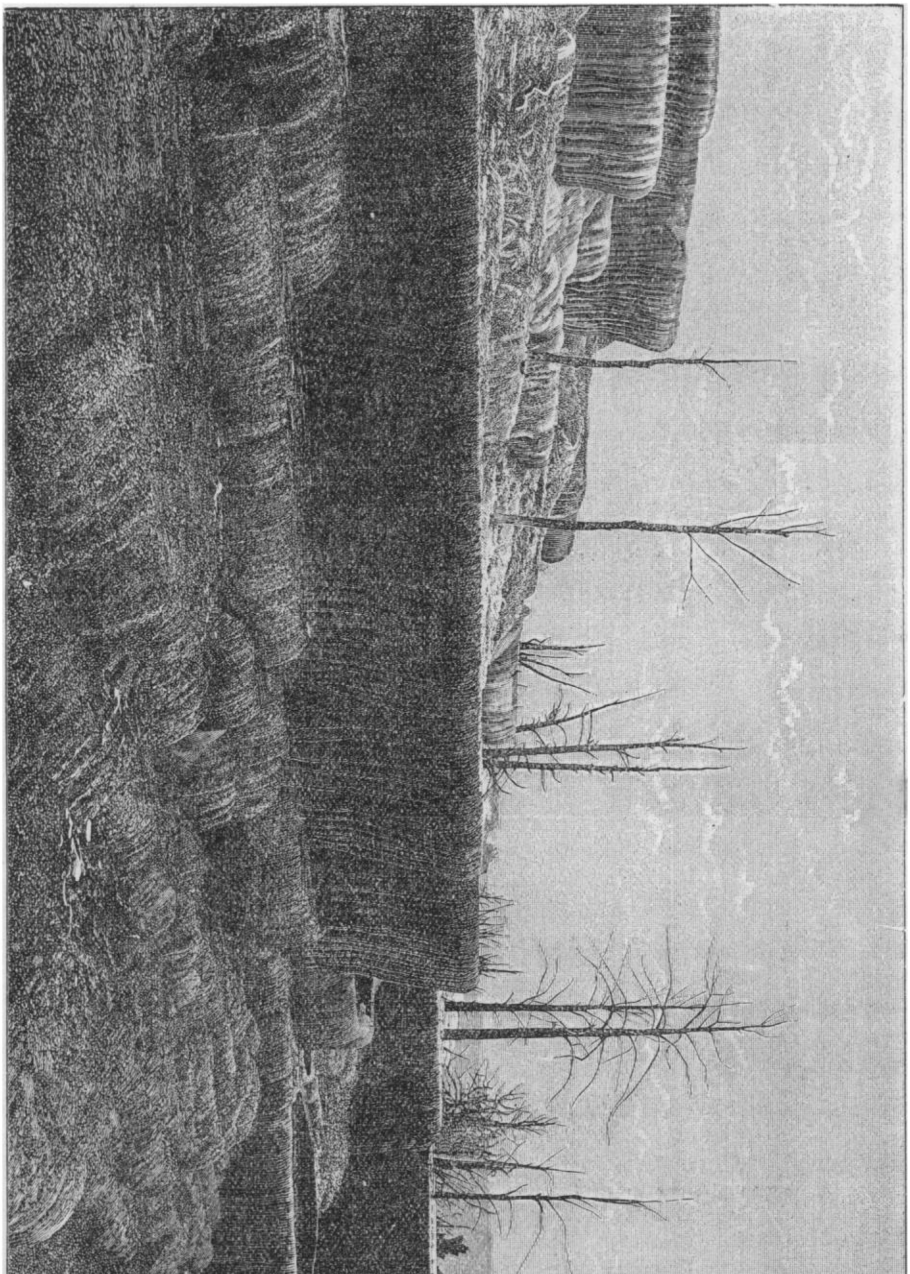

FIG. 1.—Pulpit Basins. Mammoth Hot Springs.

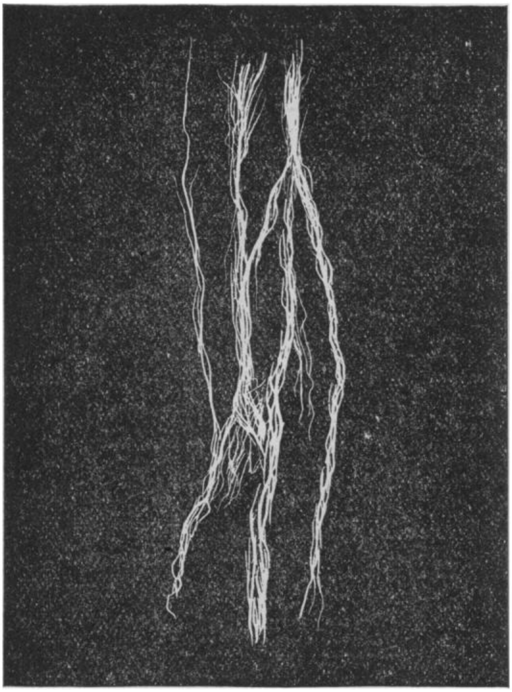

FIG. 2.

the limit of life in these hot springs, and it is not likely to be found in water warmer than 85° C.

Let us now consider the structure of some of the most striking types of plant life making up the vegetation of these hot springs. It would not be wise to go into details, and indeed I cannot well do so, for no one has ever published a critical study of these forms. The subject is really a very difficult one for several reasons. In the first place the organisms are all very minute and can only be studied under the highest powers of the microscope. The characters which define the species are particularly evasive because the forms are extremely simple in structure, and color and size are notoriously variable qualities among such organisms. Then these forms must be carefully compared with the inhabitants of other hot springs, particularly those of Germany and Italy, where such growths have been somewhat extensively studied. This is necessary in order to place the identifications upon a firm basis.

Naturally, the most interesting forms from our point of view are those living in the hottest pools. The growth is usually white or gray; much of it has a pearly luster, and the structure is filamentous. In quiet water it forms a delicate network on the bottom. In the little streams which carry off the overflow from boiling pools one may find the filaments in tufts along the edge. Such tufts often appear as in Fig. 2, but the filaments may grow to be six inches long. The highest temperature of the water in which this growth has been so far reported is 85° C., life conditions which must, indeed, be considered remarkable.

Examined under the microscope, the filaments present some curious features. Under the low powers one sees an apparently homogeneous strand of a gelatinous consistency, shown in Fig. 3, that is coated

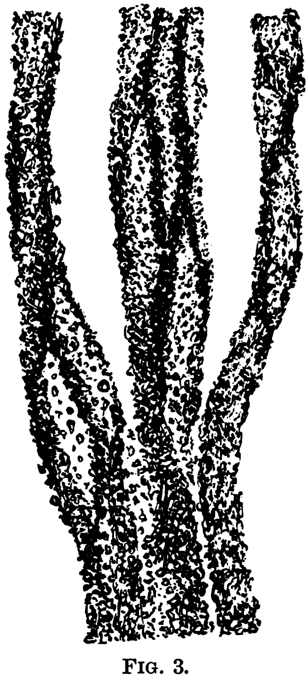

FIG. 3.

all over with small crystals. It is easy to prove that this deposit is sulphur, since the granules can be dissolved away in carbon bi-sulphide, leaving only the gelatinous filament quite soft and flaccid, where it was formerly somewhat stiff and stringy. One sees no further indication of organization until the filament is examined under an immersion lens with, perhaps, a magnification of 1,000 diameters. Even then, to obtain the best results, the specimens must be stained. Such preparations then reveal a remarkable structure. The filament is made up of innumerable bacteria imbedded in a gelatinous matrix. They are chiefly rod-like forms and are arranged in lines and chains. The individual rods vary greatly in length, but it is quite plain that the smaller forms result from the division of the larger. Fig. 4–a illustrates the characteristic form and arrangement of these bacteria under very high magnification, about 2,000 diameters. The long axis of the rods are usually parallel with the general direction of the filament, the width of which is made up of many hundreds of the organisms placed side by side. The filament is really an elongated zoogloea, or colony of bacteria, all coated over with sulphur grains.

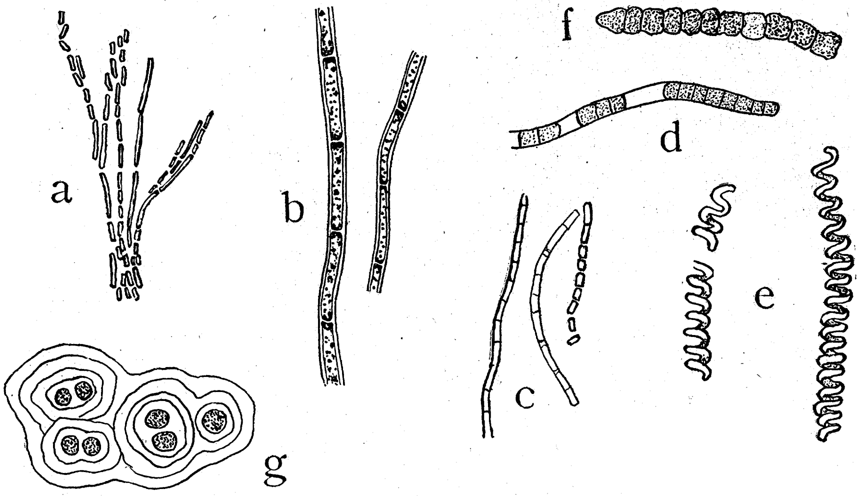

FIG. 4.

It is a difficult matter to determine exactly what form of the bacteria this is. One should know whether the sulphur grains are deposited by the activity of the organism or not. Presumably this is so, and the type is a species of *Beggiatoa*, a genus of bacteria characterized by its peculiar habit of depositing sulphur from water containing sulphuretted hydrogen in solution. But the genus *Beggiatoa* is remarkable because it includes some of the largest species of bacteria known, and the cells are of such a size that many sulphur grains may be contained in their interior. There are without question species of *Beggiatoa* in the hot springs of the Park, and it may be just as well to compare one of these forms shown in Fig. 4–b, under magnification of 500 diameters, with the organism under consideration. It will be seen that the cells of the *Beggiatoa* filament are very large in comparison with those of Fig. 4–a, although the magnification of the latter is about 2,000 diameters. The dark dots in the interior

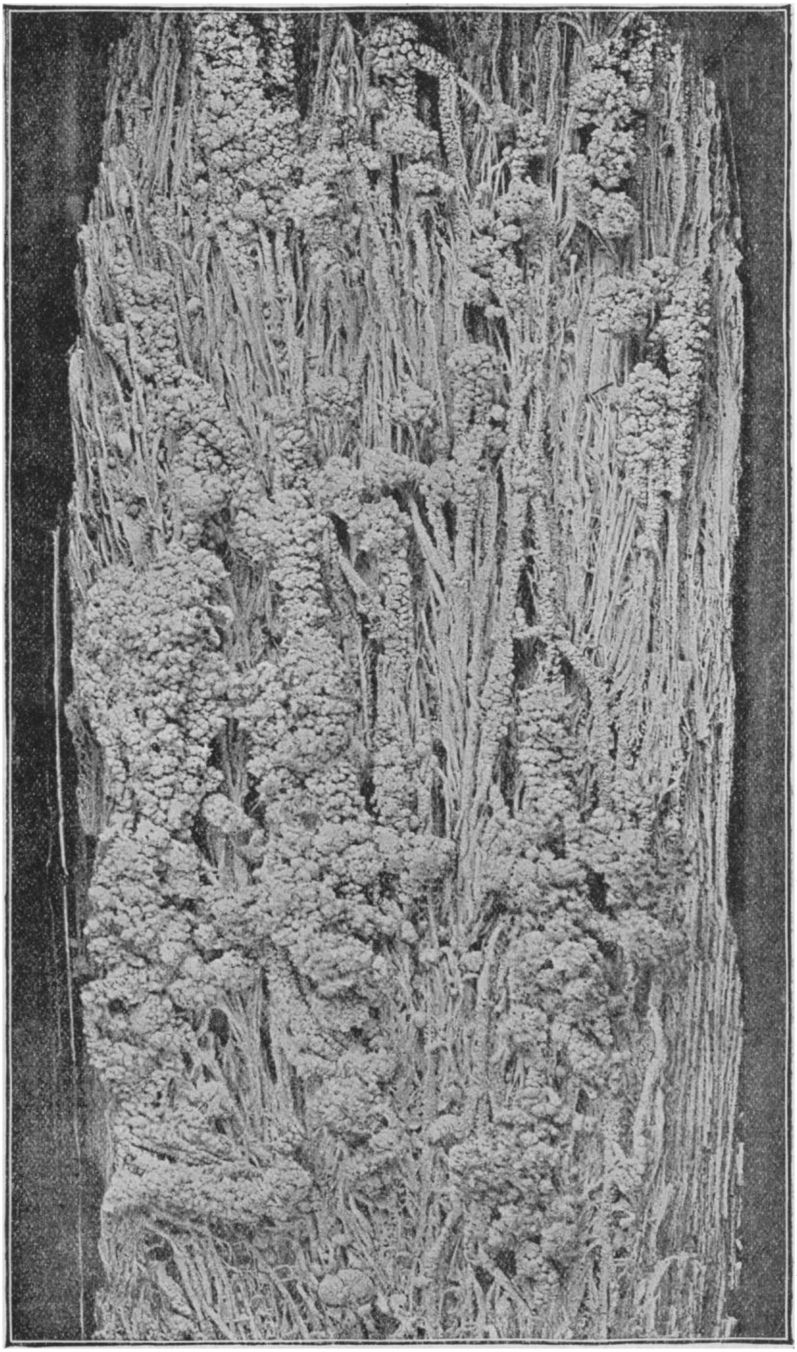

Fig. 5.—A Piece of Travertine.

of the cells are sulphur granules. If our plant is not *Beggiatoa* it would be classified as a *Bacillus* because of the rod-like character of the cells. The writer will not attempt to name it on the insufficient data, and it serves as an excellent illustration of the difficulties with which one contends in attempting to define precisely the relations of these organisms to one another. It is a very interesting form from its habits and its habitat, and probably the most adventurous organism in the hot springs.

This peculiar species of the bacteria leaves a record of itself in the mineral deposits in the following manner. The filaments, at first delicate and exceedingly flexible, become coated with such a thick deposit of sulphur and calcium carbonate that they lie as stiff fibers along the edges of the hot pools and upon the bottom of the streams. Sometimes the collections of these filaments have the appearance of frost work in the scalding hot water. Eventually the threads become cemented together by the continual deposition of lime, but they impress their individuality upon the resulting formation by giving it a fibrous structure. These points are well illustrated by the photograph of a piece of formation shown in Fig. 5.

The tufts of waxy bacterial filaments are often associated with extensive growths of quite a different character. Large areas upon the sides and bottoms of the pools and streams are frequently covered by a closely packed felt of extremely delicate filaments. The surface is smooth and slippery, and it feels like a sheet of rather stiff jelly all gritty because of the numerous crystals of calcium carbonate deposited in the substance. Under magnification the true structure is made apparent, and one sees here a closely woven mass of very minute filaments agglutinated together. The individual filaments are sometimes less than one-thousandth of a millimeter in diameter, so that they look like mere lines even under a magnification of 200 to 300 diameters. Fig. 6 illustrates the general appearance of

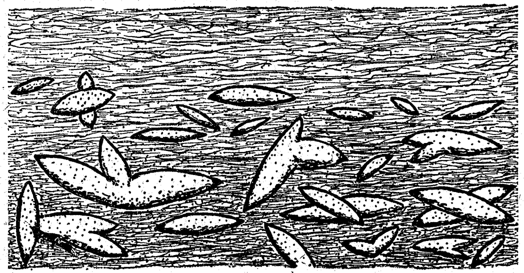

FIG. 6.

the leathery felt and shows the many crystals of calcium carbonate imbedded in the mass of filaments. The cells of this plant are several times longer than broad and the color is greenish. The genus is called *Phormidium* and contains forms closely related to a very common blue-green alga of stagnant waters, named *Oscillatoria*. There are several species of *Phormidium* in the hot springs, differing from one another chiefly in the measurement of the cells. The smallest forms, such as are shown in Fig. 4–c, are found in water as hot as 75° C., while the larger types (Fig. 4–d) only inhabit water that is several degrees cooler. The color of the *Phormidium* growths is quite variable. When actively vegetative the tint is bright green, but older sheets become brownish and the presence of various mineral deposits give the growths shades of golden yellow and dark red. If dried in the sun the colors fade out through various tints of yellow and pink to the everlasting white of the formation.

Another interesting plant frequently makes itself prominent, side by side, with the *Phormidium*. It is called *Spirulina* and, as the name suggests and the figures (Fig. 4–e) show, the form is a filament closely coiled in a spiral. This organism has the power of forward movement, the free ends swinging from side to side in such a manner that the delicate thread travels over its substratum and among other algæ. *Spirulina* mixed with *Phormidium* often forms curious raised rims about the pools of hot water. This phenomenon is especially well shown upon the edge of the Prismatic Spring in the Middle Geyser Basin, also known under the more picturesque name of Hell's Half Acre. The Prismatic Spring is an immense pool of hot water about a hundred yards wide. The center of the spring is of a dark blue color, which gradually changes through shades of green to a light yellow around the margin, where the water is shallow over the sloping bottom of the basin. On the edge of the pool is a greenish growth variegated with brown and yellow. It has the form of a rim several inches wide raised above the mineral substratum and acting as a slight obstruction to the ripples of hot water that constantly splash over it upon the formation. The substance of the growth is rather firm like wet felt, and the surface, figured with raised lines, resembles tripe. The masses of wet algæ are so warm that one cannot hold them, and the water that laps the edges of the deposit is much too hot to approach with safety. It is in situations such as these that the algæ of thermal springs play an important part in moulding the form of the mineral deposits, but this is a subject that will engage our attention later on in the paper.

We have now considered the organisms that are most characteristic of the hot water of the thermal springs. It is altogether probable that careful studies on the spot would bring out many interesting facts in respect to the number of species, and the precise range of their distribution through the various springs in relation to the temperature and character of the water. It is an interesting field for study, and deserves the attention of a botanist for three months, instead of three days, which the writer once spent in the Geyser Basin.

As the water grows cooler in the overflow streams the conditions gradually become suitable for types more familiar to the botanist. A species of *Anabæna* (Fig. 4–f) is prominent in some places, and members of the Chlorophyceæ and diatoms are found, but these types are not truly a part of the flora of the thermal springs.

One more form deserves notice from the peculiarity of its structure and the curious situations in which it is found. There are places in the Geyser Basins and on the deposits of Mammoth Hot Springs where steam issues from the cracks and crevices of the formation. One may frequently find the mineral matter in these openings colored a bright green by a delicate film of slime. This is largely made up of *Glœocapsa* (Fig. 4–g), a unicellular alga that is characterized by the presence of very thick cell walls made up of concentric layers, the outer becoming gelatinous. These slimy films must be kept continually damp by the hot steam that issues from the vents.

The inhabitants of the thermal springs are all members of one or two families of plants, and a greater interest attaches to them because the fact is plain that the conditions under which they live are not suitable for the forms of algæ that commonly crowd our ponds and streams. In a general way they are all closely related to one another. The colored forms are all members of the class Cyanophyceæ, the lowest group of the algæ, and the colorless type all belong to the class Schizomycetes, or bacteria, the lowest group of the fungi. Moreover, the forms of Cyanophyceæ and Schizomycetes are quite generally considered to be near relatives. Indeed, all the members of both groups have been classified under one name by some authors and called Schizophytes, which means plants that split. All the forms agree in having a very simple cell structure. Until quite recently investigators have been unable to find any indication of that organization of the protoplasm into a nucleus and chromatophore, such as is present in the ordinary plant cell. Now botanists are able to distinguish nuclear matter in the cells of some of the larger types, but it is found in a scattered form with vague contours and never in the shape of a well-defined, compact structure. The phenomenon of cell division is here found in its simplest type and gives the name to this group of plants. The cell simply splits apart and there are two individuals where formerly there was one. The cells may remain attached to one another and so form filaments of considerable length, but each cell is probably physiologically quite independent of its neighbors. The facts plainly indicate that the protoplasm of these types is not as highly organized as that of more complex forms of plants; probably they are able to withstand these unusually high temperatures because of this low grade of protoplasmic organization. Perhaps, but this does not necessarily follow, these organisms resemble more closely the primitive first forms of life than any other living types. One would like to know about the precise conditions governing the lives of these simple cells and something of their past history. It is possible that they may have crept into the hot springs from the colder water, or perhaps their ancestors may have always lived under the infernal conditions which now surround them. A very thorough study of various pools and streams at different temperatures might solve the problem. The field of study is as interesting as it is difficult.

Now let us examine these organisms in their rôle as geological agents or factors influencing the deposition and shape of the formation. We must remember that the formations are of two sorts: first, the calcium carbonate deposits illustrated most strikingly by the immense pile at Mammoth Hot Springs; and second, the silicious formations of the geyser basins. Calcium carbonate ($CaCO_3$), the substance which makes up the chief part of all limestone and marble, of coral and most shells, is practically insoluble in pure water. However, water charged with carbon dioxide (CO_2) dissolves calcium carbonate, and it is pretty generally believed that the latter passes over to a new substance, calcium bi-carbonate with the formula $Ca\,(HCO_3)_2$. But calcium bi-carbonate is not known in a solid crystalline form because, when water containing it in solution is allowed to stand exposed, the carbon dioxide escapes and the usual calcium carbonate immediately separates out from the solution.

The water that issues from the formation on the terraces of Mammoth Hot Springs has been under pressure and is highly charged with carbon di-oxide. It holds an unusually large amount of calcium carbonate in solution, a fact for which the bed of Mesozoic limestone, through which the boiling hot water passes on its way to the surface, is responsible. When the water emerges from the orifices of the hot springs and spreads out in the shallow streams and pools there is an immediate escape of carbon di-oxide from the supersaturated solution. The insoluble calcium carbonate is then thrown down as the dazzling white deposits of travertine. One may see the results of this property of the hot water illustrated by the absurd incrusted baskets, pine cones and horseshoes that are on sale at the hotels. This phenomenon is, of course, in no way connected with the activity of the organisms, and there is no question but that travertine would form and terraces would be built up even if no plant life were present in the water.

But the plant life undoubtedly hastens the deposition of calcium carbonate in the following manner. The green plants require carbon di-oxide for the processes of assimilation and they take it from the water, which means, in this case, the deposition of a certain amount of calcium carbonate. There are many plants that have the power of taking calcium carbonate from water. *Chara*, the stone-wort, the marine algæ called Corallines, forms of the group Siphoneæ inhabiting the coral sands of Burmuda and Florida, are examples, and besides these there are species of Cyanophyceæ closely related to the forms actually found in these hot springs. If the tufts and felts be teased out, one may find innumerable crystals of calcium carbonate, varying in size, held in the meshes of the filaments. We have tried to show the appearance of such a preparation in Fig. 6. One may observe this very significant fact that the crystals at the bottoms of the tufts and sheets of algæ are large, and there are places where they have become cemented together into flakes of mineral deposits. In the middle region and towards the surface of the felts the crystals are small and scattered. It is evident that these expanses of algal growth lay down sheets of calcium carbonate and that the tufts build up little mounds upon the generally smooth surface.

It is altogether probable that the mineral deposits follow the development of the algæ very closely and actually entomb the older filaments at the bottom of the growths in limestone crypts. It is interesting to know that the first travertine thrown down in these waters is probably associated with the vegetation at the time of the deposit. We say probably because the fact cannot be proved in these hot springs, but we can reason from analogy, for the conditions here are quite similar to those of the waters of Carlsbad, in Germany. There the springs issue from granite rocks and the travertine is not deposited until traces of vegetation appear in the water. These interesting observations were made by Ferdinand Cohn. As all the streams of Mammoth Hot Springs issue from travertine deposits, it is impossible to tell exactly where the deposition first begins.

However important these algæ may be in their rôle as rock-formers, a greater interest attaches to them because most of the beautiful sculpturing and coloring of Mammoth Hot Springs is directly due to their presence. The rims on the pulpit basins (see Fig. 7) are covered with a growth of algæ. The interiors of the basins are lined with sheets of green and yellow on a white background, but it is the outside of the basins that exhibits the most beauty. There are pillars and flutings and stalactite-like structures all colored brown and orange and green. The algæ are responsible for almost all these peculiarities. If they were not present the water would flow in shallow sheets and fresh deposits of calcium carbonate would be laid down like so many coats of whitewash with unrelieved monotony.

But the algæ change the conditions. Here they grow in ropey welts down the sides of the pulpits from the lips of the basins; there they have formed a raised rim upon some flat surface and partially dam up some small pool or stream of water. Here they hang down from some projecting ridge as a slight fringe that drips water. Everywhere the growth of vegetation is but a thin veneer over a skeleton of mineral deposits that follows closely the lines of the algal sheet. The filaments project from a granular and gritty deposit enveloping the fibers that are not so fortunate as to be at the immediate surface. Consequently when, for some reason, the water ceases to flow over a certain part of the formation, and the colored vegetation dries up and entirely fades out in the fierce glare of the sun, there is still left the form of the growth in raised relief upon the travertine.

In the shallow pools, only a few inches deep, one may find the most delicate frostwork creeping in from the side. Here the algal network is a skeleton upon which is laid a coating of calcium carbonate in the form of delicate granules. The filaments frequently have a beaded appearance, somewhat similar to cobwebs covered with minute drops of dew. The effects are particularly striking when a stream of water suddenly spreads out over a flat surface. Then the frosted growths radiate out from a common point and the effect is sufficiently prominent to give rise to the term 'fan' that is applied to such figures. Of course, the more delicate patterns upon the formation are not lasting. The wear and tear of the summer tourist season, and the freeze-up in the winter, break the lace work, but it is quickly renewed every spring. Indeed, there is opportunity for the exhibition of taste in the judicious distribution of the hot streams over the older portions of the formation. They could readily be kept in repair, for fresh deposits are laid down with astonishing rapidity.

We now pass to the consideration of the silicious formations of the geyser basin and here we encounter some peculiar problems. The water comes forth boiling hot and supersaturated with silicious matter. There is no question but what some of this must be thrown down from the solution as the water cools. Indeed, one may sometimes find soft deposits of a gelatinous nature around the vents of various springs and geysers, apparently thrown out by a sudden discharge. Evaporation alone would make possible the gradual building-up of the in-interesting cones around the orifices of geysers. However, the deposition as a rule must go on very slowly, and the calculation has been made that in certain instances not more than one-sixteenth of an inch is deposited each year.

But our problems are concerned with the beautiful transparent pools scattered over the formation. Their water is as clear as crystal and the mineral matter on the sloping sides is as firm and hard as chalcedony. There is no vegetation in the hottest of these pools, but where the water has cooled down a few degrees one may find abundant growths of algæ. There are membranous patches of various shades of green and masses of yellowish jelly and also tufts of very delicate filaments that hold many bubbles of gas entangled in their meshes, making them rise up like small balloons held down by numerous cords. There are many peculiarities about these pools that make them very interesting. The sides are frequently moulded into curious figures, giving reasons for such names as 'The Oak-leaf Spring,' 'The Aquarium,' etc.

But the most peculiar structures are pillars that stand up from the bottom of the basin. They are of various sizes, some merely slight cones that roughen the stony floor of the pools, others finger-like projections. In its fully developed state the column rises to the surface of the water. As it grows older it becomes gradually thicker until the mass of deposit resembles a small island in a miniature sea of hot water. Fig. 7 shows one of these shallow pools from which the water had been drained. There are many columns, large and small, present in this instance, and the figure illustrates a characteristic peculiarity, namely: that often the top of a pillar spreads out at the surface of the water in a form that resembles the umbrella-like top of a toadstool.

How are these columns and the figures in raised relief formed? Have they any connection with the algal vegetation? Indirectly there is a very important relation. It is not probable that these algæ secrete silica. There are comparatively few plants that have this power and among the algæ the forms called diatoms are the only examples. They are not found in these hot pools. The writer has never heard that any member of the Cyanophyceæ has this power, and the specimens that he has examined from the hot springs gave no evidence that silicious matter was secreted directly around the fibers, for the deposits were in the form of granules of amorphous silica distributed among the filaments. It is a principle well known to the physicist that matter in solution is often far more likely to be thrown down when foreign bodies are in the fluid. The mere presence of such material offers surface or otherwise disturbs the equilibrium and hastens the appropriate physical changes. Thus the phenomenon of crystallization will take place much more quickly and completely from a solution if there be strings or other

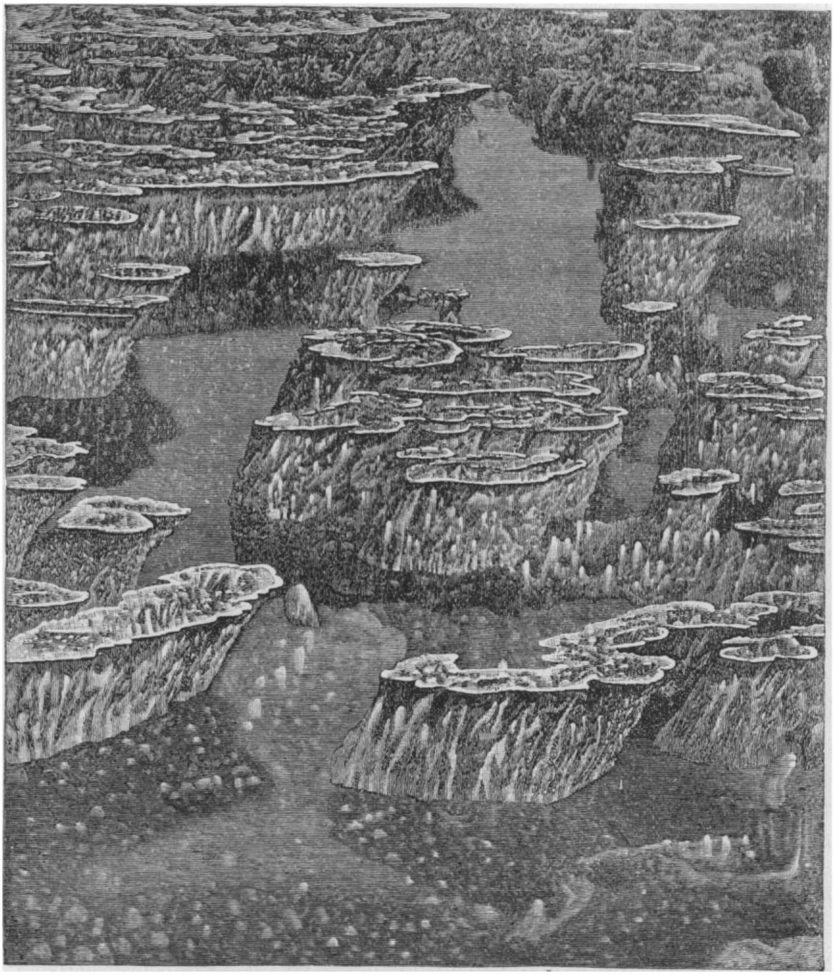

Fig. 7.

bodies present upon which the crystals may form.

It seems probable that in these facts we have an explanation of the influence which vegetation appears to have upon the deposit of silicious material in the pools of the geyser basins. The mere presence of the algal filaments as foreign bodies encourages the deposition of silica, and it naturally follows that the greatest amount of silica is thrown down where the vegetation is thickest. This gives us the entire secret of the peculiarities of columns and mouldings. As has been before described, it is the habit of algæ in quiet water to grow up in tufts. A tuft once established leads to the deposition of more silica at that particular spot, and soon there will be formed a little mound or cone, capped and covered by a mass of filament. The algal filaments always tend to grow upward in quiet water, if for no other reason because of the numerous bubbles of oxygen thrown off, which, becoming entangled in the threads, tend to buoy them up. As the algal cap on top of a cone grows upward, more silica is laid down at its base, and so a column of deposit gradually rises. When the cap of vegetation reaches the surface of the water, there is, after the habit of such forms, an immediate radiation of the filaments in all directions. Consequently, when the final deposit of silica is left upon the top of the column, it extends on all sides as an overhanging capital. As the shaft of the pillar is covered with the sheet of vegetation, we can readily understand why it should thicken and why there might be irregular protuberances or even smaller columns rising at different levels along the sides of the larger. Of course, the algal growth will not be uniform on all sides of the pillars, any spot that is especially vigorous leaving a record for itself through a larger amount of mineral deposit.

Much more must be known about the exact conditions of growth in these thermal waters, before the many peculiarities of the mineral deposits are explained. But a new interest is added to the hot springs of Yellowstone Park and their deposits when one thinks of the parts these simple organisms play in the construction.

Children of steam and scalded rock, a story you have to tell,
Writ in the glare of sunshine bright,
Sculptured and etched in marble white,
Illuminated in colors bold,
Richer than ever parchment old,
Children of steam and scalded rock, what is the story you have to tell?

Our legends are old, of greater age than the mountains round about.
We have kept our secrets epochs long,
They are not to be read by the passing throng.
It is nothing to us what men may say.
If they wish our story the price they must pay
In hard brain work, ere the tales are told. We challenge mankind to draw them out.

Children of steam and scalded rock, your challenge must rest for the present age.
I have scarcely broken the outer crust
That covers the greater truth, but I trust
Some man will follow and therein find
Knowledge, that to the Present shall bind
The Past with cords wherein entwine
Threads of the perfect truth, divine.
Children of steam and scalded rock, some man to come will accept thy gage.

BRADLEY MOORE DAVIS.
UNIVERSITY OF CHICAGO.

RAREFIED AND CONDENSED AIR.

AFTER reading Paul Guessfeldt's enthusiastic description of 'mountain-ecstasy,' as he calls it, which the rarefied air of high altitudes produces and which he describes as consisting of 'an increased sense of joy caused by an increased muscular activity, and a wonderful buoyancy of the feelings which at moments rises to ecstasy,' we are tempted to follow him to those heights in order to experience these feelings which can be so easily obtained with a little physical exertion.