THE MEMPHIS DAILY APPEAL.

BY JOHN S. C. HOGAN & CO. MEMPHIS, TENN., FRIDAY, FEBRUARY 22, 1867. VOLUME XVII.-NUMBER 91

MASONIC DIRECTORY.

HEBREW AND MASONIC CALENDAR.

A.·. M.·. 5627.

1 Tisri, 10th September	1866.
1 Kheswan, 10th October	"
1 Chisleu, 9th November	"
1 Tebeth, 9th December	"
1 Shebat, 7th January	1867.
1 Adar, 6th February	"
1 Veadar, 8th March	"
1 Nisan, 6th April	"
1 Ijar, 6th May	"
1 Sivan, 4th June	"
1 Thamuz, 4th July	"
1 Ab, 2d August	"
1 Elul, 1st September	"

Ash Wednesday, 20th February	1867.
Maunday Thursday, 4th April	"
Good Friday, 5th April	"
Easter Sunday, 12th April	"
Ascension, 21st May	"
Pentecost, 31st May	"

Saint Andrew's Day, 30th November in each year. jan2 tf

MASONIC DIRECTORY.

1867.

LODGES.

ANCIENT, No. 80. Meets 1st Monday in every month, at Odd-Fellows' Hall, cor. Court and Main. A. G. Trader, W. M.; H. T. Tomlinson, Sec.

SOUTH MEMPHIS, No 118. Meets 3d Friday of each month.—Hall, cor. Madison and Second. J. T. Sellars, W. M.; Benj. K. Pullen, Sec.

LAULA SHOTT, No. 263. Meets 1st Friday of each month.—Hall, cor. Madison and Second. John Alcofie, W. M.; H. P. Woodward, Sec.

HAMILTON, No. 288. Meets 3d Friday of each month.—Odd-Fellows' Hall. F. M. Stanley, W. M.; W. H. Butts, Sec.

KILWINNING, No. 81 (E. D.) Meets 4th Friday of each month.—204 Front street. John J. Worsham, 336, W. M.; S. K. Fuller, 236, Sec.

ROYAL ARCH.

PENN Chapter, No 1. Meets 2d Monday of each month.—Odd-Fellows' Hall. A. J. Wheeler, H. P.; H. H. Paynter, Sec.

K. AND S. S.

EUREKA Council, No. 6. Meets 3d Monday of each month.—Odd-Fellows' Hall. John Scott, Th. Ill.; N. J. Wiggin, Rec.

TEMPLAR.

CYRENE Commandery, No. 4. Meets 4th Monday of each month. John Grant, Com.; N. J. Wiggin, Rec.

A.·. AND A.·. SCOTTISH RITE.

204 Front Street.

HERMES Lodge of Perfection, 14th; No. 1. Meets 4th Wednesday of each month. John Zent, 32d, G.·. M.·.; H. T. Tomlinson, 32d, Sec.·. MOTHAN Lodge of Perfection, 14th; No. 2. Meets 4th Wednesday of each month. George Mellard, 32d, G.·. M.·.; A. E. Frankland, 32d, Sec.·.

CASTILIAN Council of Princes of Jerusalem, 18th; No. 1. Benj. K. Pullen, 32d, Tarsh.·.; ——, Sec.·.

CALVARY CHAPTER of Rose Croix, 18th, No. 1. Charles W. Adams, 32d, M.·. W.·.; H. T. Tomlinson, 32d, Sec.·.

PHILIPPIC Dodecades Council of K.·.-H.·., 30th, No. 1. Henry P. Woodard, 32d, Comm.·.; William A. Goode 32d, Rec.·.

CONSISTORY of WEST TENNESSEE, 32d. John Leslie, 32d, Comm.·. in Chief; Dodge C. Trader, 32d, Reg.·.

ST. PAUL'S ACADEMY,

HELENA, ARKANSAS.

THE Principal of this Academy begs to inform the parents and guardians of his pupils, and the public in general, that the

New School-Room and Dormitory

attached to the Academy are now ready, affording every accommodation for the advantage of pupils. Prospectus can be had on application to

novlO REV. D. J. COGAN, Principal.

JOHN McCOY, Agent,

PILCHER & BARROW,

(Successors to Pilcher & Goodrich and M. Pilcher & Co.)

COTTON & SUGAR FACTORS

—AND—

Commission Merchants,

No. 38 Factors' Row, Perdido street,

NEW ORLEANS.

Business conducted by M. Pilcher. may22tf

S. KIBBE,

DEALER IN

CHOICE FAMILY GROCERIES

Imported and Domestic

Wines, Liquors, Cigars and Tobacco,

Also all kinds of

CONFECTIONERY, NUTS, ETC.,

No. 412 N. Seventh Street,

Between St. Charles and Locust streets,

ST. LOUIS, : : : : MO.

CASH paid for all kinds of Produce. ag29

J. T. FARGASON, A. CORDES, C. C. CLAY

FARGASON, CORDES & CO.,

Wholesale Grocers,

Commission Merchants,

And Dealers in

Plantation Supplies, Wines, Liquors, Cigars, Etc., Etc.,

NO. 328 FROST STREET,

Memphis, : : : : : Tenn.

HAVE on hand and to arrive—

200 bbls. of Pork;	50 casks Bacon;
500 hhds. Sugar;	50 hhds. Sugar;
500 pieces Bagging;	400 coils Rope;
50 bales India Bagging;	100 cases Brandy Cherries;
50 cases Pigeyott Claret;	200,000 Cigars, various brands;
100 cases Brandy;	1000 bbls. Flour;
100 packages Tea;	200 caddies Western Tobacco;
200 bbls. Molasses;	100 baskets Piper Heidsick and Cliquot Champagne;
100 ½ bbls. Molasses;	100 kegs Molasses;
100 cases Wines and Liquors;	100 bbls. Meal.
500 bbls. Salt;	
100 cases Snuff;	

ag29

A. P. BURDITT JAS. H. SMYTH. ANGUS CAMPBELL.

A. P. BURDITT & CO.,

COTTON FACTORS

—AND—

COMMISSION MERCHANTS.

OFFICE—At their old Grocery stand,

308 Front Street.

Memphis, : : : Tenn.

S. O. & T. A. NELSON & CO.

Cotton Factors

—AND—

COMMISSION MERCHANTS

No. 5 Jefferson Street,

MEMPHIS, TENN.,

and No. 135 Gravier street,

NEW ORLEANS, LA

JOHN G. WALLACE & CO.

Commission Merchants

—AND—

WHOLESALE DEALERS

in Groceries and Plantation Supplies, 316 Front Street,

MEMPHIS TENN.

WE have this day associated with us in business, W. D. SIMPSON, of Memphis, and A. A. OGLESBY, of Panola county, Miss. JOHN G. WALLACE alone is authorized to sign the firm name. JOHN G. WALLACE & CO.

Aug. 20, 1866.

WM. SIMPSON, Tuscumbia, Ala. | F. A. SANDERS, Memphis. | JOHN MOORE, Memphis.

SIMPSON, SANDERS & CO.,

Successors to Simpson, Hays & Co.,

Cotton Factors

—AND—

GENERAL COMMISSION MERCHANTS

No. 256 Front st., MEMPHIS, TENN.

By giving our undivided attention to the sale of Cotton and other Produce, filling orders for supplies, etc., we hope to receive the patronage of the public. may8

Monsarrat & Montgomery,

AUCTIONEERS

—AND—

REAL ESTATE BROKERS,

Ayres Block,

Opposite Court Square.

WE have taken the spacious storehouse in the Ayres Block formerly occupied by Robertson & Mitchell, and will connect with the Real Estate business that of the Auction and General Merchandise. The ample room we now have for the storage of goods and display of the same will give us unusual facilities for disposing to advantage any consignments that may be made to us.

Liberal Cash Advances made on consignments. MONSARRAT & MONTGOMERY.

feb8 tf

J. B. HOOD & CO.,

COTTON FACTORS

—AND—

General Commission Merchants,

100 Common Street, opposite City Hotel,

NEW ORLEANS.

J. B. HOOD, JOHN C. RAGELLI, JESSE O. THAYER. } jel5

MEMPHIS APPEAL.

PUBLISHED DAILY & WEEKLY

—BY—

JOHN S. C. HOGAN & CO.

PRICE OF SUBSCRIPTION.

Daily (in advance) per annum	$12 00
" " per week	25
To carriers and news-dealers, per copy	5
Weekly, per annum (in advance)	5 00

No subscription entered on our mail books for a less time than one month.

RATES OF ADVERTISING.

One square one insertion	$1 00
" " each additional insertion	50
" " two weeks	6 00
" " one month	8 00

All advertisements considered due after the first insertion.

Eight lines of solid nonpareil constitute a square.

All advertisements in the Special Notice column will be charged 20 cents per line.

Marriage and death notices published as other advertisements.

Advertisements to be inserted in the Weekly paper only, or at irregular intervals in either of the papers, will be charged $1 per square for each and every insertion.

All advertisements not marked for a special time will be discontinued at the end of the week.

All advertisements for the APPEAL must be handed in at the Clerk's desk.

Transient advertisements must be paid for in advance.

No advertisement will appear in the Weekly paper unless by special contract.

Our friends are requested to do their best efforts to send in subscribers, and fill up our lists, and also to forward any items of news that may be of sufficient local importance to warrant their publication.

TERMS OF WEEKLY.

As an inducement to get up clubs, we have adopted the following scale of prices, which are as low as our current office expenses will admit of:

One Copy, one year	$5 00
To clubs of ten or more, each	4 50
" twenty or more, each	4 00

Invariably in advance.

THE GLACIERS.

Lecture by Prof. Agassiz on the Ancient Glaciers of the Tropics.

From the New York Tribune, 15]

A large and appreciative audience assembled last evening to listen to the third lecture of Prof. Agassiz. The particular subject selected for the lecture was "The Ancient Glaciers under the Tropics." On coming forward the speaker was received with applause. He then said:

Ladies and Gentlemen: Under the pressure of materials crowding for presentation at the close of my last lecture, I omitted two statements which I would now supply. In the first place, I would say to those who seek for relaxation and pleasure in travel, that the valley of the Amazon is at present accessible once a month from Para, and that in splendid steamships and from Para twice a month for the whole length of the Amazon, with accommodations so comfortable that our best river steamers have nothing better to offer. The other statement I want to make, is for the benefit of those who are looking for private commercial relations with Brazil, and especially with the valley of the Amazon, that all the spices of the east, the pepper, the clove, the nutmeg, camphor, and the like, have been cultivated in the neighborhood of Para, and might be cultivated to such advantage that that country could, under skillful management, share the benefit of the commerce which is now exclusively in the hands of European nations. And now let me call your attention to the subject of this evening's lecture, "The Ancient Glaciers under the Tropics." And at first I would say a few words upon the interest which attaches to the study of the glaciers. It is not long since the study of the glaciers was an accident in the study of physical geography. They were mentioned as curious accumulations of snow formed on the summits of certain mountains, and adding to the beauty of the scenery; but the influence of the glaciers then did not go beyond; that which is derived from the picturesque beauty of these masses of snow and ice. It is no longer so now. The study of their formation; the study of the changes which they undergo; the study of the greater extension and range which they have occupied in former times; the signs which have been traced of their presence in countries where they are no longer to be found; the further tracing of their former presence very far from the regions where they occur at present, have satisfied geologists that our globe has undergone changes of temperature which were not at all suspected before these investigations were made. And if I am not mistaken, I shall be able to-day to prove to you that there was a time preceding immediately the establishment of the state of things which prevails now upon the surface of the globe, and following the last geological convulsions, which have made our earth what it is now; during which the whole surface of the globe was covered by masses of ice as thick, as extensive, as compact, as those which now-a-days are limited to the Artic regions. So that a period of intense cold would have followed those hypertropical periods in geological history which have preceded the coming of man upon the earth. And if this be so, you see that the study of the glaciers may fairly claim your attention, inasmuch as they were it only to test the value of the doctrine which I advance, you may perhaps feel inclined to give me your hearing during this evening. [Applause.] In order to be able to track the glaciers everywhere where they have been, and where they are no longer, it is necessary to become familiar with the signs which they leave where they have been when they disappear; to become familiar with the indications of their former presence. And this can only be reached by a study of the glaciers as they are now. I therefore call your attention, first, to the summits of the Alps, where I find the best opportunities of studying the glaciers of our days, and then gradually invite you to travel over those regions over which the glaciers themselves have moved, and perhaps we shall see that even where the tropical sun of to-day shines, there was at one time a field of ice extending over the valley of the Amazon, that all the spices of the east, the pepper, the clove, the nutmeg, camphor, and the like, have been cultivated in the neighborhood of Para, and might be cultivated to such advantage that that country could, under skillful management, share the benefit of the commerce which is now exclusively in the hands of European nations. And now let me call your attention to the subject of this evening's lecture, "The Ancient Glaciers under the Tropics." And at first I would say a few words upon the interest which attaches to the study of the glaciers. 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The accumulation of snow and ice gradually passing from a more snowy condition into a more icy condition, and descending from the hights where snow falls into the regions where the ice and snow melt every summer. Such are the glaciers; and in their appearance they present unusual beauty. The snow which accumulates at certain hights above the level of the sea, or on the plain within the Arctic, melts only where the average temperature of the year is above thirty-two degrees. Where the average temperature remains below thirty-two, the snow may accumulate; and where large masses accumulate, the snow, if it moves from the place where it falls, may be preserved even where the temperature is above thirty-two. This is what takes place in the Alps. We have unfortunately no glacier region on the eastern side of this continent. There are glaciers only in the Rocky mountains, and on the whole range of high summits, which extend from the Rocky mountains to the southern extremity of South America, varying in hight according to the average temperature of the different levels. Within the Arctic regions the level at which the snow remains perpetually on the ground is at the level of the sea. And this condition of things prevails on this continent, especially in its eastern part, further to the south than in Europe and northwestern Asia. And from that level, which is about sixty degrees northern latitude in Greenland, and about seventy or seventy-one degrees northern latitude in Europe, the snow falls remain on the highlands at higher and higher levels as you approach nearer and nearer the tropics, to the extent that under the tropics, the land of perpetual snow rises to 14,000 feet; while in the temperate regions, under latitude of forty-five degrees say, the hight at which the snow remains permanently on the ground is about 6000 feet above the level of the sea. That is the hight at which the snow remains on the ground throughout the year in the Alps of Switzerland. And yet if you examine the valleys of the Alps, you will find that there is no uniformity in the level at which snow is permanent, but at which the glaciers come down into the valleys, for the obvious reasons that the inequalities of the surface to affect the local temperature, and in many localities, which are as much as eight or nine thousand feet above the level of the sea, warm winds from the south may sweep in such a manner as to melt away the winter snow early in the summer; while in other regions, protected from the softening influence of the warm southern winds, and, on the contrary, open to the the cold influence of northern winds, the snow may remain permanently even below the average level of the perpetual snow. And then, owing to the moving down in broad troughs of these vast accumulations of snow into lower valleys and though they there even meet a higher climate, there is such a mass of snow that even in its downward descent into the warmer valleys it is preserved, to a great extent. In the valley of the Chamouni, 1100 feet above the level of the sea, you see these masses of ice come down from the mountains. In some of the other valleys of the Bernese Oberland, the snow descends to nearly 3000 feet above the level of the sea; while in other regions their lower extreme is as high as 5000 feet, the line of perpetual snow being a little above 6000 feet. Now, this accumulation of masses of ice in certain particular valleys is owing to the form of the ground upon which the large masses of snow may accumulate during the winter. Just as you see in your streets here, where snow has been drifted, ice will be formed by alternate transformation—by alternate thawing and freezing of that snow. And this ice formed out of the snow may remain in these sheltered places much longer than the snow in other parts. In fact, the formation of the glacier is very similar to the formation of ice on our plains, in consequence of the fall of snow and the changes which the snow undergoes during the alternate modifications of the temperature. In order that snow and hail, which are the only forms in which frozen water falls from the sky, may be transformed into the glacier ice, into these compact masses of ice, it is necessary that pressure and thawing should take place, in consequence of which the snow becomes filled with water, and then that part of the snow which has been melted freezing with that which has remained in a crystalized condition, forms a sort of loose, porous ice, a snowy mass which gradually, by the repetition of that process, is transformed into a solid, compact mass of ice widely different from any ice formed by frost upon the surface of water. Glacier ice has none of the properties of ordinary ice except that it is frozen water, for in its structure it is totally different. When a sheet of ice is formed upon the surface by the accumulation of little crystals, sometimes rising from the bottom, sometimes formed at the very surface, and forming an even layer on the whole surface of the water, and gradually growing in thickness by the successive accumulation of similar layers, until the lower temperature of the season being exhausted, that will be covered by a sheet of ice of the thickness which the climatic condition of the country may permit. And that ice, when examined carefully, will be found to be stratified, that is, it presents divisions in layers which mark the successive stages of frost during the alternation of the temperature of day and night, and the alternations of temperature which are above and below thirty-two degrees Fahrenheit. Water freezes only when the temperature falls below, but when frozen, it may be retained in large masses when the temperature rises above. And so, during these intervals the lower surface of the ice which remains on the water may become so modified by air bubbles and by impurities contained in the water, that when a new layer of ice is formed underneath, and under different conditions of temperature, that the new layer differs from the layer already formed. And when you examine the ice which is left at your door, or brought upon your table, you will see that even in small pieces there are indications of stratification resulting from the manner in which the ice is formed. Now, glacier ice is totally different, and the fact that it differs in its structure as much, enables any one familiar with these differences to recognize these immense floating icebergs which we see on the Atlantic, and to ascertain that they are not frozen sea water, but glacier ice formed on land, advanced into the ocean, broken from the mass with which they were attached and then floated away. For like glacier ice, all these floating icebergs show an internal structure totally different from that of frozen water formed upon ponds. The difference arises from the transformation of the layers of snow both by pressure and by thawing. These masses of glacier ice are granular, like a kind of pelting stone, cemented together by water frozen into intervals, and you can readily ascertain that difference of structure by examining the manner in which these two kinds of ice melt. It has been a matter of wonder to seafarers to find that these immense icebergs so suddenly disappear, vanish as it were in a few minutes, while a mass of ice formed on water, which would have these dimensions, takes a long time to melt, because it melts at the surface and gradually diminishes its bulk. But ice from glaciers, owing to its peculiar constitution, and to one remarkable property of that ice, which is its transparency to heat, will permit the sun's says to penetrate its interior, to raise simultaneously the temperature of all the little intervals which intervene between the fragments cemented together, and then disintegrating in mass, an immense iceberg may crumble to pieces and be decomposed into small fragments the size of a hazel knob or an egg, and then all the fragments melt away very rapidly; so that this will explain the rapid disappearance of large icebergs when they have floated into temperate regions, and when they are affected by the temperature of the lower latitudes. I must call your attention to that fact of the transparency of ice to heat, because I shall have to resort to it to explain another curious phenomenon in the glacier. Suppose we have here a large fire, and I place between the fire and myself a large glass screen—a large pane of glass; I shall see through the pane of glass, and see the fire and the blaze, but I shall not feel the heat, because although it is transparent to the light, it opposes to the heat—heat does not readily pass through glass. Hence it is that we make windows of glass, which interferes with the change of temperature from within and without. Take instead of such a glass screen a plate of ice, an ice screen, and place it between you and the fire, and you have the same phenomenon, as to viewing the light—the blaze will be seen—but the heat will pass through it. A pane of the ice is as transparent to heat as a pane of glass is transparent to light. So that through a sheet of ice on the surface of a lake, when the sun shines upon the water, the stones on the bottom receive heat; and in that manner air bubbles are made to rise constantly. Through a large mass of ice, a rock which is at some depths under the surface of the ice may be heated in such a manner that in consequence of it the rock may be exposed and will appear. Suppose that we have here (illustrating by sketches upon the blackboard) the surface of the glacier; that we have here the inequalities of the bottom over which the glacier moves; and that here is a high rock over which it passes, the top of it being only twenty, thirty or fifty feet below the surface. That rock will be so heated through the ice that the ice will melt away above it, and any materials upon the surface of the glacier moving with it—say a boulder, for instance, or a large stone which has fallen upon the surface of the glacier and which is carried along with the glacier as it moves down, when it comes to this point, where the glacier is hollowed by the operation of the rock below, that stone will fall upon this point, and will no longer be carried forward. A glacier has very different aspects in its different parts. Suppose we have here (illustrating by a sketch) mountain inequalities, and that there is here a deep valley coming down in this way; and that upon these inequalities and mountain slopes large masses of snow have accumulated. That snow will remain in its snowy condition at hights, in the latitude of 45° for instance, above 9000 feet; so that everywhere above that level there is perpetual snow resting upon the ground. Yet that snow has not everywhere the same degree of compactness and solidity. The lower it is, the more is it exposed to the slight changes of temperature which affect the sides of the mountain. The snow will be affected less at the hight of 8000 or 9000 feet, and less and less as we go higher and higher. On ascending some of the ice peaks in Switzerland, the highest in the Bernese Oberland, the Jungfrau, I have been able to trace all these changes of temperature in the ice. At the lower end of the glacier, we find that gradually the ice is more porous, and contains a larger amount of fragments in a snow-like mass, and then gradually assumes somewhat of the character of a loose and partially-cemented snow, and then gradually the condition of pure snow—longer in the condition of loose and feathery flakes, but reduced to a condition resembling frozen sand. Such are the differences in the character of the ice; and with them arise also differences in the aspect of the ice. Snow is white because of the large amount of particles of air which it contains in its crystals. If we press snow, and expel from it in that manner the air, we render it less white; and if we dip snow in water and press it afterward, so that water may replace the air, it loses more and more of its white appearance, and becomes more transparent. In proportion as more air is driven away, and as the ice is freer from all particles interfering with the transparency of the mass, the more does it assume a greenish or bluish tinge; and finally when it is perfectly pure and perfectly compact, and when it has very few fissures through its mass, it assumes a deep blue color, which is its natural color. Water, in its natural condition, when in large masses, is blue, as gold is yellow, and silver white; and the ice of the glacier, when it is purest, has always that blue appearance. It is not the result of the reflection of the color of the sky, but it is its natural color. And ice has that beautiful bluish tinge, even when the sky is overcast, or when it rains heavily; and perhaps never does the glacier look more beautiful, appear more transparent and exhibit more glowing colors, than when all the particles that are in a state of decomposition at the surface have been washed by heavy rains. Do not imagine, then, that you have witnessed the glaciers to advantage, when you have walked to the foot of them and witnessed the snowy splendor of their surface. In order to have an idea what the glacier really is, you must see it under all possible conditions of the atmosphere; and just as the sky looks differently under different conditions of illumination by the sun, just as the ocean looks differently under different conditions of agitation, just so does one and the same glacier look differently. When it has been melting at the surface under a hot sun and a succession of thaws, it looks like a withered mass of snow—it looks like a decomposed accumulation of dirty street snow, after it has been melting for some time. On the contrary, let a heavy rain fall upon it, and then all its surface becomes fine; the dirt is washed away, and its glowing colors are brought out; and under these circumstances you should attempt to see the glacier if you want to see them to the best advantage. There are some phenomena connected with the transformation of snow into ice, so that a glacier may be formed, which are peculiar, and the results of which cause such changes upon the ground upon which the glacier rests that the presence of the glacier may be recognized at all times. I will represent two glaciers, in two different positions, so that I may give you some idea of what they are. Suppose I make a section across one of the valleys which are occupied by large glaciers. We have here (illustrating) the mountain slope; here, the bottom of the valley; and here the surface of the glacier which occupies that valley; and here the mountain peaks which rise upon the sides of the glacier. I will suppose that that valley is 5000 feet above the level of the sea, and that the surface of the glacier is 500 or 600 feet above the bottom of the valley—that is, the glacier has a thickness of 500 or 600 feet. I will suppose, too, that there are say 2000 feet of peaks rising above its surface. Now, I will represent the same glacier as seen in profile, as coming down from the mountain into the valley, this being the bottom of the valley, standing from the side of the mountain toward the lowland. I will represent here the surface as covered with snow, and gradually covered with a mass of a more icy character, extending down in this way until it terminates in this manner (continuing his illustrations upon the blackboard.) I will also represent the surface as seen from the surface, so that we shall have as it were a geographical map of the glacier. Suppose that I represent here the triangular promontory of a mountain chain, here another mountain chain, and here a third mountain chain. Here is a valley, and here is another valley. Now, when the effects of this glacier, hardly yet transformed into compact ice, but already having lost in a measure its snowy character. This valley is occupied by another such accumulation of snowy ice, which is gradually passing into the character of ice. These two arms of the glacier here meet together, and form one great glacier occupying this (third) valley, which is the result of the conjunction of these two valleys. What will take place here? From all these mountain sides there are constantly falling blocks of loose material, which separate from the wall of the mountain in consequence of the disintegration of the rock. Suppose that a fragment of the rock, say a stone of considerable dimensions may drop down, sometimes as high as a house and sometimes of smaller dimensions. All these masses will be arrested as they reach the bottom of the slope of the accumulated ice. Suppose I represent here these masses of rocks, the results of the disintegration which is continually going on, as all mountains are constantly falling to pieces. In consequence of this disintegration, immense masses are rolling down at all times. We find that the mass of loose materials and boulders accumulating from any cause, is extraordinary. I represent here all kinds of rocks accumulated upon the edge of the glacier in consequence of this process of disintegration. Where in this profile view, will these rocks be arrested? Here, at the point of contact between the ice and the rock. I must say a word about this before I proceed; I have represented the glacier as arched—higher in the middle than in the center. You see at once why this should be so. The sun shining against the walls will heat the walls, and at the points of contact with the ice, there is a higher temperature than at any distance from it. The natural consequence is that where the glacier abuts against the rock, it is melted down and is rounded off, while the center remains permanent. Now, when masses of rock fall down the mountain slope, they are arrested in these troughs, between the snow and the rock; and we have generally here at the junction, between the stone walls forming the sides of the valleys and the ice itself, these accumulations of rock; and they are sometimes so extensive that they form walls of fifty or one hundred feet or more in thickness or width. Therefore, all along the glacier, everywhere upon its sides, do we find these accumulations; and as these boulders are fragments which have broken away from the mountains, they are angular. The whole of these accumulations of loose materials which fall upon the surface of the glaciers are angular boulders. Now the whole glacier moves, and moves at a special rate. It moves for various reasons. In the first place because of the slope; but that is not, as we shall presently see, the principal cause. It moves in consequence of the freezing of water, resulting from flowing, and which, while freezing, expands. You all know that frozen water occupies more space than liquid water. If you allow water to freeze in a bottle which is corked, the bottle will burst, because ice occupies more space than water. The amount of water which penetrates the ice of a glacier, and penetrates through it, is not only that which results from the melting of the ice; but whenever, instead of snowing, it rains upon the glacier, the rain penetrates into all the holes and fissures in the ice, sinking down in streams in the snow and then, of course, in the course of time it will freeze, and in freezing it will expand, and the natural consequence of expansion is motion. The motion must take place in the direction of the least resistance—that is, down the valley; and the natural consequence of all this is that a glacier is a stationary mass of ice, but is an ever moving mass, the rate of its motion being proportionate to the bulk of the ice. The middle part of the ice, therefore, which is thicker, moves faster than the sides, which are thinner, and the middle part, being the most porous, moves faster than the upper part, which is porous, but allows the water to pass right through, and faster, also, than the lower part, which is more compact, while it admits a great quantity of water. Here I speak from measurements which I have repeated for ten years, and facts I have had an opportunity of observing with the utmost accuracy, and which were controlled by trigonometric surveys which I had made upon the glaciers of the Alps. So that there is nothing theoretical in what I tell you respecting the motions of the glaciers in this region. Suppose this to represent ridges of mountains in the Bernese Oberland; this one representing the Wetterhorn, and this the Finsteraarhorn, and you have here a glacier which I have surveyed for several years in succession, every boulder upon the surface of which stood prominently being surveyed and its position determined with reference to the side of the valley, so that the change of position during one year might be compared with changes in other years, and so that changes might be compared which occurred in different parts of the day. Thus I have ascertained and determined the change which the glacier undergoes during its onward movement, the result, briefly stated, being this: that in this region the movement is about 250 feet in the year, in the center; and the movement down here may be 150 feet in the center; and the movement at the lower end of the glacier will be perhaps only 50 feet a year in the center; while the movement up here may not be more than 200 feet, here not more than 150 feet, and still higher up not more than 20 or 30 feet in a year. All this results from the compactness or porosity of the ice, its capability for the admission of water, to be frozen there, and by its expansion to produce motion in the glacier. Another fact is that the sides move more slowly than the center. I have had stakes placed on two parallel lines, all across the glacier, and at short intervals, so that there were over twenty stakes on each line; and I have had them measured at repeated intervals; and I found that after a year these stakes would present a curve like that; that is, the center had moved the fastest; and on the sides the motion had been less; so that upon the margin the annual motion was hardly more than ten feet, even here, where in the center the motion was 250 feet. Now the masses which fall upon the glaciers will move at the rate at which the corresponding parts of the glaciers move in consequence of their peculiar structure. We shall find that boulders which fall here more very slowly along the edge, and come down to the lower part of the glacier after a very long period. The same will be the case with the boulders and fragments of rocks which are upon this side, all along the margin of the glacier the motion being very slow. But you see that what is here margin, and moves slowly, (including the inner margins of the two uniting glaciers,) when the two branches of the glaciers meet, become the center of the common glacier. Suppose two rivers which flow into one basin, and which unite. The waters flowing into the two rivers by the two sides which meet become the center of the river. So it is with the glaciers, as they meet here. The right side of this one, and the left side of this one, unite; and we have now here a mass of boulders which are in the center of the glacier, and which move at the rate of the snow; so that all the loose materials which accumulate here upon the snow are now moving rapidly downward at the rate of nearly a foot a day during the summer, or less than that during the winter, at an average rate of 250 feet in the year; so that in ten years they will have moved 25,000 feet. You see, therefore, how rapidly these boulders will be transported to the lower end of the glacier, and fall over its edge and terminate here as a concentric wall of loose materials. These accumulations of loose materials from a glacier have received names. They are called *moraines*. We have here (upon one side) a lateral moraine; we have here another lateral moraine; and these two latter moraines form in the center of a medial moraine; and that medial moraine, falling over the lower end of the glacier, derived from the union of two lateral moraines, forms what is called a terminal moraine. Suppose this ice melts away. We should see the materials strangely arranged on the bottom of the valley. We should have a large accumulation of material on the sides of the valley, and not in the center. We should have everywhere angular boulders, and we should have a wall across the valley at the lower end of the glacier, and we should have in the center a wall of equal boulders, distinct, perhaps, from the others. Now, suppose the mountain was granite, the whole of this row of boulders would be granite. Suppose we have here black slate, the whole of this would contain black slate. And suppose that here there were red porphyry, then these boulders would be of red porphyry. Thus we should have three moraines of different character, parallel to one another, one of black slate, one of granite, and one of porphyry; and at the lower end, a transverse wall across the valley, composed of these various materials combined together. Another thing takes place, as the glacier moves in this manner onward. Fragments of rock slip between the ice and the rock; and we have a similar and not an inconsiderable accumulation of such materials between the ice on the bottom of the valley and its sides. As the glacier moves on it is set with stones on its whole under surface; and this is very often quite apparent upon the rocks over which it moves, so that a glacier coming down a valley is like a file set with diamonds, which are constantly grating upon the rocks, constantly grooving, furrowing, polishing and scratching the whole surface which is in contact with the onward nature of the glacier. The effects of this mechanical agency are so peculiar that they are easily distinguished from any other kind of abrasion. I have frequently gone under the glacier. I have penetrated under them upon the side, from the lower extremity, and through cracks in the mass, when it was sometimes gaping sufficiently to enable one to descend into them. And I have seen, wherever there was such an opportunity, how extensively the lower surface of the glacier is studded with fragments of rock set in the ice in a manner which prevented their moving. Thus carried forward with the glacier, you see what a tremendous mechanical effect it will produce. It will polish down the rock, and grind up the minor particles until they are reduced to powder, when they consist of softer rocks ground easily by pressure. Harder stones set like diamonds in the ice will make scratches, and these scratches will be deeper and longer in proportion as the harder fragments of rock are larger, and occupy more space so that moving bodily they may make deeper furrows. All this may be seen under the glaciers, and sometimes under peculiar circumstances, after a more than usual motion. I have found the movements resulting from grinding up in advance of the mass which has produced the motion remaining there in front in the morning, after a heavy frost, so that I can say I have seen the glacier at work doing this kind of work which is so characteristic. Suppose this whole mass melted away, and what should we see? The surface would be polished in a way which nothing else could produce; that polished surface would exhibit small scratches resulting from the small particles of hard material; it would exhibit deeper scratches produced by the action of larger pebbles, and it would exhibit larger furrows resulting from the action of larger masses of rock. All this is easily recognized, and you see I have therefore two signs by which the presence of the glacier may be traced, even if the ice should disappear; one, the peculiar accumulation of loose materials, of rocks that have come down from the mountains and accumulated on the edge of the ice and upon the surface, and the peculiar kind of grinding which the surface of the rock exhibits from its contact with the glacier. Historically, we have the evidence that the glaciers have not always been limited within the boundaries they now occupy. The travelers on the Alps in the thirteenth, fourteenth and fifteenth centuries, and more particularly the investigators of the sixteenth century, who had already begun to explore the Alps and to study the phenomena of the mountains, have left us records of the extension of glaciers within the Alps, and their statements show that where we have now glaciers, there were larger glaciers formerly. According to their statements we can trace the concentric terminal moraines of the present glaciers in consequence of the freezing of water, resulting from flowing, and which, while freezing, expands. You all know that frozen water occupies more space than liquid water. If you allow water to freeze in a bottle which is corked, the bottle will burst, because ice occupies more space than water. The amount of water which penetrates the ice of a glacier, and penetrates through it, is not only that which results from the melting of the ice; but whenever, instead of snowing, it rains upon the glacier, the rain penetrates into all the holes and fissures in the ice, sinking down in streams in the snow and then, of course, in the course of time it will freeze, and in freezing it will expand, and the natural consequence of expansion is motion. The motion must take place in the direction of the least resistance—that is, down the valley; and the natural consequence of all this is that a glacier is a stationary mass of ice, but is an ever moving mass, the rate of its motion being proportionate to the bulk of the ice. 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