Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).............................$3.00 a year.
Scientific American Supplement (Established 1876) .... 5.00 "
Scientific American Building Edition (Established 1885). .... 2.50 "
Scientific American Export Edition (Established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, SEPTEMBER 17, 1898.

WIND BRACING IN FRAMED BUILDINGS.

The use of steel and the introduction of what is known as the "skeleton" system in the construction of large buildings has introduced many structural problems which never troubled the head of the architect in the days of brick, stone, and mortar. Most of these problems have been met and successfully solved by the application of those scientific methods of which we see the most successful applications in the great railroad and highway bridges that have been built in such numbers during the present generation in this country. The strains in the skeleton frame of a modern twenty-story building are calculated with all the care and detail that is bestowed upon the design of a complicated cantilever bridge or the three hundred foot trusses that carry the roof of a terminal train-shed. The weight of each girder, beam, and post, of each wall, partition, and roof, of fittings, furniture, and the possible floor loads of each story are closely predetermined, and the exact distribution of these loads among the various lines of supporting columns is estimated with a wonderfully close approximation to the truth. Knowing the maximum strains that will be brought to bear upon each member of the skeleton, it is a simple matter to provide steel columns of the proper diameter and sectional area of metal to carry the load with a proper margin of safety.

There is one element in the design of skeleton steel buildings, however, which frequently receives too little, if any, attention. We refer to the necessity of providing against the tendency to distortion, or overturning by the wind.

There is no denying the fact that in the earlier tall buildings the provision for wind strains was practically omitted; what lateral stiffness the building did possess being imparted by the riveting of the floor system to the columns and by the inertia of the inclosing shell of masonry. Many of the later buildings are stiffened by connecting the columns at each floor by deep girders—plate girders being used in the lower stories, where the accumulated bending strains of the superincumbent structure have to be resisted, and lighter lattice girders being used on the floors above.

While many of the later and larger buildings are thus strengthened against the bending effects of the wind, there are others in which no such provision exists. This is especially true of the smaller ten and twelve story structures which are being run up by small contractors. The buildings are put up for purely speculative purposes, and every item of cost, including the fees of a skilled architect and engineer, is cut down to the lowest possible limit. One may go out almost any day in our larger cities and see flimsy structures in course of erection, in which the skeleton is entirely of cast iron, and the only protection against the iron work shutting up under the pressure of a gale of wind is the holding power of a few bolts and cast iron lugs and flanges.

In the old system of brick and stone construction the solid walls gave all the necessary stability. They resisted the tendency to overturning or rupture by their dead weight and their inherent transverse strength; but as soon as the skeleton system of construction came in, builders appear to have lost sight of the fact that some form of diagonal bracing was necessary to replace the natural rigidity of solid walls and partitions. Nor does the brick or stone shell with which modern buildings are inclosed give the necessary stiffness, for it is in reality only a system of thin paneling, as it were, built into and carried by the steel frame.

Another point to which too little attention is given in the erection of skeleton steelwork is the provision of adequate temporary bracing during erection. The steelwork is run up and temporarily bolted too far ahead of the riveting, and while the towering columns are safe against ordinary wind pressures, they would be in serious danger of collapse if a storm of unusual severity were to strike them. Timber struts, one-inch screw bolts, and slight guy ropes that are amply sufficient to maintain the towering pile in the perpendicular in still air or ordinary breezes, will splinter and shear and snap asunder the moment a summer tornado bears down upon it.

That these remarks do not apply merely to tall buildings is shown by the collapse last week of one of the great pier sheds which are being erected for the use of the Atlantic liners on the North River, New York city. In saying this we are mindful of the fact that the storm which wrecked the building was cyclonic in its fury and that the structure was being erected by one of the most experienced firms in this class of work in the country. The plans of the shed, which was a huge affair, some 700 or 800 feet long, by 120 feet broad, had been approved by the Dock Board, and they correspond very closely to those of the many large sheds which have lately been erected by the same firm of contractors for other steamship companies. There was no motive for cheap or careless work, and as far as we could judge on a brief inspection of the ruins, the disaster was due to a storm of extraordinary force acting upon a partially erected steel structure whose temporary and permanent stiffening and wind bracing did not prove sufficient for the emergency.

We shall hope to take up the matter again in an early issue, and give an illustrated and more lengthy description of the construction of the shed and the present state of the wreck.

THE BICYCLE FRAME.

Our editorial of August 27 on the increasing weight of the bicycle has brought several letters to this office which deal not so much with the main point of the article as with a concluding suggestion which was made regarding the introduction of a strut within the diamond frame. The paragraph referred to ran as follows:

"It is strange that no maker has succeeded in introducing a feature into the bicycle which is not only thoroughly scientific, but would undoubtedly strengthen it, and at the same time allow a certain reduction in its weight. We refer to the introduction of a cross tie or strut within the frame, running either from the joint at the seat post to the joint at the bottom of the head, or from the top of the head to the crank hanger. The introduction of such a member would make the frame what it is not at present—a truss. It would cause all the strains, whether of tension or compression, to act along the axis of each tube, and it would have the important result of relieving the tubes at the joints of all bending strains acting in the plane of the frame."

Our attention is drawn to two machines in which the frame is an actual truss, that have had the test of hard riding on the road and given good results. The first was built by Mr. W. H. Hale, of New Haven, and in addition to having a strut running from the seat cluster down to the bottom of the head tube, it is an articulated frame, the connections being made by eye and bolt instead of by brazing—the construction thus approximating to that of a pin-connected truss bridge. The pin connections were adopted with a view to providing a "knock-down" machine that would be convenient for transportation, and it will interest our readers to know that this machine may be packed in a box thirty-two inches long by twenty-eight inches wide and seven inches in depth. We must confess, however, that while, under certain circumstances, the snug packing of a wheel would be a great convenience, we would not favor the substitution of bolted for brazed connections. At the same time, we are assured by the designer that while he has built these machines with brazed frames, he greatly prefers the bolted or "sectional" type, because of the ease of straightening frames, replacing broken tubes, or doing the hundred-and-one repair jobs that come to hand.

The machine in question carries a strut from the seat post to the bottom of the head tube in preference to one from the top of the head tube to the crank-hanger, experiment having shown that the former strut gives the best results. As regards the important features of stiffness and weight, we are assured that both are satisfactory. The first machine, which weighed twenty-two pounds complete, has been ridden some twenty thousand miles during the past two years by riders who have weighed up to 220 pounds, and has stood the test without any signs of failure.

This, of course, does not prove that a diamond frame of the same weight and of the common type (that is, without any interior strut) would not stand the same usage; but the presumption is that it would not. In case of collision or running over a large obstacle in the road, the diamond frame as now built is subjected to very severe bending strains at the point where the reinforcement ends, and that buckling is likely to take place at this point many a rider has found to his cost. The introduction of a strut instantly removes these bending strains, and the whole effect of a collision is resolved into simple strains of compression and tension acting along the axis of the tubes.

The thin, large diameter tubing now in use is particularly weak in resisting bending strains and wonderfully strong for its weight in resisting compressive or tensile strains acting along its axis. A parallel illustration of this fact may be shown by rolling up a sheet of drawing paper into a cylinder, standing it on end, and loading it with weights. It will stand an axial pressure out of all proportion to its weight. But if the cylinder be held at its ends and subjected to a bending or transverse strain, it will collapse under a very small load.

The internal strut, however, cannot be used to any advantage in the very low frames that are just now the fad; but when the heads have been again lengthened to reasonable proportions (a change that is likely to be made sooner or later), the obvious stiffening effect of the strut should lead to its early introduction.

Another communication has been received from Mr. Charles E. Duryea, who draws attention to his triangular frame, which consists of a single triangle made up of the rear braces, the forks, and the head, the head and the rear braces meeting under the saddle to form the apex of the triangle. There are unquestionably several points of merit, structurally considered, in this design; but we think that it would be greatly stiffened if the bottom member of the triangle ran straight (instead of in a curve) from the rear hubs to the bottom of the head, and if a center vertical strut were introduced between the apex and the crank-axle bearing. Such a strut would relieve the bottom member of the vertical bending strains and the torsional strains due to the pressure on the cranks. At the same time we think that the best results could be obtained by returning to a reasonable length of head (say twenty-four or twenty-five inches) and introducing a strut into the present type of diamond frame. The diameter of the tubing should be somewhat reduced and its gage increased, although, with the strength imparted by the strut, we question if the present gage would not be found sufficient even with a smaller diameter of tubing.

THE WATER SUPPLY AT CAMP THOMAS.

We have received from Mr. P. A. Maignan, of Philadelphia, a copy of his report recently made to Gen. Breckenridge on the supply of potable water at Camp Thomas. Mr. Maignan was sent to Chickamauga by Gens. Sternberg and Ludington for the purpose of investigating the workings of the water filters at Camp Thomas, and as the report deals at considerable length with the nature of the soil, the drainage of the camp, the quality of the water, and the methods, both mechanical and chemical, by which the water is or may be purified, we shall publish it in full in the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

It appears that nearly the whole camp is located above a magnesian limestone. The surface water passes directly through sink holes and fissures into the small water-pockets struck by the so-called artesian wells. Hence it has no chance of filtering and purifying itself, and after a freshet the wells give turbid water. There is obvious danger in drinking this water from a bacterian point of view, and the report dwells upon the fact that this water, like that of most springs in limestone formation, being very "hard," not only fails to cook the food properly, but has an injurious effect upon nutrition.

The Medical Congress of Brussels, in 1886, passed the following resolution: "Waters that are too hard, or contain mineral matters that are not in the human organism, form with the chyle an abnormal medium for hematosis (formation of blood), and they fatigue the kidneys, whose duty it is to eliminate them unceasingly, and they incrust the articulations." The effect of hard water on digestion is shown by placing the white of an egg in two test tubes with about an equal quantity of bile taken from a freshly killed animal, agitating the mixture and adding to one test tube some distilled rain water or spring water that has been softened, and to the other tube some untreated spring water or hard well water. If the tubes be again agitated, the emulsion in the first case will be perfect and readily assimilate; being perfectly soluble, it will pass into the blood, and give strength. On shaking the second tube, the contents will coagulate. The report states that this hardness of the water has had a great deal to do with the emaciated state of those men who, without any bacterian disease, have lost twenty or thirty pounds in weight. The prevalence of lumbago and rheumatism is attributed to the same hardness of the water.

The first attempt to provide good potable water by the use of asbestos and porcelain filters was a failure, as the muddy condition of the water from the creeks quickly clogged up the filtering material and rendered them useless. The report states that by treating the water with a small amount of lime and iron a heavy precipitate is formed which agglomerates and carries down the finely suspended clay, and that this treatment supplemented by filtration would have provided an excellent drinking water.

Fault is found with the spring water, which, after the creek water was abandoned, was hauled in barrels from different sources of supply. It appears that it was the custom to place an old canvas sack over the top of the barrel below the lid to prevent the spilling of the water. These sacks were often on the ground or on the floor of the wagon, and the impurities they picked up were washed out into the barrel by the splashing of the water against them.

It was the practice in the camp to have this water boiled, but boiling, while it afforded security against microbian diseases, did little in removing the mineral impurities. The recommendations of the report on this head are as follows: In addition to boiling the water, it should be analyzed to determine the exact quantity of hydrate of lime (or common quick lime) to add to the water to precipitate the whole of the bicarbonate, and the amount of carbonate of soda (or common washing soda) to decompose and precipitate the sulphate of lime and magnesia.

The best installation found in the camp was that of the 12th New York. The boilers were placed in a row over a wood fire, and the water was carried boiling into four casks, from which it fell through wooden spigots into four asbestos filters. From the filters the water passed to four other casks in which the ice was introduced. It is suggested that if the 12th New York had put a little lime and soda into the boiling water in the casks, they would have had a drinking water which would have been perfect, being both softened and sterilized.

The 14th New York, under the enterprising command of Col. Wilder, erected a distilling apparatus of sufficient capacity for the whole regiment, which, of course, settled the question of mineral soils and microbes at a stroke.

As a conclusion of the investigation, the report says that the terrible increase of sickness which has caused the camp to be abandoned has had the water supply for the main if not the exclusive cause. The July rains washed the microbe-laden atmosphere and the polluted soil and carried the morbid material into the pockets of water struck by the pumps. The spring water was polluted by the canvas bags and the muddy bottoms of pails. These causes account for the malarial and typhoid cases, while the loss of vitality, the lumbago, rheumatism, and stomach disorders are due, for the most part, to the hard water of the pumps and springs.

In concluding his report, Mr. Maignan states that by taking the precautions as outlined above there is no reason why the National Park at some future time, after suitable disinfection and proper sanitary arrangements for the disposal of excretæ and other waste, should not be a first-rate camping ground.

GEOLOGY AT THE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY E. O. HOVEY.

The numerous receptions and excursions given and arranged for through the hospitality of the citizens of Boston reduced the time for the actual reading of papers to about two days and a half for Section E, which is the department of the association devoted especially to geology and geography. In this time eighteen papers were presented by the Geological Society of America, eight by the National Geographic Society, and twenty-nine by Section E proper. As usual, the geological papers covered a wide range of topics, from the oldest to the newest strata, and included discussions in petrography and mineralogy as well. Before the regular business of the section was taken up, tributes were paid to the memory of Prof. James Hall, the veteran geologist and paleontologist of New York, who died suddenly at Bethlehem, N. H., August 7, of this year, at the age of 87. The speakers on the occasion of the memorial were H. L. Fairchild, B. K. Emerson, W. H. Niles, and H. C. Hovey, all of whom testified to the eminence and high scientific attainments of this the last of the famous coterie of founders of the science of geology in America.

The chairman of the section this year was Prof. H. L. Fairchild, of Rochester, N. Y. He chose for the subject of his set address "Glacial Geology in America." (See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1183, 1184, 1185), and presented a concise review of the history of the progress made in this department of geology.

Fifteen other papers dealt more or less directly with glacial geology, some of which aroused much discussion. The first was entitled "Some Features of the Drift on Staten Island, N. Y.," by Arthur Hollick, of Columbia University. He said, in part: The terminal moraine crosses Staten Island from Fort Wadsworth, at the Narrows, to Tottenville, opposite Perth Amboy, N. J. Its front rests partly upon the serpentine ridge and partly upon the plain region to the south. In the former locality it consists of true morainic material derived from foreign sources. In the latter it consists of a ridge or core of Cretaceous and Tertiary clays, sands, and gravels shoved forward and upward from their original positions on the island, on top of which is the morainal till and gravel. At two localities there are well defined indications of extra-morainic drift, south of the terminal moraine. The direction of glacial movement is indicated by the striæ on rock outcrops to be from about N. 17° W. The most abundantly represented bowlders are those derived from the Triassic, of New Jersey, but others have come from nearly all the outcrops between Staten Island and the Adirondacks. About 120 species of Paleozoic fossils have been obtained from the transported bowlders, and about 35 Cretaceous and Tertiary species, mostly plants, have been found in the drift which were derived from the disturbed Staten Island strata.

In addition to his vice-presidential address, Prof. Fairchild presented two papers on glacial geology. The first pertained to the Finger Lake region of central New York, and supplemented an earlier paper of his on the same subject, detailing many new observations. He has now traced out the beaches which determine the limits of the ponded glacial waters in these curious valleys, and indicate their halt at at least four levels for long periods. The work is much complicated by the post-glacial elevation of the land, which has raised the northern beaches above their original relation to the southern.

In his other paper, Prof. Fairchild described a great "kettle hole" in the gravel plateau above the village of Potter. The explanation of the phenomenon is that an isolated block of ice was left here by the receding glacier, and that the delta sands and gravels were piled around it. The subsequent melting of the ice block produced the cavity.

Warren Upham, of St. Paul, Minn., discussed the evidences of continental elevation and depression immediately preceding and following the ice age. He stated that recent mapping and investigation showed that the pre-glacial elevation in different parts of the world was greater than was supposed forty years ago, and was sufficient to account for the glacial climate. This elevation for the northern half of North America amounted to from 3,000 to 5,000 feet above the present level.

The question as to whether the summits of the White and Green Mountains were covered by the great ice sheet has been much discussed. Fresh evidence in support of the glacier having covered these summits was discovered by Prof. C. H. Hitchcock, of Hanover, N. H., during the past year, who ascended Mount Orford, 5,000 feet high, near Lake Memphremagog, and found it glaciated from bottom to top. The movement of the glacier was from the northwest. A twenty pound bowlder was found on the summit and submitted to Prof. F. D. Adams, of McGill College, Montreal, who determined it to be Laurentian gneiss from the north side of the St. Lawrence River. Previously, Prof. Hitchcock has found similar bowlders on the summits of other of the high peaks of the White Mountains, including Mount Washington. The movement of the Hudson River lobe of the Laurentide ice sheet was to the southeast, over the tops of the White and Green Mountains, to the southwest over the Adirondacks (though Mount Marcy seems to have kept its head above the ice) and due south along the low-lying valley.

The gorge of the Niagara River, from the falls to the escarpment at Lewiston, has always been a region of the highest interest to the geologist as well as to the tourist, hence the importance attached to a paper by Prof. G. F. Wright on "The Age of Niagara Falls as Indicated by the Width of the Gorge at Lewiston." The late Prof. James Hall early noted the significant fact that "the outlet of the chasm below Niagara Falls is scarcely wider than elsewhere along its course." This is certainly important evidence of the late date of its origin, and has been used by the author and others in support of the short estimates which have been made concerning the length of time which has passed since the glacial period. A close examination made by Prof. Wright the past summer greatly strengthens the force of the argument, since he found that the disintegrating forces tending to enlarge the outlet and give it a V-shape are more rapid than have been supposed. Somewhat more than forty years ago a railroad was built along the face of the eastern side of the gorge. Where a vertical exposure was then made, the shale has since crumbled away to an extent of several feet and in some places to that of twenty feet. A conservative estimate of the rate of disintegration for the seventy feet of Niagara shale supporting the Niagara limestone would be one inch a year, with a probable rate twice as great. At the lowest estimate, only 12,000 years would be required for widening the upper part of the mouth of the gorge 1,000 feet on each side, which is largely in excess of the actual amount of enlargement. Some of the recent estimates, therefore, which would make the gorge from 30,000 to 40,000 years old, are evidently extravagant and must incorporate some error in their premises. The gorge cannot be much more than 10,000 years old, and is probably considerably less.

"Another Episode in the History of Niagara River" was the title of a paper by Dr. J. W. Spencer, in which he announced the discovery that, while the falls were receding from Foster's Flats to the point of the railway bridges, the fall of the river reached its maximum height of 420 feet by the retreat of the Ontario waters toward the north. The return to the present height of 326 feet was interrupted by the subsequent rising of the level of the lake in the gorge to a height of 75 feet, thus reducing the actual fall of the river to 250 feet. The evidence of this is preserved in the remains of a terrace deposit opposite the foot of Foster's Flats and a corresponding terrace just outside the mouth of the gorge. The paper was really a sequel to one by the same author presented to the association four years ago on "The Duration of Niagara Falls."

The study of the history of drainage systems is one feature of the border region between geology and physical geography. Prof. W. G. Tight, of Granville, O., read a paper on "The Development of the Ohio River," in which he said in substance:

"A brief review of the literature shows that the generally accepted view is that the Ohio River is a very ancient stream. The work of certain geologists in New York and Pennsylvania indicated the recent origin of the Ohio above New Martinsville. In papers already published by the author the existence of a very ancient erosion basin extending in general from east to west through the central part of Ohio and Indiana is established by the restoration of many tributary drainage lines and by deep wells. Further evidence is presented to show that the Ohio in its present location has been established by the appropriation of sections of numerous north and northwestward flowing streams and their tributaries by the cutting of the ancient cols and the broadening and deepening of the valleys. The explanation for the modifications is found in the position and action of the glacial ice sheet in the various sections, thus determining also the relative age of the Ohio valley to be glacial or post-glacial. The lines of discharge of the glacial waters determined the present lines of southward flowing tributaries of the Ohio. The theory is proposed that the reason for the development of the Ohio River entirely beyond the greatest extent of the ice sheet on the eastern side of the Mississippi and the Missouri almost entirely within the limits of the ice, west of the Mississippi, is due to the different angle which the tributary streams made with the advancing ice front and their gradients; thus forcing the water over distant cols in the former case and retaining the water next to the ice front, thus wearing back the ice at the time of final recession, before the establishment of the channel by down cutting in the latter."

"The Oldest Known Rock," by N. H. Winchell, State geologist of Minnesota, was a communication in which, after a brief description of the other members of the Archean system, the author dwelt more at length on the so-called greenstones of Minnesota, which he considers the bottom of the geological scale and the representative of the original crust of the earth formed from the molten mass by the earliest consolidation. The greenstones, as such, are divisible into two parts, one igneous and the other sedimentary, the latter succeeding the former in point of time, with a confused and sometimes apparently non-conformable superposition, somewhat in the manner that a lot of surface rocks might be superposed in presence of oceanic action on a massive stone of the same nature at the same place. The sedimentary portions of the greenstones vary to more siliceous rocks, constituting great thicknesses of graywackes, phyllytes, and conglomerates, and as such have been converted by widespread metamorphism into mica schists and gneisses, the alteration, coming on by degrees, increasing in intensity toward centers of granitic intrusion and toward the great areas of granite and igneous gneiss which extend over large tracts. The Canadian Laurentian, as a whole, appears to be of later date than the greenstones of Minnesota, since the igneous portions cut them; hence these greenstones must be considered to be the oldest known rock.

The second paper by Prof. Winchell discussed the "Origin of the Archean Igneous Rocks," a topic of great difficulty, but of great interest to all students of the earth's history. The greenstones, which are spoken of in the preceding paper, are supposed to represent the original crust of the earth, and the author denies the possibility of the derivation of the alkaline granitic magma from this ferromagnesian greenstone magma by any of the methods of lixiviation or of differentiation which are currently proposed by geologists who have lately discussed the origin of the igneous rocks. The author holds that the potash resided in the ocean itself, which immediately followed the consolidation of the first crust. Such an alkaline ocean, especially if heated, would hold in solution much silica. Hence followed precipitation of alkaline silicates and of excess of silica. Hence the alkaline character of the schists and gneisses when its sediments were formed into rock and metamorphosed, and hence, when fused, the alkaline magma. The author does not attempt to account for this potassic ocean. He only throws out the suggestion that potassium, from its chemical characteristics, might have remained in the atmosphere until the consolidation of the first crust and the subsequent condensation of the moisture and less volatile vapors formed the ocean.

Our brief review has included only a few of the more popular papers presented before Section E. Although the section is intended to embrace geography as well as geology, only one paper that could be called geographic was presented before it, and it is to be hoped that there will be a marked change in this regard in the future. The value of the meeting was much enhanced to some members of the section by the impromptu geological excursions which were taken to various points of interest in the vicinity of Boston under the guidance of Prof. W. O. Crosby and Mr. J. H. Sears.

The chief officers of the section this year were Prof. H. L. Fairchild, vice-president, and Warren Upham, secretary. For next year the offices are held by J. F. Whiteaves, of Ottawa, Canada, and Arthur Hollick, of New York city, respectively.