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SCIENCE, MECHANIC ARTS AND LITERATURE.

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METEOROLOGY.

METEOROLOGICAL SUB-CONDITIONS.

BY C. A. SHAW, MADISON, WIS.

It seems to be more and more apparent that meteorology belongs to that order of experimental science which depends upon a calculation of contingencies. It resembles medical practice in the fact that for every individual case the treatment must be modified. General principles exist, are to be known, but the empirical practitioner is sometimes more successful in the cure of special diseases. It is hardly possible that in the future it can be safely said: "Two years from date such an epidemic will prevail and such a treatment of all attacked must be resorted to." Even if the first statement was acceded to the second would not be received without opposition. In fact, the difference between a scientific practitioner and the reverse is that the first is not so certain of fixed remedies. He accepts once for all the dictum that "circumstance alter cases," and that "good sense is something that all science needs to make any remedy successful."

In meteorology what is known bears a very small ratio to what is unknown, and the final "why is it," is still less definite than the general term "it may be expected." Even in civil engineering, field-practice modifies a good many theories of the school-room, and the text-book is found lamentably deficient in those details called *practical*, which are the frequent obsticles that inexperience stumbles over in attempting to use astronomical formulas where a rule-of-thumb fits so nicely.

That water runs down hill, that winds blow because mechanical pressure makes them, that clouds change from local conditions, these seem trifling axioms to the too-far-come-seeking meteorologists of some reports, official and otherwise, and yet it can hardly be doubted that the final causes of many atmospheric phenomena are by no means very remote and recondite, but on the contrary near at hand, and having similitudes in *everyday* and trifling experiences.

There is really wanted a well-edited meteorological journal—exclusively meteorological—for every special science needs a special treatment. The habits of mind of all classes of specialists take a peculiar tone from their occupation. As in art, landscape and genera artists agree as to general principles, but differ wldely in their methods of handling and treatment of subject, as in music instrumentalists and vocalists are each bound to special qualities of excellence, so in science, meteorologists cannot move quite easily with naturalists, botanists, archæologists, though there is really more sympathy than divergence between them.

However that may be, the study of meteorology seems now to be, as at first stated, a calculation of contingencies. The atmosphere seems to be a particularly unstable medium. It is exceptionally in extremes, now of heat and cold, now of greater or less pressure, and now of moisture or of dryness. Because it is of one nature to-day we may expect the opposite soon. When the barmometer is high it presages the coming of that which is termed a low. If the track of an area of small pressure is exceptionally out of its normal course it seems to take more time for nature to get back to her established routine, and meanwhile extravagance is the order of her motions.

All this is rather that of a philosophy which deals in chances than with exact science. Is it not possible that for a few years this will have to content us? although we have something fairly certain to go upon. For example, the following is a table of tracks of low barometers during March, from the point of view of a resident of Madison, Wisconsin.

If we were to put in brief form a general statement of weather conditions, it would be something in this form, taking the above table as a text or reference sheet. Taking for example,

GENERAL CONDITIONS OF STORM AREAS.

A difficult problem in modern meteorological science is the discovery of a reason for the variation of these almost periodic low barometer tracks. That there are normal directions corresponding to the several seasons of the year, is certain, and also that there are divergencies frequent enough to be expected, though when and where still eludes accurate formulating. If it be true, as those who favor the mechanical or theory of vortices believe, that there is a permanent northwesterly current north of us and a permanent south and southeast current south to southeast of us, and that their meeting and conflict, now to the partial advantage of the one and now to the partial advantage of the other, produces

A COMPARATIVE TABLE OF LOW BAROMETER AREAS DURING MARCH, 1882.

DATE.	4th	8th	11th	14th	17th	20th	23d	25th	28th
General Direction of Wind Preceeding Low Barometer.	NE	NE	SW	SW	SE	N	NW	NW	NW
Barometer Reading before Storm.	30.37	30.35	30.17	30.25	30.25	30.12	30.38	30 40	29.95
Average Velocity of Wind before Storm	10	12	15	10	10	10	14	16	20
General Direction of Wind during Fall of Barometer.	E	E	W	SE	E	E	W	SE	S
Maximum Velocity of Wind during Fall.	32	20	28	21	25	28	18	15	28
Total Wind during Fall. (24 hours).	519	300	172	274	449	418	283	326	458
Lowest Barometer Reading.	29.68	29.74	29.86	29.90	29.68	29 53	30.08	29.39	29.55
Average Fall per hour. (Gradient).	.05	.03	.02	.02	.04	.05	.01	.03	.03
Total Rain-fall during Fall of Barometer.	.58	.34	.06	.28	.15	.74	0	.40	0
General Direction of Wind after Storm.	SW	NW	NW	N	NW	W	N	NW	W
Maximum Velocity of Wind during Rise of Barometer.	25	34	24	14	25	32	30	25	28
Total Wind during 24 hours Rise.	385	449	387	218	270	503	400	415	514
Barometer Reading after Storm.	30.10	30.20	30.17	30.25	30.10	30.30	30.40	29.95	30.40
Average Rise. (Gradient per hour).	.03	.03	.02	.02	.03	.05	.02	.02	.05
Total Rain-fall during Rise of Barometer.	0	.45	0	.02	.35	.07	0	1.39	0
Direction from which Storm Approached.	SW	SW	W	NW	W	SW	W	W	NW
Passed Madison to the North, South, or Centrally.	S	S	N	C	S	C	N	N	N
Direction after Passing.	N of E	NE	E	SE	E	N of E	E	E	E

In effect, this is nearly the same as the following table, which possibly the editor will omit.

WEATHER REPORT—LOCAL SUMMARY FOR MARCH, 1882.

SIGNAL SERVICE U. S. A., MADISON, APRIL 1.

MARCH, 1882.	Mean Daily Barometer.	Mean Daily Thermometer.	Prevailing Direction of Wind.	Barometer—Rising or Falling.	Highest Temperature.	Lowest Temperature.	Rainfall—inches.	Maximum Hourly Velocity of Wind.	Total Number of Miles in 24 hours.
1	29.779	47.7	W	29.70	62	37	. . .	18	213
2	30.110	45 3	NW	R	61	37	. . .	20	175
3	30.318	40.3	NE	30.37	50	34	. . .	13	188
4	29 937	38.3	E	29.68	43	33	.58	33	519
5	29 827	35.7	SW	R	43	32	. . .	25	385
6	30 218	25.3	W	. . .	32	23	—	22	356
7	30.620	22.0	NE	30.65	29	15	—	17	249
8	30.357	30.0	E	F	36	23	.13	13	211
9	29.903	26.7	N	29.75	30	25	.66	34	484
10	30.270	29.7	NW	30.30	35	25	—	16	257
11	30.160	29.3	SW	F	33	26	.05	12	181
12	29.935	26.7	W	29.87	33	22	.01	24	301
13	30.162	25.7	NW	R	34	17	—	18	278
14	30 129	32.3	SE	F	39	27	.25	21	274
15	30.052	34.7	N	R	37	32	.05	16	218
16	30.302	35.7	E	30.36	40	31	—	20	184
17	29.911	36.7	E	F	38	34	.32	25	449
18	29.870	39 0	NW	29.67	49	35	.08	22	270
19	30.174	39.0	N	30.25	48	30	—	12	158
20	29.734	38.7	E	F	43	35	.74	28	418
21	29.722	24 3	W	29 56	39	19	.07	32	503
22	30.328	29.7	NW	30.38	39	22	—	25	372
23	30.200	34.0	NW	F R	49	22	. . .	30	445
24	30 401	23.7	N	High	35	14	. . .	24	276
25	29.916	36.0	SE	F	43	31	.35	25	326
26	29.586	39.7	N	29.39	49	35	.95	12	118
27	29.761	36.7	NW	R	43	33	.49	25	415
28	29.832	43.7	S	F	50	32	. . .	28	372
29	29.793	45.0	W	R	58	36	. . .	28	514
30	30.431	32.3	NW	30.48	41	27	. . .	25	307
31	30.213	43.3	S	F	57	31	. . .	. . .	. . .
S'm	. . .	.	. . .	. . .	. . .	. . .	4.73	. . .	9732
M'n	30.063	34.4	NW	. . .	42 5	28 2	. . .	21	314

these cyclonic nuclei which express themselves as storm centers; or whether it be that there are, perhaps, stationary heapings of atmosphere along certain latitudes which push shoulder to shoulder, like two athletes, and mutually struggle to encroach and prevent encroachment; or whether local influences, variations in the distribution of heat, either of territorial action, or from equinoctial shiftings or other suppositions, none can be applied with a dominant purpose of practical utility.

Of the immediate effect, however, of the passage of one of these areas of lower pressures the conditions follow very regularly. As the depression approaches from the west or southwest, the wind begins to blow from the southeast to east, increasing in force as the greatest gradient is reached. If the area passes south of a station, the wind follows it round from the northeast to north and northwest. If it passes to the north of the station, the wind takes a reverse direction from the southeast to south and southwest, the velocity of the following wind being dependent upon similar differences of pressure as that which acted during its approach.

The rainfall, it is to be noticed, depends rather upon local conditions, as the greater or less humidity which the winds possess from passing over areas of snow or bodies of water. It frequently happens that a wind partially saturated receives sufficient additional moisture to produce precipitation over a damp district, which would be inoperative over a dry one.

The normal action of an area of low barometers seems to depend upon its free passage in the line of its natural direction. If this course is interrupted, as by the opposition of a body of air of greater pressure, so that its movement is delayed or wholly arrested, the tendency is to narrow its dimensions, sometimes to turn it aside, and generally to increase its destructive cyclonic tendencies, while not infrequently a second area is developed at some distance to the south, which moves obliquely to join it. The contrary effect of a dissipation of a marked area results when opposition to its movements becomes removed. Its force is then expended in a lateral expansion.

Perhaps this dissipation is the result of a secondary formation, which causes a transference of direction of pressure, for if we look at the line of a track of low barometer we cannot fail to be struck by its valley-like line. It is as if it were the track of a marble among shifting elevations of an agitated soil.

Whatever electrical influences may accompany the passage of a storm area their accessory nature seems quite well proven. Their intensity is certainly associated with peculiar conditions of the atmosphere rather than with variations in its pressure, as indicated by the barometer, and if it can be shown that the mechanical action of the winds is the chief element of these disturbances there will be renewed the extraneous and conflicting theories which now distant the gathered facts and prevent accurate formulating of simple mechanical causes for their results.

WEATHER REPORT FOR APRIL, 1882.

FROM OBSERVATIONS TAKEN AT LAWRENCE, KANSAS, BY PROF. F. H. SNOW, OF THE STATE UNIVERSITY.

During this month the temperature and cloudiness were above the average, while the rainfall and wind velocity were nearly normal. The cold week, from 9th to 16th, produced only harmless "white frost," so that the immense fruit crops have escaped entirely uninjured. There was a brilliant auroral display on the night of the 16th, and a curious storm of almost impalpable dust on the 18th from 5 to 5:30 p. m.

Mean Temperature—56.83°, which is 3.02° above the average April temperature of the fourteen preceding years. The highest temperature was 88°, on the 1st and 21st; the lowest was 35°, on the 11th; monthly range, 53°. Mean at 7 a. m., 52.23°; at 2 p. m., 65.38°; at 9 p. m., 54.88°.

Rainfall—3.20 inches, which is 0.17 inches above the April average. Rain fell on nine days. There was no snow. There were five thunder showers, of which four were accompanied by hail. The entire rainfall for the four months of 1882 now completed, has been 7.18 inches, which is 0.62 inch below the average for the same period in the fourteen preceding years.

Mean Cloudiness—51.77 per cent of the sky, the month being 3.06 per cent cloudier than the average. Number of clear days, 12, (entirely clear, 4); half clear, 6; cloudy, 12, (entirely cloudy, 6). Mean cloudiness at 7 a. m., 57.33 per cent; at 2 p. m., 55.33 per cent; at 9 p. m., 42.66 per cent.

Wind—Southwest, 21 times; southeast, 17 times; northeast, 15 times; south, 9 times; north, 9 times; northwest, 8 times; west, 6 times; east, 5 times. The entire distance travelled by the wind was 14,226 miles, which gives a mean daily velocity of 474.20 miles, and a mean hourly velocity of 19.76 miles. The highest velocity was 40 miles an hour, from 2 to 4 p. m. on the 17th.

Mean Height of Barometer—29.032 inches; at 7 a. m., 29.065 inches; at 2 p. m., 29.006 inches; at 9 p. m., 29.027 inches; maximum, 29.449 inches, on the 29th; minimum, 28.542 inches, on the 21st; monthly range, 0.907 inches.

Relative Humidity—Mean for month, 61.7; at 7 a. m., 69.8; at 2 p. m., 48.7; at 9 p. m., 66.8; greatest, 100, on the 22d; least, 21.3, on the 30th. There was no fog during the month.

The following table furnishes a comparison with preceding Aprils :

APRIL.	Mean Temperature.	Maximum Temperature.	Minimum Temperature.	Rain, Inches.	Mean Cloudiness.	Miles Wind.	Mean Humidity.
1868	49.65	83.0	25.0	2.95	52.00	. . .	. . .
1869	51.44	87.0	18.0	2.43	51.00	. . .	72.1
1870	56.84	91.0	19.0	1.08	49.33	. . .	54 7
1871	57.90	92.0	30.5	2.38	47.11	. . .	53.5
1872	56.42	85.0	30.0	4.74	55.12	. . .	56.5
1873	48.85	88.0	26.0	4.42	55.89	18.371	63.4
1874	48.77	83.0	22.5	2.86	51.11	14.784	57.7
1875	49.70	82.0	23.0	2.54	48.22	14.144	57.6
1876	55.60	87.5	30.0	3.38	44.78	14.442	59.6
1877	53.90	81.0	25.0	3.13	53.00	11.976	64.9
1878	58.60	82.0	36.0	5.48	38.22	11.482	66.0
1879	56.40	84.0	20.0	4.18	49.67	11.231	61.0
1880	56.92	93.0	31.0	1.75	34.56	16.709	53.4
1881	52.47	84.0	13.0	1.27	51.78	14.495	67.6
1882	56.83	88.0	35.0	3.20	51.77	14.226	61.7
Mean of 15 Aprils.	54.01	86.0	25.5	3.04	48.91	14.184	60.7

PRECIPITATION AND AVERAGE TEMPERATURE FOR MARCH, FOR EIGHT YEARS AT MORRISON, ILLINOIS.

S. A. MAXWELL, VOL. OBS. U. S. SIG. SERV.

YEAR.	PRECIPITATION.	TEMPERATURE.
1875	1.00 Inches.	29.09°
1876	8.09 "	31.58
1877	5.19 "	26.70
1878	1.85 "	48.05
1879	2.40 "	39.57
1880	2.37 "	36.37
1881	2.85 "	28.88
1882	3.25 "	37.37
MEANS	3.37 Inches.	34.70°

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.29, on the 30th. Lowest barometer during month 28.56, on the 20th.

Highest temperature during month 87°, on the 2nd. Lowest temperature during month 4°, on the 12th.

Highest velocity of wind during month 60 miles, on the 25th.

The usual summary by decades is given below.

Temperature of the Air.	ar. 20th to Apr. 1st.	Apr. 1st to 10th.	Apr. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	29.0	49.4	33.5	37.3
Max	62.0	75.5	52.3	63.3
Min. and Max	45.5	62.4	43.0	50.3
Range	34.0	26.1	19.1	26.4
Tri-Daily Observations.				
7 a. m.	39.9	57.6	43.4	47.0
2 p. m.	61.1	69.9	55.3	62.1
9 p. m.	47.0	59.0	47.4	51.1
Mean	49.0	60.6	48.3	55.9
Relative Humidity.				
7. a. m.	.78	.78	.72	.76
2 p. m.	.43	.58	.61	.54
9 p. m.	.60	.76	.77	.71
Mean	.60	.70	.70	.67
Pressure as Observed.				
7 a. m.	29.01	28.87	28.96	28.95
2 p. m.	28.99	28.86	28.91	28.92
9 p. m.	28.99	28.86	28.89	28.91
Mean	29.00	28.86	28.92	28.93
Miles per Hour of Wind.				
7 a. m.	19.0	15.9	14.1	16.3
2 p. m.	28.7	26.2	19.1	24.7
9 p. m.	21.3	15.6	15.0	17.4
Total miles	6616	5035	4099	15750
Clouding by Tenths.				
7 a. m.	3.4	5.6	5.2	4.7
2 p. m.	3.1	5.9	6.2	5.1
9 p. m.	1.7	5.0	4.9	3.9
Rain.				
Inches	.00	2.30	.58	2.88

THE ARRIVAL OF MAN IN EUROPE.

BY JOHN FISKE.

Toward the close of the Pleistocene age, the general outlines of the European continent had assumed very much their present appearance everywhere except in the northwest. The British Islands still remained joined to one another and to the Gaulish mainland, and occupied the greater part of the area of the German Ocean. According to Mr. James Geikie, the connection with Norway again became complete, and the Atlantic ridge was again so far elevated as to bring Scotland into connection with Greenland through the Faroe Islands and Iceland. The whole of Britain stood at an average elevation of from 600 to 1000 feet above its present level. The Thames, Humber, Tyne, and Forth, must all have flowed into the Rhine, which emptied itself into the North Sea beyond the latitude of the Shetlands. The glaciers of Europe had retreated within the Arctic Circle, or up to the higher valleys of the great mountain ranges; and the climate was beginning to assume its present temperate and equable character.

At this remote epoch Europe had already been inhabited by human beings during several thousand years. How long before the beginning of the Pleistocene period man had arrived in Europe is still open to question; but there is no doubt whatever that he lived in Gaul and Britain as a contemporary of the big-nosed rhinocerous, and before the arrival of the Arctic mammalia which were driven from the north as the glacial cold set in. This race of man—described by Mr. Boyd Dawkins as the "River-Drift-Man"—is probably now as extinct as the cave-bear or the mammoth. Late in the Pleistocene period it disappeared from Europe, and was replaced by a new race, coming from the northeast, along with the musk-sheep and reindeer, and called by the same eminent writer the "Cave-Man." Both the Cave-Men and the Red-Drift men were in the stage of culture known as the Palæolithic, or Old Stone Age; that is, they used only stone implements, and these implements were never polished or ground to a fine edge, but were only roughly chipped into shape, and were very rude and irregular in contour. The Palæolithic Age, referring as the phrase does to a stage of culture, and not to any chronological period, is something which has come and gone at very different dates in different parts of the world. It may be convenient to remember that in northwestern Europe it seems to have very nearly coincided with the Pleistocene period, provided we also bear in mind that the coincidence is purely fortuitous.

The implements of the River-drift men, found in Pleistocene river-beds, are very rude, and imply a social condition at least as low as that of the Australian savages of the present day. "They consist," says Mr. Dawkins, "of the flake; the chopper or pebble roughly chipped to an edge on one side; the *hâche* or oval-pointed implement, intended for use without a handle; an oval or rounded form with a cutting edge all round, which may have been used in a handle; a scraper for preparing skins; and pointed flints used for boring." Man did not then seek for the materials out of which to make these weapons or tools, but "merely fashioned the stones which happened to be within his reach—flint, quartzite, or chert—in the shallows of the rivers, as they were wanted, throwing them away after they had been used." No pottery of any sort has been found in association with these implements, nor were there at that period any domesticated animals. The River-drift men were evidently no tillers of the ground, neither were they herdsmen or shepherds; but they gained a precarious subsistence by hunting the great elk and other deer, and contended with packs of hyænas for the caves which might serve for shelter against the storm. As to what may have been the social organization of these primeval savages, nothing whatever is known. They were a wide-spread race. Their implements have been found, in more or less abundance, in Britain, Germany, France, Spain, Italy, Greece, Northern Africa, Palestine, and Hindustan. Their bones have been found in the valleys of the Rhine, the Seine, the Somme, and the Vezère, in sufficient numbers to show that they were dolicocephalic or long-headed race, with prominent jaws, but no complete skeleton has as yet been discovered.

These River-drift men, as already observed, belonged to the southern fauna which inhabited Europe before the approach of the glacial cold. As the climate of Europe became arctic and temperate by turns, the River-drift men appear to have by turns retreated southward to Italy and Africa, and advanced northward into Britain, along with the leopards, hyænas, and elephants, with which they were contemporary. But after several such migrations they returned no more, but instead of them we find plentiful traces of the Cave men,—a race apparently more limited in its range, and clearly belonging to a sub-arctic fauna. The bones and implements of the Cave-men are found in association with remains of the reindeer and bison, the arctic fox, the mammoth, and the woolly rhinoceros. They are found in great abundance in southern and central England, in Belgium, Germany, and Switzerland, and in every part of France; but nowhere as yet have their remains been discovered south of the Alps and Pyrenees. A diligent exploration of the Pleistocene caves of England and France, during the past twenty years, has thrown some light upon their mode of life. Not a trace of pottery has been found anywhere associated with their remains, so that it is quite clear that the Cave-men did not make earthenware vessels. Burnt clay is a peculiarly indestructible material, and where it has once been in existence it is sure to leave plentiful traces of itself. Meat was baked in the caves by contact with hot stones, or roasted before the blazing fire. Fire may have been obtained by friction between two pieces of wood, or between bits of flint and iron pyrites.

Clothes were made of the furs of bisons, reindeer, bears, and other animals, rudely sewn together with threads of reindeer sinew. Even long fur gloves were used, and necklaces of shells and of bear's and lion's teeth. The stone tools and weapons were far finer in appearance than those of the River-drift men, though they were still chipped, and not ground. They made borers and saws as well as spears and arrow-heads; and besides these stone implements they used spears and arrows headed with bone, and daggers of reindeer antler. The reindeer, which thus supplied them with clothes and weapons, was also slain for food; and, besides, they slew whales and seals on the coast of the Bay of Biscay, and in the rivers they speared salmon, trout, and pike. They also appear to have eaten, as well as to have been eaten by, the cave-lion and cave-bear. Many details of their life are preserved to us through their extraordinary taste for engraving and carving. Sketches of reindeer, mammoths, horses, cave-bears, pike and seals, and hunting scenes have been found by the hundred, incised upon antlers or bones, or sometimes upon stone; and the artistic skill which they show is really astonishing. Most savages can make rude drawings of objects in which they feel a familiar interest, but such drawings are usually excessively grotesque, like a child's attempt to depict a man as a sort of figure eight, with four straight lines standing forth from lower half to represent the arms and legs. But the Cave-men, with a piece of sharp-pointed flint, would engrave, on a reindeer antler, an outline of a urus so accurately that it can be clearly distinguished from an ox or a bison. And their drawings are remarkable not only for their accuracy, but often equally so for the taste and vigor with which the subject is treated.

Among uncivilized races of men now living, there are none which possess this remarkable artistic talent save the Eskimos; and in this respect there is complete similarity between the Eskimos and the Cave-men. But this is by no means the only point of agreement between the Eskimos and the Cave-men. Between the sets of tools and weapons used by the one and by the other the agreement is also complete. The stone spears and arrow-heads, the sewing-needles and skin-scrapers, used by the Eskimos are exactly like the similar implements found in the Pleistocene caves of France and England. The necklaces and amulets of cut teeth and the daggers made from antler, show an equally close correspondence. The resemblances are not merely general, but extend so far into details that if modern Eskimo remains were to be put into European caves they would be indistinguishable in appearance from the remains of the Cave-men which are now found there. Now, when these facts are taken in connection with the facts that the Cave-men were an arctic race, and especially that the musk-sheep, which accompanied the advance of the Cave-men into Europe, is now found only in the country of the Eskimos, though its fossil remains are scattered in abundance all along a line stretching from the Pyrenees through Germany, Russia, and Siberia,—when these facts are taken in connection, the opinion of Mr. Dawkins, that the Cave-men were actually identical with the Eskimos, seems highly plausible. Nothing can be more probable than that, in early or middle Pleistocene times, the Eskimos lived all about the Arctic Circle, in Siberia and northern Europe as well as in North America; that during the coldest portion of the Glacial period they found their way as far south as the Pyrenees, along with the rest of the sub-arctic mammalian fauna to which they belonged; and that, as the climate grew warmer again, and vigorous enemies from the south began to press into Europe and compete with them, they gradually fell back to the northward, leaving behind them the innumerable relics of their former presence, which we find in the late Pleistocene caves of France and England. The Eskimos, then, are probably the sole survivors of the Cave-men of the Pleistocene period: among the present people of Europe the Cave men have left no representatives whatever.

With the passing away of Pleistocene times, further considerable changes occurred in the geography of Europe and its population. Early in the Recent period the British Islands had become detached from each other and from the continent, and the North Sea and the English and Irish Channels had assumed very nearly their present sizes and shapes. The contour of the Mediterranean, also, had become nearly what it is now; and in general such changes as have occurred in the physical structure of Europe during the Recent period have been comparatively slight. Of the mammalia living at the beginning of this period, only one species, the Irish elk, has become extinct. The gigantic Cave-bear, the cave-lion, the mammoth, and the woolly rhinoceros had all become extinct at the close of the Pleistocene period, and the elephants and hyænas had finally retreated into Africa. In Europe were now to be found the brown and grizzly bears, the elk and reindeer, the wild boar, the urus or wild ox, the wolf and fox, the rabbit and hare, and the badger; and along with these there came those harbingers of the dawn of civilization,—the dog and horse, the domestic ox and pig, with the sheep and goat. A new race of men, also, the tamers and owners of these domestic animals, had appeared on the scene. These new men could build rude huts of oak logs and rough planks, made by splitting the tree trunks with wedges. Such work was not done with chipped flint-flakes. The men of the early Recent period had the grindstone, and used it to put a fine edge on their stone hatchets and adzes; so that their appearance marks the beginning of a new era in culture. The sharp and accurate edge of the axe, unattainable save by grinding, is the symbol of this new era, which is known to archæologists as the Neolithic, or New Stone Age.

The huts of the Neolithic farmers and shepherds were built in clusters, and defended by stockades. Wheat and flax were raised, and linen garments were added to those of fur. The distaff and loom, in rude shape, were in use, and grain was pounded in the mortar with a pestle. Rude earthenware vessels were made, sometimes ornamented with patterns. Canoes were also in use. The dead were buried in long barrows, and from the almost constant presence of arrow-heads, pottery, or trinkets in these tombs it has been inferred that the Neolithic men had some idea of a future life, and buried these objects for the use of the departed spirits, as is the custom among most savage races at the present time

The celebrated lake-villages of Switzerland belong to the Neolithic or early Recent period; and the remains of their cattle and of their cultivated seeds and fruits have thrown light upon the origin of the Neolithic civilization. It is certain that the domestic animals did not originate in Europe, but were domesticated in Central Asia, which was the home of their wild ancestors; and, moreover, they were not introduced into Europe gradually and one by one, but suddenly and *en masse.* It is clear, therefore, that they must have been brought in from Asia by the Neolithic men; and the same is true of the four kinds of wheat, two of barley, the millet, peas, poppies, apples, pears, plums, and flax, which grew in the gardens and orchards of Neolithic Switzerland.

This rudimentary Neolithic civilization was spread all over Europe, with the exception of the northern parts of Russia and Scandinavia; and there can be no doubt that it lasted for a great many centuries. It certainly lingered in Gaul and Britain long after the valley of the Nile had become the seat of a mighty empire; perhaps even after the Akkadian power had established itself at the mouth the of Euphrates, and "Ur of the Chaldees" had become a name famous in the world. Still more, it is clear that the Neolithic population has never been swept out of Europe, like the Cave-men and the River-drift men who had preceded it, but has remained there, in a certain sense, to this day, and constitutes a very important portion of our ancestry.

So many skeletons have been obtained of the men and women of the Neolithic period that we can say, with some confidence, that the whole of Europe was inhabited by one homogeneous population, uniform in physical appearance. The stature was small, averaging 5 feet 4 inches for the men, and 4 feet 11 inches for the women; and the figure was slight. The skulls were "dolicocephalic," or long and narrow; but the jaws were small, the eyebrows and cheek-bones were not very prominent, the nose was aquiline, and the general outline of the face oval and probably handsome. In all these points the men of the Neolithic age agree exactly with the Basks of northern Spain, the remnant of a population which at the dawn of history still maintained an independent existence in many parts of Europe. By their conquerors, the Kelts, who led the van of the great Aryan invasion of Europe, these small-statured Basks were known as "Iberians" or "westerners" (Gael *iver*, Sanskr. *avara*, "western"), and "Iberian" is now generally adopted as the name of the race which possessed the whole of Europe in the Neolithic age and until the Aryan invasions, and which still preserves its integrity in the little territory between the Pyrenees and the Bay of Biscay. The Iberian complexion is a dark olive, with black eyes and black hair; so that we may figure to ourselves with some completeness how the prehistoric inhabitants of Europe looked.

It is probable that in Neolithic times this Iberian population was spread not only all over Europe, but also over Africa north of the Desert of Sahara; so that the Moorish and Berber peoples are simply Iberians, with more or less infusion of blood from the Arabs, who conquered them at the end of the seventh century after Christ. And it is also probable that the Silures of ancient Britain, the Ligurians of southern Gaul and northern Italy, and the rich and powerful Etruskans all belonged to the Iberian race.

In very recent times—probably not more than twenty centuries before Christ —Europe was invaded by a new race of men, coming from central Asia. These were the Aryans, a race tall and massive in stature (the men averaging at least 5 feet 8 inches, and the women 5 feet 3 inches), with "brachycephalic" or round and broad skulls, with powerful jaws and prominent eyebrows, with faces rather square or angular than oval, with fair, ruddy complexions and blue eyes, and red or flaxen hair. Of these, the earliest that came may perhaps have been the Latin tribes, with the Dorians and Ionians; but the first that made their way through western Europe to the shores of the Atlantic were the Gael, or true Kelts. After these came the Kymry; then the Teutons; and finally—in very recent times, near the beginning of the Christian era—the Slavs. These Aryan invaders were further advanced in civilization that the Iberians, who had so long inhabited Europe. They understood the arts which the latter understood, and besides all this, they had learned how to work metals; and their invasion of Europe marks the beginning of what archæologists call the Bronze Age, when tools and weapons were no longer made of polished stones, but were wrought from an alloy of copper and tin. The great Blonde Ayrans everywhere overcame the small brunette Iberians, but, instead of one race exterminating or expelling the other, the two races everywhere became commingled in various proportions. In Greece, southern Italy, Spain, and southern France, where the Iberians were most numerous as compared with the Aryan invaders, the people are still mainly small in stature and dark in complexion. In Russia and Scandinavia, where there were few Iberians, the people show the purity of their Aryan descent in their fair complexion and large stature. While in northern Italy and northern France, in Germany and the British Islands, in Iberian and Aryan statures and complexions are intermingled in endless variety. * * * —*Atlantic Monthly.*

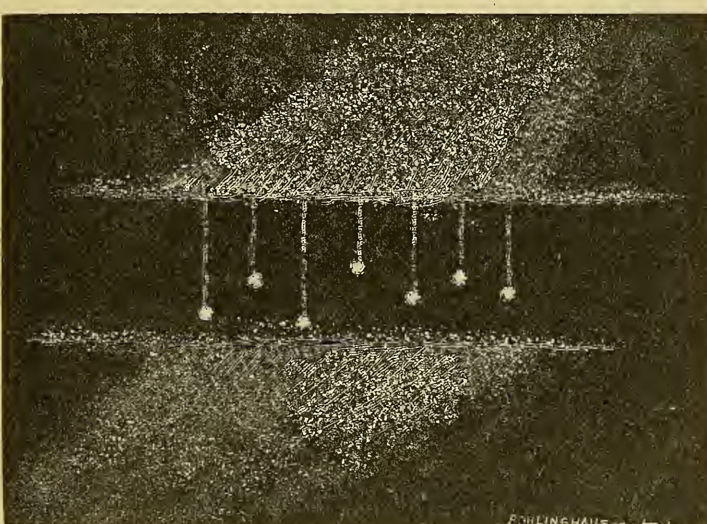
ASTRONOMY.

AURORAL PHENOMENA ON THE EVENING OF SEPT. 12, 1881.

BY E. A. ENGLER, WASHINGTON UNIVERSITY, ST. LOUIS.

As an addition to data from which a more complete knowledge of certain celestial phenomena now unexplained may in future be derived, it may not be out of place to record a description of a peculiar and interesting phenomenon seen by the writer and others at sea off the coast of Newfoundland.

On September 12th, 1881, after a nine days' voyage on the Atlantic from London towards Halifax, N. S., Cape Race was sighted about noon. Our course after noon was about southwest; at eight o'clock in the evening (ship's time) our position—estimated roughly by the course and speed of the ship—was Lat. 46° N., Long. 55° W. The sky was partly clear in the north and west and overhead, but hazy and in places cloudy in the south and east. The aurora was clearly to be seen in the northern sky, sometimes shooting up streamers of light nearly to the zenith, and varying continually in form and brightness; this display, however, was no more brilliant or interesting than many similar ones seen on other nights, and deserves mention only to be distinguished from the following. But in the southeast sky, about 30 or 35 degrees above the horizon, there appeared two horizontal streaks of light—about five 5 degrees apart and 15 or 20 degrees in length—which at the time I took to be two clouds highly charged with electricity. The accompanying sketch (Fig. 1) will be of service in describing the appearance, but must not be taken as accurate in any detail, being made after some months and from memory; moreover, the entire phenomenon was continually changing. Both streaks were luminous, with a pale hazy light very similar to moonlight. From the upper of the two were suspended by small cords of light a number of balls, brighter than either of the streaks, which were continually jumping up and down in vertical lines, much after the manner of pith-balls when charged with electricity. Above the upper streak there was a bright space, whose sides were convergent at about the angle shown in the sketch, which seemed to be composed of streamers of light, gauzy in appearance and decreasing in brightness from the streak outwards. From the lower streak a similar mass of light extended. The only difference noticed in the two streams of light was that the inclination of the lower was greater than that of the upper.



(Fig. No. 1.)

I appeared on the scene about fifteen or twenty minutes after the beginning when the brilliancy of the display was approaching a maximum. Soon after it began to fade, the balls and cords first gradually disappearing, then the streamers of light on both sides, and finally the two horizontal streaks—the whole being lost to sight in the darkness in the course of about fifteen minutes.

When first seen the phenomenon had the appearance shown in the sketch (Fig. 2.), kindly furnished me by Prof. Halsey C. Ives, who had the good fortune to see the display at the beginning, but lost the latter part of it. The sketch gives an idea of what he saw only in general form. He says that it did not seem to him that there were clouds, but rather a space between clouds through which light was streaming; the upper luminous appearance seemed to him to be an inverted reflection of the lower one. The position remained unchanged during the whole time.

No explanation of the phenomenon is offered.

The matter may have a wider interest when it is remembered that on the evening of September 12th, at the fame hour, a most remarkable band of white light was seen at Albany, N. Y., Utica, N. Y., Hanover, N. H., Boston, Mass., and elsewhere in the North Atlantic States, spanning the heavens from east to west near the zenith. The following account of the phenomenon seen at Albany, given by an assistant at the Observatory, is taken from the Albany *Argus*:

(Fig. No. 2.)

"At eight o'clock I first saw it, and its effect was absolutely startling. It spanned the heavens from east to west, and seemeed of very nearly equal breadth the whole distance. It was sharply defined. At its southern edge it extended from the horizon through Zeta and Delta Bootis; thence through Nu Pi Hercules, to and through Alpha Lyra. From that point it extended to the south of the Great Square in Pegasus. The northern branch in the east extended up through the head of Draco, and there seemed to be a strong ray of light, very marked, continuing from Gamma Bootis, while around to the north there were several parallel streaks inclined at an angle of fifty degrees with the general motion of the phenomenon. Three or four of these were noticed near the head of Draco. At 8:30 it was observed to clear away on the zenith. The eastern portion now consisted of a narrow strip, very bright, clearly marked at the edges, extending from Gamma Pisces through Alpha Lyra, and at the same time seeming to be moving southwest, it being about thirty degrees from he zenith and appearing to roll like columns of smoke spirally towards the west. At 8:33, in the east were two parallel streaks, the northern the heavier and the southern throwing out diverging lines of light that seemed to gradually curve as they approached the zenith. At 8:35 o'clock the main branches had separated at the zenith, while the western one was very narrow, extending through the Northern crown. A small line of light now extended from a point about three degrees north of Alpha Lyra to a point about seven degrees from Eta Ursa Major. At 8:39 a brighter streak appeared between Alpha Lyra and Ursa Major, while that over the Crown was broken up into a series of parallel, smaller and fainter streaks. The eastern branch was now very faint and narrow, and extended nearly from Pi Pisces to Alpha Lyra, while all along the northern horizon was a bright rosy glow like the Northern Lights, but brightest toward the west. At 8:45 the phenomenon presented a faint, yet beautiful appearance, and 8:55 it had vanished."

In the Kansas City Review of Science and Industry, November, 1881,. Prof. S. A. Maxwell, Morrison, Ills., remarks:

"The mysterious band of light seen at Albany was probably, what I have stated, a mere auroral arch, but, appearing as it did in the zenith, more nearly resembled a band than an arch. The same viewed from a lower latitude would have presented an arch-like appearance, similar to those often seen by us in the distant north; and these latter would present to an observer beneath them the same band-like appearance seen at Albany."

My point of observation was north and east of any I have seen mentioned; some other explanation is needed for the appearance there presented.—*Transactions St. Louis Academy of Science.*

COINCIDENCE OF SUN SPOTS AND AURORAL DISPLAYS.

PROF. EDGAR L. LARKIN.

Sunday, April 16th, will pass into the history of astronomy as an eventful day. From morning to night the solar surface was in violent agitation, while colossal centers of cyclonic activity were clearly seen in telescope. There were 111 spots seen during the day, the largest being 67,000 miles in length and 48,000 miles in width. These were arranged in ten clusters, none being far from the equator of the sun. Thirty-four spots was the largest number seen in any cluster. Each aggregation of spots had one or two very large, the remainder varying in size from medium to small. The large spot was seen at this Observatory at 8 A. M. April 15, already advanced on the eastern edge of the sun 15 degrees. Throughout the 15th it did not display unusual turbulence, but during Saturday night activity set in, for on Sunday morning its appearance and internal structure had materially changed. It was cut into four portions by what was termed "bridges" of fire. But these bridges did not maintain the same position an hour. They were widening, contracting, or bending into ever-changing forms. They were white-hot; that is, whiter than the solar disc,—presumably hotter. One could not see them move any more than the hour-hand of a clock can be seen in motion, but on returning to the telescope after an interval of half an hour, displacement could be detected. At 9 A. M. two tongues of fire were pointing toward each other from opposite sides of the abyss, and at 12:30 P. M. P. M. passed, leaving quite a space between. Shortly after they began a curvature, which, at 2 P. M., formed a circle, clearly a case of solar cyclone.

A sun-spot is composed of two portions, the umbra and penumbra. The umbra is the dark central portion, while the penumbra or border is many shades lighter, yet, much darker than the disc of the sun. The penumbral fringe looks like a down-rush of matter into or upon the umbra; its sides are inclined, and are striated throughout, the striæ having the appearance of willow leaves laid on the incline, parallel to one another, their small ends projecting over the back umbra, giving the edge of the penumbra a serrated form, like saw-teeth. When many of these projections join and receive an impulse, they pass entirely across the umbra, forming an incandescent bridge. And Sunday every large spot had bridges complete or in the process of formation. In the large chasm, at about 4:30 in the afternoon, one of the bridges split lengthwise, the separation requiring more than two hours, while the ends of several jets were tufted and tasseled with filaments of white hot matter, which coinciding near the center of one of the largest divisions, presented the appearance of the whirlpool rapids below Niagara, should that frenzy of water be instantly rendered motionless. We have no spectroscope, but with one of good dispersion we should have been able without doubt to behold movement in the troubled mass; or, at all events, the displacement of hydrogen lines in the spectrum of the seething vortex. Neither have we a micrometer; hence were not able to arrive at accurate measurement. But the results above, 67,000 miles in length and 48,000 miles in breadth, are within 2,000 miles of the truth. The width given is that at the maximum point; the spot, contracting somewhat toward the solar equator, gives it the shape of a rude triangle. Calculating its area, we found that thirty worlds like the earth, side by side, could plunge at once into the mighty gulf and be destroyed in a moment. Measurement was made by time of transit of longest diameter of spot over central wire in eye-piece, the time being ten seconds. But one second of time of the earth's rotation equals fifteen seconds of arc, celestial space. One second of space on the sun is 450 miles, and the diameter of the spot being 15,000 seconds arc, made 67,500 miles. Several spots beside had diameters of from 5,000 to 10,000 miles, which, forming centers of clusters, gave the solar disc an impressive aspect. There were three faculæ also on the sun—brilliant spaces much brighter than the general surface. The terrestrial atmosphere being in fine condition for telescopic manipulation, the "rice-grains," granulations and pores all over the sun could be distinctly seen. Altogether the day was one of moment in the means offered of studying solar phenomena, and we shall be impatient until Prof. C. A. Young makes a report of his observations with the diffraction spectroscope, scarcely daring to think even of a possibility of clouds hanging over Princeton, N. J. We watched the sun the entire day, and when it disappeared in the west, wished the day might be longer, but night brought still other wonders in the heavens.

At 9 P. M., while viewing Wells' comet, it waned and disappeared. Looking out to learn the cause, its obscuration was found to come from the rising arc of an aurora. The advancing phenomenon presented a yellowish-green arc of a circle, whose altitude was eighteen degrees--nearly half way to Polaris—and whose ends rested on the eastern and western horizon. The thickness of the light was five degrees, clear sky showing the stars in Cassiopeia, being between it and the horizon. The center of the auroral arc did not appear to be on a line below the pole star, so we proceeded to measure its displacement with the declination circle on the telescopic axis. The eastern termination of the arc was only fifteen degrees north of the equator, while the western was twenty-five degrees, the center, therefore, being ten degrees east of the pole of the heavens. For nearly an hour the apparition developed no sign of coming grandeur, but at 10 P. M., three pillars of crimson light shot up to an altitude of forty degrees from the western extremity of the arc, a few yellowish streamers ascending in the east. These outbursts seemed to be a preconcerted signal with the celestial pyrotechnists, for within two minutes the whole arch flashed and trembled, and then expanded, ascending eight degrees. A halt was made, which lasted, however, not more than one minute, when two flashes in rapid succession were seen throughout the widened arc now twenty degrees broad. A mighty upheaval followed, the apex of the band at once rose to Polaris, filling the northern heavens with supernal light brilliant enough to read by; but the terminal points on the horizon, east and west, did not draw nearer the earth's equator. The altitude of the pole at this place is forty-one degrees, and as there was open sky under the band ten degrees wide the belt was thirty degrees broad. The great aurora reserved its forces a few moments and then discharged simultaneously hundreds of columns of scarlet, violet, and light yellow flames, instantly converging at the zenith.

This display waned only to make way for another more magnificent; and so the whole night passed, outbursts succeeding in rapid movement. From midnight to 1 A. M. the phenomena was at its heighth, the whole northern heavens from the horizon to the equator being striped and banded with varying streamers. Flashes were incessant. A wave of light would appear in the northern horizon, and instantly rush to the zenith, producing curvature in the straight columns, which at once resumed their original position when the wave subsided, only to be wrought again within a few seconds. The whole northern hemisphere quaked with the rapidity of lightning without cessation during the hour succeeding midnight, each outburst of energy impelled light-emitting matter directly to the zenith, when it was no longer subject to upheaval, but floated slowly south. Much of this actually descended as far as Scorpio, thirty degrees south of the equator, so that nearly the entire celestial vault was filled with corruscation. This unparalled display of auroral activity was still in motion at 4:30 A. M., when the solar rays obscured the scene. The sun-spot maximum occurs at periods of eleven years, and we are now in the midst of one of these ; but it is now known that auroral displays and secular disturbance of the earth's currents of magnetic energy, as indicated by diurnal oscillation in declination of the needle, also have eleven years as their periodic time of maximum, and behold both epochs are coincident with the maximum solar period of upheaval. When the sun's surface is in agitation we have auroras and large vibration in the magnetograph following terrestrial magnetic storms.

A remarkable solar phenomenon occurred on the sun Sept. 1, 1869, and was seen by two observers at the Kew Observatory in England. Two jets of the most brilliant light burst from the solar surface just preceeding a large spot. These remained in view five minutes and moved 33,700 miles. The time of the occurrence was noted, and then the self registering magnetographs were examined, and, to the astronomer's surprise, were found to have been in great agitation at the precise time of the outburst, showing that magnetic force, whatever it may be, does not require time to traverse the distance of the sun, while light consumes eight minutes in the journey. In sixteen hours the earth suffered a magnetic disturbance, telegraph offices were set on fire, and an aurora was seen in the evening. [See Chambers' Astronomy, pp. 22–3.] These facts show that there exists a magnetic relation between the sun and earth, whose nature cannot be surmised, and auroral displays are doubtless electric or magnetic; yet this branch of science is so barren of facts that an opinion, even, on these topics cannot be formed.

The perpetual flashing of the aurora, Sunday night, was its most noteworthy feature, and seemed to clearly indicate its electric character. Polariscopic research into the nature of the light might be of service, while it is to be hoped spectra of the last display were closely examined. Study was made of auroral phenomena during the last maximum, 1870–3, but spectroscopes of such power were not then in use as may now be obtained. Anybody with a smoked glass can now see the great spot on the sun with no other optical aid. It will be well to deposit the carbon film on the glass with varying degrees of thickness. The solar turbulence, the aurora, and Well's comet are making lively astronomical times

THE AURORA OF APRIL 16, 1882.

NOTES AND OBSERVATIONS BY A. W. BROWNE, OF THE U. S. SIGNAL SERVICE, LEAVENWORTH, KANSAS.

The Aurora Polaris is a luminous appearance frequently seen near the horizon as a diffuse light like the morning twilight, whence the title "aurora." In this hemisphere it is usually termed "Aurora Borealis," on account of being seen chiefly in the north. Its congener when seen in the southern hemisphere, is called "Aurora Australis;" both may be more pertinently classed "aurora polaris," or polar light.

At 9 o'clock Sunday night a horizontal light, similar to the morning aurora or break of day, was observed along the northern horizon; gradually but steadily it extended in length and height, and after a lapse of fifteen minutes several vertical, luminous beams of a pale yellowish tint, and extending to from 30 to 40 degrees above the horizon, appeared, thus presenting unmistakable evidence of the appearance within our visual range of that beautiful and sublime phenomenon, the "Aurora Polaris." A 9:20 these beams vanished, and were immediately followed by several faint arches appearing simultaneously and parallel; they were arcs of small circles, our meridian bisecting the uppermost one at a point 30 degrees above the horizon. Beams similar to but more numerous than the primary ones shot up from these arches, while a dark segment obscured that portion of the heavens nearest the horizon, and continued throughout the successive recurrences. A more decidedly active phase of the display developed at 10 P. M., when a column of a rosy hue shot up from the horizon, at a point west of north, and quickly deepened to almost a blood red; as if by preconcertion a series of similar columns appeared in rapid succession to the right of it. They were of less width, but of greater altitude, some reaching to as high as eighty degrees above the visible horizon, and extending from north to nearly due east. This first began to wane at 10:20, and fifteen minutes later only a faint trace of the display could be seen. Traces of diminished activity continued until shortly after midnight, when an almost identical recurrence of the last active display took place. Details are therefore unnecessary. It was, however, of greater extent, as the space along the horizon from 45 degrees west of north to due east, or in all 135 degrees of the celestial vault was almost simultaneously covered with auroral light, many of the columns going as high as the "Zenith." This spectacle lasted about twenty minutes, and then the usual faint trace of diminished activity ensued until 3:10 Monday A. M., when a reaction took place, and the grandest display of the night was presented by the appearance of the "merry dancers." The space over which they frolicked was not so extended as that occupied by the previous display, 60 degrees of the horizon would embrace its eastern and western limits, the "polar star" was observed to be in the exact center of this group of luminous beams which were arranged very closely and though slender, presented unbroken outlines as they reached up to zenith, where they seemed to converge as if forming the ribs of a great dome; along the base of these columns was a dark slate colored segment which terminated at 150° above the horizon; from behind this segment horizontal flashes of light rolled up in rapid and successive waves along the luminous beams; these were the "merry dancers." The "polar star" was noted again and none of these waves were seen to pass it, most of them vanished when within 10 degrees of it. This, the grandest display of series of the late phenomenon was of about the same duration as the others, again came the usual familiar sky, and shortly afterwards the twilight arc proclaimed that the orb of day was approaching, before whose light all luminaries should pale, and so ended the auroral display of that night, but not until a fitting "finale" was had by a merry dance. The basis of the auroral light is electricity, in fact it may be considered an electric light. True, it is not so brilliant as the light of the same name as that produced by mechanical appliances. This is owing to the diffusion of electricity over a space of great extent, while in the case of the artificial light the electricity is concentrated and the arc of light instead of being diffused is made to flash from one point. That the air is highly charged with electricity during the existence of auroral displays, has been amply verified by the difficulty experienced during Sunday by telegraphers. The dispatches traversed the wires during the active displays in a confused and unintelligible manner, and at times the magnets were almost solely under the influence of nature's great electric battery the "Aurora Polaris."

VARIETIES OF AURORA.

Auroras exhibit an infinite variety of appearances, but they may generally be referred to one of the following:

First—A horizontal aurora or break of day. The polar light may be distinguished from the true dawn by its position in the heavens, since in the United States it always appears in the northern quarter.

Second—An arch of light somewhat in the form of a rainbow. This arch frequently extends entirely across the heavens from east to west, and cuts the magnetic meridian nearly at right angles. This arch does not long remain stationary, but frequently rises and falls; and when the aurora exhibits great splendor several parallel arches are often seen at the same time, appearing as broad belts of light stretching from the eastern to the western horizon.

Third—Slender luminous beams or columns, well-defined and often of a bright light. These beams rise to various heights in the heavens, sometimes, though rarely, passing the zenith. Frequently they last but a few minutes sometimes they continue a quarter of an hour, a half hour, or even a whole hour—sometimes they remain at rest, and sometimes they have a quick, lateral motion.

Fourth—The coronæ luminous sometimes shoot up simultaneously from nearly every part of the horizon and converge to a point a little south of the zenith, forming a quivering canopy of flame, which is called the corona. The sky now resembles a fiery dome, and the crown appears to rest upon variegated fiery pillars which are frequently traversed by waves or flames of light. This may be called a complete aurora, and comprehends most of the peculiarities of the other varieties. The corona seldom continues complete longer than an hour. The streamers then become fewer and less intensely colored; the luminous arches break up, while a dark segment is still visible near the northern horizon, and at last nothing remains but masses of cirro-cumulus clouds.

Fifth—Waves or flashes of light. The luminous sometimes appear to shake with a tremulous motion; flashes like waves of light roll up toward the zenith, and sometimes travel along the line of an auroral arch. Sometimes the beams have a slow lateral motion from east to west. These sudden flashes of auroral light are known by the name of the "Merry Dancers," and form an important feature of nearly every splendid aurora.

The color of the aurora is very variable. If the aurora be faint its light is usually white, or a pale yellow. When the aurora is brilliant, the sky exhibits at the same time a great variety of tints; some portions of the sky are nearly white, but with a tinge of emerald green; other portions are of a pale yellow or straw color; others are tinged with a rosy hue, while others have a crimson hue, which sometimes, but rarely, deepens to a blood red. These colors are ever varying in position and intensity.

There was another display on Thursday morning ult., lasting from after midnight until daybreak, with recurring fits of activity, but not so brilliant or extending over so much of the heavens as that of Sunday night. Although somewhat similar, with the exception that the phenomenon of the "Merry Dancers" did not occur during the display.

A remarkable and very rare phenomenon occurred during this display, viz: The sky became obscured and a light shower of rain fell from 1:35 A. M. to 1:45 A. M., shortly afterwards the sky became clear, and disclosed auroral activity simi ar to that of Sunday night, but not extending to so high an altitude. The highest beams did not reach above 60°, nor were the colors as brilliant or so well defined.

COMETS.

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Such is the magnificent aspect of comets, such their shape, so remarkable the contrast between them and the surrounding stars, so capricious do they seem in their movements, so seldom do they appear and so quickly do they vanish, that it is by no means strange that their appearance should fill the ignorant with alarm and the wise with admiration and curiosity.

Previous to the apparition of the celebrated comet of 1680, we may say nothing was known of the motions of these extraordinary bodies, except that they had been observed to make their appearance among the stars, approach the sun for a certain time, and then recede until lost in the depths of space.

In elaborating the principle of gravitation, Sir Isaac Newton had demonstrated that any body revolving about the sun under the dominion of that principle must describe some one of the conic sections, with the sun at its focus, and that the particular conic described would be determined solely by the velocity of the body at any given point of its orbit. I have here a cone so cut as to show the curves alluded to.

A body moving with a velocity equal to that which it would acquire by falling directly to the center of the sun (supposing the attraction of the sun for the body not to vary as the distance diminished) will move in a parabolic orbit. If the orbital velocity be less than this, the body will move in an ellipse. If it be greater, the orbit will be an hyperbola, the sun in every instance being situated at the focus.

For that portion of this theorem relating to elliptical orbits Sir Isaac Newton found immediate application in our planetary system, and his wonderful sagacity had anticipated that its more general application would be found in the motions of comets. The appearance of the great comet of 1680 afforded him a most excellent opportunity. He found this comet to move in an orbit which, if an ellipse, was so greatly elongated as to be undistinguishable from a parabola. The period of this comet is estimated at 575 years, and it is supposed to be identical with the comet of 1194 B. C.; with that of 618 B. C.; with that of 43 B. C., which was supposed to be the soul of Cæsar taking its place in heaven; with that of A. D. 575, which was seen at noonday close to the sun; and with the magficent comet of A. D. 1105.

Applying the above theorem to the comet of 1682, Sir Edmund Halley was led to predict its reappearance in 1759—a prediction fully justified by the event. This comet again appeared in 1835, and is again due at its perihelion in 1910.

Since the year 1680 several comets have appeared which were found to move in hyperbolic orbits, viz: those of 1723, 1771, and the second comet of 1818.

Now, since the parabola and hyperbola are curves of infinite length, it is evident that comets moving in either of these could never before have visited our system, nor is it possible that they should ever return. Again, it is found that while all the planets revolve around the sun in the same direction and nearly in the same plane, *comets* move in any direction and in planes greatly inclined to each other, which shows that they cannot be regarded as permament members of our system.

It is interesting to speculate upon the career of a comet which moves in an orbit of infinite length. We cannot but think, as it has visited us on one branch of such a curve to retire on the other, that at some time in the past it must have swept around some fixed star or sun, whose distance can be measured by no means at our disposal, and that on its outward journey it will reach a point at which the attraction of some other fixed star will predominate and cause the comet to visit it, just as it did our sun. And as these comets may thus in time traverse the utmost bounds of space in search of equilibrium, so may, and so does, our ponderous sun himself obey the same law and traverse space about some unknown center of force; and thus is it possible that he may now be moving in a cometary orbit, from which he will ultimately be deflected into a planetary by some sun mightier than he, and by the process of cooling and perturbation be reduced to the state of a planet, while the planets of his own system will become his satellites. If such a speculation be admissible, it is easy to see that in time all matter would be caused to revolve around a common center, and all systems would be reduced to one.

The motion of a comet as it recedes from the sun becomes slower and slower, so that comets of parabolic or hyperbolic orbits may reach such a great distance that their motion may be but a few feet per second. Now, such is the immense distance of the fixed stars that such a velocity may obtain before any one of them would exert a predominant influence upon the motion of the comet; and this, it is reasonable to suppose, is generally the case.

If, now, we remember that the form of orbit is determined by the velocity, we are led to suspect that, generally, comets leaving our system on hyperbolic or parabolic orbits will visit other systems on ellipses, and that comets leaving other systems on these infinite curves would be most apt to visit us in ellipses. This may explain why so few of the comets which approach the sun move in hyperbolic orbits. Since there can be but one velocity which gives a parabolic orbit, while an increase or diminution of same would give either an hyperbola or an ellipse, we may assume that few if any comets ever moved in strictly parabolic orbits. And should a comet at any time move on a parabola, it would soon be forced to abandon it for either an ellipse or hyperbola by the attractions of other bodies.

There is great difficulty in determining the exact orbits of comets: First, because (as will be shown further on) comets are very light bodies, and therefore their motions are subject to great derangements from the attractions of the planets. Second, because in most cases they can be observed while traversing only a small portion of their orbits. By lengthening out an ellipse it may be made to approach more and more nearly to the form of a parabola, so that if the two be placed with their vertices touching, they may be made to coincide for a greater and greater distance. It will be seen, therefore, that if a comet can be observed only while it is within the limits of this coincidence (which is always the case with comets of so-called parabolic orbits), it is impossible to determine the orbit beyond. A good illustration of this is afforded in the theory of projectiles. We are taught that, neglecting the resistance of the air and the motion of the earth, a body projected in any direction except vertically will describe a parabola. Now, in order that a body so projected should describe this curve, it must be given a velocity equal to that which it would acquire by falling to the center of the earth, supposing all the matter in the earth collected at that point, and the acceleration to be constantly equal to 32.2 feet per second. This would be about seven miles per second; and since no such velocity can be given to a projectile, it is evident that they all move in ellipses so very much elongated that there is no objection to regarding them as parabolas.

The difficulty, therefore, in calculating the orbits of comets is not caused by any defect in theory, is not because these bodies refuse to obey the same laws which control the motion of all matter; but simply because it is not always possible to obtain sufficient data. While science has thus reached the motions of comets, and shown them to consist of inert matter, obeying the general laws of motion, it has been able to postulate little with regard to their physical constitution.

Situated in the head of a comet is a bright nucleus like a star; next this and surrounding it is a comparatively dark substance, and next this last is a bright envelope which covers the head of the comet on the side next the sun, and trails off into space forming that remarkable appendage which renders these bodies so conspicuous. This train or tail is in some instances projected to the most enormous distances—that of the comet of 1680 attaining the length of 123,000,000 miles—a distance much exceeding that from the earth to the sun.

The process of forming the nebulous envelopes and the tail often results in giving to comets the most gigantic dimensions—the volume of the great comet of 1843, for instance, including, of course, its tail, being at one time more than three times that of the sun. This immense size indicates either a vast amount or an extreme tenuity of cometic matter. That these bodies contain but a small quantity of matter was shown in the case of Lexell's comet of 1770. Lexell had calculated the period of this comet to be about five and one-half years, yet the comet has never since been seen.

In seeking for the cause of its failure to appear as expected, it was found that on the occasion of its first return in 1776 it was completely hidden by the rays of the sun, and that in 1779 it approached so near the giant planet Jupiter as to become, as it were, entangled among his moons, the effect of which rencontre was to deflect the comet entirely out of its orbit, so that it either no longer moves around the sun in an ellipse, or if so, does not approach sufficiently near to become visible to us. While the comet was so remarkably affected there was not the slightest visible change produced in the motions of any of Jupiter's satellites, which must have resulted had the mass of the comet been at all comparable with that of those small bodies.

We have seen that the volume of the great comet of 1843 was more than three times that of the sun.

Now the earth is about 5,000 times as dense as ordinary air and the sun about one-quarter the density of the earth but contains about 314,000 times as much matter—so that if the great comet of 1843 had been of the mean density of ordinary air it would have contained nearly 1,000 times as much matter as the earth. Now if this comet was at all analogous to that of Lexell, and there is every reason to believe so, it could not have contained the $\frac{1}{1000}$ part of the mass of the earth, so that its mean density probably did not exceed the $\frac{1}{1000000}$ of the density of the air we breathe.

Comets being thus known to be bodies of small mass and great size it is natural to suspect them to consist principally if not entirely of gas. There is some question, however, as to whether a body composed entirely of gas could exist in outer space: some holding that the repulsive properties of such a state of matter would dissipate it indefinitely, to be disrupted and appropriated by bodies more dense and rigid. Against this it may be said that "Marriotte's Law of the Compression of Gases" indicates that the expansive force of a gas diminishes as the *cube* of the distance between its particles increases, while the gravitation of these particles toward each other is known to diminish as the *square* of their distances from each other increases. So that the expansion of a gaseous body in outer space would be arrested within finite limits by the gravitation of its particles.

I am led to present the two sides of this question from a remark in a very able and interesting essay on Comets by Professor Lewis Boss, of the Dudley Observatory, published in the April number of the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, where he states that "It is certain that no body entirely gaseous could exist in space."

With all due respect to the learned Professor I will say that science seems to answer the question differently. It is, however, generally conceded that while they are not composed entirely of gaseous matter, to some degree gas is present in cometary structures. Again it has been ascertained that comets shine in some degree by native and in some degree by reflected light, and the weight of scientific opinion is in favor of regarding the bright nucleus as a solid or liquid body in an incandescent state. Therefore, if we, for instance, suppose a comet freed from that influence which produces its tail we would have a body consisting of a glowing mass at the centre and surrounded by a highly attenuated substance shining partly by reflected light.

This is in fact the shape to which comets generally approach as they recede from the sun; in which, it is believed, lies the agency which produces the tail. A total eclipse of the sun reveals that he is surrounded by a luminous envelope, to which the name of "corona" has been given, which has been perceptible for a distance of 850,000 miles from his surface. In addition to this, luminous streamers have been observed proceeding in directions perpendicular to the surface of the sun to a distance of nearly 2,000,000 miles, as if expelled by some active force. Both corona and streamers have been found to shine partly by reflected light.

Taking this view of the sun we find it to consist of a glowing mass surrounded by an apparently gaseous substance shining in part by reflected light. This is precisely the condition to which we reduced the comet by freeing it from the agency which generates the tail. We may then reasonably carry the analogy further and conclude that the nucleus of a comet corresponds to the photosphere of the sun and that the nebulous envelope corresponds to the corona observed in eclipses. Also that as the phenomena of sun-spots indicate that within the shining photosphere of the sun is a darker mass which is in some manner protected from intense heat, so there may be within the bright nucleus of a comet a similar mass similarly situated and protected.

When it is remembered that the great comet of 1680 was subjected to a temperature of more than 2,000 times that of red-hot iron, a temperature capable of dissipating any known substance, this supposition does not seem unreasonable. Again, it is believed that the photosphere of the sun is composed of gas. If, then, the bright nucleus of a comet is analogous to it, the latter must be inconceivably less dense than the former, owing to the vast difference between the mass of the sun and that of a comet, and this may explain why the nuclei of some comets are transparent, and why they diminish in size with an increase of telescopic power. Again, it is as yet a unanswered question as to what maintains the heat of the sun, and if the nuclei of comets are glowing masses, the question is more pressing owing to the small quantity of matter which they contain. Moreover, the luminous streamers from the sun alluded to above would seem to indicate the presence of that agency which produces the tails of comets, and also would seem to explain some phenomena exhibited in the heads of comets.

There are are other analogies between the sun and comets which could be cited, but I think enough has been said to show it probable that comets are similar to the sun in physical composition. We will now give back to the comet its tail and briefly consider the cause of that wonderful phenomenon.

There seems to be no room for doubt that the agency which generates the tail of a comet must be sought in the sun, and that it consists of a repulsive force exerted by that luminary upon the nebulous envelope of the comet. This is supported in some cases by calculation. The tail of Donati's Comet of 1858 having been found to be nearly the shape which it would have taken under the operation of a repulsive force exerted by the sun.

Now, as this repulsion begins to act, assuming the nebulous matter of the comet spherical to begin with, it would naturally cause this substance to bank up between the nucleus and the sun, thus increasing its temperature and density and making it more luminous than any portion of the comet except the nucleus: thus forming what is called the nebulous envelopes. This repulsive force may be electrical, as has often been supposed, or it may be that same force which projects the luminous streamers from the surface of the sun, but whatever it is, it is impossible that it alone could produce all the phenomena which are presented in the tails of comets; because, generally, while the tail of a comet is single—it is turned directly from the sun and slightly curved toward that region of space which the comet has just left, and while its magnitude is greatest when its distance from the sun is least—there are exceptions to every one of these particulars.

The analogy between the physical constitution of our sun and that of comets, which I have endeavored to establish, would indicate that the same agencies exist in comets that exists in the sun and that it is to the conflicting or co-operation of these forces, to the different modes and directions of their action, that we owe the variety of phenomena presented by different comets and by the same comet at different times.

FACTS AND FANCY CONCERNING COMETS.

BY PROF. E. L. LARKIN.

At intervals of considerable regularity the press is burdened with accounts of impending disaster. Some dire astronomical event is always about to occur that will annihilate the human species. A Chicago writer, oblivious of the laws of gravity and motion, predicted evil to the earth to fall on June 19, 1881, and published a diagram of the solar system as it would appear on the eventful day. The earth was to suffer because it would be on one side of the sun, while the large planets on the opposite would so attract our world as to attract earthquakes, pestilence and death. So dense was the ignorance of the alarmist, that he actually diagramed Venus on the wrong side of a sun, in a position in which it would not arrive for more than six months. June 19 came and was all serene, but we read of some being rendered insane by these publications. And now it is sought again to awaken fear by the formulation of predictions of appalling heat that is to reach the earth, because the great comet that illuminated the circumpolar heavens last summer passed perihelion at a point close to the sun. The scheme to destroy mankind is that the comet on its return in 1897, will suffer sufficient retardation in passing through the gases constituting the corona of the sun to cause it to fall. Inconceivable heat will be generated from the arrested motion, and waves of it will surge against the earth, literally burning humanity alive. All such doctrines are without the slightest grounds in reason or scientific deduction, and the mystery is why any man pretending to astronomical or mathematical acquirements will print such dogmas.

If we raise a mass weighing 772 pounds 1 foot, and then let it fall, the precise amount of power required to raise it will be restored, and will appear in the form of heat, at the instant of impact of the mass on the earth. And, as has been proven, the amount of heat generated is just enough to raise the temperature of 1 pound of water 1° F. But the heat evolved by the fall of 772 pounds 1 foot is equal to that developed by the fall of 1 pound 772 feet. A mass weighing 1 pound that has fallen 772 feet has motion sufficient to conserve heat enough to heat 1 pound of water 1°; or 1 pound of water falling 772 feet generates 1° of heat throughout its mass. This is termed Joule's heat equivalent, and is a valuable element of human knowledge. It is a postulate of recent science that when one mode of force vanishes, another of equal intensity takes its place. Force cannot be increased or diminished; it is one of nature's constants. Motion is a mode of energy, and, invariably, when it terminates, heat—another form of force—appears.

Now, what possibly can be of greater moment than to learn how much motion is required to evolve 1° of heat. We know how great a weight, and how much space; but now comes the question, how rapid must be the motion? The velocity acquired by a falling body at any instant of its fall is equal to the square root of the product of twice the force of gravity and the space fallen through. If a body be let fall, it will be found by delicate instruments to be moving, at the close of 1 second, with a velocity of 32.2078 feet per second. And this velocity is an expression for the force of gravity exerted by the mass of the earth on bodies near its surface. By the rule, 32.2078 multiplied by 2 equals 64.4156, and this multiplied by 772 equals 49,729 feet, whose square root is 223. Of all numbers known to man for purposes of physical research, this 223 is the most important; for we now know that 1 pound of matter moving with velocity of 223 feet per second generates heat enough, when its motion ends, to heat 1 pound of water 1°. That is, this velocity represents 1 pound-degree of heat, or simply 1°, water being unity. With this magic number, all depths of space may be explored, and it can at once be told how much heat will be evolved by the cessation of motion of any cosmical body, as soon as it is learned how fast it is moving.

Having now the heat unit of the universe refined down to definite velocity, we are ready to launch into interstellar space, to learn first the velocities of bodies moving therein, and, secondly, to calculate the intensity of heat capable of being developed if the motion should be brought to a rest. The rule for finding the amount of heat evolved by the termination of motion is: Multiply the square of the velocity in feet per second by the reciprocal of the square of 223, or .00002010899.

If a mass of matter fall from an infinite distance, with unimpeded motion, and strike the earth, its velocity at the instant of impact is equal to the square root of the product of twice the intensity of gravity multiplied by the length of the radius of the earth. And this motion at the moment of collision must be found in feet per second, because the unit of measurement is 223 feet per second. Twice the force of gravity is 64.4156, and the mean equatorial radius of the earth is 20,923,161 feet. The square root of the product of these numbers is 36,645 feet, or 6.94034 miles per second, velocity acquired by a mass falling on the earth from a distance that is infinite. The force of gravity on the surface of the sun is 27.696 times stronger than on the earth's surface while the radius of the sun is 108.5113 times greater than that of the earth. Therefore, by the law of gravity, the velocity of impact of cosmic matter on the sun must be 54.8208 times more rapid than on the earth. This is known, because the square root of the product of 27.696 and 108.5113 is 54.8208, whence 36,645 multiplied by 54.8208 gives 2,008,908 feet, or 380.0962 miles per second velocity with which a mass would strike the sun after falling from an infinite distance. And this inconceivable motion must all be converted into heat at the instant of collision. Now, square 2,008,908, multiply the product by .00002010899, and we have the appalling heat of 81,154,081° F. as the intensity generated by cometary or other cosmic bombardment of the sun by masses that fall from infinite distances. Some sensational writers, having heard of this, at once seek to alarm all timid people by printing outrageous accounts of the impending destruction of man. Such publications are little better than criminal.

What we have said relates to bodies making impact on the sun after reaching it from distances that are infinite; now; how great velocity will be imparted to masses falling from distances that are finite, and capable of being handled by figures? Distance in relation to solar gravity has peculiar properties, thus: The nearest sun to ours is 20,000 000,000,000 miles away; let us go out into space half way, or 10,000,000,000,000 miles, and make computation, seeking to learn with what velocity a mass beginning to fall from that point will finally strike the sun. The velocity, 2,008,908 feet per second, is called the solar constant of velocity, and many complicated problems wherein gravity and motion are factors, can be solved in a few minutes by its use. Employing it in a calculation for a radius 10,000,000,000,000 miles, and carrying out the work into minute decimals, we shall be surprised to find that the velocity of impact on the sun, by a mass falling that distance, is only one-fourth of an inch less per second than if it came from an infinite distance, or, what is the same thing, had been falling forever! Surprise will wane, however, when it is remembered that gravity varies as distance squared inversely, and at an infinite distance must be infinitely weak, and the motion it can impart infinitely slow. Hence, 10,000,000,000,000 miles has nearly the same relations to solar gravity that infinite space has. Drawing nearer the sun, let us halt at the orbit of Neptune, 2,780,000,000 miles distant, and again apply the formula; when behold, if a mass fall through the distance of Neptune, it will reach the sun with only 155 feet per second less velocity than if it had been falling throughout all duration of time. Still nearer, we come to the orbit of the earth, 92,000,000 miles from the sun's center, and, again computing, find that final velocity of impact on the solar globe of matter from terrestial distance, would be but 2,411 feet per second less than if it arrived from infinite space. By the use of this important number, 2,008,908, it can at once be told what is the velocity of any cosmical mass at any point in its flight to the sun. Calculating for the earth's distance, it is found that a body passing our world on its way to the sun has a velocity of twenty-six miles per second, which is the greatest velocity with which anything can strike the earth. Arriving at the orbit of Mercury and again calculating, we find that a mass beginning to fall from that distance, 36,000,000 miles, will impinge on the sun with a rate of motion only 5,706 feet per second less than if it had been falling forever. Hence, terminal velocities lies within small limits of variation. Here is a table of velocities in feet per second of bodies making impact on the sun, falling different distances:

From infinite distance, maximum	2,008,908
From Neptune	2,008,753
From Mars	2,007,361
From the Earth	2,006,497
From Mercury	2,003,202
From 436,000 miles, minimum	1,420,513

It is seen that interstellar matter, whether colliding with the sun from infinite fall, or from Mercury, has 5,706 feet, a trifle over 1 mile per second difference in final velocity, variation being within the limits of 1-380 of the whole. The rate of the motion in the last line of the table is that attained by a mass falling on the sun from a distance equal to the solar radius, 430,000 miles, as we can not imagine that any cosmic matter will begin to fall from a less distance. Therefore, the least velocity of impact is 1,420,513 feet, or 269 miles, per second, and this least motion multiplied by 1.414213 equals 2,008,908 the greatest, hence the maximum and minimum velocities are to each other as 1 is to the square root of 2, or as 1 is to 1.414213.

If we square 1,420,513 and multiply the reciprocal of the square of Joule's equivalent, as above, we obtain the least heat possible, or 40,577,090° F. What astonishing results are brought to light by these researches. Incredible intensity of heat, the highest being 80,000,000° and the least 40,000,000°! What effect will such outbursts of thermal energy have on the earth? Will the heat vaporize the oceans, parch the land, and consume all organisms? Let us see. First, we must find the relations between velocity, heat and mass. Take any mass at random, say 52 pounds, and give it any velocity, say 892 feet per second, how intense will be the heat evolved when its motion ends? By analysis, 1 pound moving 223 feet per second has a motion sufficient to generate heat enough to increase the temperature of 1 pound of matter of the density of water 1°, hence if it moves 4 times as fast, or 892 feet, it has motion able to develop heat 16 times more intense, or 16°, because the square of 4 is 16 times greater than the square of 1, the ratios of their velocities.

If a mass weighing 1 pound, moving 892 feet per second, generates on impact 16°, fifty-two pounds will evolve fifty-two times that amount, or 832°, but the heat will still have the same intensity. By thermometer the mass will indicate only 16°,—that is, fifty-two pounds moving 892 feet per second can generate heat enough to heat one pound of water 832 degrees, 832 pounds 1°, or fifty-two pounds 16°. Now double the mass, by making it 104 pounds, the velocity remaining the same, and we double the quantity of heat and will have 1,664°; still the thermometer reads 16 degrees. The 1,664°, being distributed through twice the mass, can have no greater intensity than that conserved from its velocity. Therefore:

1. Increase of mass does not increase the intensity of heat. If we double velocity instead of mass the heat is quadrupled in intensity, thus: 892 multiplied by 2 equals 1,784, and the square of two is four times greater than the square of one; and since heat of impact is proportional in intensity to squares of velocities, we have four times the heat energy, or 3,328° degrees in amount, and four times the intensity or 64°. This is because four times the heat raises the temperature of fifty-two pounds four times 16°, or 64°, the3,328° degrees being able to warm 3,328 pounds 1°, one pound 3,328°, or fifty-two pounds 64°. Whence:

2. Heat depends for intensity on velocity, and not on mass. Let one pound of matter strike the sun, and whether it fall from an infinite distance or from the distance of any planet its motion will develop on collision, in round numbers, 80,000,000°; let a mass of two pounds impinge, and double the amount of heat will appear, but its intensity will be the same, since the final velocity cannot be more than 380.0962, nor less than 379.3943 miles per second. Thence:

3. A comet of great mass colliding with the sun will produce no greater intensity of heat on the sun or earth than one of small mass. Velocities of impact mentioned are those of interstellar masses falling on the sun with unimpeded motion on straight lines. Any comet that can make impact must move around the sun many times before it can collide, its perihelion at each circuit approaching, until finally it is so far retarded by gases in the vicinity of the sun that its orbit comes to almost coincide with the solar surface. Then, if the nucleus is solid, it will ricochet like a cannon-ball, and surrender portions of its heat at

each impact, nothing like 80,000,000 degrees being developed at any point. When:

4. Maximum heat can not appear unless cosmic matter fall on right lines to the sun, and not on curves. Heat is now known to be a mode of atomic motion; the greater the rapidity of atomic oscillation the more intense the heat. The reason why a mass on collision evolves heat is because the motion of the whole mass through space is instantly arrested, and massive motion becomes atomic. When the body is moving, each atom in it maintains constant relation to all the others, and no heat is developed. Let the mass strike a solid and each atom begins motion in relation with every other, the instant translation through space ends. If the velocity of impact is great, atomic motion is most rapid, and the heat intense. If the collision is not powerful enough to cause every atom to shift position, all the heat possible will not appear. Let a rifle ball strike a rock, every atom of the lead changes location, the ball is flattened, and, if velocity is sufficient, melted. But if it strike a mass of cork, resistance being so slight, the lead atoms will not shift nor heat appear. Behold the sun; its density is only 1.44, that of water being one, or about the consistency of calcimine applied to our ceilings. A comet would plunge thousands of miles beneath the liquid surface of the sun, and the heat would slowly radiate away, benefitting man instead of destroying him. Therefore:

5. Eighty million degrees of heat can not develop unless the sun becomes rigid as platinum and cometary nuclei solid. But it is not on these arguments that we rely. We will grant that comets can fall upon the sun, developing maximum heat, allowing alarmists the worst, and then demonstrate that such impact can not affect the earth in any way except for good. If we burn fifty pounds of coal in one hour it will radiate genial heat, and an iron bar suspended, say, at a distance of four feet from the fire will be warmed through, supposing it to be an inch in thickness. Now, put on a blast and consume the coal in one minute; the bar will not be warmed throughout. Consume the coal in one second, and the surface only of the bar next the fire will be warmed. Burn the coal in the millionth part of a second, the same amount of heat will be given out as when one hour was occupied in the combustion, but the human hand could be held in place of the bar and not feel pain. The heat would be intense, but of such inconceivably short duration that it would not destroy the structure of one's hand. Whence time is a factor in all problems where the action of heat is concerned. Now, let a mass in motion at the rate of one foot per second collide with the sun, and we say the time consumed in impact is such a part of a second; but let it move 2,008,908 feet per second, the time of collision is 2,008,908 times shorter, and the heat that many times more intense, the intensity of the heat depending ing solely on the time of impact, and the time directly on velocity. Hence:

6. The intensity of 80,000,000 degrees exists less than the 1-2,008,908 part of a second, and the heat-wave that can strike the earth will have the same duration. Heat, light, or any other energy emanating from a center varies in the

inverse ratio of the square of the distance. The earth is 92,000,000 miles from the sun, but to arrive at results, a ratio must first be deduced. Suppose that above where the comet strikes we place a flat surface at a distance of 100,000 miles, and admit that the radiation of heat hereon from the disintegrated comet would be 80,000,000 degrees. Of course it would not be that intense, for of such intensity is the heat 100,000 miles below; but allow that it would be, then how intense will be the heat reaching the earth? The quotient of 92,000,000 divided by 100,000 is 920, and the square of this number is 846,400. Then, the heat falling on the earth is 846,400 times less than that radiating on a surface 100,000 miles from the scene of collision. Dividing 80,000,000 degrees by 846,400 we find the intensity of a heat-wave that can reach the earth from the disruption of any comet large or small on the sun to be 94 degrees. Take a hot day with the thermometer at 94 degrees, double the heat for the 1-2,008,908 part of a second, or indeed for half a minute, and observe the effect on the human species. Really the only way to detect the arrival of the wave would be to turn a large telescope on the sun just before the comet fell, and place in the focus one of Prof. Langley's balometers capable of measuring the 1-50,000 degree of heat, and look intently on the index with a microscope. Even then it is doubtful if movement of the delicate balance could be seen. We should be pleased to have our telescope set upon the precise point of impact at the time the comet falls to see what would take place. It is scarcely possible that a movement so rapid would make impression on the retina. And high magnifying powers would have to be used, since one second of arc on the solar disc is in linear dimensions 450 miles, and is as small an object as can be seen in a telescope on the sun. But the comet of 1811 had for what was supposed to be a solid nucleus a diameter of 428 miles—less than one second of angular measurement when at the sun's distance; hence the final plunge of a comet into the solar flames could only be seen in good telescopes under favorable circumstances. But a tele-spectroscope of powerful dispersive powers set on the spot after impact might in the spectrum produced exhibit slight disturbance, such as displacement of the lines caused by outbursts of hydrogen and other gases. Hence:

7. The effect of cometary precipitation on the sun can not be detected on earth save by the most powerful instruments. What is the sun? It is a colossal ball 860,000 miles in diameter, whose mighty mass is 331,654 times greater than that of the earth. What is a comet falling into this awful furnace? Nothing but as one firebrand in the conflagration of Chicago. Explosions are always taking place on the sun, causing greater upheaval than the downrush of a dozen comets. Can cometary collision on the sun injure man? Indeed, such impact serves to keep him alive. The sun does not radiate too much heat now, and astronomers are agreed that part of the present supply is kept up by cosmical bombardment. We are flung away in some nook of the universe chained to an expiring world—a home that is already suffering encroachment of polar ice. We exist only by the heat of the sun. The real danger lies not in cometary downrush, but in the fear that not enough meteors and comets will gravitate into solar fires. The longer

comets continue to strike the sun, the longer can man inhabit the earth. We thought it the province of science to dispel superstition and fear; and least of all did we think that astronomy would be made use of as an engine of terror. We put in a plea for pure astronomy, and urge that its truths be not tampered with by sensationalists. Interstellar matter perpetually bombards the sun, each collision of meteoric hail sending to earth life-sustaining heat. We trust this cosmic war will not cease, and that at least one comet per week will dash on the sun during the next ten thousand years.

ASTRONOMICAL NOTES FOR MAY, 1882.

BY W. W. ALEXANDER, KANSAS CITY, MO.

THE SUN.

Date.	Right Ascension.	Declination N.	Equation of Time.
1st.	2h. 35m.	15° 11′	3m. 04s. —
5th.	2 50	16 21	3 29
10th.	3 09	17 43	3 48
15th.	3 29	18 57	3 52
20th.	3 49	20 03	3 42
25th.	4 09	21 01	3 18
31st.	4 33	21 58	2 34

Apparent semi-diameter on the 1st, 15′ 54″; on the 31st, 15′ 48″.

THE MOON.

Date.	Right Ascension.	Declination S.	Semi-Diameter.
1st.	13h. 30m.	12° 40′	15′ 09″
5th.	17 05	21 15	15 43
10th.	21 47	7 44	16 03
15th.	2 19	16 01 N.	16 00
20th.	7 02	18 54	15 15
25th.	10 57	1 07	14 49
31st.	15 50	20 06 S.	15 38

MERCURY.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	2h. 40m.	15° 33′	11h. 58m. A.M.
5th.	3 06	17 57	12 P. M.
10th.	3 49	21 23	35
15th.	4 32	23 50	58
20th.	5 10	25 12	1 17
25th.	5 43	25 38	1 30
31st.	6 15	25 10	1 39

Apparent diameter on the 1st, 5″; on the 31st, 8″.

By the end of the month it will be near its greatest elongation East, and will be visible in the West after sunset for 1h. 30m.

VENUS.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	3h. 46m.	20° 06′	1h. 07m. P. M.
10th.	4 32	22 31	1 18
20th.	5 25	24 12	1 31
25th.	5 51	24 36	1 38
31st.	6 23	24 42	1 47

MARS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	7h. 55m.	23° 41′	5h. 17m. P. M.
10th.	8 15	21 36	5 03
20th.	8 37	20 13	4 44
31st.	9 01	18 27	4 26

Apparent diameter on the 1st, 6.2″; on the 31st, 5.4″.

JUPITER.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	4h. 01m.	20° 00′	1h. 22m. P. M.
10th.	4 09	20 24	0 56
15th.	4 13	20 37	0 41
20th.	4 18	20 50	0 26
25th.	4 23	21 02	0 11
31st.	4 29	21 26	11 57 A. M.

Apparent semi-diameter on the 1st, 15.8″; on the 31st, 15.5″.

SATURN.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	2h. 52m.	14° 22′	0h. 15m. P. M.
10th.	2 57	14 43	11 41 A. M.
20th.	3 02	15 04	11 07
31st.	3 07	15 27	10 29

Apparent semi-diameter on the 15th, 7.7″.

URANUS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	11h. 4m.	6° 48′	8h. 25m. P. M.
16th.	11 3	6 51	7 26
31st.	11 3	6 50	6 27

NEPTUNE

16th.	2h. 58m.	15° 10′	11h. 18m. A. M.

PHENOMENA.

On the 2d, at 1h. 00m. A. M., conjunction of Mercury and the Sun superior.

On the 4th, at 1h. 00m. A. M., conjunction of Mercury and Saturn. Mercury north, 2° 22′.

On the 5th, at 1h. 00m. A. M., conjunction of Venus and Jupiter. Jupiter south, 2° 16′.

On the 18th, Mars in Præsepe.

On the 18th, at 7h. 04m. P. M., conjunction of Venus and the Moon. Venus north, 2° 45′.

On the 22d, at 00h. 00m., Neptune stationary.

On the 22d, at 7h. 14m. P. M., conjunction of Mars and the Moon. Mars north, 6° 46′

On the 31st, evening, conjunction of Mercury and Venus. Mercury west northwest, 1° 43′.

GEOGRAPHY.

THE JEANNETTE AND HER SURVIVORS.

The following account of the preparation, voyage and loss of the Jeannette and the subsequent wanderings and sufferings of her survivors has been compiled from various authentic sources, and is believed to include all of the more important events of the expedition up to the present time.—[Ed. Review:

That part of Siberia extending from the Taimur Peninsula to Behring's straits is universally conceded to be one of the most desolated, frigid, and worthless sections of country that can be imagined, and one that is wholly devoid of anything to sustain life, except from the precarious supplies of fish and sea animals found in the Arctic Sea. Consequently, except for a few brief weeks in summer, even the iron-framed nomads of that region, Samoides, Ostiaks and Tongoose, all leave the sea coast and seek in the wooded tracts hundreds of miles from the sea that protection and that relief which the intense cold requires in the long, cold Siberian winter.

From about 1620 until a very recent date in this country the Russians have sent scores of expeditions to survey and examine those gloomy, cold, inhospitable regions of the "Summa Arctus," which, to this day, is yet what Pliny and Pomponius Mela 1,600 years ago said it was: "Beyond the Caspian Sea and the coast of the Scythian Ocean the land projects to the east. The first part of this coast from the Scythian Promontory (Taimur) is not habitable for the snows. The land next adjoining is uncultivated from the ferocity of its inhabitants. These are Scythian anthropophagi and the Sacae. Near them are vast solitudes and multitudes of wild beasts. Everything here is ferocious, beginning with man. Beyond these solitudes are deserts, peopled with wild beasts, as far as a ridge or mountain hanging over the sea, which is called Tabin (probably East Cape.)"

In 1735 an experienced and energetic officer, Lieut. Wasili Proutscheschew, was sent to survey the Promontory of Taimur and the Siberian coasts near the mouth of the Lena. This was completed in part in 1736, but on his return in the fall, Proutscheschew fell sick at Olenek, a Russian village on the shore of the Arctic Ocean, and died from grief and disappointment at his non-success. His wife, who had heroically followed him, died some few days after.

In 1738 Lieut. Chariton Laptiew took the place of Proutscheschew, but was not able any more than his predecessor to finish the survey between the Lena and the Yenesei. By sea the work was finished by a land party with full success.

To survey east of the Lena, Lieut. Lassennis and fifty-two men sailed in 1735 from Jakutzsk. He went that year along the coast to a small river between the Lena and Juna. There he wintered with his vessel, sending six men with dispatches to Jakutzsk. In that terrible winter thirty-seven men died of scurvy of the forty-six men left. When in June, 1736, assistance reached Lassennis, he and all his men were dead.

After this failure Lt. Dimitri Laptiew continued the survey from the Lena east, and examined the coast to the Kolyma River, and, as some claim, he finished a complete examination of the Siberian coast to East Cape and the Anadyr River, at the Anadirskoi Ostrog, but this has been denied, and that the Lieutenant made his examination of the route to Anadirskoi by land.

In 1760 '65 Shalauroff, an enterprising Russian, attempted to finish in person the exploration ended by Laptiew at the Kolyma River. He penetrated by following the coast to Tschaoon Bay, some 300 miles east. In 1764 in no manner daunted, Shalauroff again attempted to reach East Cape. He proceeded this time, it seems, from the inhabitable Lena. This expedition was never afterward heard from, except from rumors obtained from the Tchutzki, which was that Shalauroff and his men had all died near Cape Barannoi Kamen of starvation. Wrangell afterward substantiated this fact, as some huts were found where the unfortunate explorers had all died.

In the first portion of this century Baron Von Wrangell and Lieut. Anjew, both Russian officers, explored the coast from the Lena to near Cape Sendze Kamen, on the Arctic Sea, but did not succeed in rounding East Cape by water, which feat, since the passage of Deschnew and of Tara Staduchein in the 17th century, has not been done until 1878-'79, when it was completed by Professor Nordenskiold in the steamer Vega, who rounded the whole of Russia and Siberia from North Cape to Behrings Strait.

The Liakoff Islands were discovered in the last century by Sergeant Andreef in 1770, and by a merchant Liakoff in 1770, who followed the back trail of a herd of reindeer that had crossed from these islands to the main land of Siberia. Liakoff in 1773 repeated his trip and wintered there, gathering fossil ivory, some of the tusks measuring seven seven-twelfths feet long and weighing 115 pounds.

In 1806 one Sanikof, besides exploring the islands of Liakoff, also discovered Sanikoff Island, and what is now known as New Siberia. The Russian government, interested in these discoveries, deputed a savant named Hedenstrom, a Siberian, to make a report and more detailed examinations. In 1810 Hendenstrom went out north from the mouth of the River Jana and explored the coast 250 miles until he arrived at its eastern extremity. Hedenstrom thought that this was a prolongation of the American continent.

Omitting mention of numerous explorations in other portions of the arctic regions, we will take up only those of the more immediate predecessors of DeLong in the United States. The disaster which overtook the expedition of Sir John Franklin in 1847-8 gave a new impetus to Arctic adventure, and some of the most chivalric deeds which the historian of modern times has been called upon to chronicle are connected with the Polar voyages of the navigators dispatched to ascertain the fate of that gallant commander. The story of the perils through which these brave men pass, the sufferings they endured and obstacles they overcame, reads like a romance.

In 1850 no less than eleven separate expeditions were engaged in the search for the missing explorer, and in this year Henry Grinnell, of New York City, in conjunction with the Government, fitted out the first American expedition sent to the Arctic region, and under the command of Lieutenants Griffith and DeHarten the United States brigs "Advance" and "Rescue" carried the stars and stripes well into the regions of perpetual snow. The results attained by these various expeditions, however, were meager in the extreme, and science profited little from the vast expenditure of money and occasional loss of life. In 1855 the "Advance," under the command of Dr. Kane, made a second voyage to the Arctic Seas, but beyond a delightful narrative, as fascinating in style as it was graphic in description, which the accomplished explorer left behind him, the voyage was productive of little real benefit to the scanty fund of knowledge regarding the mysteries which surround the earth's apex.

In 1850-1 Captain McClure, sailing eastward through Behrings Straits, demonstrated the fact of a northwest passage, and although compelled to abandon his vessel, succeeded in passing through to Baffin's Bay with his crew—they being the first explorers that ever passed from ocean to ocean. In 1871, Capt. Hall, who had previously made several Arctic voyages, and had lived amongst the Esquimaux for several years, and become thoroughly acquainted with their language and customs, sailed in the steamer "Polaris," determined to unravel the mystery of the open Polar Sea, in the existence of which he was a firm believer. So sanguine was he of success that a short time before his departure he stated in a public address, delivered before the Chamber of Commerce in his native city, Cincinnati, that, acclimated as he was to the Arctic winter, he felt no hesitation about going back again, and that he proposed to plant his foot upon the North Pole before he died. Capt. Hall succeeded in reaching the highest latitude ever attained with his vessel—viz: 82° 16′, while with a sledge party he went as far north as 84°, or within 360 miles of the goal of his heart's desire.

Unfortunately, however, he fell a victim to dissensions among his own crew, and died under circumstances which gave rise to the rumor that he had been poisoned. After the death of Capt. Hall, and the consequent failure of the Polaris expedition, the American people have taken little interest in Arctic exploration.

In 1873 the Navy Department, incited by popular inquiry as to the fate of the Polaris, decided to send a vessel to the Greenland coast in search of her, or, if she was lost, to obtain tidings of her survivors. The United States steamer Juniata was selected for the purpose, Commander Braine, U. S. N., was in command, and Lieut. Geo. W. De Long was on board as Lieutenant and navigator. The Juniata sailed from New York in June, 1873, and proceeded as far north as Upernavik, the most northerly settlement of Greenland. Beyond this point, which was reached in August, it was not deemed safe to proceed with the steamer. After a brief consultation it was decided to fit out the steam launch and send her into the recesses of Melville Bay, to discover, if possible, some traces of the missing vessel or her crew. The launch, which, since that voyage, is known as the Little Juniata, was thirty-two feet two inches in length, over all; eight feet four inches beam, and four feet eight inches deep. She was rigged with one mast and a jib and mainsail, and her propeller was so guarded by an iron framework that little danger was to be feared from contact with floating ice. At his urgent request, Lieut. De Long was placed in command, with the following as a volunteer crew: Lieut. C. W. Chipp, present executive officer of the Jeannette; Ensign Sidney H. May, H. W. Dodge, ice pilot; Francis Hamilton, machinist; Wm. King, fireman; Street and Meagher, seamen, and a New York *Herald* correspondent. To their number was added an Esquimaux pilot.

The Little Juniata steamed boldly away from the parent ship on the morning of the 31st of August, with coal for fifteen days and provisions for sixty days in case of emergency, but the orders of Commander Braine to Lieut. De Long were not to extend the voyage beyond eight, or at the utmost ten days. After a most dangerous and profitless exploration they returned to the Juniata in safety after an absence of eleven days. Lieut. De Long desired to make another attempt, but Commander Braine did not consider the facilities at hand sufficient to warrant the undertaking, and so declined to grant his request.

From their cruise in the Little Juniata, Lieut. De Long may be said to have imbibed his love for Arctic adventure. Soon after his return to New York he was thrown into the society of Mr. James Gordon-Bennett, proprietor of the *Herald*. Stanley had just succeeded in penetrating the wilds of Africa and meeting with Dr. Livingstone, had astonished the world by showing what the enterprise of a private individual can accomplish when backed by capital and brains.

De Long felt an ardent longing to distinguish himself by rendering similar services to science, and urged upon Mr. Bennett the undertaking. After repeated consultations, during which the cost of the expedition and its probable results were freely debated, Mr. Bennett finally told Lieut. De Long to go ahead; purchase a vessel, provision her and make an attempt to find the North Pole.

While this consultation was going on, Lieut. De Long made a trip to New Bedford, where he passed several weeks in the society of the whaling captains who are to be found there in large numbers. From conversation with them he was convinced that the Behring's Straits route was the "Down Hill" route and determined to try it. The more he studied over it and examined the charts as to the winds and currents, the more he was convinced that the whalemen were right. He imparted to Mr. Bennett the result of his conclusion, and it was decided to try it. After examining a large number of vessels, it was finally agreed to purchase the Pandora, which was lying in the dock at London at the time, having but lately returned from a cruise to the Arctic, which proved barren of results.

An act was passed by Congress allowing Pandora's name to be changed to Jeannette—in honor of Mrs. Bennett's only sister—to be enrolled as an American vessel, and to be officered by officers of the American navy, Lieut. De Long and the officers under him being assigned to duty on her for the purpose of the expedition.

All the expenses of every kind and nature have, however, been borne by Mr. Bennett, and when she sailed, she left our shores as a national expedition, as that gentleman desired his country to reap the honor of discovery, and has at all times discouraged the association of his name with the expedition, desiring it to be known only as "The American Arctic Expedition."

The Jeannette was a bark-rigged screw steamer of four hundred and twenty tons burden, and eighty-horse power nominal. She was built at the Pembroke Dock Yard in England, in 1864, and designed for a naval dispatch boat. She was subsequently sold to Sir Allen Young. She made three voyages to the Arctic. First to King William's Land in 1873, again to King William's Land in 1874, and the third time to carry mails to the Alert at Peel's Sound in 1875. She was built of Dantzic oak, and was especially strong in the hull. She had a sharp, wedge-shaped floor, which, in case she was "nipped," was to lift her on the ice, instead of allowing her to be crushed between the floes. Her bow was filled in solid, and was protected on the outside by thick iron straps, to protect her timbers when cutting a channel through the ice. She was extra planked on her bottom and bilges, and her frames and beams were of heavy timber. Her hull was further strengthened while she was at Mare Island, three double-trusses and hanging-knees, each beam ten by twelve inches, with a large stanchion in the center, being put in.

In addition to arms, food, cooking apparatus and clothing, the expedition was especially well provided with scientific instruments, and there was every reason to believe that the world would be greatly enriched by the stock of knowledge with which it would return. A complete set of photographic apparatus was taken, together with thirty dozen dry plates for views. There was a portable observatory and a large-sized telescope for taking astronomical observations. Whenever a landing was effected experiments was made with a pendulum and the vibrations noted, so that when the pole was approached the degree of flatness of the earth's surface would be detected. Accurate surveys of all lands were made and soundings taken of all harbors. Two hundred miles of telegraph wire were placed on board and constant telephonic communication was to be kept up with parties on shore at a distance from the ship. Last, but not least, the expedition was provided with an electric light of immense power, presented by Edison. Mr. Collins, the scientist of the expedition, gave a good deal of attention to the study of the winds and currents and hoped to be enabled on his return, as the result of his observation, to solve some knotty problems which have heretofore perplexed our meteorologists.

The Jeannette had on board thirty-three souls—twenty-five forward and eight aft. The commander, George W. DeLong, was a man a little above the medium height, well-built, active in his movements, and thirty-five years of age. He was born in New York City, and graduated at the Naval Academy in 1865. He was married, his wife being a daughter of Capt. James A. Wotten, an old steamship commander and formerly superintendent and part owner of the famous New York and Havre Line of Steamships. Mrs. DeLong accompanied her husband in the Jeannette from Havre to San Francisco, a voyage which lasted 165 days, and afterward in a trip overland to New York and back to San Francisco.

Lieut. Charles W. Chipp, U. S N., the executive officer of the Jeannette, was born in Kingston, N. Y.; thirty years of age and unmarried. He was with Capt. DeLong in the Little Juniata.

Lieut. John W. Danenhauer, U. S. N., was the navigator of the expedition. He was born in Chicago, Ill.; thirty years of age and unmarried.

Passed Assistant Surgeon James M. M. Ambler, U. S. N., was the surgeon. He was born in Fauquier County, Va.; thirty-one years of age and unmarried.

Chief Engineer George W. Melville, U. S N., the engineer of the Jeannette, was born in New York City, 1841. He has a wife and three children living in New York.

Jerome J. Collins, the scientist of the expedition, was a native of Ireland and thirty-eight years of age. He is an accomplished engineer, and thoroughly versed in astronomy, botany and the kindred sciences; unmarried.

Raymond L. Newcomb was a native of Salem, Mass.; twenty-nine years of age and unmarried. He was the naturalist and taxidermist of the expedition.

William Dunbar, the ice-pilot, was a native of New London, Conn., and forty-five years age.

The Jeannette left San Francisco July 8, 1879. She was heard of twice through the *Herald* correspondent on board, who wrote long and interesting letters from Illiolionk Station, in the harbor of Oonalaska, and St. Lawrence Bay, detailing the doings of the party up to August 27th of that year. In 1880, according to Danish authority, a steamer's smoke was seen near the mouth of the Lena River by the Yakuts living there, but in the transmission of this story from tribe to tribe, from the mouth of the Lena west to the Kara Sea, where the walrus hunters heard it, it was no doubt somewhat changed. Nothing further was heard of the Jeannette for a year and a half, but no grave apprehensions were entertained until the spring of last year. Then there began to be much anxiety, and finally a bill was presented and passed Congress for the fitting out of an Arctic expedition in search of the Jeannette. The Rogers was purchased and started out last summer in its search. Its plan was to proceed along the coast of Siberia, which was a correct theory, but recent dispatches give information of her destruction by fire. Five other expeditions have attempted to gain some information concerning the Jeannette, but without success. They were fitted out by private persons and had other objects as well as searching for the Jeannette.

It appears that the Jeannette, after passing through Behring Strait, took a northeasterly course, passing through an unexplored region.

Several letters from different members of the party have been published but none differ from the official report of Chief Engineer Melville, except in minor points. He says: "We arrived in the Harbor of Lutke, Bay of St. Lawrence on the 25th day of August, and on the 27th completed our supply of stores from the schooner and sailed for the Arctic Ocean, to visit Koliutschin Bay to search for Nordenskiold, and then to continue our voyage of discovery. We arrived at Koliutschin Bay on August 31st, and having found satisfactory proof of the safety of Nordenskiold we continued our voyage to the northward.

"On September 3rd came up with the ice and on the 4th sighted Herald Island. Continued to work through the ice until the 6th day of September when we became firmly fixed in the ice. On September 13th an attempt was made to land on Herald Island, but it was unsuccessful, and the traveling party returned to the ship on the 14th. We continued to drift with the ice toward the northwest, and on October 21st sighted Wrangell Land, bearing south. We continued fast in close packed ice until November 25th, when, after several days severe crushing of the ice and nipping of the ship, she was forced into open water and drifted northwest without control until the evening of the same day, when we brought up against a solid floe piece and made fast, where we again froze in and remained until the vessel was eventually destroyed.

"Long and dreary months of close confinement to the ship and anxiety for her safety continued until May 17, 1881, when we were enlivened by our first sight of land since March, 1880, when we lost sight of Wrangell Land, and as no land was laid down in any chart in our possession, we concluded it to be a new island. This island was seen when we were in latitude 76° 43′ 20″ north, longitude 161° east. The island was named Jeannette Island, though not landed upon. Its position was latitude 76° 47′ north, longitude 158° 56′ east.

The ship and ice continued to drift to the west and northwest, the whole ice field being broken up in all directions. On the night of June 10th several severe shocks were felt and the ship was found to have raised several inches in her bed. There was evidence of an approaching break-up of our friendly floe piece. At ten minutes past twelve A. M., June 11th, the ice suddenly opened alongside the ship, completely freeing her, and she floated on an even keel for the first time in many months.

"The ice continued in motion, but no serious injury occurred to the ship until the morning of the 12th, when the ice commenced to pack together, bringing a tremendous strain on the ship, heeling her over to starboard and forcing the deck seams open. This continued during the day at intervals until evening, when it was evident the ship cou'd not much longer hold together. The boats were lowered on the ice, and provisions, arms, tents, alcohol, sledges and al necessary equipment for a retreat securely placed on the floe. By 6 P. M. the ship had entirely filled with water and lay-over at an angle of about twenty-two degrees being kept from sinking by the opposing edges of the floe. On the morning of the 13th day of June, about 4 o'clock, the ice opened and the ship went down with colors flying at the masthead. Latitude 77° 15′ north, longitude 157° east.

"We remained six days on the ice organizing our system and the line of march south, during which time we had resumed a rapid drift to the northwest. On June 24th having marched south one week and obtained observations for position, we found we had drifted to latitude 74° 32′ north, a loss of twenty-four miles northwest.

"We continued our march south and west and finally landed on Bennett Island July 29th. Hoisted the national flag and took possession of the island. It is located in north latitude 76° 38′, east longitude 150° 30′. We traversed the eastern end of the island.

"Left it August 6th, and sighted the north side of Thaddeus (Faddeyev) Island, one of the New Siberia group, and remained there ten days ice bound. Landed on the south side of Thaddeus Island August 31st. Left south end of Kotelnoi Island September 6th. Camped in sight of Stolhoi Island September 7th. Landed on Simonaski Island September 10th.

"We left for Barkin, at the Lena's mouth, September 12th. Separated by a gale of wind the same night."

The list of people in the boats as follows.

First Cutter.—Lieutenant DeLong, Dr. Ambler, Jerome J. Collins, William Nindeman, Louis Norris, Hans Erikson, Henry Knack, Adolf Bressler, Carl Gortz, Walter Lee, Neils Ivorson, George Boyd, Alexia, Ah Lorn.

Second Cutter.—Lieutenant Chipp, Captain Dunbar, Alfred Sweetman, Henry Waxen, Peter Johnson, Edward Star, Shawell, Albert Kaihne.

Whale Boat.—Engineer Melville, Lieutenant Danenhauer, Jack Cole, James Bartlett, Raymond Newcomb, Herbert Leach, George Landentach, Henry Wilson, Manson, Aniquin, Long.

Fifty miles from the mouth of the Lena they lost sight of each other during a violent gale and dense fog. Boat No. 3, under command of Engineer Melville, reached the eastern mouth of the Lena on the 29th day of September, and was stopped by icebergs near the hamlet of Idolaciro-Idolatre on the 29th day of October. There also arrived at Bolonenga boat No. 1, with the sailors, Nindeman and Norris. They brought the information that Lieutenant DeLong, Dr. Ambler, and a dozen other survivors, had landed at the northern mouth of the Lena, where they were in a most distressing state, many having their limbs frozen.

Lieut. Danenhauer, who was in the Melville party, says in one of his letters that they had to travel 700 miles over the ice from the ship to the mouth of the Lena. They landed in shoal water and were compelled to wade two miles to land. They were forced to travel 100 miles further before they reached shelter, and he says he was up five days and four nights without sleep or rest. He also gives the following points of scientific interest:

"The result of the drift for the first five months was forty miles. There was a cycloidal movement of the ice. The drift for the last six months was very rapid, and soundings pretty even. There were eighteen fathoms near Wrangell Land, which was often visible seventy-five miles distant. The greatest depth found was eighty fathoms, and the average thirty-five; the bottom, blue mud. Shrimps and plenty of algological specimens were brought from the bottom. The surface of the water had a temperature of 20° above zero. The extremes of temperature of air were: greatest cold, 58° below zero, and greatest heat 44° above zero. The first winter mean temperature was 33° below zero; the second winter 39° below zero. The first summer the mean temperature was 40° above zero. The heaviest gale showed a velocity about fifty miles an hour; such gales were not frequent. Barometric and thermometric fluctuations not great. There were disturbances of the needle coincident with auroras. Winter growth of ice eight feet; heaviest ice seen, twenty-three feet. Engineer Schock's heavy truss saved the ship on November 21st from being crushed. Telephone wires were broken by a movement of the ice. The photographic collection was lost with the ship. Lieut. Chipp's 2,000 auroral observations were also lost. The naturalist's notes were saved. Jeannette Island was discovered May 16th, in latitude 76° 47′ north, and longitude 158° 56′ east. It was small and rocky, and we did not visit it. Henrietta Island was discovered and visited May 24th, latitude 77° 8′ north, longitude 157° 32′ east. It is an extensive island. Animals scarce; glaciers plenty. Bennett Island lies in latitude 76° 37′ north, longitude 148° 20′ east. It is very large. On it we found many birds, old horns, driftwood and coal, but no seal or walrus A great tidal action was observed. The coast is bold and rocky. The cape on south coast was named Cape Emma. Nothing has been heard from Lieut. Chipp's party. It is more than probable that they are all lost."

As soon as Engineer Melville learned of the landing of Lieut. DeLong he organized a search for the party, turning back to Belun and subsequently to the mouth of the River Lena at the coast. Various records and articles of personal and goveryment property were found. The latest written bulletin by DeLong was delivered to Melville by a Yokut hunter, and was dated October 1, 1881, annoucing his intention to cross to the west side of the Lena and proceed south to the settlements. The party had suffered terribly and had but two days provisions left.

After waiting a day or two for the Lena, upon which they were to pass, to freeze over sufficiently to bear their weight, they crossed it to proceed up the west bank of the stream toward Yakutsk. They hoped to find game for food. The latest information indicates that they entered a wilderness destitute of habitations or game, and soon began to experience the direst hardships. Quite likely they have all perished long before this—a sad reduplication of the fate of Sir John Franklin and his command, under almost the same circumstances, on the American instead of the Asiatic continent.

In the meantime the Russian Government has taken an active interest in the matter. M. Siberiakoff, himself an experienced arctic explorer, has tendered the use of his vessel, the Lena: James Gordon Bennett has ordered and provided means for the most energetic efforts and our own Government has sent out Lieut. Harber and Master Scheutze of the U. S. Navy, both of whom have arrived before this time at Irkutzk, to assist in the search. If Lieut. DeLong has been found and is in condition to do so, he will take command of the new expedition, otherwise, Lieut. Harber, who is next in rank, will assume command. Engineer Melville in his official dispatches assumes a cheerful tone and says that he has every reason to hope to find DeLong and his party, but in his private letters to his wife he holds out no hope whatever.

There is hardly a possibility that one of the wanderers will be found alive. As late as the middle of January, DeLong's party, which had been lost in a wilderness for many weeks, was still untraced. Only by a miracle can any of its members have survived the winter. It is not unlikely that the searchers will come across successive graves, and a last unburied body, but even this satisfaction may fail to be attained. There is less probability that the fate of Chipp's company will ever be known.*

WEST INDIAN GEOGRAPHICAL NOTES.

BY CAPTAIN E. L. BERTHOUD.

Mr. Alphonso Pirrard, a French savan in a late trip in the West Indies, has visited Saint Domingo. Here he ascertained that the remains of Christopher Columbus discovered in the cathedral in 1877, are the true remains; and that the bones transported to the Havana in 1755 are not those of the celebrated navigator, but are those of his grandson, which were lying in a contiguous vault.

After some interesting researches at Samana Bay, which furnished him a skull and the incomplete skeleton of one of the aboriginal inhabitants of Hayti, he also found a series of Indian inscriptions in the grottoes of the coast.

Proceeding to the Havana, Mr. Pirrard found in the Archives of Cuba, several articles of high interest, elucidating the geographical discoveries of the last century in the range of the Rocky Mountains. One of these is the journal of the French Canadian Jacques L' Eglise, who discovered the sources of the Missouri, and who relates that a short distance west of the head waters of the Missouri another stream took its origin, which from the account of the Indians finally empties into the Pacific Ocean.—[*Translated from l' Exploration.*]

* Dispatches just received from Melville announce the finding of DeLong and party, all dead, at the Lena Delta, about March 24th. His books and papers were all found.—[Ed. Review.

NOTE BY TRANSLATOR.—We think that L' Eglise undoubtedly alluded to the Reynolds and Henry Passes of the Rocky Mountains, where the head sources of Jefferson and Madison Forks are not over one and one-half miles from Henry's Lake, the main head of Lewis' Fork of the Columbia. I have surveyed and examined that locality personally.

MINING AND METALLURGY.

A LOW-GRADE STAMP MILL.

MRS. FLORA ELLICE STEVENS.

The low grade ores are distinguished from those of the higher class, as in the former instance there is less of the precious metals to the quantity of ore than in the latter, and consequently the method of treating the low, or poor grade must be different from that acceptably employed for the richer mineral; for it is far too expensive to use the same means of treatment with that running fifteen or twenty ounces to the ton, as would pay well in the ore running several hundreds. Of course it must be remembered, that I am speaking of silver ores, as the barest trace of gold will always pay for working.

But in a general silver region, particularly where the ore is found in the level ground, instead of among the mountains, there are a great many claims, which would pay well if they were worked by an inexpensive method of treatment. A stamp mill built to meet this exigency, I had the pleasure of visiting, a description of which I will endeavor to give, though it will necessarily be less full and complete than I would desire, as it has been a year since I examined the mill, and most of my notes made at the time have been lost.

The mill is built upon the side of the hill, as by this means an advantage will be gained in the distance the ore cars are to be raised. About five hundred yards away is the mine. A tramway, perhaps a foot and a half wide, connects the two, along which iron cars carry the ore, drawn by horses *a la tandem.* The cars run directly on to the elevator, and are hoisted to the ore or quartz house, which is the very highest division of the mill. This room is 16 by 75 feet.

The ore is "dumped" over iron screens, the fine ore dropping down to the bins, and the coarse ore falling on to the breakers, just above these, for crushing. The breakers in this mill were Blake's improved, with a capacity of a 100 tons per day. As the next step, the ore is taken from the chutes to the self-feeders, which are fed automatically by the dropping of the battery. The battery room is 36 by 75 feet, and the building increases in width as we go down in about the same ratio, to make room for the machinery, which now becomes necessary.

This battery is a knee battery of forty stamps, makes ninety-five drops per minute, and is capable of crushing 124 tons every twenty-four hours.

From the battery the sand, as it has now become, is run into settling sand tanks, there settled, and shuffled into pans for amalgamating.

These pans, often erroneously called tubs, are placed in rows, in what is known as the pan room. There were in this instance twenty combination amalgamating pans employed, of two tons capacity to the change; and with ten settlers capacity for the pans. From the settler bowls quicksilver is taken in pipes to the strainers; from the strainer safes, again in pipes to the reservoir of the quicksilver elevators, and to the pan floor into another receiver. From this it is taken in pipes to the bowls on the pans. Down from these bowls the quicksilver is let by charges into the pans, as needed to charge them—these contain the ore now reduced to a fine mass--for amalgamating

The ore, now called amalgam, is ready for retorting. After retorting the crude bullion is hauled on to an iron plate, broken up, put into crucibles, and smelted into bars, generally a foot and a half long, and eight inches thick. All that remains is to ship it to the mints.

In the mill visited the engine was 24 by 48 inches, of 250 horse power, the main belt thirty-six inches in width, while the main driving pulley of the fly-wheel had a capacity of 39,000 pounds. The boilers, four in number, were fifty-six inches by sixteen feet in diameter, of 250 horse power capacity. This is what termed the "wet" process, as the roasting does not do for poor grade ores. In the mill described, ores have been worked for less than $5 per ton.

Were I a practical miner, I would be able to enlarge upon these details, and give them with more force and clearness than I have done. As I am not, I may only submit them as the skeleton of a description, trusting that those who read it, may gain from it a slight idea of a model low-grade stamp mill.

MINING PROSPECTS IN COLORADO FOR 1882.

From an average production of only three or four millions, Colorado has suddenly risen to the first rank as a producer of the precious metals among the States and Territories for gold and silver combined; as for silver alone, it ranks first, while for gold it holds the fourth rank. In the relation of production to area, it holds the first rank, likewise, for gold and silver combined and for silver alone, and the third for gold alone. In the relation of production to population, however, it ranks only third for gold and silver together, second for silver alone, and sixth for gold alone. The total value of its product during the census year in gold and silver was, in round numbers, nineteen and a quarter million dollars, and if we add to this the value of lead and copper in crude metal produced, we have a total value of metallic product of twenty-two and three quarters million dollars.

From all sections of the State, reports received indicate that the coming season will be the liveliest in mining operations ever recorded in the history of Colorado. Not only are the Leadville and other mining districts flourishing, but, throughout the State, innumerable small camps are springing up, many of which, it is expected, will be heard from before the end of the year. Of course, active mining operations, in many places, will be retarded for a time yet by snow; but preparations are making to resume work as soon as the weather will permit, on claims that have long lain idle.

CLEAR CREEK COUNTY.

At Dumont, the Albro mine is shipping ore to the smelting-works at Golden. The Unadilla Company is taking the average quantity of ore from the Eagle mine, and is actively engaged in developing the mine by running levels and cross-cuts, and in sinking the main shaft. A drift running on the vein from the cross-cut in the Syndicate mine is in 124 feet, and exposes a vein about eighteen inches thick of solid ore upon the hanging-wall.

At Montezuma, the Silver King concentrator is running steadily, working about five tons per day. The Silver King mine is reported as looking excellent, and is employing a force of twenty men. Connection was recently made between the first and second levels, by a winze. The Little Helen Mining Company is driving a cross-cut tunnel to the Hidden Treasure lode. The various mines of less importance in the vicinity of Montezuma are reported as looking very well.

According to the census reports, this county produced during the year ending May 31, 1880, $376,041 in gold and $1,954,547 in silver, assay value.

GILPIN COUNTY.

The mill of the California Mining Company at Black Hawk will start up in a short time on ore from the California mine. The mine is yielding a fair amount of mill-dirt and smelting ore. A good body of ore was recently encountered in driving the 150-foot level of the Mountain City, west from the working-shaft. Twenty-five stamps of the New York mill are dropping on ore from the United Gregory lode. The other fifty stamps are working ore from the Cotton and other lodes. The Quartz Hill Company is meeting with fair success in the development of its mine, and expects in a short time to have the mill running.

The more prominent mines in the vicinity of Central City continue as at last report, and the mills are kept busy crushing the product. The California Consolidated Mining Company, which recently purchased the Standley-California mine, has begun work on the mine, and expects to have the fifty-stamp mill in operation in a few weeks.

Production for the census year $2,012,134 in gold, $674,727 in silver.

THE SAN JUAN REGION.

The San Juan region has always been understood to comprise Ouray, Dolores, Hinsdale, La Plata, San Juan and Rio Grande, and in it are the well-known rich mining districts, having each its own particular town or outlet as follows: Ouray, having the Sneffels, Uncompahgre, Bear Creek, Red Mountain Gulch and Poughkeepsie Gulch mines tributary to it; Lake City, having the rich mines of Hensen Creek, Engineer Mountain, and a large number immediately around the town itself; San Miguel, having the celebrated gold and silver mines of Marshall Basin, Ingram Basin, Bear Creek, Turkey Creek, and twenty miles of placer claims on the San Miguel River; Ophir, having its own rich mines all around it; Rico, being the center of all the mines of Dolores County, and having an outlet by the Denver & Rio Grande Railroad near Durango, and at a distance of about twenty-eight miles. With the exception of the latter, all these are tributaries to the main line of the Denver & Rio Grande Railroad. Silverton has tributary to some remarkably good mines immediately around the town, and those of Cunningham Gulch, Eureka Gulch and Animas Forks, and has its outlet, as aforesaid, by the Denver & Rio Grande Railroad, now under construction from Durango to Silverton. Production for this region in 1880, $891,042.

JEFFERSON COUNTY.

The smelting-works at Golden are worked to their full capacity. The mines of Gilpin and Clear Creek Counties are sending them large quantities of ore, and there is received from the Robert E. Lee mine, of Leadville, one car of ore per day, which yields from $100 to $600 per ton.

LAKE COUNTY.

The mines in and around Leadville continue in the flourishing condition noted for some time past. The roads which at this season of the year are generally impassable on account of the melting snow, are reported in excellent shape, and the large shipments from the mines are maintained.

The report of the smelters for the quarter ended March 31st is a gratifying one, showing the aggregate product to have been $4,031,433, as against $3,097,-820 for the same last year—an increase of nearly one million dollars thus far this year. This shipment is the largest ever made by the mines during the same length of time; and as the smelters have large quantities of ore on hand, and the mines are increasing their output, it may be taken as an indication that the product of the Leadville mines for 1882 will largely exceed that of any previous year. The mines are in good condition, and the shipments large and steady.

One of the most convincing indications of Leadville's prosperity is the large stocks on hand at the smelters, which, although working to their utmost capacity, can not treat all the ore they receive, and are accumulating large quantities in their bins and yards. The mines of Fryer Hill continue to be the leading features of interest, though there is a large increase in the output of the Carbonate Hill mines. Production for the census year, $82,687 in gold, $13,226,999 in silver.

PITKIN COUNTY.

This is a new county, lying westwardly from and adjoining Lake County. Its county-seat is Aspen, some thirty-five miles from Leadville. Among its best known mining camps is the Independence District where gold is the most abundant metal. The Farwell Consolidation with the well-known J. V. Farwell, of Chicago, at its head is in the lead of all, and so rich are its mines and well managed its affairs that its five dollar shares are said to be in demand at eighty dollars each. Their mines have netted about $40,000 per month, for the past three months.

The Independence mine, the Last Dollar, the Choler, Mammoth, Dolly Varden, Lincoln, Pacific and Sheba, the Minnie, Legal Tender, Bennington and Climax, are all now the property of the Farwell Company, besides the valuable properties known as the Tam O'Shanter and Brown tunnel sites. The former is now in 170 feet and the latter 500 feet. This large array of valuable mines does not comprise all the property of the company, however. The Johnson placer and many others, which are not fully developed, are owned by the company.

A good idea can be had of the extent and importance of the developments on these claims by starting from the Minnie's workings. At this mine a tunnel has been run in about thirty feet to strike the vein. The mineral varies from a foot to two feet in thickness, and is composed of honeycombed quartz, interpersed with iron and copper pyrites. Rich specimens of free gold are often encountered in these workings. The outcrop of the vein is about sixty feet above where the vein has been cut.

Many other good mines have been opened and are now being worked in this district, among which are the Lake George and Sunrise: also those of the Hamilton Mining Company. August Schott, an old prospector and experienced miner, writes as follows:

"I have just returned from a trip over the county picking up such knowledge as is necessary for my business. There is a great rush for the lower end of this county, but the snow is so deep that no prospecting can be done by strangers. The first hoisting engine has arrived in the gulch. It is for the Minnehaha mine, a claim situated between the Farwell property and that of the Hamilton Company, and joining both. There is a large body of mineral there, but it lies deep. A seventy-five foot shaft has failed to reach it, but the boys are determined to go down to it."

"Four men have been working all winter on the Mt. Hope mine, driving a tunnel to cut the vein. At the intersection it was only six inches thick, but it soon widened to six feet solid qnartz, which yielded $25 in gold per ton under the stamps, while the tailings are worth $5 per ton. The great cry is 'a custom mill' and this will be the leading gold camp in Colorado."

THE PRECIOUS METALS.

The Census Bureau has engaged Mr. Clarence King, who was recently at the head of the scientific survey, to collect the statistics of the production of the precious metals. Mr. King is well fitted for this work by his former studies and investigations, and has made a valuable report. The following table shows the aggregate production of the precious metals for the year ending March 31, 1880:

	Deep Mines.	Placer Mines.
Alabama	$ 1,301	.....
Alaska	.....	$ 6,002
Arizona	2,507,534	30,256
California	9,652,575	8,649,253
Colorado	19,146,066	103,106
Dakota	3,325,547	51,109
Georgia	14,166	67,195
Idaho	1,049,510	894,684
Maine	10,199	.....
Michigan	25,858	.....
Montana	3,539,730	1,171,105
Nevada	17,268,482	50,427
New Hampshire	26,999	.....
New Mexico	441,691	.....
North Carolina	114,367	4,726
Oregon	190,172	934,522
South Carolina	6,499	6,597
Tennessee	1,998	....
Utah	5,014,503	20,171
Virginia	9,321	.....
Washington	16,800	120,019
Wyoming	17,321	.....
Total	$62,381,448	$12,109,172

ALL MINES.

	Gold.	Silver.
Alabama	$ 1,301	.....
Alaska	5,951	51
Arizona	211,965	2,325,825
California	17,150,941	1,150,887
Colorado	2,699,898	16,549,274
Dakota	3,305,843	70,818
Georgia	81,029	332
Idaho	1,479,653	464,530

Maine	2,999	7,200
Michigan		25,858
Montana	1,805,767	2,905,068
Nevada	4,888,242	12,430,667
New Hampshire	10,999	16,000
New Mexico	49,354	392,337
North Carolina	113,953	140
Oregon	1,097,701	27,793
South Carolina	13,040	56
Tennessee	1,998	.....
Utah	291,587	4,743,087
Virginia	9,321	.....
Washington	135,800	1,019
Wyoming	17,321	.....
Total	$33,379,663	$41,110,957

It will be seen by this table that California produces in value a little more gold than Colorado does of Silver. The deep mines in California, particularly in the Bodie district, have produced more gold than the auriferous gravel which seems to be fast becoming exhausted. The Nevada mines, which produced such quantities of precious metals from 1871 to 1879, show a notable falling off, due in large part to the diminution of the Comstock lode. Nevada also lacks water to work her gravel deposits. The Utah mines give a very steady production of the precious metals. The mines of Arizona are of recent development, and full statistics have not been collected. There are large mining regions in Alaska, New Mexico, Idaho, Montana, Dakota and Washington Territory that have hardly yet been examined.

The total production of gold and silver for the year 1880 was about $74,-500,000, while the out-put in 1881 was nearly $77,000,000. It is a noticeable feature in mining operations that the production of gold mines in this country and other lands is gradually falling off, indicating that gold mines are becoming exhausted.

There may still be rich gold fields in the northern part of the North American Continent as indicated by the glaciers which have dropped gold all along their course in Indiana and other States. Prospecting for the precious metals ought not to be left entirely to private enterprise, but it could be incorporated in the scientific survey, and thus be fostered by the government. Great losses are often entailed by individuals and companies which a little scientific knowledge would have prevented. Every government certainly has the right to develop its natural resources.—*Kansas City Journal.*

THE PRODUCT OF GOLD AND SILVER FOR 385 YEARS.

Dr. Adolph Soetbeer publishes a report upon the precious metals, taking the year 1493 as the starting date in his computations, claiming that the modern history of gold and silver begins with the return of Columbus from his first voyage to the New World. Towards the end of the fifteenth century, before the treasures of America were unlocked, the supply of the precious metals in civilized countries had fallen far below the requirements of trade. Mr. Jacobs' conjecture in regard to the specie which was available for the exchanges of Europe in 1492, rates the total sum at no more than $165,000,000. Since then the mines of the world have furnished over fourteen and a half billions in silver and gold. We present below a valuation of the weights tabulated by Dr. Soetbeer, for three hundred and eighty-two years, from 1493 to 1875, supplemented by an estimate of the production for the three years 1875 to 1878, uncovered by his table:

	Production of precious metals from 1493 to 1878.
Gold	$6,612,193,087
Silver	7,976,429,920
Total	$14,588,623,007

We desire at present to direct attention to the steady increase in the supply of the precious metals from century to century, and especially to the enormous figures of the gold production during the last twenty-eight years. That the position may be seen at a glance, we have prepared tables of the annual average supply for each of the precious metals by decades or double-decades from 1493 to the end of last year. The production of each century is summarized and averaged by itself. Our readers will do well to preserve the tables for reference. Average annual production:

SIXTEENTH CENTURY.

Years.	Gold.	Silver.
1493 to 1520	$3,856,578	$ 2,015,125
1521 to 1544	4,758,536	3,867,325
1545 to 1560	5,655,746	13,359,850
1561 to 1580	4,545,864	12,841,062
1581 to 1600	4,904,748	17,960,337

The total production in the one hundred and eight years, from 1493 to 1600, amounted to $501,693,248 gold, an average of $4,645,307 per annum; and $976,024,900 in silver, an average of $9,065,045.

SEVENTEENTH CENTURY.

Years.	Gold.	Silver
1601 to 1620	$5,662,392	$18,134,837
1621 to 1640	5,516,180	16,875,600
1641 to 1660	4,828,542	15,705,112
1661 to 1680	6,154,196	14,448,875
1681 to 1700	7,154,419	14,658,962

The total production in the one hundred years, from 1601 to 1700, amounted to $606,314,580 gold, an average of $6,063,145 per annum; and $1,596,407,750 silver, an average of $15,964,077.

EIGHTEENTH CENTURY.

Years.	Gold.	Silver.
1701 to 1720	$ 8,520.172	$15,246,350
1721 to 1740	12,680,568	18,487,700
1741 to 1760	16,355,806	22,858,591
1761 to 1780	13,760,543	27,986,227
1781 to 1800	11,823,234	27,689,697

In the hundred years, 1701 to 1800, the production aggregated $1,262,806,400 gold, an average of $12,628,c64; and $2,445 371,337 silver, an average of $24,154,713.

NINETEENTH CENTURY.

Years.	Gold.	Silver.
1801 to 1810	$ 11,815,258	$38,336,681
1811 to 1820	7,606,347	23,185,513
1821 to 1830	9,447.953	19,746,510
1831 to 1840	13,484,069	25,572,793
1841 to 1850	36,392,831	33,460,293
1851 to 1860	134,107,307	38,396,813
1861 to 1870	125,284,742	52,312,537
1871 to 1878	112,081,628	82,400,000

In the seventy-eight years, 1801 to 1878, the production aggregated $4,278,938,135 gold, an average of $54,846,642 per annum; and $2,969,306,913 silver, an average of $38,068,037 per annum.

BOOK NOTICES.

A HISTORY OF THE ST. LOUIS BRIDGE. By C. M. Woodward, Professor of Mathematics and Applied Mechanics, and Dean of the Polytechnic School of Washington University. 4to, pp 400. Illustrated. G. I. Jones & Co., St. Louis, Publishers.

Long before the St. Louis Bridge was completed, Captain Eads, its illustrious builder, closed a report to the Board of Directors with the following statement: "When all of the many difficulties that have retarded this great work shall have at last been surmounted and the Bridge becomes an accomplished fact, it will be found unequaled in the important qualities of strength, durability, capacity and magnitude by any similar structure in the world."

That the bridge has become an accomplished fact and stands without a rival in the world everybody knows; but of the difficulties upon whose solution the success of the bridge as a work of engineering depended, there is very little knowledge. Doubtless in every great work new questions come up which have never before presented themselves for practical answers; but it is doubtful if any other work transcended experience at so many points. Of all these difficulties, of the various attempts both successful and unsuccessful to overcome them, and of the construction and erection of the bridge in every detail, Prof. Woodward gives an account which cannot fail to meet the demands both of the professional and non-professional reader; the happy combination of a plain statement of facts with an interesting story of events makes the work altogether *sui generis*. It is complete, clear, concise and entertaining. The book is really much more than a history of the St. Louis Bridge; its principal claim to a high place among books which last for all time is, that it has put together a great mass of experience in engineering work which would otherwise have remained scattered and useless, because inaccessible, and these he has placed in form ready for use by all the world whenever wanted. By a judicious arrangement of subjects and indices, the reader is enabled to find just what he may want without reading over much which he may not want, so that the book must prove invaluable to engineers and scientists as a work of reference. As a record of the planning and erection of a structure which required at times consummate skill both of a head and hand and not unfrequently demanded immediate answers to questions upon which experience was dumb, the book contains many chapters which would be valuable additions to scientific literature if published separately. Some of these are deserving of special mention.

The sinking of the piers was itself a great scientific work. When it is remembered that, owing to the treacherous nature of the river, which at times cours its bed of the sediment which it had deposited years before, the great piers of masonry had to be sunk to the bed rock of the river, the magnitude of this undertaking, upon which the ultimate success of the entire work depended, will at once appear. The deepest of the piers went down 110 feet below the surface of the water and of this distance more than two-thirds was below the bottom of the river. Caissons of iron were used in sinking the piers, and the weight of the masonry furnished the pressure for sinking the caissons. The special peculiarities consist of the magnitude of the masses of material handled and the number of special devices which the needs of the moment only could suggest. It does not seem probable that any large bridge will in future be built upon piers before its engineer has carefully studied the methods employed in sinking the piers of the St. Louis bridge, and for this reason the value of the chapters devoted to this subject cannot at present be fully estimated.

The sinking of the piers afforded exceptional opportunities not easily reproduced for the study of the "Physiological effects of Compressed Air." Under this title Prof. Woodward gives a *resumé* of the experiences of the men who were employed in in the caisson and an exhaustive discussion of the subject from a scientific standpoint. The explanations here given of phenomena, no doubt observed before, are, so far as we know, quite new and have been endorsed by some of the best physicians in the country.

The special features in the manufacture of materials for the superstructure of the bridge will be well shown by the following quotation from the book itself:

"No sooner were preparations made for the construction of the arches than practical difficulties appeared. It is true many of them had been anticipated, but it is equally true that the difficulties actually met surpassed the shrewdest conjecture. The steel makers found that their facilities were inadequate to the magnitude of the work undertaken; their workmen were unskilled; and their foremen without experience in working steel in such large masses.

"Both iron and steel makers were unaccustomed to the rigid tests required. The insertion into specifications of the items of elastic limit and modulus of elasticity was a new feature in bridge contracts. Moreover, the detail drawings and specifications indicated a grade of workmanship altogether exceptional. To be sure they involved nothing, as regarded accuracy, either impossible or even difficult, but they were unusual and of course expensive. All these things now add to the value and fame of the great work; without them this bridge would be merely one of a thousand bridges, and this history never would have been written; but in 1871, '72 and '73, the fame of the bridge had little weight with a contractor or with a stockholder.

"Most of the real difficulties were actually overcome; and through the influence of Mr. Eads's specifications the standard of good workmanship was raised throughout the world. In the construction of the St. Louis bridge, engineering made progress. Let me quote on this point from so eminent an authority as *London Engineering:* In its issue of October 10, 1873, the editor said: 'Our present requirement being to select some example of the most highly developed type of bridge-building of the present day, we have no difficulty in passing before ourselves in mental review the different works now in progress thoughout the world, and we have still less difficulty in electing as our example the magnificent arched bridge now almost completed by Capt. Eads, at St. Louis. In that work the alliance between the theorist and the practical man is complete. The highest powers of modern analysis have been called into requisition for the determination of the strains, the resources of the manufacturer have been taxed to the utmost in production of material and perfection of workmanship, and the ingenuity of the builder has been alike taxed to put the unprecedented mass into place. In short, brain power has been called into action in every department. * * *'

Thus wrote the accomplished critic, unmindful for the time of the perplexities of the manufacturer, the misgivings of the contractor, the anxieties of the capitalist, and the trials of the engineer. Each in his place was abundantly exercised. When cross examined before the tribunal of actual work, the steel and iron makers who had given such repeated assurance of their ability to construct all that was required, confessed themselves less confident and sometimes completely at loss, and more than all, after careful study of the drawings and specifications, even when numerous changes had been made with a view to lessening the cost of construction, the contractors claimed that the quality of workmanship required was far beyond their expectation and that on many points Mr. Eads demanded impossibilities. Every detail was sharply discussed, and agreements were reached at the expense of time and generally of money.

A complete account of all these difficulties, and of the ways in which some were overcome and others avoided, makes of these chapters a standard authority on the manufacture of iron and steel in large pieces; in the same way the records of the tests of materials, and methods and machines used in testing, have a value far beyond that of showing the care and precision with which every part of the work was constucted.

The chapter on "The Theory of the Ribbed Arch" is also deserving of special mention; the subject has never been more beautifully and satisfactorily discussed. All the mathematical calculations used are given in detail.

The book is a quarto of nearly 400 pages, and is as well printed as any book we have ever seen. It is illustrated by thirty-nine large plates of drawings, showing accurately every detail of the bridge. The drawings were made by Wm. Gerhardt, of St. Louis, and photo-lithographed by Julius Bien, of New York. They are unsurpassed. There are also eleven artotype plates, made by R. Benecke, of St. Louis, giving excellent views of the bridge in process of erection, and seventy-two diagrams illustrating special points.

The book has received the highest endorsement from professional engineers.

Birds-Nesting. By Ernest Ingersoll, 12mo. pp. 110. Salem, Mass., Geo. A. Bates, 1882, $1.00. For sale by the Nauralist's Bureau.

This little volume, made up from a series of articles by the prolific and always entertaining and instructive author, first published in the columns of *Science News*, is intended for a hand book of instruction in gathering and presuming the nests and eggs of birds for the purposes of study.

The topics are Field Work, in which instructions are given for discovering nests, on the habits of birds, naming eggs, etc. ; Preparation of Specimens, including descriptions and illustrations of the various implements used; How to construct and arrange the Cabinet; Lists of birds whose nidification is unknown; Bird architecture; the whole concluding with a full index.

To amateur collectors, or even to experts, this book will be found eminently useful, while to the casual reader it will be found to possess much of interest.

John Inglesant, a Romance. By J. Henry Shorthouse, 12mo. pp. 445 : MacMillan & Co., New York, 1882. For sale by M. H. Dickinson, $1.00.

This might just as well be termed a historical novel, but since the author prefers to call it a philosophical romance, the reader may take his choice, but under either title he will find it an unusually attractive story, not only from its historical truthfulness, its skillful management of characters and plot, but also from the strictness with which the philosophical element is kept in view at all times. The author says on this point, "In books where fiction is used only to introduce philosophy, I believe that that it is not to be expected, that human life is to be described simply as such. The characters are, so to speak, sublimated, they are only introduced for a set purpose and having fulfilled this purpose—were it only to speak half a dozen words—they vanish from the stage." If this be his only purpose, he has succeeded admirably in masking his object with an accuracy of description, a selection of important and thrilling events in history and a fascinating style of writing, so that many if not most readers will find the romance *per se* rather than the philosophical lesson the prominent feature.

First Lessons in Geology. By Prof. A. S. Packard, Jr., Brown University. Octavo, pp. 128, illustrated. Providence Lithograph Co., Providence, R. I., 1882.

This is a text book to accompany a series of lithographic charts known as the Chautauqua Scientific Diagrams, Series No. 1. Geology. It is written in a clear and popular style, while Professor Packard's connection with it guarantees its correctness beyond question. The charts are of large size, fairly executed and a very excellent aid to a lecturer or teacher in illustrating his subject. There are ten in number, beginning with the Action of Water, including glaciers, cañons, etc., then the Action of Heat including volcanoes, geysers, earthquakes, etc. America during the silurian, devonian, carboniferous, triassic and jurassic, cretaceous, tertiary, pre glacial and glacial periods. They will make a useful addition to our school literature.

THE TRANSACTIONS OF THE ACADEMY OF SCIENCE, OF ST. LOUIS; Vol. IV, No. 2, octavo pp. 394. Published by the Secretary, $2.00.

This handsomely printed volume contains important papers by Dr. G. Seyffarth, Profs. C. V. Riley, F. E. Nipher, C. A. Todd, H. S. Pritchett, Geo. Engelmann and E. A. Engler. We reprint one of these papers in the present issue of the REVIEW, and shall present others to our readers in the future as may seem appropriate.

OTHER PUBLICATIONS RECEIVED.

Commercial Relations of the United States, Nos. 13, 14, 15, from Hon. R. T. Van Horn; Transactions of the Seismological Society of Japan, Vol. II, from Prof. H. M. Paul; Bulletin of the U. S. National Museum, No. 22; Little known Facts about well known Animals, from Prof. C. V. Riley; Medicinal Flora of Kansas, by Robt. J. Brown, Leavenworth, Kansas; Time-Keeping in Paris, by Edmund A. Engler, St. Louis, Mo.; Report of the standing committee on water on the Impurity of the Water Supply of Boston, with the report of Prof. Ira Remsen, on the subject; Directions for Collecting and Preserving Insects, by Prof. A. S. Packard, Jr., M. D.; Retarded Development in Insects, by Prof. C. V. Riley; the Palæolithic Implements of the Valley of the Delaware; What is Anthropology? a lecture by Prof. Otis T. Mason; The 17th Annual Catalogue of Officers and Students of the Massachusetts Institute of Technology, 1881–2; Catalogue of Officers and Students of Marietta College, Ohio, 1881–2; Hints for Painters, Industrial Publication Co., N. Y., 25c; The Silk-Worm, a Manual of Instruction for the Production of Silk, by Prof. C. V. Riley; The Pacific Northwest, Oregon and Washington Territory, from A. L. Maxwell.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

AUTOMATIC CASH SYSTEM.

A novel apparatus, designed to take the place of cash-boys in large stores, provides a cash-box, detachably secured to an endless cord by a spring-actuated clamping-lever. The box rests on a grooved track, and is stopped by coming in contact with projections on the under side of a cover of a trough fixed to the track, into which the cash-box enters. The box is unclamped from the endless cord by a clamping-lever, and a projection on the box bearing against two spring-guides on the under side of the trough cover. Raising the cover of the trough removes the spring-guides and the stops on the trough-cover from the cash-box, which is then engaged with and carried forward by the endless cord.

COMPRESSING AND COOLING AIR.

This novel improvement consists in providing the cylinder of an air-compressor with two independent water-chambers arranged respectively upon the opposite ends or heads of the cylinder, and through which a current of cold water is continually flowing. A third water-chamber surrounds the body of the cylinder. This latter chamber is divided into two compartments, each of which is supplied with cold water near the ends of the cylinder; but they have a common outlet through an annular passage arranged between them.

MAKING BREAD BY MACHINERY.

The bakers' fraternity, realizing the importance of making and baking bread which shall offer serious competition to what is properly called home-made bread, have made quite a number of improvements. It is of importance in bread-making that the fibre of the dough be as nearly continuous as possible on the outside, so that the loaves may appear white and flaky where they break apart, and also to prevent them from drying out too rapidly. In making bread by hand conformity to these conditions is easy. By the use of machinery, however, the dough is cut into loaves by sharp knives, thus leaving the ends and sides without the fibrous covering, causing them to break badly. By the use of a novel bread-making machine this difficulty is said to be entirely obviated. This machine presses rather than cuts the dough apart, so that the fibre of the of the grain shall be preserved continuous. This object is accomplished by using in the cutting-machine thick knives which are rounded instead of sharp.

COMBINED MUFF AND LUNCH RECEPTACLE.

A novel lunch-receptacle and muff consists of two covered receptacles joined at their upper and lower extremities, leaving an intermediate padded space in which the hands are placed. The outside of this combined receptacle and muff, is highly finished and ornamented, so as to adapt it for street wear.

IMPROVED PIPE-JOINT COUPLING.

A late improvement consists of a pipe-joint for coupling pipes at any angle with each other. The coupling proper consists of two hemispherical shells fitting each other with an annular overlap joint. Each half shell has a pipe opening suitably screw-threaded, to receive the adjacent ends of the pipes. In order to keep the hemispherical shells in place and steam or water-tight, a central bolt is provided, passng through the shells, when it is desired to set the pipe-joint at a certain angle this bolt is loosened and the shells adjusted, after which the threaded bolt is again tightened.

SIGNALING BY ELECTRICITY.

This electric-signaling apparatus consists of a relay having a movable armature and retractor and a device for alternately breaking and closing the circuit thereof, combined with a local battery and circuit for operating registering apparatus, the terminals of which are controlled by the said relay-armature, whereby the condition of the local circuit is changed both at the movement of the relay-armature from and at its movement toward the poles of its magnet. A record is thus made both at the opening and closure of the main or relay circuit.

MACHINERY FOR WAXING PAPER.

This novel paper-waxing apparatus comprises a heated waxing-pan having a bar beneath its surface under which the paper is required to pass. The paper is then led to a pair of distributing, compressing, and calender rolls, located above or nearly over said pan, and an independent smoothing and cleaning device is located on the delivery side of said rollers.

DESULPHURIZING FURNACE.

A late and new process for desulphurizing ores consists of the following successive steps: first, drying the ore; second, subjecting the dried ore in a close chamber to thorough agitation; third, subjecting the ore to the action of heat; and, fourth, injecting hot air which has been dehydrated or deprived of its moisture. The air, before being admitted to the roasting-chamber, is dehydrated by being forced through a body of common salt.

ARTIFICIAL FILTRATION.

As illustrations of the process of filtration on a large scale, nothing better can be had, perhaps, than the filter-beds of the London Water Companies. They cover altogether close upon eighty-four acres of ground; and though they vary very greatly in their composition, the principle on which they are constructed is the same in all cases, and any one of them may be taken to exemplify the operation. In practice, all the companies requiring to filter their water do so by allowing it to stand in huge reservoirs, the bottoms of which are porous, and supported on brick arches, which at once form the base of the filter-beds, and the roof of a water-tank, from which the purified water is pumped up into the mains. The composition of the filter-beds varies with each company. The New River Company, the largest of them all, make their filters of two feet three inches of sand, underneath which are three feet of gravel, increasing in coarseness toward the bottom. Others are more elaborate. The Grand Junction Waterworks Company, for instance, make their filters by first depositing one foot of boulders, over which are nine inches of coarse gravel, then nine inches of fine gravel, six inches of hoggin, and two feet six inches of Harwich sand. The Lambeth and the Chelsea Companies, again, construct their beds of shells, as well as sand and gravel, though in different proportions, one having altogether eight feet of filter-ing material, the other only seven feet. The object of all of them, however, is to make a porous bed through which the water will percolate slowly enough to insure efficient purification, but yet not so slowly as to make the process too tedious and expensive. As to what should be the rate at which the process may be carried on to be effective, is a point upon which authorities differ somewhat. Dr. Tidy considers that it should be as nearly as possible two gallons per square foot per hour; Colonel Frank Bolton, the Water Examiner under the Metropolitan Act of 1871, thinks it may be two and a half gallons. All agree, however, that it must not be too rapid.

Such filter-beds as those of the London companies are only modifications of the natural process of filtration up through beds of gravel and sand, from which the best of spring water flows. Authorities say that the sand not only acts as a strainer, but it performs the office of the rock in bringing every particle of the water into close contact with the air. The sand, they tell us, is but a vast collection of minute rocks; and every grain of sand is a particle of rock, incased in a film of air.

ANCIENT ROMAN COIN.

St. Louis, April 27, 1882.

Editor Kansas City Review:—The following account of an ancient coin found in Illinois will without doubt be interesting to your readers. A few weeks since Dr. J. F. Snyder of Virginia, Cass Co., Illinios, wrote to me: "A rural friend in this county some time ago found on his farm a curious bronze coin or ornament, which he requested me to send to St. Louis or elsewhere for identification. Supposing that you are a numismatician as well as an archæologist, I will send it to you for your opinion."

Upon examination I identified it as a coin of Antiochus IV., surnamed Epiphanes, one of the kings of Syria, of the family of the Seleucidæ, who reigned from 175 B. C. to 164 B. C., and who is mentioned in the Bible (first book of Maccabees, chapter 1, verse 10) as a cruel persecutor of the Jews.

The coin bears on one side a finely executed head of the King, and on the obverse a sitting figure of Jupiter, bearing in his extended right hand a small figure of Victory and in his left a wand or sceptre, with an inscription in ancient Greek characters—basileos, antiochou, epiphanous, and another word partly defaced which I believed to be nikephorou; the translation of which is King Antiochus, Epiphanes (Illustrious), the Victorious. When found it was very much blackened and corroded from long exposure, but when cleaned it appeared in a fine state of preservation and but little worn.

Yours truly, F. F. Hilder.

EDITORIAL NOTES.

In commencing the Sixth Volume of the Review we are gratified to be able to state that it has continued to receive flattering commendations from all sources on the improvements made in its appearance within the past year and upon the popular character and good quality of the articles published. One of the most frequent comments of Eastern writers is surprise that the people of the West, where money making is supposed to be the chief object of life, should continue to support a magazine of its grade and purpose. They forget or overlook the fact that in the West liberality goes with money making and that many persons, who have little time to read the Review, think it worthy of support and have it sent to distant friends as an evidence of the progress Kansas City is making as a centre of intelligence and knowledge as well as a commercial emporium. Numerous instances can be given where this kind of patronage has resulted to the advantage of the whole community at a very small cost to the individual. As has several times been stated, the publication of the Review is a labor of love with its proprietor, who can only devote his evenings to the work and who has no expectation that it will ever be a source of profit, but who feels that it is an enterprise that should be fostered by all good citizens, not only for the good it may do in their own families, where it will pay for itself many times over every year,—but also because it helps to round out the city in those features which make it a desirable and attractive residence for the best classes of people.

All subscribers wishing back numbers of the Review bound can have it done in handsome half morocco and cloth for $1.00 per volume by leaving them at this office.

The Sixth Annual Meeting of the Kansas City Academy of Science will be held at the First Baptist Church, corner of 12th street and Baltimore Ave., on the last Tuesday of this month. The annual address will be delivered by Rev. Alex. Proctor. The exercises are open to the public.

The Signal Service Bureau has published the Report of Sergeant J. P. Finley, on the Tornadoes of May 29 and 30, 1879, in Kansas and Missouri, and No. 4 of its Professional Papers. It is a comprehensive account, statistical, descriptive and theoretical, of the whole subject, which we shall take occasion to notice fully hereafter. Mr. Finley or some other officer of the Signal Corps will be sent out soon to investigate the tornadoes of last month, in which case we are expecting a synopsis of his report in advance.

Prof. Wm. Dawson, the Quaker shoemaker astronomer, of Spiceland, Indiana, says of the Review in a recent letter, "I count it among the very choice part of my magazine literature, and hope to long receive it."

The Twenty-First Annual Session of the Missouri State Teachers' Association will be held at Sweet Springs, (Brownsville) Saline County, Missouri, June 20, 21 and 22, 1882. Every friend of education is requested to encourage, by his presence, the objects of the Association.

This number of the Review has been greatly delayed awaiting the receipt of the cuts for the completion of Mr. Wortman's article on the "Origin and Development of Existing Horses." When they did finally arrive mistakes were discovered necessitating the omission of the article and the substitution of another.

THE committee appointed by the National Academy of Science to investigate and report upon the sorghum-sugar industry, declares sorghum to be the best sugar producing plant next to the sugar cane of Louisiana, and that it has a continental spread of variableness and adaptation to various soils and climates of the United States.

ABOUT two years ago Mr. Leigh Smith, an English gentleman, sailed in his own yacht to penetrate the ice-barriers of the Polar Sea, since when he has not been heard of. The Geographical Society of England is going to send a search expedition out after him.

DE LESSEPS has recently celebrated his seventy-seventh birth day anniversary, at which time he announced that the Panama Canal would be completed by 1888, and that he expected to be at hand on the occasion of formally opening it.

PROF. TROWBRIDGE, of Glasgow, will give up teaching at the end of the present session and devote himself for a year to collecting specimens of natural history. He already has a very large collection which he wishes to dispose of to some western institution, but if he does not succeed in this it will go to some eastern museum. No better opportunity can be found for purchasing a first-class collection.

GENERAL HAZEN, Chief Signal Officer U. S. Army, promises to furnish the REVIEW with information, reports, etc., from the two Arctic stations, Lady Franklin Bay and Point Barrow, when received, probably in September or October.

THE number of distinguished scientists and literary men who have died during the present year is quite unusual. Draper, Darwin, Thomson, Longfellow and Emerson, were all men of world-wide reputations, though but one or two of them had reached much beyond sixty years of age. In our own State, Prof. J. T. Hodgen, of St. Louis, who died last week was a most skillful surgeon and able writer.

PROF. REID, of DesMoines, Iowa, in offering an article for publication says: "If I can in this way aid you in your arduous enterprise I wish to do it, for I know right well how difficult it is to keep up such a magazine as you are publishing, in this intensely business-ridden country."

PROF. C. A. YOUNG, the astronomer at Princeton College, took occasion in a recent pulpit lecture, to correct Maedler's theory of a central sun about which ours and all other solar systems are revolving as a common center.

THE Signal Service officers are collecting data for a comprehensive report upon the late flood in the Mississippi River which will be published as soon as practicable.

DR. R. J. BROWN'S report upon the Medicinal Plants of Kansas gives evidence of a great amount of careful and well directed personal labor which will be of especial importance to the State as the subject is still further developed.

PROF. G. C. BROADHEAD says of the wood being used in paving Wyandotte Street in this city: "It seems to be the kind used for telegraph poles, sometimes called white cedar. In Prof. Sargent's catalogue of 'North American Forest Trees,' he includes *Chamæcyparis Spheroidea :* wood reddish, light, soft, easily split and worked, and very durable. Still it seems too soft for my idea of paving-blocks. I don't like it. Use granite—Missouri Granite—and you will have a solid, good street."

HON. D. C. ALLEN, of Liberty, Mo., calls the attention of archæologists to certain ancient earthworks that he has observed in this portion of the State; the first in Cass County about half way between Strasburg and Gunn City and the other in DeKalb County, about three miles from Maysville on the road toward Cameron. We shall be glad to publish a full account of them in a future number.

The U. S. Steamer Rodgers, which went to the Arctic regions last year in search of the Jeanette, was destroyed by fire near the coast of eastern Siberia January 1, 1882. The Steamer Corwin has been ordered to the relief of her officers and crew.

The First Annual Exposition of the National Mining and Industrial Association will be held at Denver, commencing August 1st. It is intended to be the most complete and extensive exhibit of agricultural and and mineral products ever made in the west.

ITEMS FROM PERIODICALS.

The April number of the *Nineteenth Century* contains an article on the subject of quieting the stormy waves of the ocean by the use of oil. Many cases are cited where this means has resulted successfully.

No. 31 of the well-known *Humboldt Library*, published by J. Fitzgerald & Co., No. 30 Lafayette Place, New York, consists of Part II of Richard Chevenix French's Study of Words. It is most curious, interesting and valuable. Price for the two parts, 120 pages, 30 cents.

Among the best articles in *Harper's Monthly* for May, aside from the excellent stories, are: Spanish Vistas, by Geo. P. Lathrop; Pennybacker's appreciative sketch of the Life and Work of David Rittenhouse, one of the earlier American Scientists, and F. Johnson's description of "The Upper Peninsula of Michigan."

The *Atlantic Monthly* for May, 1882, presents the following table of contents: Two on a Tower, I.-IV., Thomas Hardy; Mad River, in the White Mountains, Henry Wadsworth Longfellow; The Arrival of Man in Europe, John Fiske; Aunty Lane, H. H.; Old Fort Chartres, Edward G. Mason; Doctor Zay, III.-V, Elizabeth Stewart Phelps; Sage or Poet, Edith M. Thomas; Progress in Agriculture by Education and Government Aid, II, Eugene W. Hilgard; The House of a Merchant Prince, VIII, IX, William Henry Bishop; Studies in the South, III; Evolution in Magic, Elizabeth Robins; The French Panic, J. Lawrence Laughlin; The Divine Right of Kings, Mary W. Plummer; Renan's Marcus Aurelius; The Contributors' Club; Books of the Month.

The *Missouri Statesman*, the best weekly paper in Central Missouri, is making constant improvements in matter and manner and is entitled to full credit for its enterprise.

We find in the *Popular Science Monthly*, for May, the following: Methods and Profit of Tree-Planting, by N. H. Egleston; Professor Goldwin Smith as a Critic, by Herbert Spencer; Monkeys, by Alfred Russell Wallace; The Development of the Senses, by Robert W. Lovett; The Stereoscope, I, by W. Le Conte Stevens, (Illustrated); Measurements of Men, by Francis Galton, F. R. S.; Liberty of Thought, by Rev. E. Woodward Brown; A Reply to Miss Hardaker on the Woman Question, by Nina Morais; The Genesis of the Sword, (illustrated); On the Diffusion of Odors, by R. C. Rutherford; Color-Blindness and Color-Perception, by Swan M. Burnett, M. D.; Stallo's "Concepts of Modern Physics," by W. D. Le Sueur; The Tree that Bears Quinine, by O. R. Bacheler, M. D.; Sketch of Sir John Lubbock, Bart., M. P. (with portrait); Entertaining Varieties: The Mountains of the Moon: The Chronicle of Hakim Ben Sheytan, etc.; Correspondence; Editor's Table: Science and Culture; Literary Notices; Popular Miscellany and Notes.

Subscribers to the Review can obtain all other magazines and books published in this country or England at from 15 to 20 per cent discount from the regular prices.

The Kansas City Review of Science and Industry is the most valuable periodical, devoted to science, published in the West, and indeed fills a place not occupied by any other magazine in the country.—*Clinton* (Wis.) *Herald.*

THE *North American Review* for May contains several valuable contributions by distinguished writers; notably Party Schisms and Future Problems, by Hon. Carl Schurtz; Days with Longfellow, by Samuel Ward; The Navy, by Lieut. Commander Gorringe; The Spent Bullet, by Gail Hamilton. That last named has probably attracted as much attention as any of them though by no means the most deserving. It is a "smart" specious, womanish essay, but as a just, critical review of President Garfield's case it is not entitled to any consideration. Its statements of fact are unfair and garbled; even the conclusions drawn from them, as stated, are illogical and unwarranted; the handling of the scientific questions involved is utterly unscientific; the discussion of the religious points is flippant and irreverent.

TWO murderers, named respectively Baber and Ward, were hung in St. Louis a short time ago. Immediately after the drop the pulse of each was counted up to the moment of death, with the following result: Ward's pulse was forty for the first minute. The third minute it was fifty-seven. After that there was a gradual decline, and in five and a half minutes the pulse ceased to beat. For the first half minute Baber's pulse was normal, the next half it was thirty per minute. The second minute there was thirty-six strokes; third, sixty; fourth, seventy; fifth, seventy-six; sixth, fifty-eight; seventh, seventy; eighth, sixty-eight; ninth, forty-six; tenth, forty-eight. At the close of the eleventh minute his pulse ceased.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. JUNE, 1882. NO. 2.

PALÆONTOLOGY.

ON THE ORIGIN AND DEVELOPMENT OF THE EXISTING HORSES.

BY JACOB L. WORTMAN.

(*Continued from page 726, Vol. V.*)

The genus *Hyracotherium*, Owen, presents us with the next step in the direct line of ancestry. The dental formula is the same as in Phenacodus. A superior molar, Fig. 4,* shows the elements as seen in the corresponding tooth of *Phenacodus* with the exception of the external rib *y*. A small fold of enamel at this

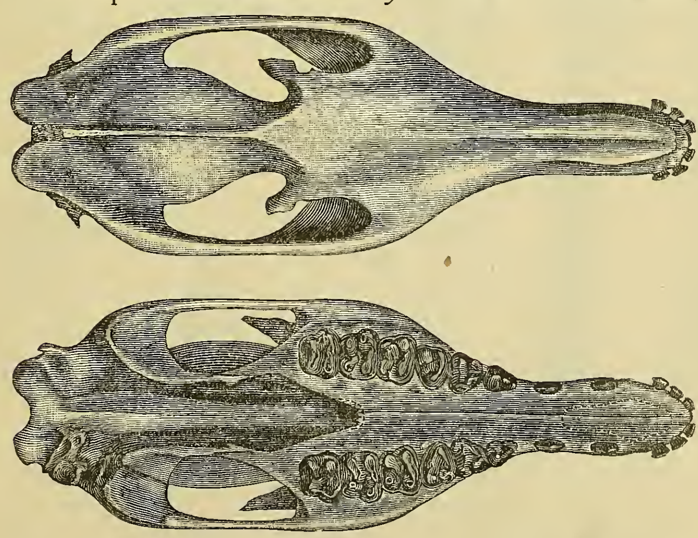


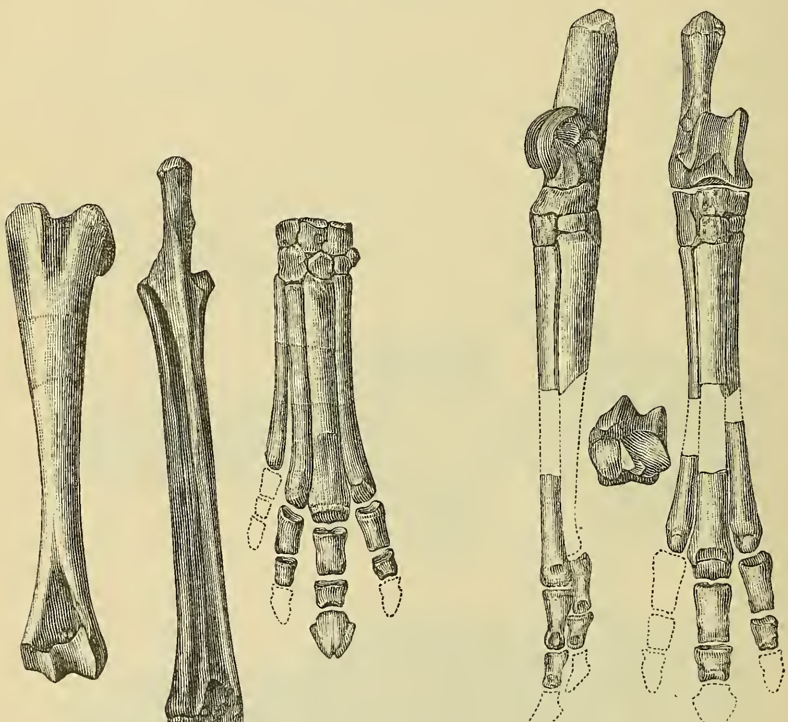
FIG. 7.

Fig. 7.—Skull of *Hyracotherium venticolum*, Cope. One-half natural size, after Cope.

* Page 725, Vol. V.

point observable in some species of this genus, probably represents it, however. The anterior lobe *x* is strong. The four principal cusps *ae*, *pe*, *ai* and *pi* are more elevated and conic, giving to the intervening spaces or valleys, greater depth. The cross crests *acc* and *pcc* assume more distinct proportions and tend to connect the internal with the external cusps. In the inferior molars the four principal lobes are higher and are connected by cross crests. The antero-posterior crest *z* passing from the postero-external to the antero-internal cusps is much better developed. The antero-internal cusp is slightly bifid at its extremity and is traversed by a vertical groove on its inner side. A well-marked ridge *k* descends from the antero-external cusp *ae*, and becomes continuous with the cingulum below. This ridge is absent in *Phenacodus*.

The feet (Fig. 8 and 9) show a reduction of one digit from the anterior and two from the posterior limbs. This genus is found in the lower Eocene, but a closely allied form is found in the upper Eocene beds.



FIGS. 8 AND 9.

Left fore and hind feet of *Hyracotherium venticolum*, Cope. One-half natural size, from Cope.

The next step in specialization we observe in the teeth of *Chalicotheriidæ*, a family in which the antero- and postero-external cusps of the superior molars are separated by an external vertical ridge (Fig. 10) *y*. The inferior molars Fig. 11

exhibit a still more complicated pattern, and furnish a complete transition between the inferior molars of *Hyracotherium* and the double crescents of the true *Palæotheroid* type. This condition is accomplished by the greater development of the antero-posterior crest *z*, and the higher cross crests, connecting the external with the internal cusps as shown in the cut. The antero internal lobe *ai* is divided into two distinct tubercles *ai* and *ai'*. The ridge *k* is strong and prominent. It is important to notice in this connection that while the teeth of the lower Eocene genera of this family (*Lambdotherium* and *Oligotomus*, Cope) resemble very strongly the teeth of the lower forms of the Lophiodonts in the shortness of their crowns and approach to the Bunodont type, the latter genera possess more lengthened cusps and simulate the selenodont forms in the crescentic section of some of them. The connections between the *Chalicotheriidæ* and *Lophiodontidæ* are so close that it is indeed difficult to draw the dividing line between them. It has been constructed, however, upon the presence or absence of the external vertical rib of the superior molars, as already mentioned, but it is questionable whether this character is of true family significance or not. The feet as far as known do not differ from those of *Lophiodontidæ*.

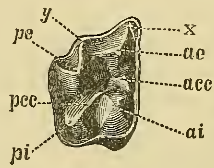


FIG. 10.

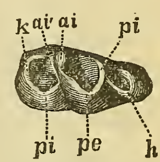


FIG. 11.

Fig. 10.—Right sup. molar of a species of *Lambdotherium*, nat. size, (after Cope).

Fig. 11.—Last inf. molar of left side of same, nat. size, (after Cope).

From this family, we pass to a consideration of the remaining links between them and the horses proper, which is afforded by the *Palæotheriidæ*. Here the premolars become more complicated and assume the same structure as the molars, while the anterior limbs suffer a still further reduction of digits, leaving three upon each, with the outer ones still more reduced (Fig. 14). In one genus, however, (*Mesohippus*, Marsh), the anterior limbs still retain a rudiment of the fifth metapodal. The structure of the true molars in the lower forms of the *Palæotheriidæ* is very little different from the higher genera of the *Chalicotheriidæ* and in point of dental specialization, the increased complexity of the premolars forms the only marked difference.

A superior molar of *Anchitherium* is shown in Fig. 12. The four principal cusps *ae*, *pe*, *ai* and *pi*, are considerably lengthened and are connected by high ridges *acc* and *pcc*, passing in an oblique direction across the crown. The elevation of the cusps and crests gives increased depth to the valleys. The anterior basal lobe is reduced and the external rib *y* is strong. The crown is further complicated by the addition of the lobe *l*.

In the inferior molars (Fig. 13) the two crescents are complete and their vertical dimentions augmented. The antero-internal lobe shows stronger separation, forming the lobe *ai'*, and the anterior ridge *k* is well produced.

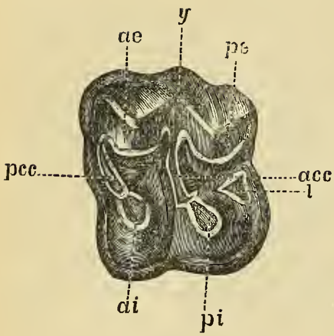


Fig. 12.

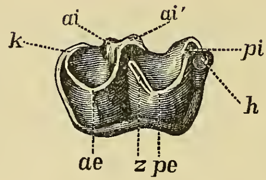


Fig. 13.

Fig. 12.—Left sup. molar of anchitherium *Aureliense*, nat. size, (after Gaudry). The letters pcc and acc should be made to change places.

Fig. 13.—Left inferior molar of same, nat. size, (after Gaudry.

In all the preceding animals, the tibia and fibula are strong and distinct. The ulna and radius are also separate and the humerus presents a single groove for the passage of the tendon of the biceps muscle, which latter fact is likewise true of *Anchitherium*. But in this animal the fibula becomes slender and its distal extremity adheres closely to the tibia. The ulna is also reduced and shows a tendency to coössification with the radius; and the skull in its general appearance is decidedly equine. The *Palæotheriidæ* range as far back as the middle Eocene, but the genus *Anchitherium* has not been found in any other strata than the lower and middle Miocene.

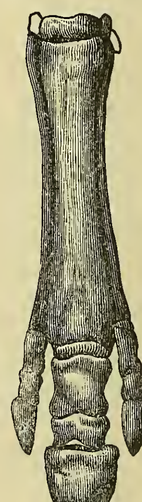


Fig. 14.

Left fore foot of *Auchitherium anreliense*, one-fifth nat. size, (after Gaudry.

Following close in geologic succession, we meet with another genus of this family, which, as we should anticipate, departs more widely from the primitive ancestral type and approaches more closely to the modern horses. This is the genus *Hippotherium*, Kaup. The outer toes are so much reduced as to have been practically functionless to the animal. The fibula is incomplete in the middle portion of its shaft, and its distal extremity is coössified with the tibia, while the ulna is firmly anchylosed with the radius but is still distinguishable throughout its whole extent. The bicipital groove of the humerus is double as in the existing horses, and with the teeth resemble those of the horses very strongly. The valleys are deepened by the lengthening of the cusps and ridges and are filled by a thick deposit of cementum. The crowns of the incisors also show that peculiar invagination seen in the incisors of the horse. The homologies of the various parts of the molars are seen in Fig. 15, a tooth in which the cementum has been removed, and the points of the cusps and ridges remain undisturbed by wear.

It is noticeable that the four principal lobes *ae*, *pe*, *ai* and *pi* hold about the same relation to each other. The cross crests *acc* and *pcc* have their obliquities increased, and the anterior bends around on the inner portion of the face and becomes confluent with the posterior ridge *pcc*. The lobe *l* which was conic in ancitherium is elongated in a transverse direction to the crown so as to close in the posterior valley and join the posterior external cusp *pe* with the posterior crest *pcc*. Additional vertical pillars are developed on the cross-ridges. In the inferior molars (Fig. 16) the lobe *ai'* is now completely separated and the ridge *k* rises to a level with the other cusps. The heel *h* is also elevated and connected by a strong ridge. The filling up of the valleys by a deposit of cementum and the consequent attrition in mastication produce a marked change in appearance from that seen in *Ancitherium* but by close observation the strictest homology is seen to exist.

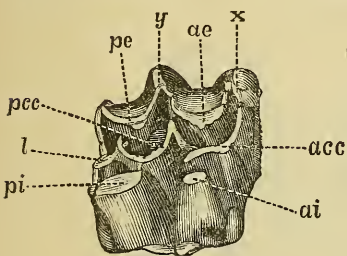


FIG. 15.

Right superior molar of a species of *Hippotherium* with cementum removed. For worn condition of same see Fig. 17, nat. size.

Figs. 17 and 18 represent an under and upper view of the cranium of *Hippotherium speciosum*, Leidy, from Nebraska.

But one other genus remains between *Hippotherium* and *Equus*. This is the genus *Protohippus*, Leidy. The only character in which it differs from *Hippotherium* is found in the superior molars. Here the anterior internal lobe *ai* is confluent with the anterior cross crest *acc* as in the present horse. This lobe in *Hippotherium* remains distinct. The feet of the two genera do not differ. Figs. 19 and 20 show two views of a skull of this animal. Fig. 21 represents a right posterior foot of the same individual.

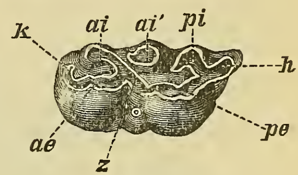


FIG. 16.

Left inf. molar of *Hippotherium gracile*, three-fourths natural size, (after Gaudry).

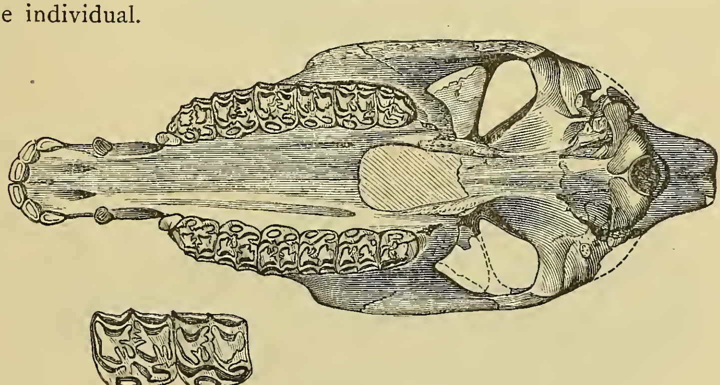


FIG. 17.

Fig. 17.—Cranium of *Hippotherium speciosum*, under view, (after Cope).

We come next to the *Equidæ* containing one extinct genus, *Hippidium*, Owen, and one living, *Equus* or horse. The outer toes are still further abbreviated and the metapodals terminate in imperfect distal extremities constituting the so-called "splint bones" (Fig. 22). The fibula is not distinguishable at its distal end and the ulna is so intimately blended with the radius as to completely disappear in the lower half of its extent. The internal lobes of the superior molars *ai* and *pi*, are connected with the cross-ridges *acc* and *pcc* (Fig. 23). The only

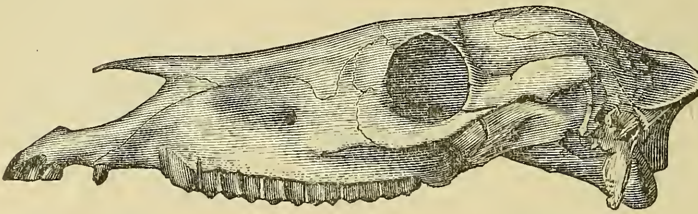


FIG. 18.

Side view of same, (after Cope).

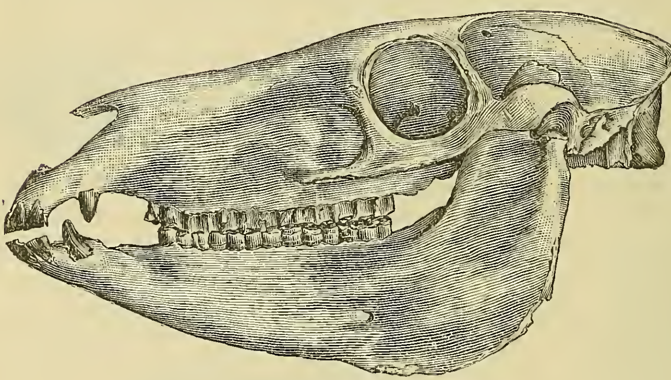


FIG. 19.

Skull of *Protohippus sejunctus*, (after Cope).

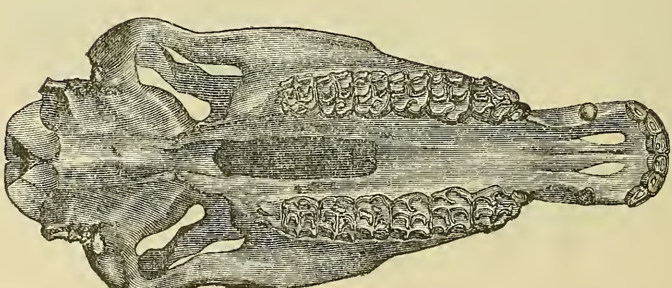


FIG. 20.

Under view of same, (after Cope).

diffe nce of generic value between *Hippidium* and *Equus* is seen in the relative of the antero- and postero-internal lobes *ai* and *pi*. In *Equus* the anterior *ai* is greatly enlarged and somewhat flattened while in *Hippidium* they are almost equal.

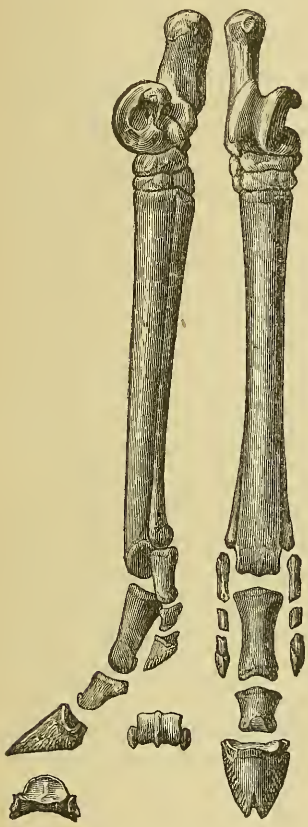


FIG. 21.

Right posterior foot of *Protohippus sejunctus*, Cope; one-half nat. size.

It should be here remarked that the genus which holds direct antecedent relation to *Hippotherium* is *Paloplotherium*, Owen. Here the anterior internal lobes of the superior molars are distinct and there is a slight deposit of cementum in the valleys. The additional lobe represented by *l* in Fig. 12, however, is very rudimentary if not in some instances entirely wanting. The ancestral line of *Protohippus* on the other hand is indicated by *Mesohippus* and *Anchitherium*, in which the inner lobes of the superior molar are connected with the anterior and posterior cross-crests.

Some species of *Hippotherium* exhibit an enlargement of the antero-internal lobes of the upper molars almost equal to that of *Equus* with a marked tendency to confluence. A new species from the Loup Fork beds of Oregon which may be called *Hippotherium sinclairi*, exhibits these characters of the superior molars in common with *H. occidentale.* It may be distinguished from the species, however, by its small size and the less marked concavity of the inner contour of the antero internal lobe. This character reaches its maximum development in *Equus* (Fig. 23 *ai*). An arrangement of some of the species of *Hippotherium* to show the extremes with reference to their approach or departure from the typical *Equus caballus* in their characters would be as follows:

H. Paniense.—Anterior internal lobe cylindric and equal in size to posterior internal lobe. Plications of the enamel borders of the valleys few.

H, seversum.—Anterior internal lobe pear-shaped with anterior angle bent inward to meet corresponding fold on cross-crest. Antero and postero-internal lobes sub-equal.

H. sinclairi.—Antero-internal lobe slightly concave on its inner border, and elongated fore and aft; much larger than posterior internal lobe.

H. occidentale.—Species large. Enamel plications many. Anterior internal lobe greatly elongated fore and aft, crescentoid in section with concavity directed inward. Anterior cross-crest throws out one and sometimes two folds toward this lobe which almost connect it with cross crest.

From these facts it is obvious that the Hippotheroid line terminated in *Equus* while the Protohippoid division terminated in *Hippidium*, and is extinct.

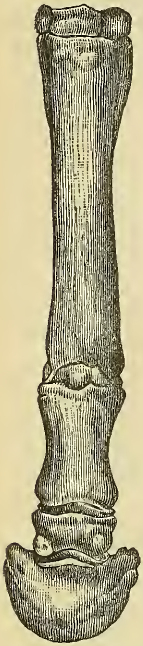


FIG. 22.

Left fore foot of *Equus caballus*, one-fifth nat. size, (after Gaudry).

I have now made clear, I trust, the successive steps in modification of limb and dental structure from the five-toed semi-plantigrade bunadont *Phenacodus* to the one-toed digitigrade selenodont *Equus* as exhibited in time by the different geologic horizons. It now remains to inquire into the causes that have led to these changes. Have they been the result of natural or physical forces, that are in operation around us to day, as well as in the remote past, or have they been produced by supernatural influence in successive creations, as opposed to the continuity of natural law, and by methods unknown? If this latter proposition be true we should find important breaks, sharply defining each new creation in the line of succession. But as I have attempted to show, the transition has been a gradual one and that each succeeding form in the ancestral line is distinguished only by the intensity of its modification in a given direction, the weight of opinion must rest with the former. I dare say that if all the intervening individuals between *Phenacodus* and *Equus* could be produced classification would be utterly impossible, so insensible would be the gradation. Considering the unfavorable conditions for their preservation, and the fractional part possible to examine in comparison to the whole area of deposit, the most remarkable fact is that palæontology can present such an array of evidence as it does.

When we speak of physical methods much is implied; but if we seek for adequate causes to explain these changes, no field offers more conclusive results than the ordinary mechanical uses of certain organs, as affecting their metamorphoses. In regard to tooth structure generally, Mr. J. A. Ryder has given us a most excellent treatise, "On the Mechanical Genesis of Tooth forms,"* in which he shows that the jaw movements of animals are intimately related to the modification of the component lobes, crests, and ridges of the crowns of the molar teeth. He also points out that the restricted jaw-movements in which the mouth was simply opened and closed, is associated with the bunadont molar. That the various kinds of excursive mandibular movements have been developed progressively. "That as these excursive movements have increased in complexity there has been increase in the complexity of the enamel foldings."

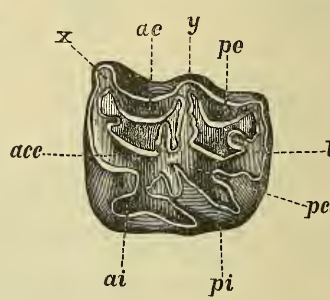


FIG. 23.

Left superior molar of a species of *Equus*; natural size.

* Proceedings Academy Natural Sciences, Philadelphia, 1878.

If we attempt to apply these facts to the ancestry of the horse, it is by no means difficult to perceive that gradual change of habitat, causing a corresponding change in diet as already indicated, would also compel greater and greater mobility of the mandibular articulation for proper trituration of the new food. The excursions of the lower jaw in these animals have assumed a lateral direction which affords, as I believe, a sufficient explanation for the broadening of the crowns and the lateral flattening of the cusps. The obvious effect of force continually applied in this direction would be to wrinkle the enamel covering of the cusps and ridges, thereby producing the accessory pillars seen in the higher types. By this method, I apprehend, a more and more complex grinding surface has been produced.

As to the causes of digital reduction, I have already assigned a primary reason. Prof. Cope has shown,* that in plantigrade quadrupeds the extremities of the toes are arranged in a semi-circle, when they are all applied to the ground. In the act of running the heel and wrist are raised, throwing the weight of the body upon the median digits. An infinite repetition of this posture in digitigrade creatures unable to withstand the attacks of their enemies and whose only escape was in flight, the strengthening of the median digits, and the consequent reduction of the outer ones, would follow according to the law of use and disuse of parts. This subtraction of toes has progressed step by step, until the modern one-toed horse has been reached.

In conclusion I may say that by resort to natural methods for explanation of these modifications we at once bring the subject within the compass of rational understanding, but, if on the other hand we invoke supernatural influence, we immediately step into a realm about which the science of palæontology knows absolutely nothing and one which is diametrically opposed to the spirit of modern scientific research.

The English have admitted the success of the electric light. Lamp posts have been erected in Bristol. The Lancashire and Yorkshire Railway Company illuminate their station platforms with it and regard it cheaper than gas. Alnwick Castle, the seat of the Duke of Northumberland, has also been illuminated. The library, a very large apartment, is lighted by three lamps, and the effect is reported superior to any light before used.

* "On the Origin of Foot Structures in the Ungulates," American Naturalist, April, 1881.

METEOROLOGY.

TORNADO STUDIES FOR 1882.

BY JOHN P. FINLEY, U. S. SIGNAL CORPS.

Without speaking too positively about the future, but unreservedly concerning the past, I can venture to say that the year before us will probably be a remarkable one in the chronology of its tornado season. Already and unusually early has the dreaded work commenced, and evidences are rife of unexampled fury coupled with those unmistakable signs which characterize the manifestations of the funnel-shaped cloud, never to be forgotten when once experienced.

Michigan was visited on the 6th day of April by remarkably violent tornadoes, especially the one which passed across the southern portion of the State, giving evidence of its wonderful power in VanBuren, Allegan, Kalamazoo, Barry, Eaton, Ingham, Livingston, and Oakland counties. This unfortunate and disastrous visitation upon the people of the Peninsula State was in part, but to a less degree, realized throughout portions of Iowa, Kansas, Missouri and Illinois, on the same day and during the same afternoon.

Within the extensive barometric trough which consumated its energy on that fatal day, whose major axis extended southwestward from the Upper Lake Region to northern Texas and its minor axis from the Mississippi and Ohio rivers northwestward to central Minnesota and southern Dakota, there appeared three points of local atmospheric intensity, viz: central Kansas, northeastern Missouri and the Lower Peninsula of Michigan. At the places here indicated the violence of atmospheric changes resulted in the formation of tornadoes.

The work of investigation in Michigan has to a certain extent been completed, at least so far, so that it has been possible for me to accomplish the removal of my headquarters to Kansas City, Mo., where under special instructions from the Chief Signal Officer, I shall prosecute the work of investigation in the Lower Missouri Valley.

This region of country embraces the States of Kansas, Nebraska, Missouri and Iowa, and can literally be termed the battle ground of tornadoes. It is here that this class of violent wind storms occur with the greatest frequency, the most unexampled violence, the most marked regularity, and with the most complete manifestation of their peculiar characteristics. Continuing my labors until the expiration of the tornado season, I shall, aside from the examination of any particular tornado, with a view to gain new and important truths, give special attention to the following important features of this class of violent wind-storms, viz :

more definite information concerning the conditions precedent and favorable to the formation of tornadoes in general; the phenomena and laws of cloud development; the velocity and power of centripetal currents within the cloud vortex; additional statistics respecting the tornadoes of former years; the arrangement and perfection of an acceptable scheme whereby reliable warnings can be sent to certain communities in advance of the tornado, announcing that conditions are favorable to its formation; and lastly, to prepare and disseminate such information as will direct people how to act in defense of their lives, and to a certain extent of their property, during the approach and passage of a tornado. In the accomplishment of these momentous results or in bringing to light new points of value, I am desirous to enlist the active support of every intelligent person throughout the Lower Missouri Valley or elsewhere. There are not a few ways in which even the humblest can assist. If you cannot give any *facts* concerning a tornado of recent date write me what you *know* about one or more whose dates of occurrence number many years past. In every description of the tornado conform as nearly as possible to the character of the questions propounded in the accompanying circulars. Perhaps you can send me some article or publication bearing upon the climatology or meteorology of your State, or some portion of it. Photographs, sketches or printed cuts of the effects of the violence of any particular tornado, no matter what date, would be very valuable and thankfully received.

As it will probably be impossible (owing to press of other work) for me to visit and conduct a personal examination in the case of every tornado that may occur in the Lower Missouri Valley or in adjoining States during the year, I will deem it a great favor, and it will certainly be a matter of most valuable service, if some one in the vicinity of a tornado's path will kindly undertake to furnish me (at his earliest convenience after the tornado's occurrence) with a complete history of its entire track. In performing this task, be careful to state as accurately as possible the place of beginning. This location is not necessarily where the tornado cloud *first* descended to the *earth*, although it may be, but more truly and hence more accurately, it is that particular spot or portion of country over which (perhaps at a great height above the earth) the funnel-shaped cloud was *first* seen to *form.*

Upon determining the place of commencement, carefully ascertain all the preliminary conditions of atmospheric changes existing prior to the development of the tornado cloud. In conducting the examination along the track and on both sides of it, make use of the questions and remarks contained in the respective circulars, according as one or the other is required. In determining the exact locality of final disappearance, exercise no inconsiderable vigilance, for you may most easily be deceived. It is a characteristic feature of the tornado cloud to rise suddenly from the earth and, continuing its northeastward course in the lower regions of the atmosphere, again reach *terra firma* after an interval of several miles. You may find a number of these gaps along the tornado track you are examining, but do not mistake them for points of termination ; rather look upon their existence as indubitable evidences of tornado (latent) activity, a sign of reappearance rather than dispapearance. If these gaps occur in consecutive order as to time and place, pursuing when taken together, a northeastward trend, and the difference in time of disappearance and reappearance at each interval accounting for the passage of that interval, there can be no doubt of their forming disconnected parts of one and the same tornado track. The invariable accompaniment of the tornado, the hailstorm, *precedes* the first appearance of its terrible companion and *succeeds* its final disappearance. This characteristic should be carefully watched for and any peculiarity minutely recorded. If any one in the prosecution of this particular work should need a quantity of circulars, the same will be mailed to them immediately, upon my receiving word as to how many of each kind they desire.

In the fulfillment of my mission I have no pet theories to advance or support, neither have I the time to speculate much or discuss the respective merits of uncertain or untenable positions, but I am prepared for the reception of *facts*, without measure. With regard to *suggestions*, I shall be a most willing recipient and I trust that no one, feeling a desire in this direction will hesitate to communicate with me at his earliest convenience. This is emphatically a public enterprise and not the effort or exclusive pride of an individual.

It is absolutely necessary and most invaluable, when a variety of people are called upon to contribute in aid of a work like this, that they should know precisely *what* information is most desired.

With a view to cultivate familiarity respecting the character of the data required, I append herewith the following list of questions and remarks: Circular No. 1 contains a list of inquiries which are to be referred in all cases to persons who on the day of the storm were situated *without* the tornado's path, (to the N. or S of it) on its immediate edge or from one to ten miles distant. In brief this is a circular for *outsiders* only.

Circular No. 2 contains a list of inquiries which are to be referred in all cases to persons situated *within* the tornado's path. In brief this is a circular for *insiders* only. The information called for in each circular is in the main entirely distinct, but nevertheless equally important in conducting a careful analysis of the phenomena of this class of violent wind storms. I urgently solicit replies, on every hand and from every quarter, concerning the matter hereinafter set forth:

CIRCULAR NO. I.—QUESTIONS AND REMARKS.

1. How far and in what direction are you situated from the centre of the path of destruction?
2. The time of day that the tornado cloud passed.
3. The direction of the wind while the tornado cloud was approaching.
4. The direction of the wind while the tornado cloud was passing.
5. The direction of the wind after the tornado cloud passed.
6. The direction of the wind during the fore part of the day and up to the time of the first threatening appearance in the heavens.
7. The prevailing direction of the wind at this season of the year.

8. Any hail, and did it fall before or after (how long) the tornado cloud passed?

9. Were the hailstones large or small, of peculiar shape, and few or many in number?

10. Did you examine the interior of any of the hailstones, and if so, how were they formed and what did they contain?

11. If hail fell at intervals through the day, state the times of beginning and ending of each precipitation separately.

12. Any rain, and did it fall before or after (how long) the tornado cloud passed?

13. Any peculiarity in the size or shape of the rain drops, or in the quantity which fell?

14. The direction of the wind at the time of the hail, and also at the time of the rain.

15. If rain fell at intervals through the day, state the times of beginning and ending of each precipitation separately.

16. What time of day did threatening appearances commence, in what portion of the horizon, and at what time were they the most decided?

17. Describe the character and motion of the surrounding clouds before, during and after the tornado cloud passed.

18. Give the time of day at which the light or dark irregular clouds surrounding the tornado cloud were in the greatest confusion, and describe the scene.

19. If you saw the tornado cloud, describe or sketch it, and note particularly any change in motion or the successive stages of development during the time of observation.

20. Give the direction of the whirl of the tornado cloud, as against or with the hands of a watch.

21. Give all the motions of the tornado cloud which you observed, or which you heard that others had witnessed, as for example: rising and falling, swaying from side to side or whirling about a central axis, etc., etc.

22. Thunder or lightning, in what portion of the horizon, at what time of the day and whether violent or otherwise.

23. Was lightning seen in the funnel-shaped tornado cloud, or in the dark, heavy clouds surrounding it to the N. and W?

24. Was the day unusually warm and sultry? Give the maximum temperature if possible and state the hour at which it was observed, together with the direction of the wind and the state of the sky existing at the time.

25. Condition of the temperature after the tornado cloud passed. Did the air suddenly or gradually grow colder?

26. What had been about the average daily temperature, together with the accompanying direction of the wind, for eight or ten days previous to the occurrence of the tornado?

27. Give the direction of the course pursued by the tornado cloud along its path of destruction in your locality, as for example: N 70° E; E 30° N or E 20° S; etc., etc.

28. Give the maximum and minimum width, in yards or rods, of the path of destruction in your vicinity, and state, if you can, whether in examining that path, it was found that on the S. side of the centre the sweep of destruction was broader and more irregular than on the N. side, or if any other difference existed between the two sides.

29. If you, or any of your neighbors, have meteorological instruments, give the readings of the thermometer and barometer, direction of the wind and the hour of observation, for two days before, the day of the storm, and for two days thereafter, viz: on the..

30. If you recall the occurrence, in times past, of any other tornado in your State, give year, month, day of month, hour of day, the direction of the course of the path of destruction as pursued by the tornado cloud, its length in miles, average width of destructive path in yards or rods, maximum width, minimum width, and if possible, the hour of beginning and hour of disappearing of the tornado cloud.

When I ask for direction of wind, I mean direction of motion of the surrounding air currents, independent of the course or motion of the tornado cloud.

When time of day is asked, give the same in hours and minutes, and state whether it is local or railroad time, and by what standard, viz: Chicago, Detroit, Columbus, St. Louis, etc., etc.

In giving your distance from the center of the path of destruction, indicate the same in miles and parts of miles or rods, stating the amount in northing and easting, northing and westing, southing and easting, or southing and westing, estimated along section or township lines.

If not individually prepared to answer any or all of the above questions, please call to your aid such persons as may, in your judgment, be able to render you assistance.

If possible, try to represent the tornado cloud by a rough sketch, as also the dark and irregular clouds surrounding it.

In describing the path of destruction, be careful to note where the tornado cloud left the ground, where it again descended, the length of the interval and the topography of the earth at the points of ascension and descension.

Send any newspaper article concerning the storm which you may have or can obtain without inconvenience.

Give name and address of any one in your State who is in the habit of keeping a meteorological record.

If possible, try and secure the coöperation of some intelligent person, who, at the time of its occurrence, was situated either in the path of the tornado or on the outer edge of it, and who will be willing to furnish me a narrative o the result of his observations.

In all descriptions of the tornado's path; in giving any particular destruction in it, or in detailing your experience while the tornado cloud was passing, be careful to state on which side of the centre (to the N. or to the S. and how far) the damage occurred or you were situated while a witness of the scene.

CIRCULAR NO. II.—QUESTIONS AND REMARKS.

1. What day of the month and at what time of the day did the tornado cloud pass? Take great care in giving the exact time. Perhaps you watched your clock or noted the approach or passage of a railroad train.

2. Give the position of your house with respect to the nearest Post Office, indicating the same in miles and parts of miles or rods; state the distance in northing and easting, northing and westing, southing and easting and southing and westing, estimated along section and township lines.

3. How far and in what direction is your house situated from the centre of the path of destruction?

4. Give the direction and distance from your house to your various farm buildings, if possible drawing a plan of the same and indicating the points of the compass. This plan need only be a rough sketch.

5. Give the dimensions of your buildings and state the character of each as to whether they are log, frame, stone or brick and weak or strong.

6. In drawing a plan of your buildings, indicate the position of the tornado's path with respect to each of them and the direction in which the tornado cloud moved.

7. State in detail and separately the damage to each building; what portion or portions were taken away or injured; how far and in what direction were they moved bodily; what portion of each was first struck by the wind, and how far and in what direction was the debris carried? Be very careful to give the exact position and peculiarities of structure of buildings which were not damaged although standing near those which were destroyed.

8. In the damage or destruction of each or any building, state particularly how far and in what direction any portion of them was carried a considerable distance.

9. If any object has been carried a long distance by the force of the wind, state where and what it came from; its dimensions; its shape; probable height to which transported in the air; whether driven into the ground or not, how far and into what kind of earth.

10. State whether articles of clothing, fowls or animals were carried into the air, to what height, to what horizontal distance and in what direction.

11. Give detailed destruction of furniture contained in the house and of farming implements in or about the barns.

12. State the number, kind and in what manner, stock were killed or injured and whether at the time of the storm they were in or without buildings. Also narrate any miraculous escapes of life.

13. With respect to your family, give the whereabouts and condition of each person on the approach of the tornado, and also after the tornado cloud passed. Give age and sex of each person and particularize the character and extent of injuries to each. State very carefully the distance and direction in which any of the persons were carried, and also narrate any miraculous escapes of life.

14. Be particular to note any evidence of the wind's extreme violence, as in the lifting of heavy objects; the twisting of trees or heavy pieces of timber; pulling up of fence posts; removing heavy stones, etc., etc.

15. In describing the injury to any person, animal or object, never fail to give the distance and direction of such person, animal or object from the centre of the path of destruction at the time the tornado cloud passed.

16. With regard to destruction in orchards, among shade trees and in forests, be particular to give the direction in which the trees lie; how they lie on the two sides with regard to each other and to the centre of the path of destruction; any special acts of violence in the twisting, uprooting or breaking off of heavy timber; give circumference of large trees, height above ground where broken off and dimensions of earth and roots where notably large trees were overthrown.

17. In general, when giving the position of any person or thing with regard to the centre of the path of destruction, state the distance in feet or rods and the direction as N. or S.

18. Give the maximum and minimum width, in yards or rods, of the path of destruction in your locality.

19. How many funnel-shaped clouds did you see? Describe each, giving their relative sizes, shapes and positions, and if possible a rough sketch of each.

20. Did you hear a roaring noise on the approach of the storm, and if so, state the intensity or any accompanying peculiarity.

21. Did you notice any peculiarity with the manner in which small objects were suddenly removed from around about buildings as if sucked in by the advancing cloud?

22. Did you notice any peculiarity in the falling of trees as the tornado cloud advanced upon them? Were they whipped about and bent to fro as in a heavy wind or were they drawn steadily inward toward the centre on both sides, as if by some mysterious but irresistible force?

23. How many rods of fencing (stating kind) did you have blown down; in what direction were the N. and S. fences carried; what was the direction in which the E. and W. fences were carried?

24. Give an estimate in money value of the loss to your property occasioned by the tornado, the number of acres of timber you had destroyed, and the number of fruit trees you had uprooted or broken off.

25. Be particular to give the exact position, also the dimensions and probable strength and weight of small objects which were not moved from about large buildings, although the latter were entirely destroyed.

26. Give the direction of the wind while the tornado cloud was approaching, while the tornado cloud was passing and after the tornado cloud passed.

27. The direction of the wind during the fore part of the day and up to the time of the first threatening appearance in the heavens.

28. The prevailing direction of the wind at this season of the year.

29. In asking for the direction of wind, I mean direction of motion of the surrounding air currents, independent of the course or motion of the tornado cloud.

30. Any hail, and did it fall before or after (how long) the tornado cloud passed?

31. Were the hailstones large or small, of peculiar shape, and few or many in number? Give exact size and weight of the largest.

32. On which side of the tornado's path (to the N or to the S.) did the hailstones appear to fall in the greatest quantity?

33. Did you examine the interior of any of the hailstones, and if so, how were they formed and what did they contain?

34. If hail fell at intervals through the day, state the times of beginning and ending of each precipitation separately, together with the direction of the wind at each occurrence.

35. Any rain, and did it fall before or after (how long) the tornado cloud passed?

36. On which side of the tornado's path (to the N. or to the S.) was the rainfall the heaviest?

37. Any peculiarity in the size or shape of the rain-drops, or in the quantity which fell?

38. If rain fell at intervals through the day, state the times of beginning and ending of each precipitation separately, together with the direction of the wind at each occurrence.

39. What time of day did threatening appearances commence, in what portion of the horizon, and at what time were they the most decided?

40. Describe the character and motion of the surrounding clouds before, during and after the tornado cloud passed.

41. Give the general atmospheric conditions of temperature, wind direction, humidity and clouds, for from ten to fifteen days previous to the occurrence of the tornado and from three to five days thereafter.

42. Give the time of day at which the light or dark irregular clouds surrounding the tornado cloud were in the greatest confusion, and describe the scene.

43. Describe any particular change or motion in the tornado cloud and the successive stages of development during the time of observation.

44. Give the direction of the whirl of the tornado cloud, as against or with the hands of a watch.

45. Describe minutely the manner in which objects were carried inward, upward and about in the whirling vortex of the tornado cloud; how thrown outward and from what portion of the cloud.

46. Describe the color of the tornado cloud; its density; how and when changes in color and density occur; the color and density of the bottom of the cloud as compared with the top; the existence of light and peculiar fleecy clouds over and about the upper portion.

47. Give the comparative size of top and bottom of tornado cloud; note particularly and describe minutely any change in form when the bottom or tail reaches the surface of the ground.

48. Did the tornado cloud remain in a vertical position as it traveled forward or was the tail of it inclined; in what direction and how many degrees from the perpendicular?

49. Give all the motions of the tornado cloud which you observed, or which you heard that others had witnessed, as for example: rising and falling, swaying from side to side or whirling about a central axis, etc., etc.

50. In examining the path of destruction, did you find any difference between the N. and S. sides of it? Which side was the widest; which the cleanest cut; which the most irregular and jagged along its outer edge; on which side were narrow paths of destruction cut inward toward the centre?

51. Thunder or lightning, in what portion of the horizon, at what time of the day, and whether violent or otherwise.

52. Was lightning or any manifestation of electricity witnessed in the funnel-shaped tornado cloud as it approached or passed? If so, describe the appearance minutely.

53. Was lightning seen in the dark, heavy clouds surrounding the tornado cloud to the N. and W?

54. Was the day unusually warm and sultry? Give the maximum temperature if possible, and state the hour at which it was observed, together with the direction of the wind and the state of the sky existing at the time.

55. What was the condition of the temperature after the tornado cloud passed? Did the air suddenly or gradually grow colder? Give the minimum temperature for that afternoon and evening, and during the night, with direction of the wind.

56. What had been about the average daily temperature, also the maximum and minimum, together with the accompanying direction of the wind, for eight or ten days previous to the occurrence of the tornado and for three days succeeding its appearance?

57. Give the direction, in degrees, of the course pursued by the tornado cloud along its path of destruction in your locality, as for example: N. 70° E.; E. 30° N., etc., etc.

58. If you, or any of your neighbors, have meteorological instruments, give the readings of the thermometer and barometer, direction of the wind and the

hour of observation, for two days before, the day of the storm, and for two days thereafter, viz: on the ....

59. When the time of day is asked, give the same in hours and minutes, and state whether it is local or railroad time, and by what standard, viz: Chicago, Detroit, Columbus, St. Louis, etc., etc.

60. If possible, try to represent the tornado cloud by a rough sketch, as also the dark and irregular clouds surrounding it.

61. In describing the path of destruction, be careful to note where the tornado cloud left the ground, where it again descended, the length of the interval and the topography of the earth at the points of ascension and descension. Also state whether the hail and rain continued to fall after the tornado cloud rose from the earth and disappeared in the overhanging clouds.

62. Send any newspaper article concerning the storm which you may have, or can obtain without inconvenience.

63. Give name and address of any one in your State who is in the habit of keeping a meteorological record or who desires to keep one and would like instructions.

64. If possible, try and secure the coöperation of some intelligent person, who, at the time of its occurence, was situated either in the path of the tornado or on the outer edge of it, and who will be willing to furnish me a narrative of the result of his observations.

65. In all descriptions of the tornado's path; in giving any particular destruction in it, or in detailing your experience while the tornado cloud was passing, be careful to state on which side of the centre (to the N. or S. and how far) the damage occurred or you were situated while a witness of the scene.

66. Give an estimate of what you consider the progressive velocity of the tornado cloud; how many miles per hour. Give the data upon which you make the estimate, and why you believe your estimate to be reliable.

67. What evidence can you give of the existence of upward and whirling currents of air within the central portion of the tornado cloud?

68. Estimate the time in minutes or seconds during which the tornado cloud was committing the destruction at your buildings or in passing them at a safe distance.

69. As the tornado cloud approached from what direction came the wind you first experienced, whether against your body or against the building within which you were situated at the time?

70. Did you notice any peculiar odor in the atmosphere during the passage of the tornado cloud, and what was it like?

71. Do you know of any one who made observations on the presence of ozone in the atmosphere on the day of the storm? If so, send me his address or give the result of the observations.

72. Do you know of any one who made observations with the galvanometer or compass concerning the deflection of the needle during the day of the storm,

especially while the tornado cloud was passing a given point? If so, send me his address or give the result of the observations.

73. Try and give an estimate of what you consider the wind's velocity within the central whirl of the tornado cloud and also the data upon which you base this estimate.

74. In the destruction of your buildings, did you notice anything in the disposition of the debris after the tornado cloud passed that would indicate the effect of an explosion, as for example, the sides and the ends of a building being thrown outward and the roof carried off or let down upon the floor?

75. In the passage of the tornado cloud over a pond, lake, or river, carefully describe every particular in the disturbance of the water; how high into the air any portion of it was carried; if any fish, shells, stones or the like were carried out and in what direction. Also state the exact position of the person or persons who witnessed the scene.

76. Was mud, bits of leaves, straw, grass or the like thrown against your buildings? If so, state on what particular portion or portions, and whether apparently thrown thereon with great force. If thrown upon the bodies of persons or animals carefully state the circumstances.

77. Sketches of clouds, of peculiar destructive effects, of hailstones, of anything that will illustrate any distinguishing feature of the storm's violence are very desirable.

78. If you recall the occurrence, in times past, of any violent hailstorm in your State, give the place, year, month, day of month, hour of day, direction of of the storm, maximum and minimum width of path in rods or miles, size and shape of hailstones, and a narration of the destructive effects.

79. If you recall the occurrence, in times past, of any other tornado in your State, give year, month, day of month, hour of day, the direction of the course of the path of destruction as pursued by the tornado cloud, its length in miles, average width of destructive path in yards or rods, maximum width, minimum width, and if possible, the hour of beginning and hour of disappearing of the tornado cloud.

My report upon the tornadoes of 1882 will be published in book form and can be obtained free of cost by applying through your Congressman, to W. B. Hazen, Brig. and Bvt Major General, Chief Signal Officer, U. S. A., Washington, D. C. My report upon the tornadoes of 1879, now ready in book form, as also another publication, "Facts about Tornadoes," the latter of which contains practical rules showing how to avoid the violence of tornadoes, can be obtained in the same manner.

My office will be at Kansas City for the next two or three months, where I shall hope to see or hear from all persons interested in this subject.

FALSE NOTIONS IN REGARD TO THE WEATHER.

BY ISAAC P. NOYES, WASHINGTON, D. C.

The weather is one of the oldest, if not the oldest scientific subjects before the world. The world thought about it, talked about it, wrote about it, and perhaps wondered why it did not know more about a subject that was ever-present with it.

Nothing tangible presented itself whereby to understand this most common of all subjects. Many of the more sensible people acknowledged that they knew little or nothing about it and became incredulous to all pretended knowledge and sayings in regard to this branch of human science. A few here and there kept a record of it, in hopes, perhaps, that something favorable would thereby grow out of their labors.

Under these circumstances it is not surprising that a great many absurd and false notions were entertained and handed down from generation to generation. For example, the influence of the planets and the moon—the instinct of animals in regard to foretelling the weather—the manner in which a storm clears off and notions that time, as to night or day, made a great difference in the clearing off of a storm. Men wrote whole books of hundreds of pages to prove something they knew little or nothing about. They thought that the different quarters of the moon *must* have some effect upon the weather. They also thought the weather *must* repeat itself. They kept statistics. Through this process they imagined that they saw certain resemblances between years, certain regular and irregular periods. From this *after-knowledge* they conceived the idea of *fore-knowledge* and attempted the role of prophets. The wiser ones soon discovered that this would not do, that it was a difficult thing to ascertain what nature was going to do in advance. They could not understand the reason why, still they had sense enough to see the impossibility of such fore-knowledge being acquired. Nature, they saw, did not repeat herself—she did not move in regular grooves. Notwithstanding this a few continued to imagine that by some superior mathematics or better reading of statistics, they could do what the rest of the world had failed to accomplish.

After many years men became more and more interested in electricity; they discovered more and more new properties pertaining to it. The years went by, electricity came to the front and in the form of the telegraph became the chief medium of news—indeed, the only medium of rapid news, far outstripping all other mediums. Still the years went by—the old men continued to keep their meteorological tables. Through this medium a few general facts were ascertained in regard to the weather, and that is all. It was too slow for gathering the important facts in this department. But one thing was ascertained, and that was that storms—at least some storms, travel in general lines from the west toward the east.

This being the case the idea now occurred to use the telegraph to report the storm in order that the people in the east might the better know when to expect it and thus be fore-warned. This at first was commenced on a small scale, and it was not, until 1870, that Prof. Abbe was established in Washington with the full power of the Government back of him and with authority to gather and report the news in regard to the storm. Little by little the facts came in. A weather-map began to appear—its first editions were quite rude affairs beside the complete ones of 1882. Improvements still go on. Not so rapidly as at first, yet all the while there is a steady advancement in this department. There are points where it would seem that this bureau could advance with more honor to itself; for example, more stations in the west would add much to the perfection of the present admirable system and comparatively would not add much to the cost.

Little by little meteorology has advanced. For centuries it made little progress—it was all the while waiting for developments in other branches. It could advance no further until the chapter on Telegraphy was worked up by the great author. Then it took a start and within the past twelve years it has advanced most rapidly. By the aid of the telegraph we now every morning have the geography of the atmosphere of the United States spread out before us—it is as if we were taken upon a high pinnacle or balloon where we could survey the whole country. We see the storm on our western borders; we trace it in its course; we see that it takes *general* lines toward the east, never twice alike—sometimes on one line, sometimes on another, and sometimes apparently defying all law—moving north, south, and *even west*, yet all the while obeying the immutable laws of this department of Nature.

Upon the present time few even of the more intelligent people of the land have become interested in this new and true knowledge of the weather system. Few know or seem to care what a weather-map is. Under the circumstances it is not surprising that men still attempt to continue the old practice, especially so when they can make much money out of their pretended wisdom in this line. The people at large, and even the most intelligent know nothing of the Weather-Map and its revelations—indeed, not one in a thousand has ever seen a weather-map or has any conception of what it is, and thousands who are so favorably situated as to see them daily, know no more about them than they do of the hieroglyphics on the Egyptian obelisks. Yet these maps are full of interest and can easily be read at a glance, and afford a great amount of satisfaction if one will but give them a little study. They have revolutionized the weather knowledge of the world, and many a pet theory and absurd notion must, through them, be buried in the oblivion of the past.

Yet men continue to write and advocate their antediluvian notions and they still retain much faith in themselves. But this is simply for the reason that the weather-map is still unappreciated. The more this map becomes appreciated the less and less will be the appreciation for the absurd and false ideas of the past and for the men who still endeavor to profit by them instead of advancing to the higher knowledge revealed by this wonderful map.

In this connection I would respectfully call the reader's attention to the fact that although the laws revealed by this beautiful map may appear new, it is only the *revelation* that is new, the laws themselves are old and date from eternity, and are therefore much older than all the absurd and false notions that have from time to time, through want of proper information been held by the world. The weather-map has revealed the information and therefore we are no longer in the dark, but stand face to face with the eternal laws that have governed, do, and will forever govern the meteorological economy of the world.

The *cycle* and *mathematical notions* in regard to the weather, have been and are still very generally believed in, and that too by men eminent in science. Likewise the notion that the other planets, together with the moon, must have a powerful influence upon our weather system, is still held by a large class of intelligent persons. Before the advent of the weather-map this was no more surprising than that before the age of geography men should have had the queer notions they did of the grouping of the land and water of the globe. One of the best representations of these notions some time since appeared in one of the Washington papers. The author strongly advocated the theory that the weather repeats itself in cycles of nineteen years, for the reason that the earth, the sun, and the moon occupy the same relative position very nearly every nineteen years, and the author of this idea attempts to prove it by what the weather has in some respects appeared to him. Yet such important things as drouths seem to be an exception. But in all such ingenious and unfounded theories the advocate thereof has a ready excuse for exceptions. In this case it was the disturbing element of the sun, moon and planets, and it would seem from his ideas, and others of his class, that if we only had our mathematics perfected, or understood better how to apply them to this subject, we might make weather prognostications a very easy thing.

This gentleman says, "If the sun and moon cause ever varying tidal waves in the great ocean of waters they must produce similar but far greater and more striking results on the still water and more flexible ocean of the earth's atmosphere. Nor can it be reasonably doubted that the attracting power of the larger planets must exert a sensible effect on the great atmospheric ocean, though their influence be entirely unappreciable on the watery one."

This may appear like good reasoning to people not familiar with the subject; for, through the influence of old-time notions and old almanacs, they have grown up with the idea of "cycles" and that by the aid of some mysterious mathematics these "cycles" and influences could be determined quite accurately, and that complete accuracy could be arrived at when the higher mathematical key was found, and through mathematics they have believed that the world would become profoundly weather-wise.

Before the era of the weather-map, which daily reproduces the geography of the atmosphere, these notions could not well have been contradicted even by the wisest. They may not have believed them, but they had no facts by which to disprove them. The weather-map reveals to us the impossibility of the weather repeating itself and that the changes which nature can produce are infinite, and that there are no mathematics by which they can be determined; indeed, it is not within the province of mathematics. Might as well, by mathematics, attempt to determine what our life will be on the morrow, or what will be the character of the next person whom we will meet on the street. The influence of the moon on the weather has already been treated at length in these pages, so I will simply call the reader's attention to the general fact that every night when the moon is shining it shines over all sorts of weather from cold to warm and from cloudy and stormy to clear and pleasant. Those who believe in the influence of the moon never seem to think of this, and that the moon's influence, if it has any, should on the same night produce such different results—drive clouds away in one place, collect them in another, etc.

The old notion about rain was that it was from clouds that were formed over some large expanse of water, that these clouds were carried by the wind toward some high mountain range and that in passing over the tops of these mountains the clouds were condensed, precipitating rain over the country! This idea shows that if man knows not of any good and perfect reason for a cause or phenomenon —his "causality" will invent one in accordance with his knowledge. The author of this idea never seems to have followed it out to its logical sequence; if he had, he would have discovered it to be necessary to have mountain ranges and large seas alternately pretty well distributed and that near the mountains they would have much rain, while at a distance therefrom they would have little or none. Practically the mountain ranges are few and far between, while the great bodies of land and water are by themselves, and we have just as much rain away from the mountains as near them. Clouds are found everywhere when there is sufficient moisture. "Low," herein so frequently spoken of, is the agent which generates the wind which gathers the clouds. The movement of "Low" across the country gathers the clouds and carries them with it, and precipitation takes place along the track of "Low."

Another common idea is that the rain must turn a certain way in order that we should have a "good clear-off." Many such ideas, which, however, are not of much account, had a reasonable origin, and though in one sense absurd, may be excused in those who know nothing of the movements of storms. The origin of this idea was this: In the winter and spring many of our storms travel on a low line of latitude and pass us to the southward. In this case the turn of the rain will be from the NE. to the NW., whereas, later in the season when "Low" gets up on a high line the turn will be the reverse, from the SE. to the SW.

Then there is the notion that the different names, tornado, hurricane and cyclone, etc., must indicate different conditions. Before the age of the weather-map—before we knew what a *storm* was and what produces these conditions, it was not surprising that these different terms were invented to designate supposed different forces. The weather-map reveals to us that all these terms essentially represent one and the same thing. All our storms come and can only come through the agent "Low" (low barometer). Tornadoes, hurricanes, cyclones, call them what we will, all come from this cause, and whenever a "Low" passes we are liable to have the terrific wind-storm, but fortunately for us the conditions are not always favorable; if they were, we, in the United States, would have one every three or four days; for about every three or four days the storm-centre "Low" passes over our territory.

There is a notion that a storm may last two and even three weeks. Before we had the weather-map we were unable to know when one storm ended and another began. Now, we see that it is impossible for *one* storm to last more than two or three days at the furthermost, and that when a stormy season is extended into weeks it is a succession of storms and not all one storm.

The storm-centre "Low" is continually on the move, on *general lines* from the west toward the east. During the early part of the season his course is such as to pass immediately over or near us, say on a line from Texas or Kansas to New England, later in the season he works further to the north, and passes up into Canada. He keeps up his regular passage across the country but goes so far to the north as to cause little or no precipitation south of the "Lake region."

To enumerate all the little absurd and false notions of the weather and to comment upon them would require more time and space than I can at least at present command. If the reader will take note of all the notions of the weather, absurd or sensible, that present themselves to him, and will then familiarize himself with the weather-map he will see wherein they are absurd or reasonable. He will understand them better than ever before and will perceive whether or not they may have some origin in fact or are the mere whim of some ignorant person.

Without regard to the movement or location of the planets, whether in opposition, conjunction, in one part of the ecliptic or another, whether the moon be large or small, new, half, full or old, whether or not there be icebergs off our coast—whether the sun, moon or stars are in eclipse, comets visible or not visible in our sky, old "Low" keeps on his way; ever on such lines as he pleases, or perhaps better, as the sun dictates. "Low," in connection with "High" accounts for all the changes not accounted for by the position of the sun in the ecliptic—only through this system can the meteorology of our globe be understood and explained.

The weather-map reveals to us the fact that the sun, through his enormous heating power, is the cause, and the only cause, of our daily changes as well as being our great agent of light and heat. These changes come and can only come through heat and through the power of "Low" as generated by the sun. As for the moon, her heat and therefore her influence, is too contemptible to speak of. As for the planets, they have about as much influence on the weather as a diamond in a lady's finger ring.

Now that we have something tangible, reliable and instructive in the weather-map, something which brings us face to face with nature, common sense bids us direct our intelligence to it, and to waste no time on "mathematics," "cycles" or even "weather-prophets," for they are of no value. The intelligence of the world has ever been interested in and striving for that which is true. Especially is this so in regard to science. Men whose moral character is such as to make them indifferent to many other truths have demanded and earnestly sought for truth in the scientific fields.

The mere love for truth has sometimes not prompted this so much as the skeptical nature we often see in the purely scientific mind. The wholly scientific mind is skeptical and will not believe that which appears at all doubtful to it, and it is prone to reject that which does not appear reasonable.

The world contains "many men of many minds," yet all intelligent minds from one source or another are interested in truth. We cannot have truth in scientific matters before we have enlightenment.

Before we had the weather-map we were as much in the dark as to our atmospheric conditions as before the days of discovery, before theworld had been circumnavigated and mapped by intelligent men, we were in the dark as to the geography of the earth. Now we have the daily atmospheric conditions revealed to us—there is no longer any excuse for ignorance in this line. There is no longer any excuse for entertaining and upholding that which is false. That which is true has been presented to us—it brings us face to face with Nature and reveals the great face of Nature to us as never before. Its glory, beauty and power are revealed to us, and in it we see Wisdom, Power and Harmony.

METEOROLOGICAL INFERENCES FROM TREE-GROWTHS.

BY ROBT. E. C. STEARNS, PH. D.

Any one who has taken the trouble to examine the annual growths, or width of the annual rings in trees, has at once perceived a great difference in their thickness in the same tree. If we may assume (leaving out young trees) that this variation is principally due to the amount or quantity of the rainfall, and that rings which exhibit maximum thickness have followed in their growth seasons of maximum rainfall, and the thinner rings are consequently the result of the influence of seasons of a less or minimum rainfall, we may also assume that if, on a given date, numerous trees were felled so that we could have transverse sections of all of the principal species, such trees being located at various points in the State and great care being taken that the trees so selected should have been subject, as nearly as possible, to the same environmental conditions, we might obtain an aggregation of data of sufficient volume to render a deduction therefrom of great value, as to the meteorology of the Pacific Coast. We might find so close a parallelism between rings of maximum thickness and seasons of maximum rainfall, that we should be justified in regarding this parallelism as something more than a series of coincidences merely, by finding these coincidences so persistent as to prove a correlation; and we could, perhaps, base our weather prognostications upon something more than a guess, and learn whether or not there is a periodicity or cyclical terms of wet and dry years. * * * *

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.34, on the 30th of April. Lowest barometer during month 28.41, on the 7th.

Highest temperature during month 88°, on the 5th of May. Lowest temperature during month 37°, on the 12th.

Highest velocity of wind during month 50 miles per hour, on the 9th.

The usual summary by decades is given below.

Temperature of the Air.	Apr. 21st to May 1st.	May 1st to 10th.	May 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	44.9	48.4	44.5	45.9
Max	68.3	71.8	65.1	68.4
Min. and Max	56.0	60.1	54.9	56.7
Range	24.1	23.4	20.4	22.6
Tri-Daily Observations.				
7 a. m.	50.4	56.5	52.0	53.0
2 p. m.	64.8	69.1	62.2	65.4
9 p. m.	56.2	59.8	56.8	57.6
Mean	56.4	60.3	57.2	58.0
Relative Humidity.				
7. a. m.	.77	.85	.77	.80
2 p. m.	.57	.57	.64	.59
9 p. m.	.65	.81	.70	.72
Mean	.67	.74	.70	.70
Pressure as Observed.				
7 a. m.	28.92	28.78	29.00	28.90
2 p. m.	28.88	28.73	29.00	28.87
9 p. m.	28.91	28.74	29.00	28.88
Mean	28.90	28.75	29.00	28.88
Miles per Hour of Wind.				
7 a. m.	13.8	15.2	16.0	15.0
2 p. m.	17.2	21.5	17.7	19.5
9 p. m.	14.2	17.3	11.7	21.1
Total miles	4017	3965	3740	117.22
Clouding by Tenths.				
7 a. m.	5.6	6.4	6.0	6.0
2 p. m.	5.8	6.7	8.0	6.8
9 p. m.	4.8	7.5	3.4	5.2
Rain.				
Inches	.65	.76	1.78	3.19

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, April 3, 1882.

The Chemin de fer du Nord, has been since some time occupied to discover an electric lamp for its locomotives, capable of lighting the line some 330 yards ahead. The difficulty to surmount consisted to find a lamp that would not become extinguished by the continued trepidations of the engine. The fixity of the electric light depends upon the uniformly maintained distance between the two sticks of carbon, in the middle of which flashes the electric arc. Now the jerky motion of the locomotive tends to break this arc. Messrs. Sedloczek & Wikulith have combined a very simple lamp, suited to the special necessity in question. The mechanism is briefly this: Two parallel vertical tubes, of unequal diameter, united below by a horizontal tube in the form of a U; in the tubes, glycerine, and above, floating on the liquid, a piston; each piston has a stem, from each stem branches a splint of carbon, one above the other, but in the same vertical line. It follows as a matter of course, that any shock which pushes up one of the pistons acts similarly on the other, so that the space between the carbon sticks is maintained, the glycerine also tends to deaden the trepidations. A cock placed in the horizontal tube, that opens or shuts by the electric current, keeps the pistons and their carbon points in their respective positions, pending the combustion.

The lamp has been satisfactorily tested; it is fed by a Schuchert dynamo-electric machine installed on the platform of the engine, the current being generated by a Brotherhood motor of three cylinders, representing a three-horse power. When the locomotive was running at forty-five miles an hour, the light remained steady, and lit up objects 500 yards ahead, and the line guards were able to discern objects at a distance of 880 yards; the light did not affect the distinctive colors of the signals, nor were the drivers of the engine when crossing, dazzled by excess of light. The results of the experiments justify the adoption of electricity for the reflecting lamp of locomotives, suspended at a height of fifteen feet.

In the elevated regions of the Cordilleras, doctors and travellers have drawn attention to the accidents resulting from asphyxia, to which newly arrived Europeans are exposed. Even domestic animals do not escape. The Indians and wild animals occupying the high points, are exempt from the dangers of the rarefied air, but the inhabitants of the plains faint away from the repeated muscular efforts to breathe. It is a disease not unlike "Mountain Sickness" in Europe, impossible to run without immediately stopping to take breath, the oppression is so acute as to produce fainting. The cause is attributed to the diluted state of the air, which does not permit of a sufficiency of oxygen being absorbed to meet the expenditure of muscular force. But how do the natives of the elevated *plateaux* escape? Why does the oxygen enter in their blood in sufficient quantity to augment combustion and produce the requisite strength? Perhaps their blood is composed a little different from ours, and capable of absorbing, in a given time, more oxygen than the inhabitants of the plain. To solve the question, M. Paul Bert demanded that samples of the blood of animals normally living more than 4,400 yards above the level of the sea, be sent to him for examination. He received some, of several species of animals, and in a very putrified state, but M. Jolyet has demonstrated that blood in that condition absorbs just as much oxygen as when fresh.

In France, the blood of herbivorous animals absorbs from four to five per cent cubic inches of oxygen, and that of man six per cent; now in the Cordilleras, the blood of the lama absorbs nine cubic inches, the vigoque, seven and one-half, the alpaca, seven; the guinea-pig, six; the hen, seven and one-half; the domestic pig, nine, and the sheep, seven per cent. These results would indicate greater absorptive power on the part of the local animals; but it has yet to be shown, that such utilize the oxygen as we do, and that their weight of blood is the same.

The Academy of Science has been called upon to give an opinion upon the subject of quarantines and particularly of that in connection with the Suez Canal. M. de Lesseps complains bitterly of such restrictions, as simply fettering commerce, and failing to protect public health. Dr. Tholozan, physician to the Shah of Persia, and author of authoritative works on oriental cholera and plagues, is an opponent of quarantines, which no nation besides, practices alike. M. Bonley, the head inspector of veterinary colleges in France, asserted that since these sanitary restrictions were imposed on Egypt, either for pilgrims or ships passing through her territory, Europe has been spared from the periodical plague of cholera.

The Academy has named a commission to study the climatic changes experienced in France where winter tends to be merged into spring. M. Blarier attributes the change to an alteration in the direction of the Gulf stream, which has already destroyed the sardine fisheries on the coast of Britany.

The nervous system continues to attract much popular, as well as scientific, attention. Well studied, the subject is certainly calculated, as Brown Sequard has shown, to throw much light on ecstacy, hypnotism and kindred phenomena. The Brothers Weber have shown that the nerves do not always act as "exciters," but in addition, as "breaks" or "checks." The pneumo-gastric nerve, if it be irritated, can stop the beatings of the heart; profound moral emotion can prevent the contraction of the muscles, so that the arms fall powerless; a rapid impression on the skin can bring about the stoppage of respiration: these actions not only arrest movements, but also the secretions, as of the saliva, etc. M. Brown Sequard affirms, that under influences of various natures, the normal properties of nerves and muscles can be affected: in one sense, abolished, that is to say, suspended; in the other, intensified, to an incredible degree. In other words, under the influence of an irritation, external or direct, certain parts of the nervous system gain or lose functional energy. What is the source of these sudden variations, whose rapidity is next to electricity? We know nothing, or rather we know, they are independent of a flux and reflux of the blood, and consequently a local nutrition, exaggerated or reduced.

Generally when there is an increase of energy on one side, there is a diminution on the other; this special activity arises suddenly, without any ordinary chemical work and without combustion. Brown Sequard states there is in reality no transport of force from one point to another at all, while the mechanism of the effects remains not the least obscure. When the skin of certain nervous regions is irritated, its nervous power is ten times more exaggerated than in the normal state. In the case of a dog, the sensibility can be so affected as to cause the respiratory movements to augment from 15 to 180 per minute. As during life, so in case of death, the same changes are observable, in the latter, the cadaverous rigidity quickly ensues, to be speedily followed by putrefaction where there is a diminution of nervous energy in the muscles, the contrary being the result where there is an excess. The augmentation of power in the spinal marrow, is notorious in the condition of ecstacy. In the case of an individual in the hypnotised state, the nervous energy of the hearing power can be so augmented, that the ticking of a watch can be distinguished at thirteen yards, while the ordinary distance is but one yard; similarly, the sensation of smell can detect the odor of a rose at sixteen yards, and the heat of the breath at thirty three yards. In extreme excitability, the hypnotised can suddenly fall into a condition of muscular rigidity and absolute torpor. Feeling is so abolished, that the subject fails to hear when a pistol is fired off close to the ear; he experiences no sensation of odor, of heat or of cold; he is insensible, even when pricked with a pin or galvanized. But when the slightest current of air is passed over any organ having been deprived of its normal activity, it will instantly recover not only its insensibility, but be followed by so intense an excitability, as to cause the rigidity of the neighboring muscles to cease. Dr. Dumontpollier has illustrated this by his "bellows" blowing on hypnotic patients; the ear that was dead to a pistol shot, when it receives a slight current of air, perceives the most delicate noise; a rose, assafœtida, ammonia, that produced hitherto no effect, can be felt at a distance of sixteen yards after a current of air has blown into the nostrils; similarly a whiff of air restores perception to the eye. The movements of respiration, of the heart; the faculty of speech, of memory, can be made to rapidly disappear and as rapidly return. These experiences are produced daily in the hospitals of Paris, and in part by professional magnetisers. M. Dumontpollier has also shown, that the artificial suspension of the senses, due to physical action as light, sound, air, etc., will be destroyed by the prolongation of that same action.

M. Dumas, corroborates the conclusions of M. Moillefer relative to the action of ozone on the salts of silver, nickel, manganese, lead, etc. It was hitherto considered that the blackening of silver was due to the action of organic matters. It is the action of ozone that effects the change, and which produces also the violet color of manganic acid, hitherto a mystery.

M. Clemandeau successfully tempers steel, by subjecting iron heated to a cherry redness, to enormous pressure in a mould. The steel is employed for fine tools and telephones.

BENEVOLENCE FOR SCIENCE.

BY B. P. REDDING.

EDITOR KANSAS CITY REVIEW:

Please correct the error contained in your magazine of April, page 734, in the article headed "Benevolence for Science." The $20,000 presented to the California Academy of Sciences, as a permanent fund, the interest of which is to be applied to aid students in original investigations in all branches of Science in California, Nevada, Oregon, and Arizona, was the gift of Mr. Charles Crocker, President of the Southern Pacific Railroad Company. My only connection with the subject was the pleasant duty of announcing the gift to the Academy.

I may add as a matter of information that since Mr. Crocker made this handsome present, to aid scientific investigation, he and Ex-Governor Leland Stanford, President of the Central Pacific Railroad Company, have jointly purchased from Mr. Ward of Rochester, N. Y., at a cost of $16,000, a scientifically labeled and arrayed collection of more than 7,000 specimens in Palæontology, Zoölogy and Geology. This collection these gentlemen have also presented to our Academy of Sciences. It is now on exhibition in this city and during the first week was visited by more than 30,000 pupils of the public schools.

We have no doubt that through the generosity of these gentlemen and other wealthy and public-spirited citizens, our Academy of Sciences will be enabled to enter upon a new career of usefulness in promoting the higher education by scientific investigation. San Francisco has many wealthy citizens who believe, with Lord Bacon, that, while scientific investigation rarely adds to the worldly wealth of its votaries, yet the wealth and comfort of the whole community appear to increase in proportion to the increase in number of the students of nature.

SAN FRANCISCO, CAL., MAY 3, 1882.

HISTORICAL NOTES.

LOYOLA AND THE EARLY JESUITS.

BY R. P. LORING, M. D.

The 15th Century was the turning point in the history of the Romish church. The warmth and light of reviving learning had commenced to penetrate and dispel the dark clouds of ignorance and superstition which had hung over Europe for nearly a thousand years. Already Wycliffe in England, and Huss and Jerome in Bohemia, had been awakening slumbering Europe with their demands for free thought and liberty of conscience, and the printing press—that great enemy of Rome—had commenced its work. A few thoughtful men were beginning to see through the veneering which had so long covered the enormities of Popery, and a moral and intellectual opposition to its long imposed yoke was quietly generating, until, later, Tetzel—the friar—with his indulgences, caused the indignation of Luther to culminate in open insurrection. Papal bulls of excommunication and the inquisition were of no avail. The Gordian knot had been severed, and Rome felt that the bonds with which she had so long fettered civilization, were being loosened. What a struggle was this. The human heart and intellect were trying to free themselves from the despotic form and precedent of a thousand years.

This was the condition of Europe when Loyola came to the front and infused that element which has modernized and saved the church of Rome, up to the present time. Jesuitism was evolved from the brain of Loyola, and in order that its characteristics may be comprehended, it will be necessary to review some of the events in the life of its illustrous founder. Loyola was of noble family, and had been educated at the Spanish Court in all subjects necessary to the training of a knight. Even while a young man, he had gained a reputation for bravery and high military ability. All biographers speak of his ardent nature as being filled, at this time, with those romantic sentiments of knight-errantry which still lingered in Spain, until a little later, "Cervantes smiled Spain's chivalry away." While defending a garrison against an invasion of the French, in the year 1521, he was severely wounded and taken prisoner. Seven months of confinement and suffering followed, during which time he read the lives and adventures of many Christian saints and martyrs. One can easily understand how the enthusiastic and intensified imagination of the sick soldier could have been excited by these narratives; how the heroic in his own nature sympathized with the sufferings of these holy men, and how he realized the contrast between their lives and and his own. He was filled with a burning desire to emulate their example, and here the Jesuit was born. This was no transient, evanescent effect. For as soon as his wounds permitted, Loyola travelled to the shrine of "one lady of Monserrato," and, after laying aside his knightly costume and placing his sword and dagger by the side of the "Virgin Mother's image," he assumed the sack-cloth, the rope-girdle and the sandals. In this more fitting garb of humility, our romantic enthusiast watched through the long hours of the night. He pledged himself to chastity, to a life of humility; pledged himself to the "mother" of the "One" whose name he afterward connected with the most artfully planned of human organizations. Soon after, this brilliant soldier, who has had all avenues to earthly ambition and happiness opened to him, is seen limping painfully by the gates of the paternal castle, begging alms; the hair-shirt, the bare head and feet, the emaciated form, bearing witness to the severity of his self-humiliation. This was something more than mere fanatic enthusiasm. We believe that there must have been a strong conviction of duty here. The contrast between the stately knight and the mendicant was wide indeed, but Lazarus was trying to realize a nobility of which Dives had known nothing. Was this Loyola insane? Only in the degree that the whole Romish organization was insane. For the Church taught the body was an enemy to the soul; that spiritual growth could only come as the body was whipped, torn, bruised and subdued; that humility came with physical abasement and suffering; and, that temptation could be escaped by flight and self-isolation. We wonder at and pity the self-inflicted tortures of one who desired, in those days, to live a holy life, but we admire the devotion of this Loyola. Was he not right in a certain degree? We sympathize with any attempt at self-growth and government, although we may think the methods absurd. Loyola was filled with an intense desire for something better. The Church taught and the people believed that certain forms of self-humiliation materially aided in bringing about this desired result. Loyola accepted this method as the best he knew, and followed it unsparingly. He retired into solitude, fasted, prayed, and scourg-himself, lived by charity and meditated on holy things.

As a result of these experiences, he, about this time, composed his "Spiritual Exercises." These teach nothing of the duties of social or domestic life, but refer entirely to the discipline and meditations of those who are undergoing a life of asceticism. Later, Loyola made a pilgrimage to Jerusalem with the desire of converting the followers of Mahomet to the true religion, but he met with so much opposition that he finally turned his back on the Holy City, and wandered again to Spain, still enthusiastic and determined. The better to prepare himself for the work of saving souls, he now resolved to undergo a long course of study, and journeyed to Paris for that purpose. While in the Parisian University, his power of attracting and compelling minds had commenced to manifest itself. It has been said that Loyola had the power of communicating motion to to the minds of others. Whatever this charm was, it existed in him in a remarkable degree, because the men whom he influenced and became his disciples were, all of them, more than ordinary in intellect and attainments. Loyola had long meditated the formation of a religious order, and while in Paris he commenced to express his intentions to others. Never did a politician act more shrewdly than did this Spaniard. He sounded his friends and carefully studied their characteristics. He broached a little of his plan to this one, a little to that; securing the devotion of one by his piety; appealing successfully to the ambition of another; and, so great was his knowledge of men and so seductive his methods, that even the brilliant and haughty Xavier at last was won. A solemn vow was taken and so the germ of the society was organized. Their intention was to go to Jerusalem to convert the Mohammedans, or, if unsuccessful, to offer themselves to the Pope: So in pilgrim garb they journeyed, on foot, toward Italy, living by alms; performing the "Spiritual Exercises," preaching vigorously on all occasions, especially against these new Lutheran doctrines; making many converts and relieving suffering, as they tarried by the way. On reaching Italy it was found to be impossible to proceed to Jerusalem, and the journey was continued to Rome. Paul III, the Pope, was looking on with anger and dismay as he saw England slipping away, Germany half Protestant, and the new heresy encroaching on Italy itself. The Jesuits, in Rome, soon distinguished themselves as successful opponents to Protestantism, and were favorably received by the Pope as the best antagonists to Luther. It was not long before the devotion and success of this new society had gained the confidence of Paul III, and the Jesuits were formally recognized as an order of the Church and Loyola was elected "General."

The professed number of the first organization was sixty, but it was afterward increased and its growth was favored by the removal of certain civil ecclesiastic and restrictions. Its members were divided into four classes, viz: 1st. The Novices, who were simply candididates undergoing two years probation. 2d. The Scholars, whose position in relation to the society was to be determined by individual ability. 3d. The Coadjutors, who may be either priests or laymen, but who aid in carrying out the interests of the order. 4th. The Professed, who have bound themselves by vows of chastity, of poverty, of obedience to the will of the General, of perfect submission to the Pope in respect to missionary enterprises. The remaining years of Loyola's life were spent in perfecting the "Constitution"—or rules of government of the Society—in arranging missions, in founding charitable institutions and the celebrated Jesuit College at Rome, in preaching and proselyting. This remarkable man died in the year 1556, in the sixty-sixth year of his age.

The Church of Rome has canonized Loyola. His name is considered sacred in Catholic countries, and the relics of his early life, in Spain, are objects of veneration. On the other hand, he had been villified as much as he has been adored. Almost the whole vocabulary of abusive epithets has been applied to him, occasionally by Catholic and frequently by Protestant. But, there is something wonderful in the history of the man who has stamped himself so indelibly on a system that his influence has been projected through three centuries. How shall we defend this character? As a young man, ardent, chivalrous. By a sudden and natural transition he becomes an enthusiastic and devoted proselyte of the received religious ideas of his time. He seems to have acted sincerely on his convictions at this period. But experience subdues the romantic in his nature. To his devotion and enthusiasm is added a polished artfulness, and Loyola crystallizes into the Jesnit. Ambitious and filled with concentrated enthusiam; having a prôfound knowledge of the weakness and strength of human nature; knowing perfectly how to turn virtue, vice or ambition to the advantage of the church; possessed of a finesse, a flexibility, a duplicity, a dexterity in management almost Machiavellian, preferring truth and gentle procedure—if convenient—but capable of black deception and pitiless cruelty, if necessary; believing the doctrines of the church *verbatim et literatim*, and devoted heart and soul to its interests. This was Loyola, and such is Jesuitism. In this organization the result of Loyola's early military education is seen, in the strict code of discipline; in the dependence on and allegiance to the head, or general, who, in his turn, acknowledges the Pope as his director; and, in the sharp distinctions between the different grades.

So skilfully has Loyola managed his "Constitutions," and so carefully is the discipline applied to the Novices, that none but the most capable can reach the highest and most influential grades, and all lose in the course of their training their influentiality—becoming automatoa—guided only by the will of the "Superior." The vows of poverty and obedience wean them from the world and make them devoted to the order. The discipline and instruction of the Society teach them that the highest duty lies in working for the church.

So in the 16th century, when the Romish organization was losing its power, was staggering from blow after blow from Lutherism, the Jesuit force came forward, instituted itself as a prop under the tottering edifice and gave a vitality to the diseased Church, which has continued to this day. The missionary enterprise and flexible adaptability of the Jesuits, have largely caused the growth and spread of the Church power in all directions and under adverse circumstances. From the days of Xavier, to the present, the Jesuit missionaries have displayed heroic enterprise and energy. Most romantic are some of their histories; leaving civilization behind, crossing pathless oceans, fearless of death, plunging into unknown lands, they have penetrated everywhere; and to-night, the vesper melody from the Jesuit Mission bell floats out on the air in every clime. Truly these men deserve respect for their undying devotion! But, it is in the courts, in the centres of civilization, that the Jesuits have fought their most determined battles and have applied all their arts. Striving with something more than energy, with hope against hope; now controlling kings and being the power behind the throne; plotting, deceiving, committing black crimes; losing ground, being expelled *vi et armis*, struggling back again into power; again shaken off, and finally trodden under foot; never destroyed, but appearing again in a new phase, relentless and almost resistless.

What a wondrous history, theirs! Animated, as it is, by the soul of one, Ignatius Loyola, who died three centuries ago.

ANTHROPOLOGY.

INDO-CHINESE CIVILIZATION.

BY A. B. STOUT, M. D.

[*Read before the Academy of Sciences, San Francisco, Cal.*]

At the last meeting of the Indo-Chinese Academic Society, of Paris, the Marquis de Crozier announced the return of Lieutenant Delaporte of the French Navy, member of the Society and principal officer of the Archæological Commission of Cambodia, who has just arrived at Toulon on the Government transport, the Tonquin, and publishes the principal results derived from the Commission.

M. Delaporte, accompanied by a part of his staff, departed from Marseilles on the 3rd day of October, 1881. On his arrival at Saigon, he was received with the utmost hospitality by M. Le Myre de Vilers, Governor of Cochin China, who immediately placed a steamer at his disposal and accorded to him, through the Colonial Council, an appropriation of 8000 francs for the initiatory expenses of his journey. The important navigation company, "Roque," offered him their steam cutters, proposing to transport gratuitously his staff and material during the entire continuance of his explorations. L. Fourès, temporary representative of the French Protectorate of Cambodia during the absence of M. Aymonier, occupied himself sedulously in facilitating the final equipment of the explorers.

From Phnom Penh, the capital of Cambodia, M. Delaporte went directly to the ruins of Angkor. There he was enabled finally to solve the difficult problem of the destination of the religious edifices of that ancient metropolis of Indo-Chinese civilization. His discoveries have warranted him the conclusion, both interesting and unexpected, that the ancient Khmer temples were dedicated to Brahmanism. In his explorations at Angkor-Vat, he exposed on its eminences the *chefs d'œuvres* of Cambodian sculpture of bas-reliefs, formerly brilliantly gilded pediments and entablatures, all the designs of which, as well as those which decorated the most interior sanctuary, are consecrated to the exploits of Rama and to the glory of Vichnu. To these gods then was Angkor-Vat dedicated. At Angkor-Tom new monuments were found, the most of which presented in the principal entablatures the exploits of Rama and of Vichnu. He there verified the presence of the emblem of Siva—the linga or phallus of the ancients. He excavated and removed the dèbris from the ancient palace of the Khmer kings, and thus brought to light the most grandiose and marvelous sculpture; terraces superposed on each other, decorated with superb compositions in bas-relief. The tricephalic elephant Iravâlti is there enthroned in all the places of honor, and, also, in the angles of all the gates of the city, where he appears mounted by the god Indra, accompanied by the two Apsaras, or celestial dancers of his paradise. M. Delaporte had succeeded in collecting 300 photographs, forty casts in plaster and a small number of original pieces of great value, when, on the 1st day of January he, as well as his second in staff, M. Farut, engineer, and one of his draftsmen, M. Tille, were compelled to yield to the fever of the country and return to Saigon and enter the hospital, thence to embark on the first transport for France. Although much reduced in strength, he was enabled to endure the voyage, and is now a convalescent.

The Commission, notwithstanding the departure of the chief officer, still continues its work. M. Delaporte delegated his command with his instructions to Dr. Ernawhit, physician in the navy, assisted by M. Ghilardi, in charge of the castings, and M. Laedhric, draughtsman and photographer.

At the date of the 16th day of January the investigation of these explorers was in active operation. The party, reduced to three Europeans, accompanied by two interpreters, twelve native soldiers and several Cambodian and Siamese mandarins, took the route of Batta-Bong, whence the party was shortly to embark upon the frigate placed at his service by M. Le Myre de Vilers, its destination being to reach the ruins northeast and to visit, afterward, the monuments situated on the banks of the Më-kong. The operations may be continued until the middle of March, when the heat will become too intense and the weather too stormy to permit Europeans to endure the severities of the climate. The Commission will probably return to France by the end of April or the beginning of May.

We hope that the entire recovery of M. Delaporte will soon permit him to present, in person the results of his mission to the Socioty. At the same meeting the Society received a very interesting communication from M. Lion Dru, engineer, upon the opening of the Isthmus of Krou and the Peninsula of Malacca. The Indo-Chinese Academic Society, desiring to assure to itself the necessary aid in the explorations which it proposes to undertake in the Philippines, Carolines and the Marianne Islands, as well as the researches which it is prosecuting in the archives and libraries of Spain, has solicited the patronage of H. M. Alphonso XII, begging him to to take an interest in its proceedings, and to accept the title of High Protector. A member of the Council, Count Alphonso Dilkan, has repaired to Madrid to present to the King a collection of the proceedings and a diploma of membership in the Society. His Majesty promptly accorded to him the kindest reception, accepting the title thus presented him. The King promised to the members of the Society his most cordial aid in its explorations in Spanish Malasia, and in their researches in the archives and the libraries of his kingdom.

THE CLIMATE OF PARIS IN PREHISTORIC TIME.

BY CAPTAIN E. L. BERTHOUD.

There is no reason to doubt that for a long time in the past, Paris and its neighborhood enjoyed a tropical climate, where dwelt the elephant and rhinoceros, animals fond of heat; then, that at other epochs this country was subjected to glacial periods, which numerous relics of reindeer prove beyond doubt.

We have new facts proving this: Mr. G. Vasseur has placed in the hands of Prof. A. Gaudry, the famous palæontogical professor of the Museum, numerous relics obtained on the heights of Montreuil in the environs of Paris at an altitude of 326 feet above the sea.

These fragments are of the quaternary period and consist of portions of the skeletons of bisons, elephants, and especially of reindeer, which latter, however, do not belong to that period of prehistoric time known as the "Reindeer Age"; for the erosion of the bed of the Seine, which at a latter age took a very large extension, had not then taken place.

Thanks to this last discovery at Montreuil we can divide the Quaternary period into six prominent intervals each characterized by alternations of cold and warm climate, realizing the extreme conditions "enter se" of glacial, temperate warm and torrid. To each of these corresponds a fauna and flora of special distinctions.

In this tropical locality of Montreuil, be it well marked, not a vestage or indication of man has been found anywhere.—*Translated from l'Exploration, Feb. 22, 1882.*

MISSOURI ARCHÆOLOGY.

BY O. W. COLLETT, ST. LOUIS, MO.

[*Read before the Missouri Historical Society, February 22, 1882.*]

On April 14th last, I took the afternoon train to Kirkwood, and thence afoot went down to Fenton, stopping by the way a little while at the Cerre Sulphur Spring. I slept at the village, and next morning, which was Good Friday, retraced my steps as far as the Spring, and there and in the neighborhood spent the forenoon.

The day is fixed forever in my memory, for I do not remember ever to have experienced the like of it, or an occasion on which the aspects of nature impressed themselves so vividly on my imagination. The transparent atmosphere was the special charm.

Cerre Spring is in fact two separate fountains, one impregnated with sulphur, the other with salt, whose waters have been united and gush forth as one stream. It is situated one and one-fourth miles from Fenton, about the centre of a piece of level land three or four acres in extent, and which is the mouth or junction with the second bottom of the Meramec, of a small valley through which a rivulet meanders. The Spring is a hundred paces west of a hill, and discharges its waters about a foot below the surface of the earth into a deep trench. It appears to flow beneath a small marsh, and it may be that excavations of sufficient depth, made thereabouts, would bring to light animal remains.

The second bottom, or valley proper, of the Meramec, is hereabouts near a mile wide. Benches or terraces, more or less inclining, but much higher than the alley, jut out from the hillsides to the westward. The present valley was once, perhaps far back in quaternary times, the bed of an immense lake or river, and the terraces may then have corresponded to what is now the second bottom.

The locality around Cerre Spring once abounded in archæological objects; but sixty years ago people began to carry away the "Indian curiosities." As they were called, found there, and as they have continued to do so until the present time the supply is well nigh exhausted. On the flat land near the Spring arrow points are found occasionally, and directly opposite westwardly, about one hundred yards distant, the plateau is strewn with fragments of thick pottery, which was probably made, and certainly used on the spot. On the same ground also some noteworthy implements have been picked up. The potsherds vary in size from quite small pieces to six inches square and in thickness from half an inch to one anda quarter inches; they appear to be of the same composition as to material, as what is usually designated Mound-Builders' pottery, loam, with a small portion of pounded shells intermixed. Some of the fragments at least are of vessels that could have held thirty gallons, and were ornamented near the rim with cross-lines, or simple indentations, or finished plain, probably according to the fancy of the maker. In form they were wide shallow pots. No whole vessel or a large piece of one of this class of pottery I believe has ever been found. Similar pottery has frequently been discovered in the immediate vicinity of Salt Springs, but I am informed nowhere else. These two facts seem to justify us in determining its use and giving to it the name by which it is commonly known, salt kettle pottery. For the most part it has been well fired. I have never seen a fragment which showed salt glaze; nor do I know of a single instance of salt having been found in a mound or burial place. It is possible that the water was evaporated only so far as to produce concentrated brine, or that evaporation was produced by the heat of the sun.

It is certain that white men did not make this pottery; and it appears that the Indians before Europeans came among them did not use salt; besides, it is impossible that Indians could have made such large vessels without our having certain knowledge of the fact. I am inclined to think that the makers of this pottery, the constructors of the stone graves, and the builders of the mounds were one and the same people. The implements referred to just now were picked up by myself. One is a fragment of limestone about five-eights of an inch thick, in form an size much like the blade of an iron hatchet broken off below the swell of the eye, and ground at the cutting line three-quarters of an inch wide on both sides to an edge; the other a triangular or canoe-shaped flint seven inches long, one inch broad on the face, tapering to a point at one end and nearly so at the other, the apex of all the angles ground off, and the less pointed end somewhat rounded by the same process. I cannot conjecture the use of these implements. I have since obtained from Mr. Wm. Kaut a fragment picked up in Fenton of what seems to have been a precisely similar implement, but ground all over.

Between the pottery ground and the hill, but at some little distance from the former, many potsherds of the usual thickness are found; and in one spot, on a previous occasion, a companion (Dr. Chas. D. Stevens) and I dug into a deposit of muscle shells, perhaps half a bushel. I am inclined to think ordinary pottery was manufactured hereabouts. For some distance up the little valley already mentioned, flint lances are thrown out by the plow, though rarely a fine specimen, and once in a great while a small axe.

On the terrace which extends around the hill to the west of the Spring and on the hill itself, were once altogether five or six burial places; groups of stone graves, each grave formed by placing flat stones edgewise in the earth as has often been described. All that were situated on the terrace have been rooted out long ago, and their stones used to build the foundations and chimneys of neighboring farm houses. The burial place on the hill still remains, but every grave has been opened. Mr. Wickersham, a grandson of Jacob Wickersham, who settled on the Meramec in Spanish times, informed me on my way from Fenton that there was still one undisturbed cyst, and described the exact spot where it could be found. Toward noon I turned my back upon the valley and set out to follow up Mr. Wickersham's directions, though with strong misgivings of the trustworthiness of his information. On entering the woods a rabbit started under my feet, bounded away a few paces and then stopped and took a deliberate look at me. A little farther on my attention was attracted by a bright white flower, peeping out from between the roots of a tree, the first greeting of spring, its beauty greatly enhanced, like a maiden's in a locality where marriageable girls are few, there being none others to be seen. I stooped down and plucked it, and even brought it home pressed in my note book; it was the blood root, but I admired it none the less. Next day many were seen, and on Sunday they were abundantly common. Having gained the top of the hill and being well acquainted with the locality, I had no difficulty in finding the spot to which I had been directed; but the grave was not an exception to the others. Presently I sat down upon a slab, which had served as the cover of a cyst, surveyed the country around, watched the movements of the clouds and mused. Around me were the vestiges of ancient peoples—of men whose coming, whose sojourn, whose departure are problems unsolved—the dead records of a past and almost its only records, still, awaiting an interpreter. My foot rested upon a fragment of limestone, in which were imbedded a number of fossils. I took out the hammer and broke off several, which, on my return to town, I gave to Dr. Hamback. Overhead was a gourd depending upon a dead vine. I reached out and plucked it. This species and others are indigenous. They grew in the days of the pottery makers and appear to have served as the models of some of their vessels. In many of their pots there is an imitative resemblance to gourd forms, and occasionally so exact that one would imagine the clay had been dexterously built up around the fruit and the latter subsequently removed by the burning process. But this could scarcely have been, as the plastic material would have cracked in drying, had its contraction been resisted by a rigid substance within.

Fenton is an old place. Long before the Fenton of to-day, the locality was a rendezvous of the Indian and before him the site of a town, probably coeval with the Mound-Builders, whose population disappeared centuries ago. The locality early attracted attention from the fact of its being a vast graveyard, and the river just there affording the first convenient ford above its junction with the Mississippi. Lieut. Long describes it in 1819, and *Beck's Gazetteer* in 1823 speaks of ruins supposed to be of a prehistoric fort. In 1818 people began to open the graves. They found to be twenty-five to fifty inches in length. Mr. Roessel informed me that not long ago (within three years) he had discovered a cyst at Fenton not over sixteen inches long. It was imagined by many that they were the tombs of a race of pigmies, and a spirited contest arose, conducted in the columns of the *Missouri Gazette*. It need not be said that the notion of a race of dwarfs was unfounded. None of those receptacles of the dead are now in existence; they were destroyed by degrees by curiosity-hunters, in the building of the town and cultivating the adjoining fields. The ruins of the fort, or of whatever it may have been, have also disappeared. All that remain of the ancient necropolis and the people who dwelt thereabouts are three mounds on the river's bank, innumerable potsherds and fragments of flint littering the earth. Some whole vessels, many flint implements, a few axes and perhaps other objects of stone found in times past, have been taken away and are now scattered over the country. I, myself, have collected some specimens on the spot, and from time to time obtained others which had been found there, though few that are noteworthy by reason of their form or workmanship.

On the top of the hill at which the upper end of the village abuts, there are several stone heaps which may be artificial, and at short distance below Fenton, on a hill also, as I am informed, there is a shell heap.

Southeastwardly, about three miles distant from the village, is Clamorgan's salt spring, the site of the first salt works erected west of the Mississippi. There is of record a document which gives us an authentic account of this primitive establishment. The factory, situated within fifty paces of the spring, was forty feet long, twenty feet wide and built of posts planted upright in the ground, after the manner of all the wooden houses of the time. The furnace, which was constructed of stone, was as long as the building, and its equipments consisted of forty-four square cast-iron cauldrons two feet two inches by two feet two inches, weighing 200 pounds each, and eight lead cauldrons two feet nine inches by two feet three inches and eleven inches deep. In September, 1792, the establishment, brand new, and unused, was rented to Thomas Tyler, together with the following implements, slaves and outhouses: A new ox-cart and two yoke of cattle; four negroes, Charles, twenty-five years of age, worth $600, Sam, twenty years of age and George fourteen years, worth $500 each; and James, thirty years old worth $400, and their clothing; and four little cabins near by. The lessee was authorized to cut as much wood as he needed on the premises. Clamorgan was to receive thirty (minots) bushels of measured dry salt as the monthly rent, and in case of any failure $6 for every bushel of salt not delivered according to contract, and besides, if any kettle were broken, Tyler was to pay five pounds of lead for each pound of iron in the broken cauldron, that being the price it had cost. We have here an apt illustration of the value of old documents. I have just been quoting from a legal instrument executed nearly one hundred years ago, a paper in which one would scarcely expect to find anything that would interest us to-day, and it furnishes a definite account of the construction, extent, and equipment of the first salt works in Missouri; the price of men, farm slaves, and the relative value of several articles of merchandise at that date (archive 2,893).

In the immediate vicinity of the Spring there are several groups of stone graves; but every cyst has been opened and its contents disturbed. I have never heard of any thick or salt-kettle pottery having been found in the neighborhood of the Spring.

Beyond Fenton, in the direction of Meramec Station, I discovered several localities where spear-heads can be found, which I examined carefully; but although my searches were rewarded with finds, there was not a single fine specimen among them.

MINING AND METALLURGY.

THE SUBSTANTIAL PROSPERITY OF COLORADO.

BY HON. THOS. M. PATTERSON.

* * * For the twenty-seven years beginning with 1850, the money invested, the labor expended and material used in mining for precious metals in the United States, are fairly estimated at $709,000,000, while the money returns therefrom, and created values in mines and mills, amount to $2,200,000,000, giving to the investors more than 200 per cent as actual profit. Within the last twelve years the mining States and Territories have produced more than $875,000,000 of gold and silver bullion—the highest value of any of the years being $95,000,000 and the lowest being $52,000,000.

For the same period of twelve years the struggle for the supremacy in the contest of precious metals had been with California and Nevada. Like well-matched athletes, now one seemed to prevail and now the other.

Colorado, though robust and aspiring, seemed a pigmy beside these giants, but in 1879 she took up the gauntlet, and from a product of $8,000,000 the preceding year, that year came to the front with more than $17,000,000. California gave to the world the same year $18,000,000, and Nevada contributed nearly $22,000,000. But their insignificant triumph of that year was their last. The infant had grown into a man, aye, it became a giant, for in 1880 Colorado, from its river beds and mountains made the world the richer $23,000,000, while California and Nevada followed in the rear, the one with $19,000,000 and the other with but $15,000,000.

But unapproachable as is our State in the production of the royal metals, exploration and experiment have shown that States gray with age and decorated with a century's industrial badges for achievements in the arts where coal and iron are used, have just reason to fear the rivalry of this youngest of the sisterhood in all branches of mechanical industry where the intervention of the humble metals is invoked. Colorado, while it leads the van in furnishing the material for the world's money—the metals of which crowns are made, and flashing coronets and tinsel, and fashion's baubles, is equally in the front with vast stores of what commerce terms the baser metals, but which in their universality of use and adaptability to every phase and necessity of a world's rugged and healthful wants are in fact by far the nobler.

The age of gold and silver in Colorado has been supplemented by the age of iron and coal. Pennsylvania through its blast furnaces and coal beds has become the second State in the Union, both in wealth and population. California, from its golden sands, has wrought itself into a giant commonwealth, the gateway to the Union for the commerce of the Pacific Islands, and 400,000,000 of Asiatic people. Colorado has within her borders the metals and minerals of both these great States in equal degree. While she has outstripped the one in the joint production of gold and silver, she has of iron and coal, that which ere a generation passes, will make her the rival of the other in that vast net-work of mechanical devices fashioned from them, which are so interwoven with human life that they form a part of its warp and woof. Every quarter and section of the State is pregnant with the wealth which forms the sum of its greatness. The golden fissures of Gilpin and Boulder, the silver fissures of Clear Creek, Summit, Custer, the Gunnison and San Juan, are reservoirs of the two metals which will not be exhausted until the primeval curse dooming man to labor shall be revoked. The coal beds of Las Animas, Fremont and Gunnison, the iron joined in nature's wedlock to them, the clays, silicates, timber, grasses, soils in every section of the State where the sun shines and the winds blow, make up a grand total of material elements which invites capital to profitable investment and labor to generous remuneration.

The world recognizes that Leadville is the most magical city of the age. From its mines and smelters more silver annually flows into the arteries of the world's commerce than is supplied by any entire State or foreign land. In Pueblo, with its vast steel works and iron furnaces, its product of Bessemer and pig, its proximity to vast beds of coal and iron, its railroad facilities and geographical position, we but anticipate the future Birmingham or Pittsburg of the great and growing West. In Denver we behold the Queen City of the mountains and the plains. For five hundred miles north, south, and west, the continent pays constant tribute. Twelve lines of railway, which are still stretching out their iron arms to encircle new possessions, carry in and out the moving multitudes and distribute the contents of her warehouses and the products of her shops. She is without a rival, and envy has been silenced in her presence. * * * —*La Plata Miner.*

ANALYSIS OF LEADVILLE ORES.

BY D. BAUMAN.

As a fair average of Leadville ores I give the analysis of lots stored at our smelters, from all divisions of the camp:

LOTS NO.	TONS.	SILVER. OZS. PER TON.	LEAD. PER CENT.	SILICA. PER CENT.	MET. IRON. PER CENT.
1	300	35	35	15	18
2	200	35	40	12	23
3	5	300	18	11	18
4	10	100	7	12	20
5	20	35	10	30	20
6	3	140	6	62	4
7	5	200	2	50	4½
8	5	80	44	12	2
9	400	75	35	41	5
10	550	85	44	30	5
11	400	100	22	24	28
12	50	55	27	45	10
13	10	45	28	18	30
14	200	80	30	22	16
15	300	48	18	30	24
16	200	48	22	16½	28
17	260	75	42½	14½	15
18	10	800	2	66	5
19	50	80	16	18	10
20	3	2,000	3	65	4
21	30	10	29½	20	18
22	30	20	61½	4	5
23	15	520	6	40	10
24	24	68	33	12	15
25	50	57	46	25	8
26	13	153	18	30	40
27	7	424	54	10	15
28	35	140	42	16	2
29	30	104	48	10	16
30	50	63	12	50	7

GENERAL MINING NEWS FROM COLORADO.

PITKIN COUNTY.

The Farwell Consolidated Mines embrace 19 claims in and about Independence or Farwell Pitkin County, Colorado. The following are the most exten sively worked: The Independence, Last Dollar, Mammoth and Mount Hope. The first two have been worked about 300 feet on the veins, with some stoping; tunnels are driven to reach the vein at a considerable depth, and are within 40 feet of the ore-bodies. In March, the average yield of gold ore was $26; in April, $32 per ton. The company operates its own mill of 50 stamps, 30 of which have been running all winter. The mill is wet crushing, amalgamation process; the concentrates are caught on blankets and buddled. The following statement is the quarterly output: January, $25,000; February, $29,000; March, $38,000; to April 15th, $19,500.

The Hamilton Company has finished the survey of its placer and lode claims, and will receive a patent for them from the Government in a short time. This property, adjoining as it does the Farwell, is known to be very rich and the Company is doing a wise thing to obtain ownership of the land before developing the mines.

CHAFFEE COUNTY.

The mines of the Chalk Creek District, including the Alpine, St. Elmo and Hancock mines, are getting into shape, preparatory to an early resumption of active mining. At Alpine the Diamond Queen Company is developing its property, consisting of several lodes, the most important of which, the Diamond Queen, is opened by an incline of 135 feet, from which a drift has been run north and south about 25 feet each way. Some good ore is reported to be exposed in the workings, and the company propose, during the coming season, to erect machinery and ship ore to the Buena Vista sampling works. The grade of the ore from the Kerber Creek mines is said to be improving, some of it showing a net gain of 50 per cent in value.

GILPIN COUNTY.

The numerous claims in the vicinity of Central City, many of which are worked by private parties on leases, continue, as at last report, shipping considerable quantities of ore. The Wyandotte Consolidated Company is pushing explorations on the west lower level from the working shaft on the Wyandotte vein. The Cameron Consolidated Company is meeting with a fair degree of success in the operation of its properties.

GRAND COUNTY.

One of the properties in the North Park that is reported showing up extremely well for the amount of work performed on it is the Wolverine. There are five feet of good mineral in the breast of the lower tunnel and nearly 600 tons of ore on the dump.

GUNNISON COUNTY.

Tomichi District, in this county, is a section which gives promise of becoming one of the most important mining districts in the State. In Buckhorn Gulch, which forms a portion of the district, the quartz carries sulphurets and, in some places, wire silver. Several new and important strikes have been reported during the last few weeks.

CLEAR CREEK COUNTY.

The mines of this county, particularly those in the immediate vicinity of Georgetown, continue to make large shipments of ore that averages about 200 ounces of silver to the ton. Several of the leading Georgetown mines are shipping small lots of ore, some of which runs as high as 1,000 ounces to the ton. The Red Elephant Company is reported to have a good vein of ore exposed in the eighth level that mills from 50 to 150 ounces. At Idaho Springs, the mining interests are reported to be prosperous. When the Freeland resumes operations, which it is said will soon be done, this section will be one of the busiest in the State. At Dumont, the Unadilla Mining Company is taking some good smelting ore from its Eagle lode. The Albro Company has exposed a vein of good ore between four and five feet wide, fifteen inches of which is smelting ore that yields $109 a ton, net, the rest being concentrating and milling ore. The mill treats about twelve tons every twenty-four hours, and a weekly shipment of one car load of smelting ore is made to the Argo works.

LAKE COUNTY.

The mining interests of the Carbonate camp continue in the prosperous condition that has been noted for some time past. The large output of the mines is maintained, and there are unmistakable signs that, unless some unusual interruption should occur, the product of the mines for the current year will be larger than ever before, surpassing even the best days of the Little Pittsburg, Chrysolite and Little Chief. While the large output is maintained, prospecting work is still carried on with great diligence, particularly in the mines located on Fryer Hill. The Amie strike, concerning the value of which considerable doubt was at first expressed, is said to be showing up better than ever, some of the ore extracted netting $400 to the ton. The new manager of the Chrysolite has taken charge of the mine, and is starting considerable prospect work. The Climax has given two more leases on sections of the mine. The Robert E. Lee Company is meeting with renewed success in the development of its mine, large bodies of ore being reported exposed. The little Chief is doing poorly ; it is said that there will shortly be a change made in the mine management. There is considerable work doing on the Big Pittsburg property, and the prospects are a little brighter.

PUEBLO COUNTY.

The first steel rail ever produced in Colorado was turned out the Pueblo works at about four o'clock on the 11th day of April, 1882. This marks a new era iu the history of Colorado's industries. It is one of the State's most important stepping stones to a greatness which is already astonishing the world.

ASTRONOMY.

ASTRONOMICAL NOTES FOR JUNE, 1882.

BY W. W. ALEXANDER, KANSAS CITY, MO.

THE SUN.

Date.	Right Ascension.	Declination N.	Equation of Time.
1st.	4h. 37m.	22° 6′	2m. 24s. —
5th.	4 54	22 35	1 46
10th.	5 14	23 02	0 50
15th.	5 35	23 20	0 12 +
20th.	5 56	23 27	1 18
25th.	6 17	23 23	2 21
30th.	6 38	23 09	3 22

MERCURY.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	6h. 20m.	25° 01′	1h. 39m. P.M.
5th.	6 34	24 13	1 38
10th.	6 45	22 58	1 29
15th.	6 48	21 37	1 32
20th.	6 44	20 19	0 48
25th.	6 33	19 18	0 18
30th.	6 18	18 40	11 40 A. M

Semi-diameter on the 1st, 4″; on the 30th, 5.8″.

VENUS.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	6h. 29m.	24° 41′	1h. 48m. P. M.
5th.	6 50	24 27	1 54
10th.	7 16	23 54	2 00
15th.	7 42	23 05	2 06
20th.	8 08	21 59	2 12
25th.	8 33	20 38	2 18
30th.	8 57	19 03	2 22

Semi-diameter on the 1st, 5.8″; on the 30th, 6.5″.

MARS.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	9h. 03m.	18° 17′	4h. 23m. P. M.
10th.	9 24	16 40	4 09
20th.	9 46	14 42	3 52
30th.	10 09	12 35	3 35

JUPITER.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	4h. 30m.	21° 18′	11h. 48m. A. M.
15th.	4 44	21 47	11 07
30th.	5 01	22 14	10 16

Semi-diameter on the 1st, 15.5″; on the 30th, 15.7″.

It is visible as morning star in the constellation Taurus, and too near the Sun for its satellites to be observed.

SATURN.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	3h. 08m.	15° 29′	10h. 25m. A. M.
15th.	3 15	15 55	9 37
30th.	3 21	16 19	8 44

Semi-diameter on the 1st, 7.7″, on the 30th 8″.

It is west of the Sun and will rise about 2h. before the dawn of morn. Apparent elements of its ring: Outer Major Axis 37.3″; Minor Axis 14.3″; Inclination of northern Semi-Minor Axis to circle of declination from north to east, 1° 32′; elevation of the Earth above the plane of the ring, 22° 37′; elevation of the Sun, 21° 40′; Earth's longitude from Saturn counted on plane of ring from the ring's ascending node on Equator, 102° 31′; Ecliptic, 59° 26′.

URANUS.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	11h. 03m.	6° 50′	6h. 23m. P. M.
30th.	11 06	6 35	4 33

It is in the constellation Leo about 15° east of Regulus, the brightest star.

LIVING ON MOUNT ÆTNA.

Hitherto the hospice of the great St. Bernard, which stands 8,200 feet above the level of the sea, has enjoyed the distinction of being the most elevated inhabited building in Europe. This honor it can now no longer claim. During the past year the city authorities of Catania, in Sicily, have caused to be erected near the summit of the great volcano, Mount Ætna, an astronomical observatory which stands 2,943 meters above the sea level, or fully 1,000 feet higher than the hospice of St. Bernard. The structure is nine meters in height, and covers an area of 200 square meters. It consists of an upper and a lower story, and is built in a circular form. In the lower story there rises a massive pillar, upon which is placed the great refracting telescope. The lower story is divided into a dining-room, kitchen and storerooms. In the upper story there are three bedrooms intended for the accommodation of astronomers and tourists visiting the establishment. The roof consists of a movable cupola or dome. From the balconies of the upper story a prospect of vast extent and grandeur is presented. The spectator is able to see over half the island of Sicily, the Island of Malta, the Lipari Isles, and the province of Calabria, on the mainland of Italy. The observatory is erected upon a small cone, which will, in the case of eruption, protect it completely from the lava stream, which always flows down on the opposite side of the volcano.

BOOK NOTICES.

Handbook of Invertebrate Zoölogy. By W. K. Brooks, Ph. D. Octavo, pp. 392. Boston: S. E. Cassino, 1882. For sale by M. H. Dickinson, $3.00.

This work, which is most handsomely presented by the publisher, is a careful and minute description of some typical forms of the invertebrata, with cuts, mostly made for the purpose, and many of them drawn by the author himself, illustrating every essential point in their structure.

To students intending to prosecute their researches no handbook could be used more likely to thoroughly prepare them. The author says: "In the treatment of each type I have not attempted to make an exhaustive monograph for the use of specialists, or to present all that is known about it; but simply to call the attention of the beginner to the structural features which he can readily observe for himself." This he has done most minutely with the Protozoa, taking as examples the shapeless Amœba and the more advanced Infusorians, as the Vorticella, the Calcareous Sponges and the Hydroida; the Radiata, including the Medusæ, the Star Fish and the Sea Urchin; the Articulata, typified by the Earthworm and the Leech; the Crustacea, including the common Crab, the Crayfish and Lobster and the Cyclops; the Mollusca, represented by the bivalve Mussel and the Squid.

In each of these classes a careful description is given of the development, anatomy, external and internal structure, and metamorphoses of each example, and nothing seems to have been left undone that is necessary for the information of the student. For instance, thirty-two pages are devoted to the grasshopper, including full details of the hard parts and its internal conformation, twenty to the earthworm, etc. The illustrations are very well executed. The work will rank among the best of the present day for the use either of teachers or students.

ATLANTIS, THE ANTEDILUVIAN WORLD. By Ignatius Donnelly. Illustrated; 12mo. pp. 490. New York: Harper & Brothers, 1882. For sale by M. H. Dickinson, $2.00.

Whether we adopt the conclusions of the author or not, we must certainly give him credit for sustaining them creditably with facts, arguments and plausible theories, and no one who commences to read it will fail to finish it and to be surprised at the number of authors drawn upon and the wide scope of research manifested, as well as the cumulative evidence thus secured.

To give an adequate idea of the purpose of the work, we quote from the first chapter: "This book is an attempt to prove several distinct and novel propositions. These are, (1) That there once existed in the Atlantic Ocean, opposite the mouth of the Mediterranean Sea, a large island, which was the remnant of an Atlantic continent and known to the ancient world as Atlantis. (2) That the description of this island given by Plato is not, as has long been supposed, fable, but veritable history. (3) That Atlantis was the region where man first rose from a state of barbarism to civilization. (4) That it became, in the course of ages, a populous and mighty nation, from whose overflowing the shores of the Gulf of Mexico, the Mississippi River, the Amazon, the Pacific coast of South America, the Mediterranean, the West coast of Europe and Africa, the Baltic, the Black Sea and the Caspian were populated by civilized nations. (5) That it was the true Antediluvian World, the Garden of Eden, the Gardens of the Hesperides, the Elysian Fields, the Gardens of Alcinous, the Mesomphalos, the Olympos, the Asgard of the traditions of ancient nations, representing a universal memory of a great land where early mankind dwelt for ages in peace and happiness. (6) That the gods and goddesses of the Ancient Greeks, the Phœnicians, the Hindoos and the Scandinavians, were simply the kings, queens and heroes of Atlantis; and the acts attributed to them in Mythology are a confused recollection of real historical events. (7) That the Mythology of Egypt and Peru represented the original language of Atlantis, which was sun-worship. (8) That the oldest colony formed by the Atlanteans was probably in Egypt, whose civilization was a reproduction of the Atlantic island. (9) That the implements of the Bronze Age of Europe were derived from Atlantis. The Atlanteans were also the first manufacturers of iron. (10) That the Phœnician alphabet, purest of all the European alphabets, was derived from an Atlantean alphabet, which was also conveyed from Atlantis to the Mayas of Central America. (11) That Atlantis was the original seat of the Aryan or Indo-European family of nations as well as the Semitic peoples, and possibly also of the Turanian races. (12) That Atlantis perished in a terrible convulsion of nature in which the whole island sunk into the ocean with nearly all its inhabitants. (13) That a few persons escaped in ships and on rafts and carried to the nations east and west the tidings of the appalling catastrophe, which has survived to our own time in the Flood and Deluge legends of the different nations of the Old and New Worlds."

Every point of the above is supported more or less strongly; maps showing an extensive shoal in the Atlantic, demonstrated by the soundings of the Challenger, the Dolphin and other exploring vessels are given; ethnological illustrations are presented, etc. In short, is a most fascinating book, and it will undoubtedly arouse much interest in the subject.

ZELL'S CONDENSED CYCLOPÆDIA. By L. Colange, LL. D. One volume, octavo: pp. 984; Philadelphia. T. Ellwood Zell, 1882. For sale by H. C. Train, Agent; $7.50.

This volume contains in a condensed form a general fund of critical and practical information upon every branch of knowledge that is at all likely to be required by ordinary readers or in the family circle. It is corrected and perfected down to the present day, and is copiously illustrated with maps and engravings. No work of the kind furnishes at so low a price the same amount of valuable and useful reading in so convenient a shape.

MOROCCO: ITS PEOPLE AND PLACES. By Edmond De Amicis. Octavo: pp. 374. G. P. Putnam's Sons, New York. For sale by M. H. Dickinson; $2.

This is another of the wonderfully brilliant and enthusing books which have brought Signor de Amicis to the front as one of the best travel-book writers of the present day. His description of persons and places have a life-likeness about them which few writers can equal, while his grouping of salient points either in history or philosophy is skillful and artistic.

The subject of this volume is one little known at the present day and it will therefore create a double interest in the minds of his readers. In his treatment of it he will bear comparison with our own Irving, whose style is somewhat similar, though less sparkling and vivacious. The titles of the chapters alone will arouse interest, which will by no means decrease on perusal. They are as follows: Tangiers, Mahomet, Had-el-Garbia, Alkagar-el-Kebir, Ben-Auda, Beni-Hassan, Fez, Arzilla, etc., etc. The illustrations are good and the make-up of the book is first-class.

THOMAS CARLYLE. By James Anthony Froude, M. A. Two volumes in one; 12mo.: pp. 280; New York; Harper & Bros., 1882. For sale by the Kansas City Book and News Co.; $1.00.

Carlyle, during his lifetime, frequently expressed the wish that no biography of him should be published, but, becoming convinced that such a wish was in vain, turned his journals, correspondence, one or two autobiographies and a memoir of Mrs. Carlyle, to be used as he pleased. From these materials the present volumes have been made up. They include his life from infancy to forty years of age, and necessarily present him in his natural and normal character, whether as to his associations or literary tendencies and occupations, though he had not by any means reached the acme of his fame at that time.

His life was in most respects an exemplary one, for though hasty in temper and sometimes rough in speech, he was industrious, affectionate and just. His biographer says "When the Devil's advocate has said his worst against Carlyle, he leaves a figure still of unblemished integrity, purity, loftiness of purpose and inflexible resolution to do right, as of a man living consciously under his Maker's eye and with his thoughts fixed on the account which he would have to render of his talent." The book is a cheap but well printed edition, illustrated with portraits and representations of localities.

GARFIELD'S PLACE IN HISTORY. By Henry C. Pedder. Octavo: pp. 104. G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson; $1.25.

This essay is a careful analysis of the character of the late President and a faithful comparison of his position when assassinated with that of Mr. Lincoln and other rulers under similar circumstances, taking into account the status of the Government at the different times.

In comparing Mr. Garfield with his predecessors he says, "In order of Providence, Washington represented national independence; Lincoln national unity and Garfield national independence and unity, made stronger and more beautiful for the force of his intellectual grasp, his nobleness of life and his breadth of culture." As an orator and scholar, he justly places him in the foremost rank of Americans and properly holds him up as an example to American worth.

It is a well written essay and the future historian will doubtless justify many of the author's conclusions.

OTHER PUBLICATIONS RECEIVED.

The Inception, Organization and Management of Training Schools for Nurses, from the Bureau of Education; Third Annual Report of the Archæological Institute of America; Official Army Register for 1882; Journal of the American Agricultural Association; The Currents and Temperatures of Behring Sea, (Appendix 16 to U. S. Coast and Geodetic Survey for 1880), by W. H. Dall; Centennial History of Licking County, Ohio, by Isaac Smucker; The Opium Habit, Its Successful Treatment by the Avena Sativa, by E. H. M. Sell, A. M., M. D., New York; *The Millstone*, April, 1882, Indianapolis, $1.00 per annum; The Death-Rate of Memphis, by Geo. E. Waring, Jr., Newport, R. I.; The Education of the Blind, a historical sketch by M. Anagnos, Boston; Soils and Tobacco Lands of Missouri, by G. C. Swallow, LL.D.; Money and Its Substitutes, by Horace White, New York; Imports, Exports and the French Treaty by J. K. Cross, Esq., M. P., London, England; Creation or Evolution, Geo. C. Swallow, LL. D., Columbia, Mo.; Johns Hopkins University Circular, No. 13, Proceedings of University Societies and Objects of Important Papers read at recent meetings; Notes on the Mineralogy of Missouri, by Prof. Alex. V. Leonhard, Washington University, St. Louis, Mo.

SCIENTIFIC MISCELLANY.

THE PROBLEM OF LIFE.

BY DAVID ECCLES.

Out on a boundless, surging sea,
With unknown port or destiny,
  Our feeble lives are thrown;
Against life's breakers dark we toil
And struggle through the dread turmoil
  With many a weary groan.

From whence we came, no man can say—
We know but this: we're here to-day
  A transient life to run;
In vain we try to recollect
Our being's dreamy retrospect
  Beyond mind's horizon.

Such as we've been, we yet must be,
Still changing through eternity
  And toiling to attain
A mirage happiness in view,
And which we franticly pursue
  O'er life's tempestuous main.

Above, around, beneath, within,
We hear the surge's awful din
  In elemental strife;
To seize the reins of ruling power—
This the vast problem of the hour—
  The problem of our life.

For this we toil, for this we wait,
For this unite or segregate,
  Through life's tumultuous course;
The moral laws we frame to bind

The promptings of the uncurbed mind,
Express, alas! but force.

Adjustments to surroundings change,
And vice, with transformation strange,
To virtue turns betimes;
E'en Love, emotion sacred, bless'd!
Fixed on some being prepossessed
We number with the crimes.

Up through the swaying, toiling throng,
Scarce knowing right or knowing wrong,
All blindly do we press;
Around us sink, with dying wail,
The friendless, ignorant and frail,
And few relieve distress.

We cry for justice through our tears,
But no responsive being hears
Our heart-sore lamentation;
E'en when we fain would share alike,
No human power, for us, can strike
The infinite equation.

Each ego-seat—that unseen thing—
For greater power is centering,
And by accretions rise;
The atoms coalesce, and then
The molecules, then cells, then men,
Up through the boundless skies.

For power alone, for this they strive!
The greatest unions men contrive
Have only this in view:
Some mightier grasp on life to take,
Some mightier destiny to make,
Nor knowing whereunto.

* * * * * *

The heart desponds. This dreary theme
Shuts out e'en Hope's inspiring beam
That buoys us o'er life's storms;
Yet see! an inspiration bright
Illuminates our darkened sight,
And all the scene transforms!

Still persevere, ye toiling throng!
But know, the strength for which you long,
Is safe in Wisdom's power!
You glean but fragments, while the pure
Discern this truth, eternal! sure!
With Justice dwelleth Power!

Into this central truth doth fate
Make every purpose gravitate,
And work for good alone;
Far, far beyond man's feeble will
Abides a Power that guideth still—
Unmeasurable, unknown!

Each selfish thought, by law, must tend
Unto the universal end,
And for the common weal;
Dependencies with power increase,
And thus all tyranny must cease
When other's ills we feel.

Hope on! for Time will lift Death's veil,
And solve life's problem, though men fail;
And might and right unite;
We're building higher than we know,
And safe are we, where'er we go,
Throughout the infinite.

Kansas City, March 27th, 1882.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

Telephone Mouth-Piece—This improved telephone is provided with the usual diaphragm. A magnet in the shape of a split ring is bolted to the casing, the ends of the split ring constituting the poles of the magnet. Upon one end of this magnet is wound a helix looped into the main telephone wire in the usual way. The other pole carries an arm resting in contact with the diaphragm. It is asserted that the most delicate shades of articulate speech can be received and transmitted by this instrument.

Novel Belt-Tightener—In this improved device the tightening pulley is carried by a hinged frame. Pivoted to the frame, so as to lie about at right angles thereto, is a rack passing through a standard provided with a pinion engaging the rack. A stop panel is provided for securing the proper adjustment of the tightening pulley.

Process of Manufacturing Gas—A late improved process for generating gas consists, first, in subjecting bituminous coal to the direct heat, by contact; secondly, evolving, by means of a mass of incandescent fuel, the gaseous vapor from the former, and at the same time decomposing steam by injecting it into the incandescent mass of coke or fuel, and conducting the resulting hot products, hydrogen and carbonic oxide, through the distilling mass of bituminous coal for taking up the heavy tarry vapors therefrom; thirdly, carbureting the mixed gases and vapor thus formed, while hot, in a separate chamber; and finally, combining the carbureted mixture into a fixed gas by bringing it into contact with a mass of highly heated refractory material in a separate chamber.

Cable Railroad—This improvement is designed to be used on a railroad where the cars are propelled by a moving cable. It relates to a method of accelerating or increasing the speed of the car or train, which consists in so combining one or more pairs of the wheels that support the car on the track with rolling sheaves that grasp the cable, so that the friction of the wheels upon the track shall serve as a driving agent to set in motion the rolling sheaves to increase the speed of the car.

Machinery for Reducing Ores—This improved apparatus combines a series of concentrically arranged troughs or vessels for receiving the material to be ground or crushed. They are provided with a series of traveling, grinding or crushing rollers or wheels arranged in the troughs. An elevated mechanism travels in one of the troughs and follows the rollers, by means of which the material is carried upward from said trough. A screen or sieve moves with the elevating mechanism and is arranged to receive the material therefrom. A chute or conveyer is located beneath the screen, and arranged to discharge the material from the inner into the outer adjacent trough.

Novel Telephone—This invention provides, in combination with a diaphragm, of a sound augmenter box having an opening at which the mouth or ear may be applied. It is provided with a number of resonant wires, under tension, secured within the box between the opening and diaphragm. Each wire is capable of independent adjustment, and a device is employed whereby all the wires may be adjusted at once.

Watchman's Time Detector—In this improvement a time-movement carries a drum or carrier having a strip of paper or other material surrounding or facing the same. The device is placed in a case, the body of which is provided with a lock, and the lid of which is provided with a hasp. A perforating or marking device for the paper, is arranged within the body of the case adjacent to the lock, and is adapted to be operated by said hasp in opening or closing the lid.

Lubricating Steam Chests of Engines—In this device, by the opening of a valve, the steam enters and forces the lubricant out of the cup at side, down through a glass tube into the valve chamber, and delivers the lubricant at the back of the valve which regulates the supply of lubricant passing into the steam chest.

COST AND MAINTENANCE OF THE STREETS IN PARIS.

For cleaning streets, machine sweepers are employed drawn by a single horse, cleaning about 5,000 square meters an hour (1.46 square yards 1 meter).

The cost of keeping in repair is quite different for the different avenues; for the Rue Lafayette it is 16.08 francs (about $2.09 per square yard).

The asphalt roadways have a joint area of 225,120 square meters, to which should be added about 34,000 square meters for the walks through the Macadamized streets. The price of construction varies from twelve to fifteen francs per square meter ($1.56 to $1.95 per square yard).

The repairing is done by contract for 1.10 francs per square meter per year for the roadways, and 1.70 francs for the walks.

The mean cost of repairing roadways in Paris, which was 1.08 francs in 1870, has been reduced to 0.82 francs. This reduction is due especially to a change in many places from Macadam to paved roadways. The mean cost of repairing pavement never exceeds 0.60 francs, while Macadam roadways cost 1.80 francs per square meter. The latter should therefore be replaced, except where they serve as promenades and ornaments, as in the boulevards and avenues.

The following estimates are extracted from a recent report to the Municipal Council of Paris by M. Watel.

The number of vehicles which pass daily through some of the principal thoroughfares of the city have been ascertained to be as follows:

Boulevard de Sebastopol	11,602
Avenue des Champs Elysees	11,734
Rue de Rivoli	13,898
Rue Royale	16,117
Boulevard des Capucines	19,043

The paved roadways have an aggregate total area of 5,458,000 square meters; their maintenance requires the constant service of 431 men (*cantonniers*). The cost per square meter varies from 15.90 francs to 20.40 francs according to the gauge (.10 to .16 meter) ($2.07 to $2.65 per square yard).

The cost on hand labor in keeping the pavements in order is 0.154 francs per square meter (about .2 of a cent per square yard).

The Macadamized roadways cover an area which, although less than in 1870, is still 1,900,000 square meters. The number of *cantonniers* required for their maintenance is 965.

The steam rollers employed weigh about thirty tons each. The rolling is generally completed in a single night.—*Van Nostrand's Magazine.*

BERLIN'S ELECTRIC RAILWAY.

Our Berlin correspondent, describing the new electric railway there, already referred to in a telegram, says that the system, which has been in use in Berlin for more than a year, has not proved a financial success. It has also been found that there is some inconvenience attending the transmission of the electric current through rails. A horse, while crossing this line, striking it with his shoe, received a severe shock. It is impossible, moreover, to repair or remove the rails without the suspension of traffic over the entire route, since such removal interrupts the current. Herr Siemens, to meet these and other objections, devised his new system, which is far more practicable than the first. Over the entire line two cables are suspended parallel to and about twelve inches from each other, on poles approximately sixteen feet above the ground. Along these cables a system of wheels passes, connecting with the tram car by another cable, which can be detached from the car at pleasure. The cables are charged with electricity, which is generated at a station about the middle of the route, and which is taken up by the apparatus as it runs over them. It then passes through the connecting cable, down beneath the tram car over a system of drums which unites with the running gear. The apparatus passing along the suspended cables either precedes or follows the car. The speed of the vehicle is regulated by a crank, and a complete stop can be made as readily as if it be drawn by horses. On Saturday, during the trial, two cars were run, first separately and afterward together. In the first case two distinct connecting cables are necessary, while in the second one answers the same purpose, the electricity passing through the car couplings, the only difference being a diminution of velocity owing to the additional weight. The length of the route run over on the trial trip is about three miles, a portion of the distance being up hill, an inclination of 1° to 28°. A car can be run up the grade at the rate of from fifteen to twenty miles an hour, while on a leoel it will make thirty miles to the hour. After having thoroughly tested the working of the railway, visitors were driven to the country to witness the operation of a car which Herr Siemens has invented. It also is propelled by electricity on the same principles as those described for the tram cars. It runs as smoothly as a common carriage, and is perfectly manageable. It is directed by the driver, who sits in front, by turning a wheel very similar to those used in steering ships, and is started or stopped by a simple pressure made upon a lever. This car is intended to run between towns whose populations are too small to make a railway profitable pecuniarily. "It appears to me," adds our correspondent, "calculated to meet this end when once the question of its economy over the running of stage coaches has been demonstrated."—*London Daily News.*

THE PROPER DIMENSIONS FOR BRICK PIERS IN BUILDINGS.

The committee of architects appointed by Kraft, Holmes & Co. to investigate the fall of the building lately occupied by them, in St. Louis, have made their report. It is made on calculations based on standard authorities, and reads as follows:

1. A floor, such as the floor of the building now under consideration, composed of 3x16-inch joists, nineteen feet long, and placed twelve inches from centre, will carry 1,914 pounds per square foot as a breaking load; and if we take one-sixth of this as a safe load we will have 319 pounds per square foot as a safe load to place upon these floors. In order to be within the most reasonable bounds we will throw off the nineteen pounds and call the load 300 pounds per square foot, and base the following calculations on that amount: The joists being nineteen feet long and the space between the posts being thirteen feet, as they are in this building, there will be supported by each post and the corresponding girder 19x13 equal to 247 square feet of floor surface, which, if loaded as per above calculations, will give a probable load of 247x300, equal to 74,100 pounds on each floor space throughout the building.

2. The girders, which are made of two pieces of 5x16-inch white pine timber and one piece of wrought iron ¼x16-inch, will carry 200 pounds, 860 pounds as a breaking load, and taking one-sixth of this, as above, we will have as a safe load 33,476 pounds. If this is compared with the load found above as the amount the joists were reasonably calculated to carry, which is 74,100 pounds, it will be seen that the girders were not proportioned to the same load as the joists, and would carry only about one-half as much.

3. The load imposed on one of the 12x12 oak posts in the second story, which are 10x11 feet long, will be the same as on the girder multiplied by three. There are being that many floors above it, also the roof, the weight of which must be added to it, which gives 74,100x3, equal 222,300 pounds, the roof-space, 247x30, equals 7,410 pounds; these amounts added will give 229,710 pounds, which will be about 114 tons. The crushing load of an oak post of this size is 432 tons, and taking one-sixth of this as the safe load we will have 72 tons. This will be seen by comparing it with the above load to be but little over one-half what the post might have imposed upon it.

4. The iron posts having shown no defects, we omitted to compute their strength.

5. The brick piers in the basement will have to carry the load of all the floors and roof added. This will be 74,100x5, equal to 370,500, to which add 7,410, and will have 377,910 pounds, which is 189 tons.

The dimension of the brick piers being one foot ten inches by two feet five inches, will give four and one-half square feet as the area of each pier. The average crushing load of first-class hard brick work laid in cement mortar is about sixty tons per square foot, and again taking one-sixth as a factor of safety, we will have ten tons per square foot as the safe load, and if each pier has four and one-half square feet, it will give forty-five tons as the safe load to be imposed upon piers of this size.

It will be seen from this that the load of 189 tons was four and one-quarter times as great as the pier was reasonably able to carry. It is therefore evident that the brick piers, being the weakest part of the structure, had to give way first, and they caused the disaster.

While the above calculations are based upon brick piers of the very best quality of workmanship and materials, the piers in this building were not a fair average of work.

The side walls of the building are of the regular thickness, and strong enough for all practical purposes. The workmanship and material are of average quality.

(Signed), CHARLES R. RAMSEY,
THOMAS B. AMAN,
F. W. RAEDER.

THE LAY TORPEDO.

The most successful type of the moveable torpedo is found in the invention of Mr. John L. Lay, of Buffalo, New York, who has heretofore been mentioned as associated with Chief-Engineer Wood in the invention of the torpedo used by Cushing. As excellent as the Lay undoubtedly is, it still has the same defect as others, namely, want of sufficient speed; this, however, does not seem to be an insuperable obstacle, and with each successive construction a greater speed is obtained. The boat is always under the control of the operator, who can stop or start it, steer to either one side or the other or fire the charge whenever he pleases. All these things are of course extremely advantageous, and greatly enhance the value of the weapon. The motive power is carbonic acid gas. This gas (as is well known) becomes liquified under a pressure of forty atmospheres, and in this state it is stored in a flask in the boat. When the valve closing this flask is open, vaporization ensues, and the gas is taken to the engine, first passing an automatically acting reducing valve, so that the pressure will not be too great. As the liquid expands, great cold is produced, and trouble is experienced from its use as a motor; this, however, is not a serious difficulty, and remedy will doubtless be found. The explosive chamber, containing five hundred pounds of material, is at the bow, and is so constructed that on contact with a vessel it is disengaged from its resting-place, and drops several feet, the idea being that an explosion in that position will do more damage than at the water-line. In one compartment of the boat is a drum, from which is paid out the cable through which the electric current passes. A suitable arrangement of magnets opens a valve which allows gas to enter a cylinder, the piston in which causes the helm to be put in the desired direction; and a similar arrangement causes the throttle of the engine to open or close. The explosion is caused on contact if it is desired, or it may always be kept under the operator's control. Some of these boats have but one wire in the cable, over which the various functions are caused to operate, others have a multiple cable, with a wire for each thing required to be done. Over a mile and a half of wire is carried, so that the effective range becomes very much greater than that of any of its rivals. Mr. Lay is constantly at work introducing improvements, all of which are protected by numerous patents. His system has been definitely adopted by Russia after a satisfactory trial of ten of the boats built for her. A factory has been established, and is proposed to use them very extensively in any future war.—*Harper's Magazine for June.*

THE ORIGINAL HOME OF THE HORSE.

There is no doubt that the original home of the horse is not Europe, but Central Asia; for since the horse in its natural state depends upon grass for its nourishment and fleetness for its weapon, it could not in the beginning have thriven and multiplied in the thick forest-grown territory of Europe. Much rather should its place of propagation be sought in those steppes where it still roams about in a wild state. Here, too, arose the first nations of riders of which we have historic knowledge, the Mongolians and the Turks, whose existence even at this day, is as it were, combined with that of the horse. From these regions the horse spread in all directions, especially into the steppes of Southern and Southeastern Russia and into Thrace, until it finally found entrance into the other parts of Europe, but not until after the immigration of the people. This assumption is, at least, strongly favored by the fact that the farther a district of Europe is from those Asiatic steppes, i. e., from the original home of the horse, the later does the tamed horse seem to have made its historic appearance in it. The supposition is further confirmed by the fact that horse-raising among almost every tribe appears as an art derived from neighboring tribes in the East or Northeast. Even in Homer the ox appears exclusively as the draught-animal in land operations at home and in the field, while the horse was used for purposes of war only. Its employment in military operations was determined by swiftness alone. That the value of the horse must originally have depended on its fleetness, can easily be inferred from the name which is repeated in all the branches of the Indo-European language, and signifies nearly "hastening," "quick." The same fact is exemplified by the descriptions of the oldest poets, who, next to its courage, speak most of its swiftness.—*Popular Science Monthly for June.*

A meteorological observatory has been built on the summit of the Pic du Midi in the French Pyrenees. Preparations are now being made for the next six months' blockade by the snowstorms.

THE BACILLUS TUBERCULOSIS THE CAUSE OF TUBERCLE.

The important investigation of Koch on the bacillus tuberculosis, are attracting considerable attention in professional and lay circles.

Koch has examined for *bacilli* the expectoration of people suffering from pulmonary phthisis, and has found them in great abundance. Such a sputum, when injected into the circulation of an animal, quickly produced tubercular disease. The expectoration, on the other hand, of non-phthisical individuals contained no *bacilli*, and did not injure the health of an animal inoculated with it. Another point of considerable interest for the practitioner is, that the *bacilli* do not lose their vitality when dried; for phthisical sputum which had been kept dry for two, four, or eight weeks, was as capable as ever of producing tubercle in animals into which it had been injected. Koch's observations are, therefore, of the greatest value; and with the precise knowledge of the contagium of tubercle which he has placed at our disposal, if fully confirmed, we will be warranted in believing that we are within measureable distance of preventing and arresting one of the most fatal maladies to which the human race is subject.

Other *bacilli* succumb to the toxic action of many of the antiseptics; the *bacilli* of tubercle will doubtless prove no exception. The main difficulty will lie with the impermeability of the non-vascular tubercular nodule, in which the *bacilli* are embedded, to the antiseptics. With a sufficiently volatic and diffusive antiseptic this difficulty may be overcome, and tubercle be placed among the more curable diseases.

EDITORIAL NOTES.

The Seventh Anniversary Meeting of the Kansas City Academy of Science was held at the First Baptist Church on the evening of the 30th ult. The Annual Address by Rev. Alexander Proctor was listened to by a large and attentive audience. The principal points made were as follows:

1. The two great problems presented always and everywhere to the human mind for solution, viz: Nature and the Life of Man, or Matter and Spirit. 2. The reason why these problems have been so hard how to solve lies in the universal presence of superstition. 3. This rendered necessary some allusion to its history showing what forms these problems have opened from time to time in its history. 4. It still persists in the most advanced forms of thought in the most advanced civilizations, making the necessity for the continuance of the struggle as great as ever. 5. Specific instances of its presence in the best forms of our scientific and religious thought. 6. The study and practical cultivation of the natural sciences the only means of its removal.

After the address, which will probably be published in full next month, a business meeting was held at which the Annual Reports of the various officers were made and the following officers elected for the ensuing year: Hon. R. T. VanHorn, President; W. H. Miller, Vice-President; J. D. Parker, Recording Secretary; Theo. S. Case, Corresponding Secretary; Dr. S. D. Bowker, Treasurer; S. J. Hare, Librarian and Curator; Dr. T. J. Eaton, Member of the Executive Committee. A very considerable increase in the library and museum was reported and the prospect for rapid advancement in the future is very good.

MR. J. R. MEAD, of Wichita, Kan., writes as follows: "I value the REVIEW highly, read it carefully, and wish it long life. The articles relating to the early explorations of the Missouri Valley, its various tribes, and the discoveries of remains of extinct people, are very interesting to me."

PROF. ALEXANDER WINCHELL, of the University of Michigan, says of the REVIEW: "I was unexpectedly gratified to find it filled with matter of so substantial character. * * The REVIEW and your Academy of Science have my sympathy, and both deserve the encouragement and support of the population amongst whom they exist. * * * Mr. Wortman's article on the Origin and Development of the Existing Horses, is one of high scientific merit, and might well have been written by Professor Cope himself. It is a resumé which might advantageously receive the attention of the professionally scientific and implies an advanced intelligence of the readers of the REVIEW."

WE call especial attention to all western readers of the REVIEW to the article upon "Tornado Studies for 1882" on page 76. It has been carefully prepared by Mr. Finley, of the U. S. Signal Corps, in the hope and belief that the resulting replies when thoroughly arranged and digested, will enable him to understand the laws governing such storms and to formulate rules by the observance of which some of the most serious effects may be avoided. It is a matter of vital importance to us all, and no one should fail to aid him in every possible way.

THE annual meeting of the Kansas Pharmaceutil Association will be held at Topeka, June 7th, 1882, at 2 p. m. The programme will be the reading of answers to queries, and papers on Pharmacy and its branches, the election of officers for the ensuing year, framing a law to regulate the practice of Pharmacy, and such action as may be deemed necessary for the protection of the drug trade under the prohibitory law.

DRS. HEATH & FETTERMAN recently put on exhibition at Wyandotte, Kansas, for the benefit of a benevolent association, a large portion of their South American curiosities, consisting of minerals, fossils, Indian clothing, arms, etc., insects, birds and fishes, numbering nearly two hundred rare specimens. It was a rare treat to appreciative visitors.

THE Thirty-First Annual Meeting of the American Association for the Advancement of Science will be held at Montreal, Canada, commencing at 10 o'clock A. M., on Wednesday the 23rd day of August, 1882; under the presidency of J. W. Dawson, LL. D., F. R. S., principal of McGill University, Montreal. Special invitations have been sent by the Local Committee to distinguished scientists abroad and it is believed that several will be present. The headquarters of the Association will be at McGill University, where members will register as soon as possible after arrival. The hotel headquarters will be at the Windsor. The offices of the Local Committee and of the permanent Secretary will be at the University. The General Sessions and the meetings of the Sections and Committees will all be held in the University buildings. The particular rooms will be designated on the programme for Wednesday. Members expecting to attend the meeting are particularly requested to notify the Local Secretaries, S. C. Stevenson and Frank W. Hicks, the earliest moment possible. The address of the Permanent Secretary, Prof. F. W. Putnam, will be Salem, Mass., until August 17th; after that time and until the meeting has adjourned, his address will be Windsor Hotel, Montreal, Canada.

The Tenth Commencement Exercises of the University of Kansas, to be held at Lawrence, June 2d to 7th, will be as follows: May 29th to June 1st (inclusive), Annual Examinations. June 2d, 8 p. m., Anniversary Exercises of the Oread Literary Society. June 3d, 8 p. m., Anniversary Exercises of the Normal Literary Society. June 4th, 8 p. m., Baccalaureate Address by Rev. F. T. Ingalls, of Atchison, Kansas. June 5th, 9:30 a. m., Prize Declamations; 8 p. m., Anniversary Exercises of the Orophilian Literary Society. June 6th, 10 a. m., Class Day Exercises; 8 p. m., Annual Address before the United Literary Societies, by Prof. John C. Ridpath, A. M., LL.D., of Greencastle, Ind. June 7th, 9:30 a. m., Exercises of the Graduating Classes of the Law, Normal and Collegiate Departments; Master's Oration; and Distribution of Diplomas, with short addresses to Graduates from Hon. D. J. Brewer, of Leavenworth, Kas., Prof. P. J. Williams, D. D., and Chancellor James Marvin. Reduced rates on the railroads and at the hotels have been secured for visitors.

The 13th Annual Commencement exercises of the Kansas State Agricultural College will be held at Manhattan, from June 4th to 7th, 1882. Order of exercises:

Sunday, June 4th, 8 p. m., Baccalaureate Sermon, by the President. Monday, June 5th, 7:30 p. m., Undergraduates' Exhibition. Tuesday, June 6th, 8 p. m., Annual Address, "Work and Wages," by Rev. E. B. Fairfield, LL.D., Chancellor of Nebraska University. Commencement Day, Wednesday, June 7th, 10 a. m., Exercises of the Graduating Class and Master's Oration. Afternoon and evening, Alumni Reunion. The annual examinations will be held on June 5th and 6th, in the several class rooms and shops from 7:40 a. m. to 12:20 p. m. of each day.

We will pay 25 cents each for copies of No. 10, Vol. 3, Feb., 1880, of the Review.

American geologists favorable to the formation of a strictly geological society in America are requested to communicate with any member of the committee appointed by the American Association for the Advancement of Science, in order that a proper report may be made at the Montreal meeting. The committee is composed as follows: Profs. N. H. Winchell, Minneapolis, Minn.; John R. Proctor, Frankfort, Ky.; H. S. Williams, Utica, N. Y.; John Collett, Indianapolis, Ind.; G. C. Swallow, Columbia, Mo.; W. J. Davis, Louisville, Ky.; S. A. Miller, Cincinnati, Ohio.

The Boston *Journal of Commerce*, which is one of the very best papers for manufacturers, artisans and tradesmen in this country, has recently adopted the quarto shape and now presents ten large pages of solid reading matter and six pages of advertisements. It is fully illustrated, ably edited and has a circulation of over 10,000 copies weekly. Price $3.00 per annum.

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ANTHROPOLOGY.

MAN'S ZOÖGENETIC LINEAGE.

BY H. A. REID, SEC'Y ACADEMY OF SCIENCES, DE MOINES, IOWA.

About twenty-five years ago appeared Nott and Gliddon's two great works, "Types of Mankind," and "Indigenous Races of the Earth," to which Prof. Agassiz was a contributor, and in which the doctrine that different types or races of men originated at different periods of geologic time and in different parts of the earth was ably and learnedly maintained. I once heard a bevy of clergymen at a Harvard Alumni dinner joking the great professor about his having taken their "father Adam" away from them. Next came Darwin's "Origin of Species," and about the same time Lyell's "Antiquity of Man." This was soon followed by Darwin's "Descent of Man," and Huxley's "Man's Place in Nature." And now within a few years Quatrefages' "Human Species"—Vol. XXVII Appleton's International Series)—Haeckel's "Evolution of Man," and Winchell's "Preadamites" have appeared; besides Prof. Whitney's recently restated and reinforced proofs that man existed in our Pacific Coast region as low down in the geological scale as the Tertiary age. (See Geological Chart in the REVIEW, Vol. V, No. 3, July, 1881.)

Prof. Haeckel's work on "The Evolution of Man," strikes the deepest of anything yet brought out on the subject, and bids fair in its essential principles to eventually sweep the field. I will therefore trace the zoögenetic lineage of man after Haeckel's schedule, as concisely as possible.

The studies and researches in the science of embryology for more than two hundred years past, by De Graaf (1672), Leuwenhock (Spermatazoa, 1674), Purkinge, Von Baer, Agassiz, and many others, had wrought out the fact or general law that the embryo of each species of animals passes through stages and forms of structure simulating successively the typical forms that are below it in the scale of animal progress; and Man is no exception to the rule. Haeckel verifies this general law, but brings out some new and important points or theories with regard to this law of ontogenesis in general, and to the case of Man in particular. He traces the line of genetic succession, or the "connecting links," systematically down through all the geological ages, to the uttermost primordial inception of organic matter in the lurid and steaming muddy ooze of the pristine seas.

Scientists are now fairly agreed that protoplasm is the primordial form or condition of all organic matter, whether animal or vegetable; and Haeckel uses the term *moner*, to designate the ultimate particles of organic matter, as distinguished from *atom* the ultimate particle of inorganic matter. Eight genera of *moners* are now known and classified—and of course others may yet be discovered. Some of them are animal moners, some vegetable, and some neutral. A moner, then, is the last term, the absolute lowest, the very uttermost primordial form of organic matter. All embryos, all living creatures start here. So he calls the "Moner" stage of life *stage one* in the creational line which ultimates in Man—both as to the individual man born to-day, and as to the species Man in geological time. For the law of evolution, the law of heredity, and the law of embryology all converge into this one zoögenetic rule:—The growth-history and experiences of the individual of any species is in a general way the history and experience of the species to which that individual belongs.

From this first stage, or animal moner, comes the form of life called *Amœba*, which is merely an aggregation or community of animal moners. You will find the amœbæ described in any of our recent text-books on zoölogy; and they are generally regarded as the lowest form of animal life. It is a very minute or microscopic creature; and if you should look at it through a good microscope you would see at first what seemed to be only a bit of jelly, or slimy substance, of no certain form, and apparently inanimate. But presently at some part of its surface it begins to bulge, and it keeps on bulging until a rude sort of finger has been protruded. Perhaps it will touch some particle that may serve it as nourishment; then that bulged finger will bend a little and hug or clasp the nutrient particle to the body, and there it is dissolved, absorbed and assimilated into the substance of the creature, and the finger having, done its work, melts back into the general body again. The amœba has no mouth, no nose, no eye, ear, heart, stomach or bowels; no head or tail, no arms, legs or fins, it is simply a speck of animated jelly or slime-like mucos matter, sometimes called also *sarcode*, that improvises an arm or finger and a stomach at any part of its surface where occasion for it happens to arise. It is for this reason also called *pseudopoda*—that is, false-footed, or not-to-be-depended-on footed.

There are many different species of amœbæ, and here the differentiation or divergence of specializing lines of animal structure already commences. And the next advance stage of animal life is the *Protozoa*, of which Professor Tenney, "Elements of Zoölogy," says: "The protozoans are probably more numerous than all other animals of the globe. * * * Rocky strata, hundreds of feet in thickness are wholly made up of their remains."

From the protozoan stage branched out many divergent forms, but the main trunk of the tree of life, according to Haeckel, kept on steadily toward Man. The third stage he calls *Synamœba*, or synthesized or compound amœba. The fourth stage is *Planæada*, a form of animal life corresponding to what is familiar to well-educated physicians as the blastosphere stage of embryonic development—a hollow sphere with walls composed of a single layer of cells. The fifth stage is *Gastræada*, or the stomach-animal—a specialized digestive sac, with one opening to serve at once as mouth and ventrum. Its walls are composed of two cellular layers instead of one; and it is laid down as an established law of embryology that in all animal embryos at this stage, it is from the outer layer or exoderm that are developed the outer skin, hair, nails, feathers, scales, horns, hoofs, and all the organs of locomotion and external sensation; but from the inner layer, or entoderm, are developed the inner lining of the entire cavity of the body, also the glands and organs of nutrition, and the lungs, liver, heart, etc. Haeckel holds that as low down in the geological scale as the Laurentian period (see Geological Chart as above referred to) this form of animal must have existed quite extensively, as a free inhabitant of the yet simmering seas; but it had no hard parts of bone or shell or strong incasement, and therefore left no relic of its form or locality. The nearest living representatives of this hypothetical Gastræada are the larval forms of what are called in zoölogy ascidians or tunicata—a class of animals composed simply of a tunic or sac. They are sometimes called salps, or salpidæ, and you will find them described and figured in any recent good text book of zoölogy.

The next or sixth stage is called *Archelminthes*, or the primordial worm. The sac has become annulated or ring like, and has developed an intermediate layer of cells between the outer and inner layers of the gastrula stage. This vermiform stage is found in all higher animal embryos, and is represented by the zoölogical order of worms called *Turbellaria*. The seventh stage is a very slight modification of the last, and is called *Scolecida*, which is a general term for a large class of worms, some of them, like the *Turbellaria* themselves, being composed of only one joint or ring, and others of more; and here the pigment spots or rudimentary eyes are first detected. From the *Scolecida* stage of paleozoic life, as Haeckel thinks, branched off the line that developed the *articulata*—that is, all jointed animals, like crabs, lobsters, spiders, scorpions, bugs, ants, and insects of every sort; and also the line that developed the whole vast realm of molluscan life. But the main trunk of the tree of life pushed on upward toward Man. And the eighth stage Haeckel calls the *Chordonium*—that is, when in the developing embryo (human) the first faint inklings of a dorsal chord begin to appear. This stage is represented in modern zoölogy by animals called *Appendicularia*, which are in appearance precisely like the embryo at this stage.

The ninth stage is called *Acrania*, or headless animal, and is the primordial vertebrate—the backbone, though merely rudimentary, being now distinctly indicated. This stage is represented by the animal called lancelet or *Amphioxus*, which Haeckel, himself, first demonstrated to be a true vertebrate and the transitional form or connecting link between the worm class and the vertebrate class. He thinks, at one period in the world's history animals of this type predominated and were the highest forms yet brought forth; but because of their having no hard parts their remains are not found in the rocks.

The tenth stage is the *Monorhina*, meaning that the mouth and nostrils are one—the nearest rudimentary development toward a specialized head; and this stage is now represented by the lamprey eel and the hag-fish or Myxine. The eleventh stage is *Amphirhina*, or mouth and nostrils differentiated. This stage is represented by the Selachian group of fishes, the remains of which are found certainly as low down as the Upper Silurian rocks, and they are the primordial type of fishes. These fishes had only a cartilaginous skeleton and not a true vertebral column or backbone; but their brain and nervous system, as also the heart and the organs of the senses were more highly developed than in the true bony fishes even of the present time; and their embryos showed a decided approach toward the amphibians. The modern rays, sharks, and some others, belong to this class of fishes. At this stage in the zoö-geological scale, according to Haeckel, the line of the bony fishes branched off, while the upward line developed into the twelfth stage, called *Dipneusta*—that is, double-breathers (having gills and lungs both), a type which is now represented by the animal called Lepidosiren. Prof. Nicholson, whose "Manual of Zoölogy" is a standard text-book in Scotland, the United States and Canada, says of this animal: "It exhibits a distinct transition between the fishes and the amphibia," (p. 399.) And again: "It may justly be looked upon as a connecting link or transitional form between the two great divisions of the fishes and the amphibians," (p. 401).

The next or thirteenth stage is c lled *Sozobranchia*, which means that they retain their gills through life although they cease to use them. The modern *Proteus*, the *Siren*, and the Menobranchs represent this stage. The fourteenth is the *Sozura*—that is, retaining the tail through life, and which type is represented now by the Tritons and Salamanders. From this stage the Batrachian class branched off, as represented by the gigantic extinct labyrinthodonts and the modern toads, frogs and salamanders.

Fifteenth is the *Protamnion*—a supposed animal in which a fœtal membrane first began to be developed, instead of the spawning process of the amphibian and lower forms. This stage is located as probably in the Permian period of geology, which was a great revolutionary or transitional epoch, a sort of interspaced tumultuous and convulsional epoch of geological phenomena, between what is called Paleozoic and Mesozoic time. Its fossils are few, and it is therefore, called a "lost record" period of Prof. LeConte and others. The precursors of the *Dinosauria* or great biped reptiles, belong to this period; and it is specially noteworthy that the *Cheirotherium*, or "hand-beast" is first found here, for this is the first appearance on the earth of any form of anatomical structure which became ultimately a distinctive characteristic of Man and his zoölogical congeners; and this fact is certainly favorable to the supposed line of Man's evolution which I am now tracing through. It is from this stage that Prof. Haeckel thinks branched off the whole race of true reptiles—or the progress from spawners to egg-layers, (like turtles, alligators, etc.) and from this latter class ultimately came the birds, as shown by the researches and discoveries of Huxley, Marsh, Cope, and others.

But the anthropogenetic line moved on into its sixteenth stage, the *Promammalia*, or primordial mammal type, which is now represented by a class of anomalous animals called monotremata, with a combination of bird, reptile and mammal features in their anatomical structure, and of which the *Ornithorhyncus* and *Echidna* are the only living examples. And from this class or type the line of progress passed into its seventeenth stage, or the *Marsupialia*, representing a still nearer approach toward the true mammal. It is interesting to note here that some of the Dinosaurs (biped reptiles) were marsupial in their maternal characteristics. From this stage branched off one form of placental structure and habit called *Indeciduata*, or the placenta not falling off, and this divergence ultimated in the cetacean, the edentate and the ungulate families; while another branch called *Zonoplacentalia* ultimated in the carnivorous class, such as wolves, hyænas and dogs, besides cats, tigers and lions, and the great family of pinnipeda or seals. But another line called *Deciduata*—that is, the placenta ripening and falling away at parturition—continued on toward Man.

The next stage, eighteenth, is called *Prosimiæ*, or primordial ape-like animal. It is most nearly represented now by the lemurs; and from this stage branched off lines leading to the rodents, the bats and the insectivorous mammals, all of which have a discoid attachment of the placenta and also the ripening and dropping away of the placenta, the same as in Man.

The nineteenth stage is *Brachytarsi*, or short-footed; the *Macrotarsi* or long-footed type having branched off into the insectivora, like ant-eaters, armadillos, etc. The twentieth stage is *Anthropoidii*, or the man-precursor type of anatomical structure and physiological function; and from this stage, and partly also from the one below it, branched off the line which ultimated in the true *Simiæ* or anthropoid apes—the gibbon, the orang, the chimpanzee, and the gorilla. Haeckel dissents from Darwin and Huxley's theory that man is *derived from* the apes. He shows physiological and embryological reasons why that cannot be the line of Man's evolution—but that the *Simiadæ* or ape type branched off, specialized, culminated in the modern great apes, and could develop no further; hence they are a closed type, and will remain at their present status until they become extinct, while the human type is in the embryonic line and still goes on toward higher developments.

The twenty-first stage Haeckel calls *Alalus Erecti*, or speechless man, (*Pithecanthropus* is another name for the same stage). And the twenty-second stage is *Homo Sapiens*, or true Man in the zoölogical and anatomical sense—the "carnal man" of the Bible as distinguished from its "spiritual man."

Of course I have had to run hastily over this consecutive chain of the great typical stages of the ascent of life from the *moner* up to Man, and omit the ample details of fact and reason, and known laws of life which Prof. Haeckel gives at every step to show on what scientific and philosophical data he bases each point or stage in the ascending scale. Every human being born into the world has passed through these successive transformations in his own embryonic development from the *moner* or primordial ovulum and its conjunctive spermatozoa, up to the perfected physical form of man. This is a settled truth of embryology, familiar to every cultured physician or physiologist. And whether Prof. Haeckel's localization of the corresponding stages in zoölogical evolution and geological time be literally correct or not, it makes a most valuable working hypothesis, around which to gather new facts and discoveries and prove or disprove any particular point in the schedule.

Then, animal man (the "carnal man" of the Bible) had come into existence by this long line of creational stages and processes; and each real or supposed change from any one stage up to the next higher one was in no case a greater variance or transmutation, either mentally, functionally or structurally, than are known to occur within human observation. And, as Haeckel well shows, there were constantly branching off lines of brute-life, thus eliminating out of the man-preparing line those grosser elements which produce shells, scales, fins, and armor-plates—pachydermatous skins, horns, hoofs, tusks, hair, wool, feathers, beaks, claws, and the like. All these elements had been diverted, drawn off, eliminated, strained out into diverging streams of animal nature and structure, before a kind of being was produced by this refining process which was sufficiently fine in quality of texture, and sufficiently complete in its coaptiveness of functional capabilities both mental and physical, so that God could make it into his own image—could breathe into its nostrils the spirit of life and make it a living or self-conscious soul. It is an old theological doctrine that Man was potentially in the Creator's mind and purpose from the first; and this Haeckelian schedule shows in a rational and tenable way how all the long slow processes of zoölogical evolution and geological time steadily worked toward the one grand purpose—the creation of Man as a finite intelligent being, and therefore an image or likeness of the Infinite intelligent Being.

THE STONE AGE IN AFRICA.

BY J. F. SNYDER, M. D.

A time undoubtedly existed in the early history of many primitive peoples when the appliances man brought to his aid, in the struggle for life, were such only as he readily found at hand convenient in form to meet his necessities, as sticks, shells and stones; and that in course of time experience suggested modifications of these natural objects, and he gradually learned to shape them, by breaking and grinding, into serviceable weapons and tools. When stone constituted the chief and best material for such implements that his ingenuity could discover, man is said to have lived in the "Stone Age." From wrought stones he learned the secret of reducing and combining in certain definite proportions the ores of copper and tin, making a compound, termed *bronze*, in many respects superior for his purposes to stone, and by its adoption attained the "Age of Bronze;" and, finally, in the discovery of iron, he began the "Iron Age" and his wonderful civilization.

The different eras of man's advancement indicated by these "Ages;" or, more properly, *stages*, of intellectual development, were not, as some are led to suppose, sharply defined measures of time during which the entire population of a continent or country simultaneously employed the use of stone, bronze or iron exclusively; but in each "Age" all substances previously found serviceable were of course retained in use; and a people in one locality may have known the art of utilizing metals at the same time another people occupying contiguous territory were ignorant of any better material than wood or stone.

These so-called "Ages," marking at the time the highest limit of a people's material culture, and not chronological periods, have come and passed in different parts of the world at different times, and now, at the present day, when the iron age is almost universal, tribes of degraded savages are known to be still destitute of all metals.

In considering the growth of mechanical ideas—constituting the basis and origin of civilization—this inquiry arises: have *all* primitive peoples, in emerging from the lower status of human life, passed through these grades of advancement in regular sequence, as pupils in our schools proceed from the elementary to the higher branches? Have wood and stone *invariably* constituted the alphabet and grammar, so to speak, of human skill in mechanism, necessary to be mastered before gaining knowledge of bronze and then of iron?

In reading reports of African explorations we are surprised to learn that some degraded savage tribes of the interior, who apparently had never before come in contact with civilization, were found to be supplied with not only beautifully wrought implements of wood and ivory, but also of iron produced from native ores and forged by native artisans. Their adroitness in smelting hematite and working the metal is amazing. Another curious feature of that curious region arrests the attention; neither Livingston, Baker, Barth, Stanley, Speke, or other traveler, so far as my reading extends, ever mentions having seen there a wrought stone implement; and Dr. Livingston, in his last journal, remarks as a strange fact, that in all his wanderings in Africa he had never found or seen a stone artificially fashioned into a tool or weapon.

Travelers and other writers of first-class respectability have asserted that no stone age proper ever existed in Africa; some maintaining that its first inhabitants were exotics who carried with them from their starting place the knowledge of using iron, and others believing that the first negroes were autochthons who learned at once to smelt hematite, because they found that ore was the most abundant material and easiest of adaptation to their mechanical wants that their country produced.

In the course of certain investigations, relative to this subject, which for some time have engaged my attention, I addressed one of several notes of inquiry to Sir Samuel W. Baker, the renowned traveler and soldier, to which he promptly sent me the following courteous and characteristic answer:

SANDFORD ORLEIGH, Newton Abbott, Dec. 25, 1881.

My Dear Sir,—"In regard to your questions respecting a 'Stone Age' in Central Africa, I have never seen any stone that has been chiseled or worked in any manner of masonry. No vestiges of ancient masonry have ever been discovered among the purely negro tribes, nor do I believe that negroes, either in ancient days, or in their present savage state, were in the habit of shaping stones for dwellings. A stone age will only be represented in savage countries where stones suitable for cutting purposes exist. Flints, obsidian, quartz, but especially those which upon cleavage produce a cutting edge, are always adapted to the points and heads of weapons, should they be present upon the locality. But in some countries where such stones do not exist there never was (in my opinion) and never would be a 'Stone Age.'

"I have seen vast districts of alluvial soil in Africa where no stone, neither any metal could be found. In those localities there never was either a 'Stone' or an 'Iron Age,' but there was a 'Wooden Age' existing at the period of my experience, as their weapons were clubs, and spears, and arrows pointed with an exceedingly hard wood.

"Three or four hundred miles south of these districts the natives were good blacksmiths because hematite iron ore abounded upon the surface.

"These blacksmiths worked upon an anvil of a smooth block of hornblende and they used a hammer of the same stone.

"I never saw a stone weapon in Africa, neither did I see any other tools of stone except those I have described.

"There might be a 'Stone Age,' an 'Iron Age,' and a 'Wooden Age' existing at the same period within a few hundred miles of each other in any savage country where communication was difficult and the peculiar conditions of the various localities supplied a particular material in the absence all others; but I do not think a vestige of the so-called 'Stone Age' has been found in Central Africa.

"Trusting that this short opinion may be sufficient in reply to your note, I am Truly yours, etc.,

SAMUEL W. BAKER."

There has certainly *so far* been discovered not the least trace of a stone age in the interior of Africa; yet, no one has gone there purposely to look for it. While the observations and opinions of Sir Samuel W. Baker, (in many respects one of the most remarkable of living men), must be accepted as the highest authority in matters pertaining to his sphere of labors, it must be borne in mind that neither he, or any other intrepid men of education who have penetrated the depths of that strange continent, were especially devoted to the solution of its archæological or anthropological problems.

Vestiges of a stone age have been found in several parts of Africa bordering upon the coast; but so singularly limited in the number of objects discovered, when compared to the great profusion of lithic remains collected in the other continents, as to strengthen the impression that they may have been of extraneous and intrusive origin.

A few chipped flint weapons and neolithic polished celts from Algeria are in the museums of France, presumed to be relics of the Iberians, who crossed the Mediterranean about the close of the Pleistocene Age, and settling on the Barbary coast became the progenitors of the Berber and Moorish peoples.

A flint arrow-head is reported to have been found in Sierra Leone; and Mr. John Evans, F. R. S., F. S. A., mentions in his great work on "The Ancient Stone Implements of Great Britain," a celt, a hammer-stone, pestles, and some other articles of stone, in the Blackmore Museum, collected in the neighborhood of the Cape of Good Hope. The same author states that flint flakes are of frequent occurrence in the diamond diggings, and have been noticed in many different parts of the continent from the Cape to Tripoli.

In the African department of the Philadelphia Centennial Exhibition of 1876, were several palæolithic cutting implements of stone which the attendant in charge informed me were found not far from the coast in the vicinity of Port Beaufort. They were merely flat, irregularly round water-worn pebbles, of dark trap or hornblende, as large across as the palm of the hand, averaging three-fourths of an inch in thickness and ground down at one side to a sharp cutting edge. Neolithic stone implements have frequently been recovered from the old Egyptian tombs, and their manner of use is historical. Herodotus and Diodorus Siculus tell us that in the ancient rite of embalming, the body was always cut open with these sharp stone instruments, but the brain was extracted with a crook-iron. Recently, however, another class of stone implements have been found, deep below the surface of the ground, in the valley of the Nile, which Prof. Henry W. Haynes, who went to Cairo purposely to investigate them, after critical examination and comparisons, pronounces unquestionably palæolithic, of the true St. Acheul class, and of course antedating by a vast lapse of time the earliest Egyptian civilization. From Herodotus we also learn that in the army of Xerxes, (B. C. 480), the arrows of some of the Ethiopian contingents were pointed with stone.

And this meagre record comprises almost the entire sum of our present knowledge concerning the employment of stone for implements on the African continent.

We can readily understand that primitive man, when completely isolated by natural barriers, could have learned to utilize only such materials as his habitat supplied; but on continents where his energies and movements were unrestrained by impassable limits, he must have been devoid of intelligence and capacity to progress if, in time, he did not become acquainted, either by migration, or barter, or reprisals in war, with the best substances attainable to serve his wants. Thus, the savages of the Pacific Islands, when first visited by Europeans, were dressed in garments made of the bark of their native trees, and armed with weapons made of wood and stones, and ornamented with sea shells indigenous to their shores. They could, unaided by visitors from other lands, never have done better; for their islands contained no metal-yielded minerals, or other materials than those they had learned to use. But in Europe and America the diverse peoples, restricted in freedom of range only by perpetual mutual enmities, learned the arts from one another and laid regions widely separated tribute to their needs.

The Indians of the Mississippi delta and Gulf coast, a vast tract of low alluvial country destitute of rock, were when first seen by the whites by no means in the simplicity of a wooden age, but were well supplied with implements of stone, including hornstone from Ohio, obsidian from New Mexico, and mica mirrors from North Carolina, and sported ornaments of copper from Isle Royale. During the stay of Cabeca de Vaca, for six years, upon the rockless shore of eastern Texas, he made several journeys far into the interior for supplies of flint for which he bartered the products of the coast; and the mounds of Wisconsin and Illinois, a thousand miles from the ocean, contain beads and drinking cups made of marine shells.

There is no reason to believe that the Indians of the Mississippi Valley, who built the mounds, and carved the hardest stones into pipes and images of admirable proportions and beauty, were in point of intelligence, mechanical skill, or in any other respect inferior to the iron-working savages of Central Africa; yet they dwelt for centuries upon and around the mountains of bare iron ore in southeastern Missouri and east Tennessee and elsewhere, surrounded with forests of fuel, without gaining a higher knowledge of the mineral than to use it as a common stone. They mined native copper with stone mawls and wooden shovels, by the aid of fire and water, and used the glittering metal only as a malleable rock. The outcrops of coal were their favorite haunts, but they never knew that the black diamond was combustible. They camped for generations on veins of galena without discovering that fire would melt it. With these minerals in the greatest abundance they had no better implements than those made of stone; and with deposits of ores the most readily fused and manipulated protending from the surface all around them, profoundly ignorant of their properties, they journeyed hundreds of miles, braving the gravest dangers and hardships, to procure flint. As clubs and arrows they employed wood for weapons where flint and iron ore was as easy of access. The historians of De Soto's expedition recount the wounding of one of Mocoso's men, in western Arkansas, as the tattered cavalcade was returning from the plains to the great river, by an Indian in ambush, who sped an arrow that pierced the soldier's iron mail, passed through the muscles of the thigh, penetrated the saddle, and entered the horse's body, nailing the rider fast to his steed. On cutting and extracting the arrow they were astonished to find that it was merely a reed with the end hardened by fire.

After carefully sifting the glowing romances of Cortez and Bernal Diez, with the embellishments added by almost every historian in that field for the last three and a half centuries, it appears that the Pueblo Aztecs whose communal adobe houses were huddled together in the Mexican lagoon, were yet only in the stone age, possessing no better implements than those made of wood, flint and obsidian, and without knowledge of metals save ornaments of hammered copper and gold. The few objects of bronze; the unique and grotesque sculpturing, and splendid pottery of prehistoric Anahuac are the remains of a more advanced southern people conquered and displaced by the Pueblo horde that swept down upon them from the north, as the Vandals inundated Rome, destroying a culture which they had not the capacity to adopt or imitate.

Africa presents to the scientists many surprises, and among them possibly the amazing anomaly of a primitive savage people attaining at one bound the stage of development in mechanical arts gained by all other races of mankind, by slow degrees through ages of time and experience. The adoption of mechanical aids and appliances has been the outgrowth of man's necessities and environments, and the evolution of all his arts has been effected by gradual increments suggested by his increasing wants and expanding intellect. To this law Africa *may* present startling exceptions. As yet its interior is a *terra incognita* and its ethnography an unsolved enigma. Patient and careful research may in future be rewarded with some knowledge of the origin and migrations of its native races. Until exhaustive search for archaic remains has been instituted throughout its entire extent we are not warranted in assuming that any of its tribes, because of convenience of hematite, have suddenly sprung from Simian savagery to proficiency in blacksmithing. If after thorough search no traces of a stone age are found we must suppose that the aboriginal negroes had not advanced beyond the use of sticks and unwrought stones when the reduction of iron ore was introduced among them by Asiatic wanderers.

VIRGINIA, Cass Co., Ills., June 10, 1882.

THE TABLET OF THE CROSS.

BY WARREN WATSON.

An interesting and ingenious article appeared in the *Century Magazine* for December, 1881, on "The Hieroglyphics of Central America," a subject which has attracted the labors of many *savants* and the curiosity of the civilized World. Hitherto the inscriptions upon the mysterious ruins of Copan and Palenque have proved inscrutable; and the mossy records of a forgotten American civilization, preserved for posterity with such laborious care, are "sermons in stones" that none may read or expound. For a time it was supposed that a key had been discovered in the "*Relacion*" of Bishop Lauda, which contains what purports to be a Maya alphabet with an awkward explanation of the mode in which the letters were combined into words. But all efforts to decipher the inscriptions by its aid have thus far been fruitless.

In the article referred to, Mr. Edward S. Holden gives the result of his researches, in this field, with so much *eclat* that the reader is almost ready to admit his claim as discoverer of a clue to the difficult problem. This clue is the result of the study of a segment of hieroglyphs from the celebrated "Tablet of the Cross" at Palenque; and this being the fact a grave doubt arises as to the value of his discovery.

The "Tablet of the Cross," when *in situ*, occupied the south wall of the inner sanctuary of a small temple at Palenque. It consisted of a centre-piece, which contained the famous cross, on each side whereof was an inscription in hieroglyphics. The cross was embellished with the most bewildering arabesques and bore, perched on its top a grotesque bird; it rested on a hideous caricature of the human face. On the west side of the cross stood the figure of a priestess, perhaps, and on the east side a priest was making an offering to the bird. To the east of the priest were six perpendicular rows of hieroglyphics, there being seventeen in each row; and a similar inscription appeared to the west of the priestess. That the whole tablet, as thus described, is a genuine antique there is no sort of doubt; the difficulty lies in accepting the authenticity of the east inscription as given by Mr. Holden.

He states that "the cuts which accompany the present article are all copied from those given by Stephens, except the few which have been taken direct from Mr. Bancroft's "Native Races of the Pacific States" and from monographs for comparison. Turn to the cut given by Mr. Stephens of the Tablet of the Cross, (Cent. Am., Vol. II, p. 345,) and it will be found that only the centre and the west inscription are represented; and (on page 346) Mr. Stephens states: "The stone on the right (east) is broken, and unfortunately altogether destroyed." In Mr. Holden's cut the tablet is given entire with both inscriptions; that part, however, drawn by Mr. Catherwood, for Stephens' work, is reproduced exactly with his signature, while, joined to this part in a clumsy fashion, the east inscription also appears bearing the signature "C. F. Trill." From this fact we are assured that Mr. Holden's cut is a piece of patchwork; and the assertion of Mr. Stephens' that at the time of his visit this inscription was "altogether destroyed" forces us to seek the source of Mr. Trills' drawing in the works of earlier explorers.

Calderon surveyed the ruins of Palenque in 1764, and was the first to make drawings of its antiquities; but his drawings were never published and are probably lost. In 1786 Del Rio made a very thorough exploration of the ruins. His report was published snd translated into English, and the translation contains a drawing of the Cross Tablet; but only the centre is given, both inscriptions being omitted. Dupaix was the next to explore and depict the ruins; and he had ample time (from 1805 to 1808) and the fullest means and opportunities to do his work thoroughly. His picture of the Tablet contains only the central stone with a row of eight fanciful hieroglyphs on each side. In 1831 Galindo described the ruins and made some sketches; but these have not been published and it is not known whether the Tablet of the Cross was among them. In 1832, Waldeck, who had engraved the plates for the English translation of Del Rio's report, visited the ruins and devoted two years to their examination. His drawings are the most careful, complete and beautiful that antiquarian zeal could produce, but the Tablet, as depicted by him, contains only the centre piece and the west inscription; that is it is precisely similar to Mr. Catherward's picture. Then came the visit of Stephens and Catherwood in 1840. Since that time M. Charnay has photographed the Tablet, but strangely enough, his plate contains the central stone alone. Other drawings are said to exist in various Spanish, Mexican, and Central American collections but none, other than those mentioned, have been given to the world in any publication accessible to students. The east inscription does not appear in the admirable compilation of Bancroft, in Shoot's "North Americans of Antiquity, or in any monagraph by original explorers that I have been able to find.

Now where did Mr. Holden get his authority to complete Mr. Catherwood's drawing by adding to it the east inscription? If the restoration of the Tablet, thus made, is authentic, he has performed a service of great value to American antiquarians (less favored with means of obtaining information) whether his exegetical speculations merit the claim he so enthusiastically makes for them or not; and it is hoped that the authenticity of his cut can be established. In the meantime, it seems a waste of leisure to attempt the interpretation of these baffling inscriptions, by means of a clue deduced from the stone so mysteriously recovered from the fragments found by Mr. Stephens, around the doors and corridors of the Temple of the Cross.

METEOROLOGY.

TORNADOES: THEIR SPECIAL CHARACTERISTICS AND DANGERS.

BY JOHN P. FINLEY, U. S. SIGNAL CORPS.

Having in a previous article touched upon the method of investigation, the importance and necessity of careful preparation and exact work, and portrayed at some considerable length the character and extent of the data required, I will now consider some of the practical results of such methods of labor. In other words I will, as far as present advance in this work will permit, answer the oft repeated questions on every hand: "What is the object of all this systematic labor under Government authority? How is it possible for the *people* to derive any benefit from that which appears to be conducted for the advantage of scientists only?"

In the first place we are starting out to discuss what? The cyclone? No. The tornado? Yes. Let us commence then by a use of the *right* name. Acquire the habit of calling things by their *right* names if you know them or have the means of information, and you will thereby avoid confusion of terms. Very likely you will save yourself many a fruitless search and not a few misemployed hours of study. The terms cyclone and tornado are constantly interchanged in their use and, in the minds of nine-tenths of the people who have occasion to use them, mean one and the same thing. This is not altogether surprising when we consider the meagre possessions of the most of mankind in regard to *accurate* meteorological knowledge and the general disposition of intelligent minds to speculate about the weather. There is, perhaps, no branch of science where a field for the roving and unsettled theorist is more opportune or more completely at his mercy. Discreet thinkers and careful observers everywhere, should grasp the importance of this situation and actively extend their sympathy and support in favor of mature considerations of well known principles. They should cheerfully assist in dredging the channels of human thought and clear away the feeling of mystery, even superstition, making common and useful one of the most important of all subjects, bearing upon the welfare of mankind.

Those atmospheric disturbances properly classed under the head of Wind Storms may be designated as follows: Cyclones, tornadoes, hurricanes, whirlwinds, waterspouts, hailstorms and thunderstorms.

CYCLONES.—A cyclone is not a tornado and it never can be. The two storms are essentially different. The former possesses the following characteristics: The path of the storm is a *parabolic curve*. It trends northwestward from the West Indies until it reaches parallel 30° N. when it curves to the NE. and continues in that direction, either at some distance off the Atlantic Coast, on its immediate border or a short distance inland. The storm finally disappears ocean-ward in the vicinity of parallel 50° N. The diameter of the storm's path varies from several hundred to over one thousand miles. At the immediate centre of the storm there is a dead calm, a most fatal place for ships to be caught. At no point without the storm's centre does the air actually move or whirl in a circle, but there is a cyclonic tendency of the atmosphere about the region of barometric minima, viz: where the barometer is the lowest. Upon taking a number of points, located here and there in the four quadrants of the meteoric disturbance, it will be found that in the northeast quadrant the winds are from southeast to northeast; in the northwest quadrant, from northeast to northwest; in the southwest quadrant from northwest to southwest, and in the southeast quadrant, from southwest to southeast.

Again I repeat, a cyclonic *tendency* only. The barometer is a very important factor in all calculations bearing upon a determination of the character and approach of the cyclone at *any point* in the parabolic course of the storm. The wind very rarely reaches either an estimated or measured velocity of 100 miles per hour. The maximum velocity generally ranges from sixty to eighty miles per hour. As a rule there is no sudden, overwhelming dash of the wind, but a gradual approach or increase of movement which eventually culminates in a fierce intensity sufficiently powerful at times to destroy buildings or sink the largest ships. Cyclones occur most frequently in the months from August to November. In the China and Japan Seas this class of wind storms are called typhoons. In general, as to their place of origin, cyclones form south of the Tropic of Cancer, between the belt of calms and the southern limit of the trade winds; say briefly, in the vicinity of 10° N., 50° W. This region coincides with the zone of constant rainfall, where evaporation is very rapid, cloud formation exceedingly brisk, the air almost constantly saturated with moisture, and heavy condensation a regular feature of the day. Typhoons form south of the Tropic of Cancer and in the vicinity of the Philippine Islands, moving thence northwestward to the Asiatic Coast and then curving to the northeast over the adjacent seas and islands. As to the character of the region in which they form the same remarks apply as in the case of cyclones.

TORNADOES.—Comparing with the tornado which is truly and invariably a land storm, we find this peculiar atmospheric phenomenon possessed of the following prominent characteristics: A path varying in width from a few yards to eighty rods. The general direction of movement of the tornado cloud is invariably from a point in the southwest quadrant to a point in the northeast quadrant. The tornado cloud assumes the form of a funnel, the small end drawing near to or resting upon the earth. This cloud or the moving air of which it is the embodiment, revolves about a central, vertical axis, with inconceivable rapidity, and always in a direction contrary to the movement of the hands of a watch. The destructive violence of the storm is sometimes confined to the immediate path of the cloud, as when the small or tail end just touches the earth. While on the other hand as the body of the cloud lowers, more of it rests upon earth, the violence increases and the path widens to the extreme limit. The tornado with hardly an exception occurs in the afternoon, just after the hottest part of the day and generally disappears before the going down of the sun. The hour of greatest frequency is between three and four P. M. A tornado very rarely, if ever, begins after six P. M. Understand me, a tornado *commencing* about five P. M. may *continue* its characteristic violence until nearly eight P. M. which only means that the tornado cloud may be *traveling* after six P. M. or after seven P. M., but it does not *develop*, that is, make its appearance, for the first time after those hours. Without the path of destruction, even to the shortest distances, at times even along the immediate edge, the smallest objects often remain undisturbed although a few yards distant the largest and strongest buildings are crushed to atoms. At any point along the storm's path, where there is opportunity afforded the tornado cloud to display its power, the disposition of the debris presents unmistakable signs of the revolving right to left action of the wind. The violence and intensity of the destructive power increases directly as you pass from the circumference of the storm to its centre.

Observations with the barometer are of little practical value at any one point, whether made before or after the tornado cloud has formed or while it is approaching. Such observations will not indicate its approach however near the position of the instrument to the point of the cloud's inception. The tornado season is embraced between the 1st of April and the 1st of September, although it can be considered unusual to record their appearance at any time in the former month. The months of greatest frequency are June and July. There are exceptional instances in a long series of years where tornadoes have been reported in every month of the year. They may, and sometimes do occur in some of the Southern States during the winter and spring months. Taking the whole United States together and averaging the dates of occurrence for a long series of years (nearly 90) it is found that the region of greatest frequency is the Lower Missouri Valley, embracing the States of Kansas, Nebraska, Missouri and Iowa. Of all the States in the Union, Kansas ranks the highest in regard to frequency.

HURRICANES.—Although it seems hardly necessary to define the hurricane, it will perhaps be well to state that as here considered it means a straight wind of extraordinary velocity. They may and frequently do occur without the accompaniment of any precipitation. On the summit of Mount Washington, White Mountains, New Hampshire, a measured velocity of nearly two hundred miles per hour has been recorded. On the summit of Pike's Peak, Rocky Mountains, Colorado, a measured velocity has several times exceeded one hundred miles per hour. On the coast of the Carolinas maximum measured velocities have ranged from seventy-five to one hundred and sixty miles per hour. In the Eastern Rocky Mountain Slope and in the Lake Region measured velocities are sometimes recorded ranging between sixty and eighty miles per hour. This storm may be known as the Blizzard of the Northwest, the Chinook of the Northern Plateau, the Norther of the Southern Slope and Texas, or the Simoon of the Desert. Hurricanes may occur at any hour of the day or night and in any month of the year. The most violent, however, take place during the spring and autumn. The width of the path of the storm is very irregular and may vary from many rods to many miles. In either case the velocity at all points within the storm's path is not necessarily the same; in fact such a conditon never occurs. The duration of the storm is also extremely variable, it may continue for only a few minutes or for several hours, although in the latter case the maximum velocity is not maintained throughout the entire period. On the contrary there are periods of recurrence alternating with decided diminutions of the highest activity. There are perhaps but few portions of the country altogether free from the possibility of their occurrence. In the low table lands of mountainous regions where most of the country is extremely broken, the habitable portions are shielded from the power of violent wind storms. No surface currents can attain any great velocity in such regions although on the mountain peaks and elevated plateaus dangerous hurricanes at times prevail.

WHIRLWINDS.—In defining these disturbances it will be best perhaps that you should be asked to recall the occurrence, on a warm, dry day, of the formation of a dust-whirl as it suddenly bursts upon you in the open street, fairly enveloping your body with fine particles of dirt, straw, leaves and the like. Whirlwinds suddenly start up from some barren, sandy spot unduly exposed to the direct rays of the sun. Over a small surface thus exposed the air rapidly rarifies and ascensional currents form which move spirally inward and upward, carrying dust, leaves, straws and sometimes objects of considerable weight. The air within the whirl moves either from left to right or in the contrary direction. The whirlwind's path has a diameter of several feet (sometimes rods) and the direction of its course of movement is decidedly irregular, possibly moving toward any point in the compass. On the sandy plains of Arizona, Southern California and Nevada these phenomena occur with great frequency during the summer months. Columns of whirling sand, sometimes several in a group, move rapidly over the surface. Whirlwinds are harmless and generally of but a few moments duration. In comparison with the tornado let it be born in mind that the former starts from the earth's surface, extends upward and moves onward, not leaving the earth, being solely confined to the region of surface currents. The tornado forms near the superior limit of the lower regions of the atmosphere and between the upper and lower sets of currents or the currents prevailing in the upper and lower regions of the atmosphere. The former currents are indicated by the appearance of the fine cirrus clouds and the latter by the heavy cumulous formations. From this lofty seat of origin the tornado cloud gradually descends to the earth's surface increasing rapidly in size and augmenting in power.

WATERSPOUTS.—These disturbances generally form at a considerable height in the air, although at times they seem to ascend from the water's surface; that is to say, there is no visible agent influencing the ascension of the water, but of course in every instance the causative power is from above and in the latter case near the water's surface. When I speak of the formation of the waterspout at a considerable height in the air, I mean that the embodiment of the whirl or the revolving current of air, first appears as a dark cloud of minutely divided particles of water, the result of rapid condensation, of course in the air and therefore above the water. The swift passage of the air in a spirally upward motion over the surface of the water raises it in the form of spray and carries it upward in the centre of the whirling cloud, which then presents the appearance of a densely opaque body and conveys an impression to the eye of the observer, that a huge column of water is ascending in the form of a long spout, widening gradually toward the top. There are instances, however, where the force manifested was sufficient to raise a considerable quantity of water several hundred feet in the air. Waterspouts form during periods of excessive heat, generally in the afternoon and at or near the hottest part of the day. In the temperate zone they only occur during summer months.

They are of most frequent occurrence in the region of calms between the Tropics, but are not altogether strange sights in the Gulf of Mexico and along the Gulf stream south of parallel 40° N. In regard to motions they possess both a rotary and progressive action, but in neither do they manifest a permanency of direction. Waterspouts cannot be considered as altogether harmless for there are instances where vessels have been wrecked by them.

Hailstorms—Are peculiar atmospheric disturbances which, in regard to the dimensions of their paths, are next to the tornado the most circumscribed of all storms save the whirlwind. They are characterized by a strange cloud formation and a peculiarity of precipitation unlike any other phenomena in the category of storms. The cloud from which the hail falls is basket-shaped with a dark and portentous exterior, a ragged and ominous looking opening at the bottom, and within, a whirling conglomeration of snow-flakes, pellets of snow and ice, partly formed and perfect hailstones, the latter of an almost infinite variety of shapes. The hail cloud forms between the currents of the upper and lower regions of the atmosphere and moves forward in the plane of these currents, either within or just above the upper limit of the lower atmospheric regions, where it finally disappears and the deposition of hail ceases. The path of the storm as indicated by the distribution of the hailstones is at times very narrow, although the range of width is decidedly inconstant, varying from one to fifteen miles. The hailstorm travels quite rapidly, from thirty to fifty miles per hour, and the length of its path is even more variable than the diameter, ranging as it does from ten miles to two or more hundred. The direction of the course pursued by the storm is always from some point west to some point east. It may be from northwest to southeast or from southwest to northeast. Hailstorms may occur at any time of the day or night, although they are most frequent in the afternoon, just after or near the hottest part of the day.

They are most prevalent in that region of country embraced between the parallels of 30° and 50° N. South of parallel 30° N. hailstorms are of rare occurrence at the level of the sea, but at the height of one or two hundred feet they occur more frequently, and in the mountains of British India they are very common, the hai stones being usually of large size. Hailstorms are not necessarily confined to the land areas, but may and frequently do occur over large and small bodies of water.

THUNDER-STORMS.—These phenomena are atmospheric disturbances of great variability of extent and power. They are invariably accompanied by such manifestations of the presence of electricity as are ordinarily termed thunder and lightning, the former being entirely consequent upon the existence of the latter. Thunder is but the reverberations of the concussion produced by the inconceivably rapid propulsion through the air of that physical element we are pleased to term electricity. Thunder-storms may be a few miles or several hundred in extent, and their length of duration is quite as uncertain, viz: from a few hours to one or more days. There is no regular time of day for their occurrence, although they are perhaps more frequent in the afternoon. However, they may occur at any time during the day or night. As to the season of year, summer is the period of greatest prevalency. There is no month of the year entirely free from them. Whether the precipitation be rain or snow the presence of electricity has still been manifested in the usual form. With the former character of condensation of vapor, the evidence of electricity is most common, while with the latter it is the rare exception.

As regards geographical distribution, thunder-storms are most frequent between the equator and parallel 40° N. and from thence to parallel 70° N. the average frequency diminishes with considerable rapidity. In the vicinity of parallel 80° N. it is believed they never occur, although this in the main is mere supposition. There are certain portions of the United States where thunder-storms are unusually frequent as compared with other parts. They seldom occur in the Pacific Coast States, especially California, and are most frequent and violent in the Eastern Rocky Mountain Slope, the Lower Missouri Valley and in the Lake Region.

Having briefly outlined the characteristics of the various classes of storms we will now proceed to consider more in detail the most important (at least in certain respects) of all atmospheric disturbances. At this stage of our inquiry in regard to the character and classes of storms, I presume it will be admitted, that no two of the several storms defined, at least *appear* to be alike. There are, however, points of resemblance and in some, these features are stronger than in others. As each is studied more carefully, the essential points of difference will be more clearly contrasted. It is not within the province of this memoir to discuss at *length* the points of difference or harmony nor enter into an intricate analysis of meteorological phenomena and the multiform operations of atmospheric changes attending the origin, development and complete formation of these disturbances. On the contrary it is my desire to make this publication, in *general*, a brief but comprehensive *resumé* of the leading features of storms, as known at least in the United States, if not in North America, and in *particular*, to present rather a minute consideration of the peculiarities of tornadoes, with a view to place at the disposal of the *people most interested*, the *facts* and *practical* results of past and present investigations of this most terrible and yet most wonderful and interesting of *storms*, the dreaded tornado.

THE TORNADO.

What is a tornado? In defining this storm it would seem almost a necessity to rehearse its long line of striking characteristics, but this in the common acceptation of the term would not strictly be a definition. At the sacrifice perhaps of clearness, but for the sake of brevity, we will state that the tornado is that form of atmospheric disturbance which takes the outward, visible fashion or figure of a funnel-shaped cloud, revolving about a vertical axis from right to left with an inconceivably rapid movement and an immensity of power almost beyond calculation.

Conditions of Formation.—These may be divided into classes. First, those within the reach of and which may be known or investigated by an isolated observer. Second, those conditions only to be witnessed and analyzed by the intelligent and practiced eye of the student of the Weather Map. To the single observer, located mayhap at his farm home, the work-shop or the store, there are important atmospheric conditions which he may carefully watch and study with profit, viz: the gradual setting in and prolonged movement of the air from the north and south points; the gradual but continued *fall* of the thermometer with a prevalence of the former currents, and a *rise* with the predominence of the latter. If the northerly currents are the prevailing air movements at your place of observation, the atmospheric disturbance is forming to the southward, but to the northward of your location, if the prevailing air currents are from the south. Carefully study cloud development, color as well as form, also manner and direction of approach. The approach of the cirrus cloud (perhaps at a height of six to eight miles) from the southwest is very significant and is the first evidence of the gradual, but certain advance of the upper southwest current which eventually plays so important a part in the development of the tornado cloud. Clouds are but the embodiment of air currents, yet they are full of meaning. A study of the upper currents of the atmosphere would be impossible without their manifestations and that too in a variety of forms. Dispense with cloud formation, the face of the sky would become a blank, and intelligent reas ning thereof a superhuman task

Wind direction, temperature and clouds are the proper subjects of observation and thought by the isolated observer. The barometer is of little if any importance in this line of inquiry. If you cannot compare your barometric observations with those taken at near or distant points and at the same moment of actual time, they are of no practical moment, even though your instrument is a standard one and your corrections for temperature and elevation carefully applied. The storm you are watching for (the tornado) is an extremely local affair, whereas the barometer indicates general changes, affecting a large extent of country. Your instrument, if a standard, does not lack the possession of a delicate sensitiveness requisite for all the purposes of its construction. But if it were placed in the immediate track of the tornado cloud, it would not indicate its presence until the crash of the storm was upon the instrument, when of course it would be too late and at best rather injudicious, to weather the fury of the storm for the sake of noting the rise or fall of the mercury. Barometrical observations appear to advantage and are absolutely necessary to a successful consideration of the meteorological conditions of tornadoes from the standpoint of the Weather Map From this panoramic view of the situation a vast extent of country can be most carefully watched from hour to hour, for days, weeks or months. Atmospheric conditions on opposite sides of the probable course of the storm can be watched from their inception and any relation easily detected and analyzed. From a study of the Weather Map it has been found that the formation of what is termed a barometric trough or elongated area of low pressure (where the barometer stands below the normal for that region at the hour of observation) precedes the occurrence of tornadoes in the Lower Missouri Valley or adjoining States to the south and east. This low pressure area assumes the form of an elipse and generally extends from southwest to northeast between northern Texas and the Upper Lake Region. Such a depression may lie between the Central Mississippi Valley and the Lower Lake Region, trending northeastward just south of Michigan and over the Ohio Valley. The major axis of either of these depressions is easily estimated, while the minor axis may be stated as generally varying from three to five hundred miles. To the north of the major axis, even to a distance of several hundred miles, the winds are found to proceed from any or all points between northeast and northwest with comparatively low temperatures accompanied sometimes by a cold rain or even snow. South of the major axis and generally to a greater distance, the winds come from any or all points between southeast and southwest, accompanied by comparatively high temperatures, high humidity and often dashes of quite heavy rain.

As these conditions continue to prevail there is a growing contrast of temperature to the north and south of the major axis, owing to the long continued movement of the atmosphere from opposite directions, such movement eventually affecting the disposition of air in the warmer regions of the extreme south and likewise the colder regions of the extreme north. The contrast of temperature now naturally increases with marked rapidity and the formation of clouds commences in earnest. Huge masses of dark and portentous appearance bank up in the northwest and southwest with amazing rapidity and soon the scene becomes one of awful grandeur. The struggle for mastery in the opposing currents is thus indicated by the gathering cloud formations. The condensation of vapor from the extremely humid southerly currents by contact with the augmenting cold of their struggling opponents continues. It increases rapidly. Finally, when the tenacious hold upon a stable equilibrium can no longer be maintained (which is controlled by the rapidity and extent of condensation,) the opposing forces are, as it were, broken asunder, followed by the upward rush of huge volumes of air. The outward indication of this event is first shown in the whirling, dashing clouds over the broken surface of the heavy bank of condensed vapor, forming the background. A scene not easily depicted or realized by one who has not witnessed it, but never to be effaced from the memory of the actual observer. There is an awful terror in the majesty of the power here represented, and in the unnatural movement of the clouds, which affects animals as well as human beings. The next stage in the further development of this atmospheric disturbance is the gradual descent of the funnel-shaped cloud from a point apparently just beneath the position of the enactment of the first scene. The tornado is now before us, not fully developed, but soon to acquire that condition, when the terrible violence of its power will make the earth tremble, animals terrified, and men's hearts quake with fear.

Premonitory Signs.—On the day of the storm and for several hours previous to the appearance of the tornado cloud, what indications of its probable formation and approach are within the comprehension of any ordinary observer and can readily be detected by him? A sultry, oppressive condition of the atmosphere thus described by various observers as follows: "I really experienced a sickly sensation under the influence of the sun's rays." "I was compelled to stop work on account of the peculiar exhaustion experienced from physical exertion." "It seemed as if the lightest garments that I could put on were a burden to me." "There was not a breath of air stirring." "The air at times came in puffs as from a heated furnace." "I felt a want of breath, the air frequently appearing too rarified to breathe freely." "I was startled at the sudden and continued rise in the thermometer, especially at this season of the year." "In the forenoon I actually wore an overcoat, but shortly after dinner I put on my straw hat and worked in my shirt sleeves." "I noticed a remarkable change in the temperature, many of the neighbors spoke about it and said that there was peculiar feeling about the heat, something they had not before experienced in years." "It was terribly oppressive; it seemed as if the atmosphere was unusually heavy and pressing down on me with a great weight."

Enough examples have now been cited to clearly indicate the character of this peculiar sultriness. Other signs equally important and reliable may be found in the development and peculiar formation of the clouds in the western horizon. Sometimes these peculiar clouds extend from the southwest through the west by the north to the northeast. More frequently, however, they form in the northwest and southwest, sometimes commencing, first in the former quarter and then again in the latter, but in either case they are equally significant. The marked peculiarity of the clouds is found to occur not only in the *form* but in the *color* and *character* of development.

The sudden appearance of ominous clouds, first in the southwest and then almost immediately in the northwest or northeast (perhaps the reverse in the order of their appearance) generally attracts the attention of the most casual observer and frequently overcomes him with astonishment. In almost all cases these premonitory clouds are unlike any ordinary and usual formation. If they are light, their appearance resembles smoke issuing from a burning building or straw stack, rolling upward in fantastic shapes to great heights. Again, like a fine mist or quite white like fog or steam. Some persons describe these light clouds as at times apparently irridescent or glowing as if from their irregular surfaces a pale, whitish light was cast.

The dark clouds at times present a deep greenish hue, which fairly forebodes the greatest evil and leaves one to imagine quite freely of dire possibilities. Again, they appear jet black from centre to circumference, or in a change of form, this deep set color may only appear at the centre, gradually diminishing in intensity as the outer edges of the cloud or bank of clouds are approached. Sometimes these dark clouds, instead of appearing in solid and heavy masses, roll up lightly, but still intensely black like the smoke from an engine or locomotive burning soft coal. They have been described as of a purple or bluish tinge, or at times possessed of a strange lividness. Frequently dark green, again an inky blackness that fairly startles you with its intensity. Many observers are at a loss for words in which to give an adequate description of the terrible scenes and simply say: "They were the worst looking clouds I ever saw, perfectly awful." Said one observer, "The clouds seemed to be boiling up like muddy water, the upper surface of the cloud reminding me of the incessant eddies or whirls seen in the muddiest portions of the Missouri River." Other observers as follows: "I saw two whirling circles of lightish gray clouds in the west; they were acting independent of each other and moved slowly inward toward each other from opposite directions. The clouds were very low; seemed to be on the earth, the wind in contrary directions across the face of the western sky and surrounding clouds in great confusion." "Observed clouds moving in all directions, some of a dark green color, others white as steam." "The lower end of the cloud was very white like fog." "I saw a great smoke, and supposed at first it was a fire." "I saw a terrible cloud of a dark purplish color." "There was a peculiar and terrifying look to the clouds." "I saw a green looking cloud in the northwest surrounded by others not so deep set in color. Under the cloud from the southwest, there came a large number of little thunder-heads, some very dark but others as white as steam. They seemed to be separated and running very low. I never saw clouds so low before. Pretty soon they began to go in all directions, some up, some down, right and left, backwards and forwards. I next saw a cloud that looked even all over in color and very white, the edges pretty even. It moved remarkably steady and seemed to be right under the edge of the cloud from the southwest." "The clouds looked as if a mosquito net had been spread out over the sky." "I saw clouds tumbling over and over in terrible confusion." "I noticed a strange action in the clouds and saw a cloud rolling on the ground coming from the southwest." "The ground was covered with white steamy looking clouds that prevented one from seeing any distance." "Two clouds, one from the northwest and the other from the southwest seemed to meet, and after meeting passed still lower. Above their place of meeting black smoke appeared in very peculiar shape." "The air presented a very peculiar appearance, it seemed to be in different shaded strata and quite marked." "At the bottom of the cloud a hazy appearance rose up, obstructing the view." "Two clouds came together, one from the southwest and the other from the northwest; the latter was the highest, and the former the heaviest and looked the worst." "A heavy cloud spread out before us to a width of about six hundred feet, and as black as night."

The peculiar *action* of the clouds while they are forming is another interesting and significant feature which should be carefully watched. Under ordinary circumustances clouds form, move about and disappear without causing the slightest remark or perhaps thought, from the casual or even the interested observer. In the event of a thunder-storm or hailstorm the movement and disposition of the clouds are not looked upon with fear or as possibly possessed of a power to create great havoc. But on the occasion of a tornado the formation and movement of the clouds strike most persons almost dumb with fear. There seems to be some strange connection between the almost simultaneous appearance of clouds in the southwest and northwest, possessing as they do, such unusually threatening forms.

As they approach from opposite directions they are suddenly thrown into the greatest confusion, breaking up as it were, into small portions which dash pell mell over each other and in every direction, now darting toward the earth, now rushing upward to considerable heights like the ascension of a sky-rocket, or at moderate elevations rolling over each other in a well developed whirl. An observer in describing the approach of the clouds from the southwest and northwest stated that they "came together with a terrific crash as if thrown from the mouths of cannons." Generally, following closely upon the existence of this condition, the funnel-shaped tornado cloud appears against the western sky, moving boldly to the front from without this confused mass of flying clouds. As the tornado cloud advances these scuds continue to play about its top and sides, constituting a characteristic feature of the scene.

Another and invariable sign of the tornado's approach is a heavy roaring noise which augments in intensity as the tornado cloud advances. This roaring is compared to the passage of a heavily loaded freight train moving over a bridge or through a deep pass or tunnel. To the roaring of a railroad train such as is heard on damp mornings when the sound is very clear and loud. It is also likened to the rumbling of a long train of empty freight cars. The sound coming from the rapid movement of a large number of empty box cars is accounted rather peculiar and quite noticeable.

At times the roaring has been so violent that persons have compared it to the simultaneous "rush of 10,000 trains of cars." Of course there is no import ance to be attached to the exact *number* here given, it being used in a figurative sense and is quite likely exaggerated. Again, the roaring is likened to the low rumbling of distant thunder. The varying intensity of the roar as here represented is, in the main, due to the lack of uniformity in the positions of the various observers with respect to the advancing tornado cloud. Those situated nearest the cloud, other things being equal, experience the loudest roar, while to those at greater distances the noise is proportionally weaker. In any event, however, the noise is sufficiently peculiar and distinct to create alarm and as a means of *warning* should not be overlooked under any pretext.

How to Benefit by Signs.—In order to be prepared for the possible appearance of a tornado, so far at least as the above indications are concerned, let every person situated in those regions of country where the tornado is of yearly occurrence commence (to-day is none too soon) to carefully observe and record the daily changes in the face of the sky, the variations of temperature, the direction of the wind and the character and development of clouds. I do not mean that any person should devote all or most of his time to this work of observation, and possibly not even all of his spare time. For the sake of regularity and uniformity I will suggest certain hours for regular work of this nature, viz: 7 A. M. 2 and 9 P. M. These hours are not altogether arbitrary, for there is a reasonable amount of prudence in their selection, looking to a proper and successful use of the results of your labor.

Should the violence of a storm be unusually marked during either the hours of the forenoon or afternoon, or even in the night, it would be advisable to increase the number of hours for observation and record, possibly making them every hour or half hour, or even at shorter intervals, as the importance of the case demands. By this means of frequent observation every feature of the storm would become the subject of inquiry and quite probably the most important results attained. For purposes of investigation of this class of storms your observations need not continue throughout the entire year, at least in the Northern and Western States, although such a length of record would by no means fall amiss of much value. Yearly records will pay. However, observations without fail, should commence by the 1st of April and continue unremittingly until at least the 1st of September. Observations through the autumn can be maintained with profit. It will be a valuable adjunct to this work of regular hour records if a summary of miscellaneous phenomena is kept. Enter the dates of occurrence and important particulars of such phenomena as auroras, mirage, meteors, lunar and solar halos, prairie and forest fires, the migration of birds and insects, the leafing and blossoming of trees, flowers and shrubs, droughts, excessive rainfalls, earthquakes, zodiacal light, frosts and the formation of ice. Blank record sheets, upon which such observations can be entered to advantage may be obtained free of cost on application to the Chief Signal Officer U. S. Army, Washington, D. C., provided, however, that a duplicate of each month's work, for which sufficient blanks and stamped envelopes will be forwarded, shall be mailed on or near the first day of each succeeding month, to the office of the Chief Signal Officer, U. S. Army. All such observers under the title of Voluntary Observers, Signal Service, U. S. A., in view of their labors in the interests of the Signal Service, will be entitled to and receive a copy of the Annual Report of the Chief Signal Officer, for that year within which they make the observations, and also a copy, (monthly) of another publication of the Signal Service called the "Monthly Weather Review," a most valuable journal of between twenty and thirty pages.

Character of Tornado Cloud and Attending Motions.—The tornado cloud is, generally speaking, funnel-shaped, that is to say, it tapers from the top downward, not always in the same degree with every appearance of the cloud, but the lower end of it (the part nearest the earth) is invariably the smallest. Whatever the inclination of the major axis of the cloud to the perpendicular, the lower end is the narrowest and nearest the earth. As seen in different positions and stages of development by various observers, located differently, the tornado cloud has been called: "balloon-shaped"; "basket-shaped"; "egg-shaped"; "trailing on the ground like the tail of an enormous kite"; of "bulbous form"; "like an elephant's trunk," etc., etc. In the majority of instances however, observers describe the cloud as appearing like an upright funnel. When the tip end of the cloud reaches the earth, the violence of its whirl creates a powerful suction over a small portion of the surface and immediately thereupon a peculiarly formed cloud of dust, and finely divided debris, around which there plays small gatherings of condensed vapor, is formed. To all appearances now, the tornado cloud has two heads, one on the surface of the earth and the other in the sky, the bodies of each joining in mid-air and tapering both ways with the smallest diameter at their junction. In other words, the cloud now assumes the shape of an hour-glass and the lower portion, or that assuming the form of an inverted funnel, displays an extraordinary violence. The extreme fury of the tremendous power of the tornado cloud is now experienced and nothing is able to stay the force of its awful march. This last and most fatal form of the tornado cloud is fortunately not a constant feature of the storm. The tornado cloud is constantly changing from the hour-glass form to that of the upright funnel or some other intermediate shape previously referred to.

The various gradations of form, not any of which however, affect the stereotyped relation between the size of top and bottom, number some twenty-five or thirty, so far as I have been able to gather information upon this point. These variations of form are quite important in a critical study of the tornado. They depend upon the peculiar movements of the whirling currents of air within and about the cloud vortex, the direction of the currents being outlined to the eye by the singular disposition of the rapidly condensing masses of vapor. The characteristic motions of the tornado cloud number four and are described as follows:

No. I. is called the *whirling* or *gyratory* motion of the tornado cloud, which is invariably from right to left or against the course of the sun. From the peculiar character of the formation of the tornado cloud, this motion is in all probability the first evidence of the existence of the cloud and should therefore be placed first in order of consideration. Of all other motions, this is attended with the greatest violence and its velocity of movement is far in excess of any one of the others. This gyratory motion forms what is termed the vortex of the tornado cloud, within which the velocity of the centripetal currents of air is almost beyond conception. Many efforts have been made, but most of them altogether fruitless, to estimate the rate of progress of these currents and velocities ranging from 100 to 800 and even 1,000 miles per hour, have been approximated. The two latter are the extremes that have been ventured upon and of course are not reliable, while in the majority of instances more trustworthy determinations have ranged between 100 and 500 miles per hour.

The uncertainty arising on this point of ascertaining the velocity of centripetal currents, depends upon or is rather an outcome of the difficulty attending the acquirement of the requisite (absolutely) reliable data. In all carefully conducted investigations heretofore made, there has unfortunately occurred such a long interval between the happening of the storm and the arrival of the person authorized to commence the work, that valuable and satisfactory results in this direction were precluded. It is always of prime importance to ascertain definitely, what portion of a building or other object was first struck by the wind in order to determine the configuration and inclination of the exposed surface. As a rule such examination is rendered next to impossible by the rapidity with which devastated districts recover from the violence of the storm. This statement is a most praiseworthy and well deserved commentary on the exemplary industry and determined spirit of the people of the Lower Missouri Valley. With the gyratory motion of the tornado cloud, objects are drawn inward to the centre of the storm and then carried violently upward by a spirally inward and upward motion which fairly crushes and grinds into pieces buildings, trees and whatever else falls in the line of the advancing cloud. The spirally upward motion throws the ascending debris in a circular manner, outward at the top of the tornado cloud. This debris when beyond the central whirl of the cloud, falls to the earth, but in such a manner and so disposed as to indicate the character of the force which acted upon it.

No. II. is called the *progressive* motion of the tornado cloud, the motion which determines the cloud's progress from one point to another. The rate of progressive velocity ranks next in order to the velocity of motion No. I. although it is certainly at all times far below the high degree of the latter.

The rate of progress of the tornado cloud is subject to great variability throughout the path of any one storm, although on the average tornado clouds possess a moderately uniform velocity of progression. Some observers have indicated the movement by the following expressions: "All in an instant." "Gone in a moment." "Quicker than thought." "Without a moment's warning." "It moved no faster than a horse gently galloping." "I just saw what it was, and then all was over." "Before I had time to turn about in my tracks it flashed by me." "It seemed to remain almost motionless, as if held to the ground by some mysterious force;" "I shuddered, held my breath, and the monster had vanished." "It seemed to move no faster than I could run."

These estimations of velocity are not to be taken altogether literally. The circumstances under which the impressions were received must be considered, viz: undue excitement or abject terror. However, the comparative results are important, and to a certain extent reliable. Through them, you will at least not be led astray in your conceptions of the awful grandeur of the panorama, or fall into the fatal mistake of encouraging a belief that the tornado is not what the united experience of all observers has portrayed it.

This data will not answer however, to figure on very closely, but the factors, average diameter of cloud, actual time (local or standard) and measured distances, must be carefully obtained before an approach to accurate calculations can be secured. Reliable data are very difficult to obtain, especially time. This fact should be thoroughly appreciated by observers and every reasonable effort made by them to examine their clocks or watches upon the approach and passage of the tornado cloud. Generally speaking, it is a good habit to form, of jotting down in some place of ready reference the hour, day, month and year of notable events.

In regard to this matter of time, so far as past determinations can be valued, the progressive velocity of the tornado cloud is variously estimated at from twenty-five to seventy miles per hour. The former is perhaps too low and the latter quite likely too high, and although in both instances they represent the extremes, yet either of the above velocities may have existed for short intervals. The true average is probably about forty miles per hour.

No. III. is termed the *rising* and *falling* motion of the tornado cloud, the character of which finds definition in the following expressions from various witnesses: "The top of the cloud seemed to pop up and down, and then to rush forward." "It bounded over the ground like a ball." "It was the strangest jumping and flopping object I ever saw." "At times it seemed to lash the earth in terrific fury with its huge tail." "It came along, popping up and down in a most fantastic way." "Rising up like the uncoiling of a huge rope, it cut loose from the earth and passed over us with a horribly whizzing sound." "Ever and anon it would shoot directly upward from the earth, sometimes with great rapidity, and then again quite slowly, each time dashing to the surface with apparently renewed vigor."

It is perhaps clearly, seen that this a distinct motion with striking peculiarities which define its character. Sometimes, upon the lifting of the tornado cloud from the earth, it does not again descend for a distance of several miles, at times making the return movement or descension twenty or thirty miles distant, the intervening space proving a complete blank in its track. More frequently, however, these gaps are from one to five miles in length.

While the tornado cloud is traversing the atmosphere at some considerable distance above the earth, it may reach down so low as to just skim over the tops of the highest trees; descend to a level with the roofs of buildings, simply scaling off the shingles in spots or entirely on one side, leaving the roof-boards and rafters unmoved; removing the tops of chimneys; taking out all the fans in the wheel of a wind-mill and leaving every portion (even the tail) of the remainder of the mill unharmed; take off the cornice without disturbing the remainder of the roof; removing simply the top board of a five-board fence, or one or two of the top rails of an ordinary rail fence.

The tornado cloud may, however, remain at a perfectly safe distance throughout its aerial course and where it may be seen at a great height, moving solitary and alone, like a huge balloon. While in this condition it has, not a few times been unwittingly taken for the latter object, but the mystery and sensation was entirely dispelled when the news came in from the surrounding country of the frightful power of this now silent monster.

There is still another condition, which the fearful aeronaut may assume in his flighty movements. Upon rising from the earth and passing through a few uncertain struggles, apparently to decide as to whether the final direction shall be up or down, the tornado cloud is ultimately lost sight of in the surrounding clouds, and reappears suddenly again at its point of descension, or perhaps only to remain at a safe distance.

No. IV. is called the *zigzag* motion, or swaying from side to side of the central line of cloud movement. This motion is sometimes quite suddenly performed, but generally it is a moderately slow movement and one that can be attached and easily identified. It seems to occur most frequently just as the tornado cloud touches the earth in completing the last act of motion No. III. In completing the extent of a single act of this motion, the tornado cloud will diverge about an equal distance on either side of the central line of movement, though these tangents to the major axis are not necessarily of equal length.

At the commencement of this motion the tornado cloud, always moves first to the left (N. N. E.) and then to the right (E. S. E) forming an obtuse angle on the north side of the major axis. On the return movement, the cloud may or may not cross the major axis (to E. S. E.). If it does, it will then form a similar obtuse angle on the south side of the major axis. This zigzag movement, first from one side and then from the other of the central line of progressive action, may continue for several miles, or it may cut short its existence after the first few moves.

The regularity of this pecular action appears to depend upon indraughts from the south side of the major axis, of violent currents of air, which frequently advance (only from the left side) and give evidence of their existence by swaths or narrow paths of destruction (alternating with spaces of no damage) cut inward toward and joining with the central line or track. The tornado cloud may, upon the return movement, whether executed upon the north or south side of the major axis, it matters not, fail to cross it, but upon reaching it continue onward in the central line of movement to the northeast.

The distance traveled by the tornado cloud in departing from the major axis, either to the north or south, is generally subject to considerable variability, ranging from forty to fifty yards to nearly as many rods. While executing this zigzag motion it very frequently happens that the tornado cloud simply skims over the earth without manifesting its extreme violence.

Building Spots.—In regard to the matter of buildings, the question may be asked whether there is not some choice in a building spot, with a view to safety from the violence of the tornado cloud. Many persons have thought that if their house or barn was perched upon some high "divide" or on the brow of a steep decline, in fact upon any marked rise above the surrounding level, the tornado cloud by reason of some mysterious effort of clemency would rise from the earth and pass over them. This is a careless and unreasonable supposition when the facts are known. It does not seem to occur to the mind of an observer that there is no reason why the tornado cloud should not follow the rolling surface as well as the plain.

The tornado cloud pursues a general course to the northeast without regard to the character of the earth's surface and if your buildings are in the line of its destructive path, whether upon a hill, in a valley or within a ravine they are subject to its violence. Western towns as a rule are not built upon high "divides" but more frequently sheltered between neighboring hills. The same may be said of farm buildings, it being the prevailing custom to select building spots along the low bottoms of a stream for convenience to water and timber, and for protection from the continued heavy winds that break over the open prairies.

From the above facts it will be seen, that there is very little opportunity offered the tornado cloud to display its violence on the hill-tops, even though it were so diposed. Repeated investigations have shown that buildings were destroyed with as great violence and completeness upon high lands as upon low lands, but the largest number in valleys because of the facts above cited In many instances the funnel-cloud has passed from one ridge to another, doing damage on both, but skipping the intervening depression. Again it has followed high "divides" for several miles when they coincided with its general course of movement. Ridges and valleys are almost invariably crossed at right angles when their courses are from northwest to southeast.

Electricity—The rain and hail which sometimes precedes and at other times follows the tornado cloud, but always accompanies the heavy clouds which form in the north and west is not always but generally attended by lightning; sometimes most violent manifestations and then again but occasional flashes. The most terrific displays are reported during the heavy precipitation which often occurs after the tornado cloud has passed, some ten to twenty minutes. Very often its darting flash is observed in the dark clouds which begin to rise above the western horizon an hour or more before the storm.

What relation has electricity to the formation and power of the tornado cloud? Most persons are utterly at a loss to account for the terrible manifestations of the prodigious power presented to them by the destructive effects of the wonderful cloud formation. If they make the least attempt to philosophize upon the subject, they are determined to assign the cause to some mysterious interference of electrical force. Whenever a piece of iron is bent, broken, twisted or carried a considerable distance, a tree torn up by the roots, or clothing snatched from the body, it is attributed to electricity. The fact that it does not appear in the funnel-cloud is explained away by supposing that its subtle presence produces powerful effects through some incomprehensible modification of its usual character. There is a dogmatic predisposition to attribute everything, the result of unusual power in the operation of the tornado cloud, to this one member of the category of physical forces. Of course it is the easiest way to get rid in a difficult problem.

If a hurricane did similar work I dare say that the electrical (final and all-satisfying) cause would not be thought of. It being generally accepted that little is yet known of the peculiar nature of electricity, there would be comparative safety in assigning the cause of a strange atmospherical disturbance to its wonder-range of power, feeling satisfied, that for a considerable time at least, there would be no probability of a decided advance into the analysis of such a relation. The funnel-cloud is a mere collection of clouds of the same rarity as the mass from whence they are drawn. Its descent is evidently the mechanical effect of the whirling currents of air accompanied by the rapid condensation of vapor. Even if electricity is present there is no requirement of its intervention to produce the force required. It is plainly evident that the movement of a current of air at the rate of from 200 to 500 miles per hour is sufficiently powerful to demolish the strongest buildings, lift a piece of iron or if necessary distort its shape. This subject is considered more at length in my published Report of the Tornadoes of 1879.

MEANS OF PROTECTION.—First in regard to life. How can you save your lives or avoid the terrible injuries that often fail to result in death, but from which there is no respite while life hangs on? Much will be offered you in the solution of this vital problem from the results already permitted in a careful analysis of the facts now at hand. Perhaps it is more than you expect, perhaps it is less, but at least it is all that past or present investigation will sustain. In regard to this question much, if not everything, depends upon the manner and in what direction a person *moves*, together with the distance of the tornado cloud, its direction and the kind of *motion* prevailing at the *instant* you determine upon changing your position.

We will now suppose the various conditions and proceed to point out the necessary action in each instance. In all cases it is granted for sake of convenience in illustration, that you are in front of or situated directly in the line of the advancing tornado cloud. Under these circumstances if No. II or the *progressive* motion of the cloud is prevailing and your distance from it is say, eighty rods or more, *move* directly and with all possible dispatch to the *north*. Whenever this motion is prevailing *always* run to the *north*, unless in so doing you would be obliged to cross the *entire* path of the storm. A sharp glance to the *westward* will tell you whether you are about on the *southern* edge of the probable *path* of the tornado cloud, or more to the *north*. If in the *centre* or *halfway* between the *centre* and the *southern* edge, your chances are best in a direct course to the *north*. If further to the *south*, move directly and very rapidly to the *south*, bearing slightly *east*. In *no event* should you ever run directly to the *east* or *northeast*. Suppose the tornado cloud to be distant from you (W. or SW.) eighty rods and its progressive velocity sixty miles per hour, it would follow that one mile is passed in sixty seconds or eighty rods in fifteen seconds. Assuming the average width of the destructive path of the tornado cloud to be forty rods and your position at the centre of that path, it will be seen that you have fifteen seconds in which to reach the outer edge of the path to the *north* (a distance of twenty rods) before the tornado cloud could arrive at your location.

I have taken an extreme case in every particular. Most persons first see the tornado cloud at a much greater distance, from one to three miles, sometimes five and ten miles on the prairies. Of course at the unusual distance of five or ten miles you could not determine very satisfactorily its probable course, especially with regard to your buildings or the safety of your own location. Watching the approach of the tornado cloud closely at a distance of ten miles and from that position on and on in its eastward course until it came within a mile or so of your point of observation, would give you sufficient opportunity to predict its probable course in regard to your location. When that matter is settled satisfactorily to your judgment, *move* immediately and without further hesitation. If you wait until the tornado cloud is distant one mile you have at least sixty seconds in which to run a distance of thirty rods, supposing that you are obliged to cover more than half of the destructive path of the storm. In an average case you will probably have between eighty and ninety seconds in which to run a distance of twenty rods. In either case I am supposing that you are prepared in every particular to *move* at the very *instant* of timely warning. Further, I am supposing that you have been watching the weather of the day and understand that a terrible storm is imminent. There is, under ordinary circumstances, no reason why you should not be so informed. A tornado cloud does not come out of a clear sky, and there are many and ample signs of its approach.

What has been said in regard to the *directions* in which persons should move when the progressive motion is prevailing, will for all practical purposes apply to motions Nos. I and III. With respect to motion No. IV, (the *zigzag*) the following preliminary remarks should be most carefully considered. Remember that while possessed of this motion the tornado cloud crosses from one side of the central line of movement or major axis to the other. That this peculiar motion most frequently occurs just after the termination of the *rising* and *falling* motion (No. III) so that when you see the tornado cloud descending to the earth from one of its aerial flights you may expect (not absolutely) the *zigzag* motion to follow. That the first departure of the tornado cloud from the major axis is to the left or on the *north* side of the path. That all departures from the major axis, whether *forward* or *return* movements of the tornado cloud are invariably executed to the *eastward*. There is no backward movement to the *west*. That the tornado cloud never continues to move in the direction of any *tangent* to the major axis but in the event of any departure it ultimately returns to the central line of movement. Having these points well in mind you are quite satisfactorily prepared to act when the exigency occurs. When the departure of the tornado cloud is to the *left* and your position is at any point in the central line of movement (better near the centre of the path) *move* directly *north* with the utmost rapidity, even if the cloud is at a long distance from you. Should it chance that your distance from the cloud is reduced to from twenty to forty rods, run instantly to the *south*, bearing slowly *west*. This movement will take you away from the forward and return action of the tornado cloud. Another case, suppose your position to be the same as just given, viz: at any point in the central line of movement, but that the tornado cloud had just crossed over that line to the *southward*. In this event you should move instantly and directly to the *north* bearing slowly *west*. This movement will also, as in the case previously cited, take you away from the forward and return action of the tornado cloud.

To recapitulate in regard to tornado cloud motions and the manner of movement with respect to them. Remember, that under no circumstances, should you move to the *northeast*, *east* or *southeast*. Never wait until the tornado cloud is almost upon you before you *move*. When watching the cloud in order to determine the course of its movement and decide upon the manner in which you will act in regard to its motions, place yourself directly in front of and as nearly as possible in a direct line with the advancing cloud. By thus selecting your position for observation you can determine more easily than in any other way the prevalence of characteristic motions, the change from one to the other and the most desirable *moment* in which to act in regard to any motion.

How to Act on Its Formation.—The following remarks apply to your manner of action when the evidences of the existence of the tornado cloud are undeniable. At this juncture the actual tornado cloud is not yet in sight but other infallible signs (heretofore given) of its formation and probable approach from a point possibly below your horizon, are present Act immediately, judiciously and with the utmost rapidity, but never for one instant allow yourself to become excited or reckless in anything. Take the situation as calmly as possible, knowing as you ought (or probably will) the terrible power you have to deal with. Do not with an over-weening sense of fancied security or an inclination to a superstitious feeling that your life is mysteriously over-shadowed by a peculiarly beneficent power, think and act leisurely about the matter of self-protection. A tornado cloud never sends forward a flag of truce or even solicits the "right of way." There are certain indications which we have heretofore spoken of that frequently, if not always, manifest themselves from half an hour to two or three hours in advance of the tornado cloud. Do not wait to make sure of the existence of the cloud or call into play a telescope to detect the charateristic outlines of the intruder and see if he corresponds with the regulation standard. It will pay you to run the chance of being trifled with, or disappointed if you so prefer to call it, several times rather than be compelled (when the opportunity to relieve yourself was once within your grasp) to weather a storm of this character. Of course you *may* get through alive, but then it is not such a change of scene and situation, so unusual and delightfully frisky in its nature, that you will needs pass through life with a stinging regret that you might have actually experienced this chief of "twisters." Even though you may feel an uncontrollable desire to serve the interests of science and those of the United States Weather Bureau, cast such ambitious and patriotic thoughts aside and prepare to flee, your back to the foe. Many foolhardy acts have been committed (perhaps through fear and excitement or positive ignorance) by persons, which have resulted in death or dreadful injuries, because they tried to run in front of the tornado cloud, thinking they could outstrip it in such a race. Others have attempted to cross the path just ahead of the advancing cloud feeling that they could reach a safe distance on the opposite side before the funnel shaped monster passed. In one of our late storms a person essayed this trip with two horses and a lumber wagon, confident that he could at least rush his horses across the apparently narrow path of a storm which seemed to progress within such circumscribed limits. Not so. He was instantly killed, one of his horses dreadfully mangled, the other seriously injured and the wagon a total wreck. The work of an instant. An ignorant, reckless rush into eternity.

Had I the space I could enumerate many similar instances to show the folly and ignorance of people, and the importance of looking at this matter (the progress and power of the tornado cloud) as one of life and death. The second and last question arising under this heading (Means of Protection) pertains to the protection of property. What can be done to in any way lessen the actual damage (present or prospective) to property, especially buildings? In the first place it is utterly impossible to move your building or buildings from the path of the advancing tornado cloud. Secondly, it is positively impossible to stop the tornado cloud after it has started on its course of death and destruction or in any way prevent its formation. Thirdly, it is impossible to construct any building strong enough to completely resist the extraordinary violence of the tornado cloud. To sum up, this is all equivalent to saying that you can never expect to save your buildings. This is the truth as I comprehend it and it is that to which all thought upon the subject will sooner or later conform. It is advisible that, under all circumstances, you should avoid any labor *especially directed* to the construction of any building whatsoever, for the express purpose of resisting the violence of the tornado cloud. Build your houses, barns and stores as you would without the *knowledge* of a tornado. Other things being equal, a *frame* building is better than a *brick* or *stone* one. The former will hold together longer, is more elastic (if you will permit the term) and persons seeking refuge within its walls are much less liable to injury. There has at times been evidence to show, that of all frame buildings, those constructed with a hip-roof and a story and a half in height were the best able to resist the violence of the tornado. But where there are cases reported of this class of buildings being saved there are as many, if not more, where they were destroyed precisely as any other frame building would have been under similar circumstances.

It matters not how you construct or of what material, if your building rises above the surface of the earth (which it must necessarily do) it thereby offers obstruction to the advance of the tornado cloud and it will go, either from the foundation, or into kindling-wood and a distracted mass of bricks and mortar, in spite of the propagation of any theory or the possibilities of architectural skill. In conclusion I would finally say, that you must take every precaution to *avoid* or *remove* from, rather than attempt to *fight against* or in any way *resist* the power of this formidable adversary. The question now suggests itself, what can be done? That which remains to be done can be accomplished in an unostentatious and quiet, but secure manner. Every man can and should construct a "dug-out" at some suitable point, within a convenient distance of his house. If a person is situated within a town or city let him select some portion of his yard for the purpose, but if residing in the country he will not be confined to narrow limits in the selection of a desirable location. Where a person living in the village has no yard, he must, if he has a cellar, construct a cellar-cave, to be described further on. With respect to the "dug-out," in no event should the roof be other than level with the surface of the earth, in fact it is highly desirable that the retreat should be so constructed that the ordinary surface of the earth would form the roof or covering and that all preparation of the domicile proceed by way of excavations and supports from beneath. As to location there is not much to be said, the most important points being convenient distance, a high, dry place, and possible opportunities to excavate into the northern or eastern slope of a knoll or hill. In the latter instance the entrance way would suffer less from the violence of the storm providing, perhaps, that it did not entirely envelop your retreat, for in that event, in the whirl of the flying debris, all sides alike would be at the mercy of the winds. Having decided upon the location, as regards your house or other buildings, prepare to sink a shaft, say four to six feet square, the entire depth of your "dug-out." From either the northern or eastern (better the former) wall of this shaft cut out a stairway leading upward to the surface of the earth, for purposes of ingress and egress. On the side of the shaft opposite the stairway commence the excavation for the enclosed retreat. The size of the room will of course depend upon how much you may at any time wish to secure from injury. Better have the excavation too large than not large enough. The slight difference in the expense of time and labor may, perhaps, be the means of saving you a great deal when you least expect it. The entire room should be below the surface of the ground, a distance of at least three feet and the overhanging roof of earth should be supported from beneath by heavy timbers, to provide against any emergency like the dashing of heavy debris upon it or the tramping of horses and cattle.

In the event of a tornado your retreat ("dug-out") may be entirely buried beneath huge piles of debris. Everything must be made as secure as possible. The entrance door should be made of the heaviest timbers and supported between casings of similar strength of construction. Arrangements should be made to secure the door by heavy fastenings. In order that ventilation may be provided for, a box spout, squaring eight inches, should be let through the roof. The top of this spout must be level with the surface of the ground and protected by iron gratings. Ventilation may be provided for by openings through the upper portion of the door, but these also should be protected by iron gratings.

The "dug-out" should be large enough to contain your family and remove thereto, such of your personal effects as are considered most valuable, viz: important papers, trunks of clothing, books, dishes, silverware, costly pieces of furniture, anything of special value in this class of property. There are many instances where persons have lost the most valuable articles, even large sums of money, from supposing that if such things were placed in securely bound trunks or boxes they would be perfectly safe. There are cases where iron-bound trunks and even iron chests (not the regular merchant's safe) especially made to secure valuable articles, have been crushed or torn to pieces and the contents scattered to the winds. You might consider it advisable to purchase a heavy merchant's safe in which to lock your valuables. I would not advise you to the contrary, although it is a costly expenditure. It might resist the force of the wind to the extent that it would not be broken open, but if the tornado cloud possesses sufficient power (which it does)to remove loaded railroad cars from the track or overturn huge locomotives weighing tons, it will be seen that your safe will not very likely remain in its original position throughout the storm. Safes are not *safe* in a tornado. They may cost you several hundred dollars and even then you must prepare the "dug-out" for your family. Why not expend this money or that portion of it which is found necessary, in preparing not only a secure refuge for your family but sufficient room for your valuables? This "dug-out" need not prove a worthless investment even though you do not experience a tornado. On the principle alone that "an ounce of prevention is worth a pound of cure," the outlay cannot be considered a failure. It may be used for various purposes as an out-door cellar. If it prove the means of saving a life once in five years (and that, perhaps, your own) you would hardly regret the expenditure.

There is still another kind of underground protection which can be prepared to advantage if you are provided with a cellar, either under your house or store. Having the cellar, cut an opening (say six feet high and four feet wide) into the *wes* wall. Carry the excavation to such an extent underground as to provide sufficient room for your family and valuable personal effects. The roof of this cellar-cave should be composed of at least three feet (in depth) of the undisturbed surface earth, and supported from beneath by heavy timbers. In every way it should be made as secure as the "dug-out." The provisions for ventilation may be made through the roof or entrance door, but in either case well protected by iron grating.

Protection in Cases of Emergency.—In the event that you are not possessed of the dug-out or cellar-cave your best plan is to *move* from your house or wherever you may be at the *instant* stationed, as directed in regard to the various motions of the tornado cloud. If not able to benefit by these directions retreat instantly to your cellar and place yourself, face forward, against the *west* wall. This is the best position in any cellar. If, for any reason you cannot get to the *west* wall take your position (the next best) face forward against the *south* wall, but as near the *southwest* corner as possible. In these positions the building, if removed from the foundation, will always be carried above and over you, or if torn to pieces, the debris will be instantly removed to the eastward. *Under no circumstances, whether in a building or a cellar, ever take a position in a northeast room, in a northeast corner, in an east room or against an east wall.* Remember that the tornado cloud invariably moves in a *northeasterly direction.* I have not space here in which to relate to you how many and in what manner persons have been instantly killed or terribly crippled, for no other reason than that they ignorantly threw themselves in the very grasp of the monster cloud. The lives of nineteen-twentieths, if not more, of the people destroyed in tornadoes can be saved by a clear understanding and a strict adherence to the simple rules herein set forth.

The rule regarding the movement to the *northeast* must be obeyed. The *northeast* quarter is a fatal position and I care not what you may tell me about destruction to life or property in any other. If you can get out of your house never remain in it or any other building that is at all likely to be torn down or removed from its foundation. If through some misfortune you are "close pressed" by the advancing cloud never remain *standing* and attempt to weather the storm, but throw yourself *prone* (face downward) upon the ground, head to the east and arms thrown over the head to protect it. If you should chance to be near a large stone or stump, or some heavy object low down and firmly imbedded in the ground, take a position directly to the east of it, lying prone upon the earth, head toward the object, protecting the former with your folded arms. This advice is given in the event of extreme exigencies where other and better opportunities have been forfeited. It is better, if possible, never to trust yourself behind or about any object located within the centre of the storm's path; by all means not a tree or any object that rises some distance above the surface of the ground. If forced to remain in your house and where you have no cellar, always take a position against the *west* or *south* wall (better the former) either prone (face downward) upon the floor or standing with your back to the wall.

In any building always take your final position on the first or ground floor. Never stand or lie in front of a door or window; near a stove or heavy piece of furniture. Make every effort to get into the *west* room and if possible before the onslaught remove therefrom all furniture, at least from the western portion. Always shut tightly every window and door in your house or other building in which you may be located at the time of the storm. You should never let doors and windows remain open during any violent storm. Never take refuge in a forest, in a small grove of trees, in an orchard, or near a fence of any kind, unless all these obstructions are entirely out of the line of the storm.

If possible always open your buildings and let your stock out, driving them to the *north.* In this matter of caring for stock (which should not be neglected if otherwise possible) always drive them from your buildings to the (as a rule) *northward.* Try and perform this duty on the first indications of the character of the storm, though not until you have assured yourself of the probable course of the tornado cloud. Of course it is quite possible that the tornado cloud may pass to the north of your buildings, in that event your stock should be driven *southward,* and *vice versa.*

With regard to the protection of life and property in the many small towns, and even cities, liable to be visited by the devastating tornado cloud, what has already been suggested in the manner of *north* and *south* movements, dug-outs and cellar-caves will, of course, apply here. Where, as in a village or city a large number of persons are congregated, each intent upon his particular business, it is hardly to be expected that perhaps any person would find the time or think of giving any attention to the face of the sky. Should it chance that any person watched the changes of atmospheric phenomena and received indications of the approach of a tornado cloud he might not think it his duty (probably forget it in his excitement) to warn others of the impending danger, or provide for more than the safety of his own family.

Of course in any event it is natural to suppose that he would first secure his own household. This supposed case is a very probable one; at least nine times out of ten we find that towns are devastated without apparent warning and the unfortunate people startled from their imagined security, are killed in their struggling efforts for escape. Some provision should be made for the mass of inhabitants who are performing their various duties in and out of doors, and who by reason of their peculiar situation or labor could not, if they would, ascertain the prognostics of the sky.

With regard to this matter I will offer a few suggestions which may not be amiss. On any day when there is presaged in the weather conditions evidence of the probable approach of a violent wind storm, it should be the duty of those in authority to deputize certain intelligent persons, one or more in each ward, the number depending up the size of the town, to watch the character and approach of the storm, and if a tornado, to give timely warning of its advance to the various families in their respective wards, and take charge of the removal of persons and property to places of safety. In the matter of warning the various portions of the town, it would probably be to advantage to make use of the church and school bells by ringing them perhaps in a peculiar manner, the character of which to be decided upon by previous arrangement and generally understood. It should be generally known that the persons above referred to, give them what rank, title or emoluments you may, are possessed of special authority while performing their duties. They should be cool, brave, active and judicious men. They should completely understand the situation, know precisely what is needed and how to supply it. All persons should at the proper time appreciate the situation of these men and avoid confusion by a strict compliance with orders. I think that it will be clearly comprehended at this juncture, without resort to unnecessary recapitulation, that it will not be necessary for these persons so deputized by the proper authority, to be adepts in the science of meteorology or to take their posts of duty on the 1st of April and without removing their eyes from the heavens (except in the event of a tornado) gaze thereon until the 1st of September.

The signs (as before described) of tornado cloud formation and approach are distinct and sufficiently suggestive to afford opportunity for timely and concerted action. The time for action will necessarily be limited and the watch need not commence until there is every reason to believe that such a course is absolutely necessary. Some persons may be disposed smile at the novelty and minuteness of this arrangement, or at the idea of employing weather guards at western towns. I will venture to say that these smiles will not appear on the faces of persons who have experienced the irresistible and overwhelming violence of a tornado. I have never detected many smiles among those who were left to tell the tale of distress in any of the many almost annihilated towns of the West. You may smile or wonder at the thought of hardy, brave men who have, without flinching and in support of their country's honor, faced the red-hot belchings of a score of batteries, who now at the sight of a threatening cloud or the experience of a brisk wind make a bold dash for places of safety or throwing themselves upon the ground clutch at the first object within reach. Such is the abject terror which possesses all alike after the experience of a tornado. The character and extent of your smile is but the measure of your blissful ignorance, and it should not be considered a misfortune to be compelled thus to remain without possession of the truth.

Immediately following (and for some weeks thereafter) the occurrence in Kansas and Missouri of the violent tornadoes of 1879 hundreds of people along the tracks and in the vicinity of the storms, hardly went to bed, but remained dressed and, with their lanterns trimmed and burning, watched intently every foreboding appearance of the sky. Every dark cloud or sudden increase of the wind was calculated to affect them with an indescribable terror which could not be allayed until every vestige of the supposed danger had vanished. This is not the pitiful tale alone of Kansas and Missouri sufferers, but wherever the dreaded tornado makes its way, be it in Michigan, in Mississippi, in Georgia, In Massachusetts or in Minnesota, the awful roar and power of its march strike all life dumb with fear. A great deal can be accomplished towards allaying this fear by a dissemination of practical knowledge concerning storms and by a general effort among intelligent people to appreciate such information. All intelligent persons can and should become familiar with the various classes of storms and be qualified to detect their formation and approach. The work of investigation is not yet finished. Much remains to be accomplished. We have yet a great desideratum probably within our reach, but not without careful preparation in the study of local and general atmospheric conditions. It is, that we shall be able to furnish timely and reliable warnings to certain communities, announcing conditions favorable to the formation of tornadoes. We shall then, with the knowledge now in our possession and in yours, be able to understand and act in regard to this wonderful storm in a manner quite satisfactory and little dreamed of a few years ago.

In a previous article (Tornado Studies for 1882) I have directed attention to the urgent necessity and the undeniable obligation resting upon every person who can, to furnish all the information within his power toward rendering the repeated investigations of tornadoes under the direction of the Chief Signal Officer, of the utmost value. The well organized State Weather Services of Kansas, Nebraska, Missouri and Iowa, under the efficient supervision of their several Directors, are doing most excellent general meteorological work. They should receive the hearty aid and appreciation of the people, and of the legislatures ot their respective States. Every State should have a Weather Service, every township an observer and every chief observer at the county seat authorized to receive monthly reports from the various observers within his jurisdiction and forward the same monthly to the State Director of such Service. Each Director should have the time and force at his disposal to thoroughly digest the meteorological conditions of each and every month throughout the year, preparing and publishing at the termination of each twelve-month a general summary of atmospheric phenomena coupled with the evidence of earnest and well directed efforts toward comparative study and practical results.

Such funds as would be necessary to carry forward a work of this kind should yearly be appropriated by the State Legislature. As so organized and in working order each State Weather Service should coöperate with the United States Weather Service, at Washington, and thus complete a system of meteorological work without parallel in the nations of the World, which would effect a marvelous advance in the study of this most important science, and develop rapidly and with practical results the meterological conditions of this great country. I can here give but the merest outlines of a subject with regard to which I have given much thought.

There is no country on the face of the globe where meteorology can be studied with so much advantage practically and scientifically as in North America. The elementary principles of meteorology, especially in regard to storms, should be taught in every school, country, town and city. In the colleges and universities an advanced course should be prescribed. Speculation regarding the weather is exceedingy rife, affecting every branch of the science and in a manner quite without precedent in the line of methodical knowledge. In view of this fact and the scarcity and uncertainty of desirable text books, *facts* and *principles* should alone be considered in administering the prescribed course of any educational institution, from the lowest to the highest grade.

The American people as a rule are too much in haste for the solution of meteorological problems. They perhaps divine the benefits in store for them from those already received and cannot wait for a judicious presentation of them, but the law is in patience, possess ye your souls. Truth comes slowly but it is worth the waiting. I do not consider that in this short presentation of most important facts, I have altogether met the supreme desire, or perhaps, the hope of the people interested in the subject of tornadoes. Such desires or hopes may never be realized, at least not until the investigation and analysis of these phenomena have been perfected, yet you have before you in very brief form the results of over five years of labor and an examination of over 600 tornadoes.

I urgently request all persons who can give me any information on the subject of storms in general or of tornadoes in particular, to communicate with me at their earliest convenience. Specially prepared circulars, on what facts to furnish in tornado investigations, will be sent to any person whose address I can obtain.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.52, on the 22nd. Lowest barometer during month 28.59, on the 17th.

Highest temperature during month 89°, on the 18th. Lowest temperature during month 37°, on the 26th.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	May. 20th to June 1st.	June 1st to 10th.	June 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min.	49.6	52.9	59.9	54.1
Max	66.7	75.6	81.0	74.4
Min. and Max	56.3	64.2	70.4	63.6
Range	20.7	22.6	20.9	21.1
TRI-DAILY OBSERVATIONS.				
7 a. m.	53.7	61.3	66.8	60.6
2 p. m.	63.1	74.2	79.1	72.1
9 p. m.	57.6	63.9	70.1	63.9
Mean	58.3	65.8	71.5	65.2
RELATIVE HUMIDITY.				
7. a. m.	.89	.81	.85	.85
2 p. m.	.75	.57	.66	.66
9 p. m.	.84	.73	.90	.82
Mean	.83	.69	.80	.77
PRESSURE AS OBSERVED.				
7 a. m.	28.97	28.95	28.87	28.93
2 p. m.	28.93	28.91	28.84	28.89
9 p. m.	28.94	28.91	28.85	28.90
Mean	28.95	28.92	28.85	28.91
MILES PER HOUR OF WIND.				
7 a. m.	13.3	8.7	..	..
2 p. m.	16.1	14.2	..	..
9 p. m.	8.5	12.4	..	..
Total miles	3334	..	..	..
CLOUDING BY TENTHS.				
7 a. m.	6.7	3.9	6.1	5.6
2 p. m.	7.1	4.9	3.4	5.1
9 p. m.	6.5	1.9	4.2	4.2
RAIN.				
Inches	1.95	.98	2.90	5.83

GEOLOGY.

GEOLOGICAL NOTES ON A PART OF SOUTHEAST KANSAS.

BV PROF. G. C. BROADHEAD.

We find well exposed, below Iola at Humboldt in Allen County, about twenty feet of a whitish or light gray limestone, often cellular, with the cells ferruginous stained; it also often shows numerous facets of limpid calcspar. A similar rock occupies the bank of the Neosho River at Neosho Falls, also cropping out low in the hills at Chanute and is also found at Galesburg in Neosho County. At Galesburg we find a succession of strata, including a few feet of rough ash-gray limestone on hill-top, then twenty feet of calcareous shales and thin rough layers of limestone containing *Athyris*, *Sutbtilita*, *Productus splendens*, *P. prattenianus*, *Bryozoa*, *etc.* Below this we find beds of pure whitish and gray limestone, ferruginous tinged and containing *Bryozoa*, *Spiriferlineatus*, *etc.*, and with much crystallized calcite. This last limestone I regard as equivalent to the whitish limestone of Humboldt, and from its associated beds I would, in the absence of better evidence to the contrary, refer it to the age of a similar limestone very well exposed on the hill tops a few miles south of Ft. Scott and named by Prof. Swallow in his Geological Section of Southeastern Kansas, as the "Pawnee Limestone." We would also recommend a comparison of this limestone with another known limestone of Bates County, Missouri, occurring there less than twenty feet below the Mulberry coal, and described in Mo. Geol. Rep. 1874.

The occurrence of this limestone at Iola, Humboldt, Chanute and Galesburg would indicate a southerly dip. From Iola there is also a regular northern and western dip.

A half mile south of Galesburg we find twenty-five feet of sandstone and shales reaching to the bed of the creek. The connection of these with the Galesburg limestones was not seen and I was disposed to assign the sandstone to a lower horizon. But it may be possible that it is higher in the series and have a southern dip which has brought it into its present position. No local dip was observed, but if there is, it is then the equivalent of the Thayer flagstones. It is flaggy at both places

Sandstones do occur about forty feet below as well as thirty-five feet above the white limestone. At the railroad quarry, two miles north of Chanute, we find on the hill-top a bluish gray limestone. The sandstone below shows an outcrop of twenty-three feet including layers of good building stone. Three miles east and across the Neosho River the sandstone extends to the hill-top, and at the base of the hill we find the white limestone. There must, therefore, be about fifty feet of this sandstone in this vicinity. At the head of Chetopah Creek, half way from Chanute to Thayer the sandstone crops out in thick beds. A similar sandstone has also been extensively quarried at Neodesha in Wilson County where it shows on the surface some remarkably interesting fucoids.

From this general view of the Neosho Valley rocks we pass to a special description of the Thayer coal.

The town of Thayer, Neosho County, is situated on the summit of a gently sloping ridge, descending eastwardly to a valley by a long and gentle slope, the same ridge descending more abruptly to the west. The highest rock at Thayer is a sandstone in flag-like layers. From the hill-top to the coal is fifty feet, the lower twenty feet of which is occupied by thinly bedded sandstone, the layers becoming much thinner near the coal and also more argillaceous.

The coal in the shaft is, when drifted on, from fourteen to eighteen inches thick. In some places the overlying sandy shales rest directly on the coal. When these shales are free from sand they often abound in fossil leaves of various plants, chiefly of ferns, some of them in an excellent state of preservation.

The coal is mined two to four miles south of Thayer, just west and northwest and six miles west, or over an area of about six miles square, employing in December, 1881, about 100 miners.

At Dickson's shaft the coal rests on four feet of underclay, below which the miners report a thin limestone layer resting on about twenty feet of clay shales. A half mile down the creek I observed a disintegrating limestone at six feet below coal. For two miles west I observed no marked change but observed a limestone in bed of creek at thirty feet below the coal. On the bluffs of the Little Chetopah Creek, in Wilson County, four miles southwest of Thayer, we find the coal separated by a clay band. Above the coal there is twenty-five feet of sandstone —the upper in thick brown beds, the lower in thin blue laminæ.

The coal is here divided thus:

10 inches—Coal.
6 inches—Blue clay shale.
6 inches—Coal.

The blue shale contains knife edges of coal. At Babcock's, six miles west and one mile south of the Thayer road, the coal is still divided, thus:

1. Thick bedded sandstone.
2. 15 feet thin bedded sandstone.
3. 5 inches coal.
4. 1 inch laminated clay.
5. 8 inches coal.
6. 6 inches laminated clay.
7. 6 inches coal.
8. 1 inch black laminated coaly shale.
9. 4 inches coal.
10. Fire clay.

Further in the drift we observed:

Coal, 6 inches.
Clay, 1 foot.
Coal, 10 inches.

One and a half miles north the coal is separated by five inches of blue clay shales, and a thin limestone band is insinuated in the overlying clay shales. Sandstone crops out above. Twenty-five feet below the coal we here observed layers of ferruginous limestone conglomerated in three layers of 6 inches, 4 inches and 8 inches with 4 feet of clay shales beneath. One mile still further north the coal and its associated rocks appear thus:

1. Thin layers of deep blue limestone.
2. 2 inches roughly bedded limestone.
3. 1 foot of drab calcareous shales.
4. 20 inches of deep ash-blue pyritiferous limestone, containing remains of *crinoideæ* including fragments of *Zeacrinus microspinus.*
5. 2 to 6 inches brown calcareous shale.
6. 10 inches coal.
7. 4 inches blue laminated shales.
8. 9 inches coal.
9. 2 feet fire-clay.

A quarter of a mile west observed as follows:

1. 4 feet blue clay shales.
2. 6 inches blue limestone.
3. 6 inches brownish gray calcareous shales.
4. 4 inches of limestone—No. 4 of last section.
5. 5 inches brown shale.
6. 9 inches coal with thin coal seams.
7. 4 inches blue clay.
8. 5 inches coal.

A quarter of a mile northwest we still find some changes with the following section:

1. 2 feet brown and drab limestone.
2. 6 feet of dark shale, the lower 1½ feet thinly laminated bituminous shales.
3. 0 to 1 foot blue concretionary limestone.
4. 10 inches thinly laminated calcareous shales and concretionary limestone.
5. 3 feet sandy and clay shales.
6. 6 inches blue clay shales.
7. 10 inches coal.
8. 4½ inches clay.
9. 6 inches coal.

We thus find that in passing west, the coal is divided by clay bands, and that beds of limestone become insinuated in the superincumbent shale beds. But the total thickness of the coal does not diminish. The fossil flora formed in the shales near the coal is peculiarly interesting including, as it does

Calamites—2 species. *Lepidodendron brittsii.* Lx. *Sigillaria. Neuropteris* 2 or 3 species, probably *N. loschii, N. hirsuta, N. rarinerois, N. angustifolia, Sphenopteris, tridactylies, alethopteris, serlii. Pecopteris squamosa. Annularia longifolia. Stigmaria, etc.*

In the sandstones above, good specimens can also sometimes be obtained of ferns, *Lepidodendron*, *Calamites* and *Sigillaria.* From the railroad we can see three noted mounds about seven miles northwest from Thayer. The highest is about 125 feet above the adjacent plain and ridge on which Thayer is situated, and is capped by broken layers of limestone. Other mounds can also be seen in the distance.

PLEASANT HILL, MO., May, 1882.

PHILOSOPHY.

THE CAUSES AND CONDITIONS OF KNOWLEDGE.

BY R. J. M'CARTY.

There is a difference between the cause of a thing and the conditions which make it possible. Thus time and space are two of the conditions which make existence possible, yet they do not cause it. Therefore, when we have treated of a subject with reference to its causes, up to a point beyond which the human mind is incapable of proceeding, we may still inquire into its conditions.

The object of this paper is to treat of *knowledge* in this manner, viz:

To define the limits within which it may be treated as the effect of some cause.

To treat of the conditions of its possibility—conditions without which there could be no such thing as knowledge and which obtaining make all knowledge possible—and to show that neither the causes so far as traceable nor the conditions as developed indicate that any of our knowledge is innate.

Truth is possibility. Fact is possibility realized. Idea is a modification of mind produced in any manner whatever. Object is anything capable of producing idea. The act of consciousness is the culmination of mental effort.

Knowledge cannot be defined, for to do so would require a state of mind superior to that produced by its acquisition.

The utmost effort to discover the causes of knowledge must conclude that it results from an inexplicable operation of the mind called the act of consciousness, (inexplicable because it lies above knowledge), by which the object producing an idea is recognized in its *true* relation to the nature of things. Therefore the act of consciousness marks the limit beyond which we may not proceed in inquiring after the causes of our knowledge The conditions necessary to the proper operation of this act of consciousness will therefore be the conditions necessary to the possibility of knowledge.

Now it is evident that no knowledge would be possible without the conditions of Fact or Truth, Mind, Idea and Consciousness: but these are not all the conditions necessary. There can be no knowledge without conviction, for no man can know a truth and not believe it, and if he fail to believe truth it is because he does not know it.

Still there may be conviction without knowledge—for instance, for a long time men believed that the earth stood still and that the stars revolved around it, and their conviction was as firmly established as if such had actually been the case. They certainly did not *know* that the earth moved, nor did they know that it stood still, for it did not. Therefore they knew nothing whatever about it. They were mistaken. Hence, we may say that conviction, without knowledge is error.

Again, the knowledge of no man is superior to his conviction nor is there any difference between the processes by which knowledge is gained and conviction established, because no man will investigate what seems to be a truth, further than to establish his conviction concerning it. If he stops short of conviction he will confess that he has gained no knowledge, but if he reaches it, it will be impossible to get him to proceed with his investigation until his conviction is shaken. And, furthermore, every man's conviction, though wrong, is the same to him as knowledge until he has found his error. From which it must follow that conviction results from the same act of the mind as that producing knowledge, with the difference, however, that the object producing an idea is recognized in a particular relation to the nature of things, which relation may be true or false. It is evident then that knowledge is impossible without *true* conviction.

Again, should the contemplation of different objects produce the same idea, we should not be able to distinguish one object from another, and should an object at one time produce an idea different from that produced at another, we should not be able to recognize it. So that in order for knowledge to be possible it is necessary that each object should always produce in the mind a particular idea and no other, and that this idea should be different from that produced by any other object whatever. This is the well known condition of Identity and Diversity of Idea, which involves both mind and object, and renders necessary an adaptation of the one to the other.

It will be seen that this condition does not require that the idea should represent the object just as it is—that is, the condition of Identity and Diversity will be fulfilled if the idea be either a symbol, or an image of the object, and hence arise those numerous disputes about the doctrine of perception into which philosophers enter by contradicting each other—seldom carry far without contradicting themselves and which often end in useless wars over the meaning of words.

But to proceed—knowledge in general may be divided under three heads, Knowledge of Fact; Knowledge of Law and Knowledge of Necessity. Knowledge of Fact arises from the consciousness of those ideas produced in the mind by perception. Such knowledge is possible with the conditions of Fact, Mind, Idea, Identity and Diversity of Idea, the act of consciousness, and true conviction.

Knowledge of Law arises from a consciousness of the relations between facts and involves an action of the mind about its Knowledge of Fact which action, not being spontaneous, must be determined by something.

Now everything of which we are sensible must, we are compelled to think, be the effect of some particular cause or causes. This is called the Notion of Causality and is what prompts the mind to seek for the Knowledge of Law.

The process of reducing cause to effect must stop at a point immediately beyond which lies the absolute or unknowable, which has been demonstrated to be the one and indivisible cause of all that is. What the nature and attributes of the absolute may be is a theological question which does not concern this paper other than that it is the creator of law and the author of existence.

Now, whether this first cause may or may not be capricious we have no means of knowing and thus it happens that Knowledge of Law having for its basis the arbitrary will of the Absolute is colored with a feeling of dependence upon that will for its persistence. The conviction accompanying such knowledge is based upon the known constancy of this will in the past, but can never be pure unless we could know that this constancy could extend to all future time. And thus it happens that we are able to conceive all Knowledge of Fact, and with it all Knowledge of Law to become void. Hence those sciences which have the Knowledge of Fact for their basis, and which are but the Knowledge of Law systematized, such as mechanics, natural philosophy, chemistry, etc., are all dependent upon the uniformity and persistence of natural law. We see therefore that in addition to those conditions necessary to a Knowledge of Fact, a Knowledge of Law could not be but for the Notion of Causality and would be impossible unless nature is uniform.

We now come the Knowledge of Necessity. Necessity is that which must be and which being it is impossible should not be. It must, therefore, be independent of fact and (so far as we can know) independent of the will of the Absolute, and must persist if persistence is possible.

Now *propositions* which are independent of phenomenal existence are true if they are possible. Their truth determined renders their falsity impossible, and we cannot conceive them to be dependent upon any contingency for their persistence. Take the proposition "things which are an equal to the same thing, are equal to each other." While the practical application of this truth depends upon existence, the truth itself does not, nor can we conceive it possible that the universe could be wiped out and rcreated without this proposition reasserting itself.

The case is different with natural law. For instance, the law of gravitation would vanish with matter but need not reappear with it.

Propositions which are independent of existence, in the sense just illustrated, are therefore emblems of necessity, and our knowledge of necessity must result from the determination of the truth or falsity, or what is the same thing, the possibility or impossibility of them. Now these propositions are of two kinds: knowable and unknowable. It will, therefore, be necessary to distinguish them.

No one can conceive of an impossible thing, and whosoever thinks he can will find by reflection that his conception is of something which is not, in his opinion, likely to happen. For instance we can conceive of the Gorgon's head, the winged horse and the golden fleece and such things are possible, but by no means probable. Still, possibility is not limited by conception.

Take the proposition "space is limited." We cannot conceive of a limit to space without conceiving of space beyond that limit. We cannot conceive of space as boundless, for we cannot conceive of infinity. Yet we know that space is either limited or it is not. The proposition is unknowable, and so is *any* proposition neither extreme of which is conceivable. Again, these propositions, being either true or false, there cannot be one of which both extremes are conceivable because one must be impossible. The only propositions, therefore, which are knowable are those of which one extreme is conceivable, the other not.

(This is substantially the Principle of the Conditioned as enunciated by Sir William Hamilton.)

Knowable propositions are of two kinds, self-evident and demonstrable, or to be less general, axioms and theorems. Axioms are called self-evident because the mind comes by the knowledge of them apparently without effort.

Now since these propositions, as well as the human mind, may be regarded as independent of phenomenal existence, it was thought necessary by many philosophers to account for the knowledge of necessity as it obtains with us, just as they would, did there exist nothing but mind and truth. This view, of course, necessitated a relation between mind and truth which would be independent of fact, and as it was impossible to see how the mind could be affected by abstract truth except through the medium of fact, many philosophers got rid of the difficulty by assuming the ideas of axioms to be innate. But it would do just as well to assume that these propositions in some unknown way affected the mind and it would be more philosophical.

Still, in either case, more would be assumed than could ever be proven. To deal with this question it must be treated just as it is presented to us, and in this aspect we will endeavor to find the conditions of the possibility of necessary knowledge. It cannot be denied that we *could* gain the knowledge of axioms just as we do the knowledge of law. Nor can it be denied that we get the knowledge theorems by reasoning from axioms in precisely the same manner that we get the knowledge of law by reasoning from fact.

Moreover, the notion of causality is as necessary to the knowledge of theorems as it is to the knowledge of law. So that if we for convenience deprive axioms of their attribute of necessity (which will in no way invalidate our reasoning) and place them in the category of natural laws where, in fact, they would then belong, knowledge of law and knowledge of necessity would become identical and the conditions of the one would become the conditions of the other. This shows that the knowledge of law and the knowledge of necessity may be obtained under the same conditions, and that since no one ever held the ideas produced by facts to be innate, those produced by axioms should not be so considered.

The only objection to this conclusion would be that in order to reach it it was necessary to reduce axioms to the category of natural laws, where they do not belong and that if we restore their attributes of necessity we would get a knowledge different from the knowledge of law. This is true, but by what is the difference determined? The answer is by a difference of conviction alone.

Giving back to axioms their attributes of necessity and we find the only effect is to strengthen our conviction of their truth so as not to be shaken by anything of which we can conceive. It only remains to account for the manner in which the mind becomes possessed of this distinctive conviction. We have shown that a proposition to be knowable must have one of its extremes conceivable, the other not.

Now the question "Is a proposition knowable?" is as important as the question "Is it true?" for our criterion of truth cannot be higher than our criterion of the limits within which truth may be investigated.

Whence the following enunciation: When the mind can conceive of the possibility of a proposition which is independent of existence and cannot conceive of its impossibility, the proposition is knowable and possible and true. This then is the mind's criterion of truth. But since we may imagine ourselves to conceive when we do not and fail to conceive when we can, the following is also true: When the mind has apparently conceived of the possibility of such a proposition and apparently cannot conceive of its impossibility, the proposition may be knowable or unknowable possible or impossible, true or false Knowable, possible and true if the conception is real, unknowable or impossible and false if the conception is imaginary. From which it would seem that the criterion enunciated is of little value.

But granting it to be fallible, it is still sufficient to establish in the mind that peculiar conviction which accompanies the knowledge of necessity and by which alone such knowledge is distinguished. Because necessary propositions are such that their possibility determines their truth. So that whosoever conceives the one must conceive the other, and no man can conceive such a proposition to be true and not believe it—and moreover he cannot then conceive the proposition to be false. It is thus therefore that the mind gets its distinctive conviction of necessary truth. It is by this conviction that knowledge of necessity is recognized as such, so that without it all our knowledge would be as of one kind.

In support of what has been said can be cited the credulity of the untrained mind which often accepts as truth the uttermost absurdity. The caution of the trained intelligence which often runs to extreme skepticism, and the fact that none of the results of reasoning from either axioms or facts can ever be entirely emancipated from the probability of error. All of which while pointing to the fallibility of the mind's criterion of truth indicates its nature.

It therefore seems reasonable to conclude that the mind gets its ideas of necessary truths through the medium of *fact* somewhat as it gets its idea of a true through the medium of light, and as the sense of touch would prove the true to exist in the absence of light, so the criterion laid down would prove truth to persist in the absence of fact; that the knowledge of necessity is known only as such by the peculiar conviction accompanying it; that this conviction is a condition of the knowledge of necessity being recognized as such but is not a condition of its possibility; and that innate ideas are not to be found among the causes and conditions of knowledge, and, hence, do not exist.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, June 3, 1882.

M. Loyet has published a very remarkable work on the Health and Disease of the Peasantry, contrasting those of France with the rural populations of other countries. The author commences by studying the influence of soil and the nature of land. Marshy districts play the most important role in the question, and are of three classes: those connected with the seaside, the offspring of rivers, or inland lakes. On the shore of the Mediterranean, from Nigues-Mortes to Perpiguan, the death rate is very high; there are localities where the mean average of life hardly attains the two-thirds of the total rate for all France, namely:—24 instead of 36 years. There are also some agricultural industries which necessitate veritable marshes, such as the cultivation of rice, and the steeping of flax and hemp. These bring about an alteration of water and air.

On the west coast of France, there are extensive salt marshes to the deleterious influences of which the population has to submit. Then there are also extensive bogs. In the country, the inhabitants are more affected by the influences of the soil than in the case of towns; in the latter, the state interferes to connect the insolubrity and encourages hygiene. The dwellings of the peasantry are a fruitful source of disease; in the most smiling districts of France, where vegetation is most vigorous, the peasants' houses will ever be found to be next to buried in the soil, and deprived of almost openings. It is the same picture for all France; the rooms serve for every usage, and between the accommodation for the inhabitants and the domestic animals, the separation is but slight.

In the mountainous regions of the Alps and the Iura, the cottages are miserable, they are constructed in wood, covered with green turf, with an aperture at the top for chimney and ventilator. The residents live in an atmosphere of smoke. At the sides of the hut are annexes filled with dry leaves or maize straw; these form the bed-rooms. On an opposite side, the domestic animals are housed, but only for the night. M. Loyet attributes the principal cause of the insolubrity of rural habitations to their defective walls, which permit humidity to enter. The thatched roof he admits may be thick and solid, but it rots quickly, and is the refuge for horrible worms. The earthen floor is objectionable, and wherever one in wood, tiles, or flags can be laid down, it ought first to have a sub-stratum of broken stones and mortar. a concrete bed in fact.

The dwellings are invariably overcrowded, and the rarity of windows is the natural consequence of the baneful tax on doors and windows. The average "openings" per each house-occupant, is for fifty-three more than the one-half of the departments of France, a little above one, and, as this sad condition exists chiefly in the rural districts, disease follows regularly in the wake of habitations so constructed. Respecting manure heaps and fœcal drainage, it is the old story. As to the dietary of the peasants, it is very defective; the bread is too often mouldy; but then there are localities where it is baked for months in advance. Ordinarily the regimen is maize, oat meal, buckwheat and millet, and consumed in the form of porridge. When the grain is diseased, as in the case of ergot rye, the consequences can but be deplorable, but damaged maize produces the malady of *pellagre*, only second in point of disaster, as Lombardy and Venetia can testify. In reference to *pellagre*, misery is not the cause of the scourge, but rather a favorable medium for its development. It is unknown among the poor of Ireland and Silesia, and is due, according to Professor Lombraso, to degeneracy of the grain, caused by parasitical mushrooms, and that induce the formation of a toxical alkaloid.

Being rather accustomed of late to the visits of comets, may explain why no very marked interest is taken in the present visitor. It travels at the daily rate of three millions of miles, nearly double that of our earth's diurnal rotation round the Sun. Its tail, always foremost, turned toward the Sun, like every comet's, presents the form of a plume of feathers, and is estimated to be 600,000 miles in length. Other comets have had tails from 120,000 to 240,000 miles long. However, the tails are only rays of light, transparent and imponderable. Spectral analysis has shown that carbon and hydrogen are the predominating elements of such luminous volumes; were they to affect the constitution of our atmosphere, the result would be grave; a diminution in the proportion of oxygen, would plunge us into a state of heaviness and lethargy, while an augmentation would bring about a condition of exhilaration and nervous excitement, caused by the rapid combustion of the blood in the lungs and arteries, not less fatal. No fear is to be apprehended under the head of a collision, the comet is not a "star of terror." Some comets have attained one million and a half miles in diameter; that of 1811 had a tail one hundred and thirty-two millions of miles. But density is wanting, and so they could not make an incursion into our atmosphere. However, they have been launched with such a formidable velocity, and their temperature is so elevated, since their elements are in a state of incandescence, that some of their *noyaux*, or kernels, have appeared composed of an aggregation of aërolites immersed in a burning gas. If a rencontre took place, though it would not be mortal, it would certainly not be inoffensive.

The role of comets in the universe is still an enigma; they seem to be an exception in the general harmony of the movements of the heavenly bodies. Do they voyage from one star to another, or do they circulate from systems to systems? Some in traversing our planetary system have been attracted by the power of Jupiter. Saturn and Uranus remained captive, a permanent addition to our solar world. If a comet escapes the sphere of planetary influence, it will travel during eternity in the void of ether. It is presumed that comets are some nebulosities abandoned at the commencement of the solar world, some external scraps of that primitive nebulosity of which the sun, the earth, and planets are the condensations. The central-fire of our system attracts them, they flit round it as moths around a flame. Other comets may have originated from other systems, ruins, representatives of "the wreck of matter and the crush of worlds." Kepler believed, that comets were as numerous as the fish of the sea. Analysis of cometic light reveals it to be analogous to that of the flame of alcohol, that is to say, contains the elements carbon, hydrogen and oxygen, the primordial constituents of organic life. If the comet has come from the nearest star, that represents a traveled distance of twenty-four thousand millions of miles.

The angry discussion taking place respecting the addition of alcohol and sugar to wine, presents so many scientific features, as to merit examination. The wines produced in many regions of France, and notably the south, are liable on account of the large quantity of sugar they contain, to undergo after being placed in hogshead, to a new fermentation, which profoundly alters their character. The addition of alcohol stops this fermentation, and so enables the wine to be exported to distant countries. In the preparation of artificial wines and liquors the fermentation of the must is stopped, in order to conserve the natural sugar of the grape; then alcohol is added to impart body. Not a few vineyard proprietors employ sulphur for this process but it is less efficacious and unhealthy. The addition of sugars to the must, augments the alcoholic richness of the wine, since fermentation of the sugar yields the spirit. Increasing the alcoholic strength of wine not alone imparts to it the qualities of generosity and conservation, the process diminishes also the acidity of the wine. Tartaric is the dominant acid in wine, but it is combined with potash, under the form of bitartrate, and which is precipitated in the form of crystals on the sides of the hogsheads. Now the solubility of that acid in wine, diminishes in proportion with the quantity of alcohol present. Further, as the coloring matters of wine are more soluble in alcohol than in water, the addition of alcohol develops the color of wines.

But this important point must be kept in view; if it be intended to add sugar to a must poor in that substance, the sugar ought to be of the same nature as that peculiar to the grape. Now, crystallized beat-sugar supplies this want. In a year when the sun's heat and light are defective, the grape is deficient in sugar but rich in acid; hence, the addition of beet or cane sugars supplements an absent sun; that sugar ferments in the same conditions and produces the same alcohol as the natural sugar of the fermenting fruit. Glucose, that is syrup prepared from maize or wheat, is wholly unsuitable.

After a first fermentation, and a drawing off of the wine so resulting if more sugar be added to the contents of the vat, an excellent second, and even a third small wine can be prepared, called *piquette.* Vineyard proprietors with good brands assert, the wine industry of France will lose its reputation, and will cease to be remunerative, if facilities are afforded to manufacture wines, by conceding latitude to add alcohol directly, or indirectly by the use of sugar to induce extra alcoholic fermentations.

HISTORICAL NOTES.

KANSAS IN 1786.

BY J. R. MEAD.

Any facts bearing upon the early exploration, or history of Kansas or the Missouri Valley, should be carefully collected and preserved in some form accessible to the future historian; I therefore give the REVIEW an item which possibly may be of interest.

In the spring of 1860 I was in camp upon the north bank of the Smoky Hill River, about two miles east of Cedar Bluff as then known in what is now the county of Ellsworth, and some forty miles west of Salina, Kansas. The south bank of the river was a steep bluff of sandstone from the summit of which the table land extended back to the divide. While hunting buffalo upon this table-land I noticed quite a deep ravine extending a mile or more back, with a number of lateral branches, and apparently emptying into the river nearly opposite my camp. Not having noticed any opening in the bluff I concluded to follow the ravine to its outlet, and, to my surprise found it ended in a cave about two hundred feet from the river which was as far back as the sandstone extended. On entering this cave I found it had been formed by a small stream of water running from the table-land over the bluff, and in time cutting a narrow, crooked channel from one to two feet in width down to the level of the river, and in course of ages it had widened out at the bottom into considerable chambers, and the soil from the ravine had washed through it into the river.

As soon as my eyes became accustomed to the imperfect light of the cave I discovered its walls were covered with hieroglyphics and representations of all the animals common on the plains, and others to me unknown, also battle scenes and figures of men with an arrow across the body. The figures of men were made with a triangle for the head, and another for the body. These figures appeared of great age, many of them overgrown with moss, and were ruder and different from the representations of men and animals made by the wild tribes of the plains at that time.

While studying these interesting characters, to my surprise I saw letters in a language I could understand, and on rubbing off the moss there stood revealed, carved by the hand evidently of an educated man, the name and date "T V R E D O, 1 7 8 6." The letters and figures were about an inch in height, of beautiful proportions, and of uniform size and slope. I could discover no other evidence of civilized man having visited the spot.

A careful examination of the cave at this spot satisfied me that the walls had remained in the form I then saw them unchanged, perhaps, for centuries. On going around to the river outlet of the cave, I found the walls covered with hieroglyphics, but not in so perfect a state of preservation. I intended to make a sketch of the representations on the walls and to explore further in the dark and crooked recesses of the cave, but on the second night we heard the distant sound of drums up the river, and on going to the top of Cedar Bluff saw the valley lighted by the camp-fires of the wild Indians. Hastily gathering up our effects we drove rapidly down the river, and I have not visited the place since.

Will some tell us who Mr. "T V R E D O" was and what he was doing in the heart of Kansas in the year 1786.

TREATIES WITH INDIAN TRIBES FOR LAND IN MISSOURI.

BY JOHN P. JONES, KEYTESVILLE, MO.

Within a year after the treaty of peace with Great Britain in 1783, our Government began a system of treaties with the various Indian tribes living in its territory with a view of definitely locating the districts in which they should be allowed to live and hunt unmolested, and rendering them a compensation for the territory which they relinquished to the whites. After the acquisition of the Louisiana purchase in 1803, a part of the area of which, is embraced in the State of Missouri, the Government continued its treaties with the Indian tribes claiming rights and privileges therein, realizing that it owed a duty to the hardy spirits who were pushing across the Mississippi, to bring to their firesides as much as possible, a sense of security from Indian attacks, that they might be the better enabled to prosecute the development of the newly acquired country.

Our State historians have universally omitted any reference to these treaties by the Government for the friendship of the Indians, and the extinguishment of their claims on our lands, though they were of first importance to our pioneers, securing to them, as they did in a great measure, immunity from midnight assaults and depredations, and the restoration of friends held as captives, and property previously stolen.

Were it not for benefits of this nature there would be something ludicrous in our Government solemnly treating with the tribes that it did, for that portion of our State lying north of the Missouri River. They had driven the Missouris, lately scourged by an epidemic, from their homes, and were claiming the country from their ability to hunt over it and raid through it, owing to the near location of their villages to its borders. This claim, however, was prudently acknowledged and treated for by the Government on three different occasions. The first treaty for any part of our State north of the Missouri River, was negotiated at St. Louis, Nov. 3, 1804, by Wm. H. Harrison, Governor of the Territory of Indiana and superintendent of the Indian affairs for that territory and the district of Louisiana, on the part of the United States and five chiefs of the Sac and Fox Indians for their tribes. The second article of this treaty stipulates that "the general boundary line between the lands of the United States and of said Indian tribes shall be as follows, to-wit: beginning at a point on the Missouri River opposite to the mouth of the Gasconade River, thence in a direct line so as to strike the river Jeffreon at a distance of thirty miles from its mouth and down the said Jeffreon to the Mississippi, thence up the Mississippi to the mouth of the Wisconsin River, and up the same to a point which shall be thirty-six miles in a direct line from the mouth of the said river, thence by a direct line to Fox River branch of the Illinois, thence down Fox River to the Illinois, and down the same to the Mississippi."

By this treaty the Government acquired the eastern portion of the State lying north of the Missouri River, the northwestern part of Illinois and the southwestern part of Wisconsin. The consideration paid was $2,234.50 in goods paid down, and the promise of $1,000 worth to be delivered at St. Louis, yearly. Among the chiefs who signed this treaty were Jumping Fish, Sun Fish and Bear. This treaty was assented to or re-ratified at Portage des Sioux, St. Charles Co., Missouri, on the 13th day of September, 1815, William Clark, Ninian Edwards and Auguste Chouteau acting as commissioners for the Government and thirty-four Sac and Fox chiefs on the part of these tribes, among them Big Eagle, Sturgeon, The Devil, and He-that-Stands-by-the-Tree, of the Sacs, and Sur, Quick Riser, Scenting Fox, White Skin and others of the Foxes. The object of this ratification was to re-establish the peaceful relations existing between the parties thereto, prior to the war of 1812, which had been disturbed by emissaries of Great Britain.

The Sacs and Foxes who had been parties to this treaty and to its subsequent ratification were a division of these tribes that had removed from Wisconsin, across the Mississippi and hunted from that river to the Missouri. On the 13th day of May, 1816, the Sacs and Foxes of Rock River, Wisconsin, entered into a treaty of assent and ratification of the treaty of 1804 at St. Louis, Mo., confirming that and all other contracts and agreements heretofore made between the tribes and the United States. Messrs. Clark, Edwards and Chouteau were the commissioners for the Government, and the Indians were represented by The-One-Who-Speaks, Jumping Sturgeon, Bad Axe, Bad Weather, Swan-Whose-Wings-Crack-When-He-Flies, and others. No consideration was expressed in the terms of this ratification and none paid except presents to the chiefs who were parties to it.

The treaty of 1804 and its subsequent ratifications contributed with other causes, to bring on the Black Hawk War. That warrior contending that the chiefs who were parties to it in 1804 had separated from the nation and consequently were without authority to act, and that those who ratified it in 1816 received no compensation and their assent to it was obtained while they were under the influence of liquor.

Eight years after this last ratification a party of Sac and Fox chiefs and head men fully deputized to act for and in behalf of their said nations, visited Washington, D. C., in company with deputations from other tribes and negotiated another treaty with the Government represented by William Clark, Superintendent of Indian Affairs.

Article first stipulated that the Sac and Fox tribes cede, relinquish and forever quit claim unto the United States all right, title, interest and claim to the lands which the said Sac and Fox tribes have or claim without limits in the State of Missouri which are situated lying and being between the Mississippi and Missouri Rivers, and a line running from the Missouri at the entrance of the Kansas River, north one hundred miles to the northwest corner of the State of Missouri, and from thence east to the Mississippi.

This conveyance it will be seen includes all the territory of the present State of Missouri, north of the Missouri River, and the Government agreed to pay as a consideration fifteen hundred dollars in cash and one thousand dollars for ten years. Among the chiefs who were parties to this treaty were All Fish, Crouching Eagle, Wrathful Fox, Rising Cloud and White Nosed Fox.

This treaty ended the dealings of the Government with the Sacs and Foxes for Missouri territory, and when we consider the slight claims they had to the country conveyed, we cannot help concluding that the consideration paid was more in the nature of a bribe to induce good behavior than for value received. These Indians were interlopers on any territory west of the Mississippi, they being of Algonquin stock and had made their home for centuries about the great lakes. When first known to the whites their home was near Lake Erie on the Canada side. About the year 1650 they moved west and located near Lake Michigan, finally settling on Fox River and its tributaries in Wisconsin, where they remained for a century and a half. Here they were found in 1670 by Father Allonez, the Jesuit missionary, who says in his relation of that year, "The 16th day of April I embarked to go and commence the mission of the Outagamies (Foxes) a people well known in all these parts. The 17th we went up the river St. Francis, and after having advanced four leagues we found the village of the Indians named Saky (Sacs). The 20th we arrived in a river that came from a lake of wild rice which we came into and at the head of which we found the river which leads to the Outagamies." Father Allonez found the Indians very much dejected on account of the loss of several of their families who had been captured near Lake Michigan by a party of Iroquois warriors.

From this date these Indians are freqently mentioned by the early explorers of the lake country. In 1671 their chiefs were present at the congress of tribes at Mackinaw when St. Lusson took possession of the west in the name of the French king. In October, 1679, Hennipin and LaSalle met a party of them on the south shore of Lake Michigan, and two years later Hennnpin passed through their villages on Fox River, when returning from captivity among the Sioux. LaSalle visited their villages in 1681 in search of his men who had been driven from the Illinois country by the Iroquois, and heard from them of the safety of Tonty and the others. Father Charlevoix, the celebrated Jesuit who traveled through Louisiana in 1720-1, spent some time with the missionaries among these Indians in 1721, and urged the Sacs to greater respect for their Missionary if they hoped to retain the favor of the French King. Jona Carver the first prominent native American traveler in the west, was among these Indians in 1766 and mentions that one village of the Sacs could furnish three hundred warriors.

There was nothing in the character of the Sacs and Foxes in any way differing from the other Indians of the west and in an intercourse of one hundred and fifty years with the whites, Black Hawk is their only warrior that has won distinction.

But the Sacs and Foxes were not the only Indians who claimed an ownership in Missouri. The Ioways put forward a claim to the country and on the 4th day of August, 1824, the Government entered into a treaty with them at Washington, D. C., by which it was agreed that the Ioways cede forever quit claim and relinquish to the United States all the right, title, interest and claim to the lands which the said Ioway tribe have or claim within the State of Missouri and situated between the Mississippi and Missouri Rivers and a line, which has been run and marked by Colonel Sullivan, running from the Missouri, at the mouth or entrance of the Kansas River, north one hundred miles, to the northwest corner of the limits of the State of Missouri, and from thence, east to the Mississippi. The consideration paid the Ioways was five hundred dollars in cash and the promise of five hundred dollars to be paid annually for ten years. They were represented by Mah hos-kah, or White Cloud, and Mah-ne-hah-nah, or Great Walker, and this was the first treaty with the tribe in which they disposed of any land.

This tribe had more right to treat for the disposal of Missouri territory than the Sacs and Foxes. Their hunting-grounds were on the water-courses that flowed to the Missouri River and they frequently made incursions into the territory when the Missouris held sway there, they were of the great Dacotah family whose natural home was west of the Mississippi, and they assisted in driving away the remnant of Missouris, hence their claims may be said to have had some foundation.

Of the many perversions and changes that have taken place in the names of our Indian tribes, that of Ioway, (or Iowa, as now spelled), is not more marked than that of many others but an explanation of this instance will serve as an index to the many errors with which our Indian nomenclature is crowded. The word Ioway has been made up from the Dacotah designation of the tribe, Ayuliapa, by taking the first two syllables Ayu, and adding to it one of the common French terminations to tribal names, either *vois*, *vais*, or *ouez*, as this was the manner in which the name first appears in early French annals. For instance in LaHarpe's narrative of LaSuer's expedition to the Blue Earth region in 1700, they are mentioned as Ayavois; in Penicaut's narrative of the same expedition they are called Aiavos. Charlevoix in his History of New France, 1722, speaks of them as Aiouez. On the map of De Lisle, published at Paris, 1703, in what is now the State of Iowa, on a small stream an Indian camp is represented with the following legend, "Village des Aiaoues on Pantez." One hundred years later Lewis and Clark mention them as Ayauways. Lieut. Z. M. Pike who ascended the Mississippi in 1805, mentions that the Aiowais were called Nez Perce by the French, which means pierced noses, but why he does not state, nor is it true that this tribe were more in the habit of wearing ornaments in their nose than others.

The name which the Ioways gave themselves is Pa-hutchae, which means dusty heads. The prefix "Pa" anciently signified head, and the origin of the name is accounted in the fact that they lived for many years on the Upper Missouri and were accustomed to bathe in its yellow muddy water, and when they dried off after coming out, the sediment of the water remained on their heads making them look dusty and gray.

The first mention of the tribe is found on Marquette's map drawn in 1673, where under the name Pahutet they are located as living on the Missouri above the Omahas and Otoes, and which was their location until the establishment of French posts on the lakes and near the Mississippi drew them east for the purpose of trade.

The friendly relations existing between the Sacs and Foxes and Iowas at the beginning of the present century did not date back to the time when the tribes first became known to the French. Under date of July 10, 1700, Father Marest of the Jesuit Mission on the Illinois, wrote to Le Suer as follows: "I have the honor to write in order to inform you that the Sauks (Sacs) have been defeated by the Sioux and Ayavois. These people have formed an alliance with the Kickapoos, Mecoutins, Foxes and Metsegamies and have gone to revenge themselves, not on the Sioux for they are too powerful, but perhaps on the Ayavois, or more probably upon the Osages who suspect nothing.

BOOK NOTICES.

Appleton's Annual Cyclopædia. Vol. XXI, 1881. Octavo, pp. 905; cloth, $5. For sale by L. B. Bailey, General Agent, Kansas City, Mo.

This is the sixth volume of the new series, and the twenty-first of the whole series. The publishers truthfully and aptly say, "It has grown in size to meet the increased activity in human affairs and to present the interesting public questions and scientific developments which have arisen and the discussion of their principles."

Among the historical subjects presented, none is more interesting at the present time than the summary of the Garfield assassination; the trial of Guiteau; the discussion of the insanity question; the history of the treatment of the President's case, etc. All of the stirring events in South America, Russia, Germany, France, Italy and Spain, are carefully summarized under proper heads by the most competent writers.

The progress of science is given with unusual minuteness and accuracy, whether in chemistry, philosophy, engineering, electricity, physics or zoölogy.

The results of the 10th Census are given a large space and illustrated with reduced copies of the maps showing density of population, native, colored and foreign.

Four fine steel portraits, as usual, embellish the volume, viz: Longfellow, Blaine, President Arthur and Gambetta, in addition to which are numerous maps and other illustrations.

No book or publication of any house in the United States equals this in value or importance to the reading public. Each volume brings the world's history forward in a convenient, comprehensive and strictly reliable form and at a price within the reach of all classes.

Gateways to the Pole. By Silas Bent. 8vo. pp. 40; R. P. Studley & Co., St. Louis.

This address was delivered before the St. Louis Mercantile Library Association upon the thermal paths to the pole, or the currents of the ocean, and shows the influence of the latter upon the climates of the world. The author speaks of the currents of the ocean with all the naturalness and vividness of a voyager, and the reader can almost see them pouring their mighty floods toward the Pole. The address gives a valuable sketch of the explorations and discoveries made in the Arctic Seas since 1868. The main object of the lecture is to show that the ocean currents open the natural highways to the Poles, and should be followed by the Arctic explorers if they would attain any substantial results. The theory is well expressed in the closing paragraph as follows, where the author says: That the Gulf Stream and Kur-Siwo are the prime and only cause of the open sea about the Pole, with its temperature so much above that due to the latitude; that the only practical avenues by which ships can reach that sea, and thence to the Pole, is by following the warm waters of these streams into that sea; that to find and follow these streams, the water thermometer is the only guide, and that for this reason they may be justly termed the "Thermometric Gateways to the Pole."

WORMS AND CRUSTACEA. By Alpheus Hyatt; pp. 68. Ginn, Heath & Co., Boston, Mass, 1882.

This is one of the publications of the Boston Society of Natural History designed to supplement lectures given to teachers of the public schools of Boston.

This is the eighth number of a series of ten publications or pamphlets on scientific studies designed for teachers. Besides simple illustrations and instructions as to the modes of presentation and study, there are, in each pamphlet, hints which will be found useful in preserving, preparing, collecting and purchasing specimens. These publications ought to be in the hands of every teacher who loves nature, and if one does not love and study nature, is he fit to teach?

WANDERINGS IN SOUTH AMERICA. By Charles Waterton, 8vo. pp. 64. MacMillan & Co., London, 1882.

In this publication we have the wanderings of a naturalist in South America, the northwest of the United States and the Antilles, in the years 1812, 1816, 1820 and 1824 with original instructions for the preservation of birds, etc, for cabinets of natural history.

There is a biography of the author by the Rev. J. G. Wood, and an explanatory index by the same. This publication is chiefly valuable as a work of history. In the last fifty years there has been much progress in natural science. The narrative is quite interesting to the reader.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. Part I, January to April, 1882. 8vo. pp. 104.

This publication contains fifty-six papers, illustrated by several charts. The papers are thoroughly scientific in character and very valuable.

HORSES' TEETH. By William H. Clarke. 12mo. pp. 262; New York, 1880. $1.

This is a treatise upon the teeth of horses, their mode of development, physiological relations, anatomy, microscopical character and pathology, made up from the works of Profs. Owen, Huxley, John Hunter, Dunglison, Youatt, Chauveau, Percivall, Tomes, Gamgee, Leidy and others, and will be found a very useful and readable compilation of authorities upon all the topics above named. It is also valuable for its practical suggestions concerning various diseases of horses' mouths and teeth, and especially for a vocabulary of thirty pages defining all the technical terms ordinarily used in scientific works upon the subjects treated.

The student of comparative anatomy, as well as the veterinary surgeon, will find much of interest to him in this work and will be put upon the track of much more by the copious quotations from notes and references to the noted authors named above and many more of equal standing.

OTHER PUBLICATIONS RECEIVED.

The Reduction of Air-Pressure to Sea Level, at Elevated Stations West of the Mississippi River, by Henry A. Hazen, from Signal Bureau; Publication No. 5, by Samuel Gaty, Missouri Historical Society; *Chemical Review and Journal*, Chicago; *The Peoria Medical Monthly;* Catalogue of Missouri University for and 1881–2; Annual Report and statistics of the Meteorology of the City of Oakland, Cal., for 1881, by J. B. Trembly; Notes on the Mineralogy of Missouri, by Alexander V. Leonhard; *Northern Indiana School Journal* for June, 1882, Valparaiso, Ind., $1.25 per annum; Hints for Painters Decorators and Paper-Hangers, New York Industrial Publication Co.; Publication No. VI, Archæoloogy of Missouri, by F. F. Hilder, Missouri Historical Society; Hereditary Traits and other Essays, by R. A. Proctor, Humboldt Library, New York; Vignettes from Nature, by Grant Allen, New York; The Kansas Kikkabe, 1882, Lawrence, Kansas; *The Kansas Review*, June, 1882, Lawrence, Kansas; A New Method of Bright-Wire Illumination for Position Micrometers, by S. W. Burnham, Esq.; Catalogue of the Univerisity of New Mexico, 1881, Santa Fe, N. M.; Catalogue ot the Bookwalter Engine, New York.

Prof. Morangoni shows by a conclusive set of experiments that moist air is not a conductor of electricity. He proves that the loss of current in telegraph wires and the want of action in electrical machines during misty or wet weather is due to the condensation of moisture, carbonaceous deposits, adherent dust, spiders' webs or the contact of branches of trees.

The silk industry is reviving in Louisiana, the news of this spring's hatching being very encouraging. Interest in the culture is growing, and inducements are offered to silk workers to come from France and engage in the business. The first exports of silk from Louisiana were made as far back as 1718. The culture of silk is also being revived in South Carolina and Georgia.

SCIENTIFIC MISCELLANY.

THE THUNDER-BIRD.

AN INDIAN LEGEND, BY WM. H. R. LYKINS.

It is believed by some of the Indian tribes that thunder is caused by a great bird, which has its home in the skies. The sound, they say, is caused by the flapping of its wings as it revels in the storm cloud sweeping over the earth. In connection with this bird they tell the following story:

An Indian hunter was one day returning from a visit to his traps. On his back he carried two beavers which he had taken, tied together with strings of bark. In his hand he carried a long hunting spear. As he was walking quietly along something like a dark cloud suddenly over-shadowed him, and looking up he saw an enormous bird swooping down upon him. Before he could place himself in an attitude of defense, he was grasped in its talons and borne rapidly upward. Soon the tall trees dwindled into shrubs, next the high hills faded away, and finally the whole earth disappeared. Upward and onward through space the bird carried him until there appeared far in the west a long range of lofty and precipitous cliffs. Toward these cliffs the bird directed its flight, and having reached them, sailed slow and heavily along their sides. At times she would dash the hunter violently against the rocks, but with his spear which he still retained, he warded off the blows and escaped unharmed.

At last they arrived at the mouth of a great cavern into which the bird threw the hunter and disappeared. He lay stunned by the fall until aroused by an unearthly shriek, and lifting his head he saw in one corner of cavern a young thunder-bird which was now clamoring for its noonday meal. Hastily untying the beavers from his back he threw them to the bird which swallowed each one of them at a gulp, then quietly settled back in its nest. The hunter now took a view of his situation. The floor was strewn with the bones of deer, wolves and great serpents, with here and there a grinning human skull which seemed to mock his helplessness and remind him of the terrible death which awaited him. He approached the mouth of the cavern and looked out. Far away on either hand stretched that wall of rock, lonely and desolate. Not even a blade of grass could find a resting-place on its steep and sterile sides; not even the hum of an insect or the chirp or a desert cricket broke the oppressive silence. Above and below were the awful depths of blue.

There seemed to be but little chance for an escape from such a place but the hunter was one of the bravest of his tribe; tried in many times of danger and not one to despair while life remained. Approaching the young bird which was now quietly sleeping after its lunch of beaver, he plunged his keen hunting-knife into its throat, killing it instantly. Then making an incison in its breast he carefully drew through it the body and thighs, leaving the skin intact. Next he stretched the wings out to their full length and in this position bound them firmly to the shaft of his spear with the strings which had held his beavers. His arrangements were now complete, and dragging the skin to the mouth of the cave he crawled into it leaving his head protruding from the hole in its breast and boldly leaped off into space. His project was a complete success, and to his great delight he found himself slowly descending in graceful circles toward the earth. He alighted in safety and taking two of the feathers of the bird—as much as he could carry—he started homeward, and on the evening of the third day after his capture he was seated before his lodge relating to his friends his wonderful adventure.

Often as the traveler journeys over the western plains he will see a tall column of dust suddenly rise and after whirling along a short distance as suddenly disappear. This the Indians say is caused by the "Thunder-Bird," who, when she descends to snatch a serpent for her young thus conceals herself from mortal sight. And sometimes when the air is pure and the skies are clear the Indian thinks that far away in the western sky he can see that place to which the hunter was borne and from which he so miraculously escaped—perhaps some summer cloud which lies weltering upon the horizon which his "untutored mind" imagines is the rocky home of the "Thunder-Bird."

CHARLES DARWIN.

BY JOHN FISKE.

It is fitting that in the great Abbey, where rests the ashes of England's noblest heroes, the place of the discoverer of natural selection should be near that of Sir Isaac Newton. Since the publication of the immortal Principia, no scientific book has so widened the mental horizon of mankind as the Origin of Species. Mr. Darwin, like Newton, was a very young man when his great discovery suggested itself to him. Like Newton, he waited many years before publishing it to the world. Like Newton, he lived to see it become part and parcel of the mental equipment of all men of science. The theological objection urged against the Newtonian theory by Leibnitz, that it substituted the action of natural causes for the immediate action of the Deity, was also urged against the Darwinian theory by Agassiz; and the same objection will doubtless continue to be urged against scientific explanations of natural phenomena so long as there are men who fail to comprehend the profoundly theistic and religious truth that the action of natural causes is in itself the immediate action of the Deity. It is interesting, however, to see that, as theologians are no longer frightened by the doctrine of gravitation, so they are already outgrowing their dread of the doctrine of natural selection. On the Sunday following Mr. Darwin's death, Canon

Liddon, at St. Paul's Cathedral, and Canons Barry and Prothero, at Westminster Abbey, agreed in referring to the Darwinian theory as "not necessarily hostile to the fundamental truths of religion." The effect of Mr. Darwin's work has been, however, to remodel the theological conceptions of the origin and destiny of man which were current in former times. In this respect it has wrought a revolution as great as that which Copernicus inaugurated and Newton completed, and of very much the same kind. Again has man been rudely unseated from his imaginary throne in the center of the universe, but only that he may learn to see in the universe and in human life a richer and deeper meaning than he had before suspected. Truly, he who unfolds to us the way in which God works through the world of phenomena may well be called the best of religious teachers. In the study of the organic world, no less than in the study of the starry heavens, is it true that "day unto day uttereth speech, and night unto night showeth knowledge."—*June Atlantic.*

A CHEMICAL STOVE.

An alleged improvement by a Dresden chemist, Herr Nieski, in the new method of heating with acetate of soda, consists in mixing hyposulphate of soda with the acetate. The former melts more quickly than the latter, and retards crystallization in cooling. Herr Nieski uses one volume of acetate with ten of hyposulphate. The cases are filled to the extent of three-fourths, hermetically closed, and kept in hot water till one no longer hears a sound from crystals within on shaking. The cases will then give an equable heat from ten to fifteen hours according to size. A room-stove acting on this principle is described by Herr Nieski in the Deutsche Ind, Zeitung. It consists of an inner and outer cylinder, the latter having numerous small holes. In the space between the two stand three of the heating cases. These can be easily lifted out by the handles and put into water in the central cylinder, which can be heated in position by means of a burner below (or removed to be heated elsewhere). This done, the cases are lifted into their places in the circular space. The stove runs on castors and has a cover. The water in the inner cylinder furnishes, by evaporation, a wholesome degree of moisture. —*Boston Journal of Commerce.*

DEADENING SOUNDS.

A new plan to deaden floors has been patented, and is being tested in a new building at Philadelphia. A 6x3 plank is inserted between each joist two inches from the bottom of the joists, and projecting four inches beneath. Underneath the intervening planks the ceiling boards are nailed and the space filled with sawdust to within one inch of the joists. By this method the waves of sound are carried off, and it is claimed that the most vigorous hammering cannot be heard in the story beneath.

EDITORIAL NOTES.

We have given considerable space in this number of the Review to the article on "Tornadoes," by Sergeant John P. Finley, of the U. S. Signal Service, for two reasons: The paper is extremely opportune in view of the great number and violence of the tornadoes this year, nine tornadoes having already occurred. It is also a valuable contribution to science, and probably contains more scientific and practical information on this subject than can be found in any other similar publication. Under the direction of the Signal Service Bureau, Sergt. Finley has devoted five years to the special study of tornadoes. He has carefully gathered on the field the data of between six and seven hundred tornadoes, using pen and pencil in making up his note-books. Sometimes he has followed in the path of the tornado five and six hundred miles carefully placing on record the reports of all ocular observers, and has put himself in correspondence with thousands of observers of tornadoes in various portions of the country. This immense mass of material has been digested, and the substance has been compacted in this valuable paper.

In the death of Henry W. Longfellow, America has lost a poet who takes very high rank in the republic of letters. His death marks the close of the first important epoch in American literature. The life of literature, like all other kinds of life, is one of pulsation; it has its ebbs and flows, its seasons of activity and inactivity. Chaucer and Gower were identified with the first forceful throb in English literature, after which came a barren epoch which was completely extinguished by the glory of the Elizabethan Age. Seldom does a nation experience more than one grand era in its history of literature. Such an epoch results from the crystallization of a nation's thought, and when the material is exhausted there must be time for the nation to gather new material, and receive new inspiration. When Bacon, Shakespeare and their contemporaries had passed from the scene the harvest had been gathered, and the nation's intellectual life was marked by feeble pulsations. Before the time of Bryant, Holmes, Whittier, Motley, Bancroft, Prescott and Irving, American literature can hardly be said to have demonstrated its own existence, or to have any real character. Of all writers of his age, and ot all ages, Longfellow is distinguished for his purity of thought and beauty of diction. If poetry is the apprehension and expression of the æsthetical, Longfellow ranks among the best poets of this or of any past age. Longfellow was a man of the greatest personal worth, he was fairly womanly in the refinement of his sensibilities, his whole nature was as bright and joyous as a morning in May, and his inner being responded with youthful enthusiasm to everything beautiful or true in Art or Nature. His life was rounded out to the full period allotted to man on the earth, and the celebration all through New England and elsewhere of his seventieth birth-day was a golden fruition seldom accorded to the most favored ones of earth. We are painfully reminded that the golden era in American letters has closed, and we do not know how long it may be before the Nation may come to another fruitage.

By the death of Charles Darwin natural science has lost its best observer. No work in science has been written about so much, or called forth so much criticism as the "Origin of Species." That work was written twenty-three years ago, and the effect of the new theory of evolution was prodigious. Many editions of the work in England and America have been published, and translations into all the chief foreign languages have been made. A catalogue was published in Germany a few years ago giving the "Literature of Darwinism," which covered thirty-six pages, with the names of several hundred authors who have written on evolution. Charles Darwin was born in 1800, and was educated at Christ College, Cambridge. Soon after taking his degree he set out on a tour of the world in the ship "Beagle." The trip lasted five years during which he made vast collections in natural science, a part of which was published in 1839 in a three-volume narrative of the expedition. In the course of twenty years half a dozen other volumes were published whose foundations were laid during the voyage of the "Beagle." The result of these works has produced a marked modification of scientific belief, many of the best Christian scientists now believing in a species of theoristic evolution. It was a fitting token of honor that the great scientist should be buried in Westminister Abbey, by the side of royalty. Perhaps Mr. Darwin has given the best definition ever written of the theory of evolution in the following sentence: "Those who hold the theory of evolution conceive that there are grounds for believing that the present conformation and composition of the earth's crust, the distribution of land and water, and the infinitely diversified forms of animals and plants which constitute its present population, are merely the final terms in an immense series of changes which have been brought about, in the course of immeasurable time, by the operation of causes more or less similar to those which are at work at the present day."

WASHINGTON UNIVERSITY, at St. Louis, closed in June of this year one of its most successful years of work. In all departments of the University were enrolled about 1,400 students. This includes the Law School, the Undergraduate Department, the Manual Training School, the Smith Academy and Mary Institute for Girls and the Art School. At the annual meeting of the Board of Directors reports were received from the different departments. The Art School shows a large attendance and presents an urgent request for greater means. The Manual Training School is filled to its utmost capacity and during the present summer a large addition is being built. From the Director of the Observatory a report of the Extension Time Service of the Observatory was made and an urgent request for a few thousand dollars to to be spent in the way of fitting up the Observatory was presented. It was determined to raise three thousand dollars for this purpose. In view of the rapid growth of the various departments of the University, a resolution was passed that one million dollars additional endowment shall be raised within the next five years to place the University in proper shape for its work. It is confidently expected that this sum shall be raised within five years. On Friday evening, June 9th, occurred the exhibition of the Art School. The commencement of the Manual Training School and the Mary Institute occurred on Wednesday morning, June 14th, and the commencement of the Undergraduate Department and Law School was held in Memorial Hall on Thursday evening, June 15th. Besides a large law class three received the degree of B. A., three the degree of Engineer of Mines and one that of Civil Engineer. Upon Judge John R. Shipley was conferred the degree of LL. D., and upon Prof. C. M. Woodward, of Washington University, the degree of Ph. D., these being respectively the second and third honorary degrees ever conferred by the University.

THE Kansas Editorial Convention met in Lawrence, June 5th, and was largely attended. The sessions were held in Liberty Hall. Mayor J. D. Bowersock and Judge S. O. Thacher gave welcoming addresses to which Capt. Henry King returned the thanks of the Convention in his usually felicitous manner. The address of O. H. Rothacker, of Denver, (in his absence) was read by W. H. Rossington, of Topeka. After the meeting at Lawrence adjourned, the members visited the State Institutions. The convention was very enjoyable, the programme being carried out for the excursion under the excellent management of Col. S. S. Prouty, to the complete satisfaction of the whole party.

PROF. WILLIAM B. ROGERS, of the Institute of Technology, at Boston, died very suddenly, May 30th, while delivering a lecture at the Institute. His funeral drew a large number of scientists and scholars, and was largely attended by citizens. Professor Rogers was President of the National Academy of Science which is an office for life, the previous occupants having been Profs. Bache and Henry. In the death of Professor Rogers science has suffered a great loss.

WASHBURN COLLEGE, at Topeka, held its annual commencement beginning with the Baccalaureate Sermon, delivered by President McVicar, Sunday evening, June 11th. The Annual Address was delivered by James G. Dougherty, Monday evening, June 12th, the subject being "Orthodoxy." On Wednesday the commencement exercises proper, were held in the Congregational Church with a large audience. The college year has been one of unusual prosperity, and the College is growing and doing a good work.

THE Western Academy of Homeopathy held a convention in Kansas City, beginning June 20th, and lasting two days. There was a good attendance of members, and much interest manifested. A number of valuable papers were read and the subjects discussed. The next meeting will be held in St. Louis.

THE National Academy of Sciences was an outgrowth of the American Association for Advancement of Science. It is composed of the magnates of science in this country, and takes rank with the leading scientific associations in Europe. The Presidency is a life office and has had but three occupants, Profs. Bache, Henry and Rogers. The Academy consists of ninety-five members and four honorary members—ninety-nine in all. Thirty-four live in New England, seventeen in Massachusetts alone, and nine in the west—one in Ohio, one in Kentucky, one in Illinois, two in Missouri and four in California. Forty-three represent the mathematical sciences, as pure mathematics, astronomy, geodesy, engineering, physics, etc. Twelve represent chemistry; sixteen represent the geological sciences; twenty-four represent biological sciences and four are unclassified. Prof. James C. Watson, the astronomer, left about $50,000, the bulk of his property, to this Academy.

THE Kansas University held its commencement exercises June 6th. The attendance was unusually large, many being present from various portions of the State as well as a delegation of Kansas editors who were attending the Editorial Convention. Nothing transpired to mar the exercises which passed off pleasantly, the graduates doing themselves credit. The University is receiving a vigorous and substantial growth.

WE have received a hatchet from Mr. Teubner which has been forwarded to Prof. Putnam, of Salem, Mass. We shall be glad to hear from Prof. Putnam in regard to it, in due time.

THE storm of June 16th was remarkable for its violence, its brevity and the wide area over which it extended. Its intensity was greatest at certain points in eastern Kansas and western Missouri. At Kansas City one man lost his life by the falling of a building, and property was destroyed estimated at over $150,000. At Leavenworth four girls were killed at St. Mary's Academy, and the city received considerable damage. The storm occurred between twelve and one o'clock at night. It was not a tornado, but a hurricane. The wind at Kansas City was estimated at between sixty and seventy miles an hour, at Leavenworth it reached at its maximum over seventy miles an hour.

KANSAS CITY

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GEOLOGY.

NORTH PARK, COLORADO.

G. C. BROADHEAD.

On the 15th day of June, 1881, we passed west from Omaha, gradually ascending the mountain slopes. Approaching Sherman we observed the geological features to be very similar to those observed the year previous near Las Vegas, New Mexico, evidence of the extension of the same geological uplift. The red beds are seen and the "Hog-back" also seen at Las Vegas; and at Sherman the red granite is boldly prominent.

Between Sherman and Laramie City, in the distance, are seen remarkable weathering of columns of red beds capped with harder projecting strata, and away up the Laramie plains, twenty-five miles south of Laramie City, are seen the bold escarpments of red strata with the snow-capped Medicine Bow range beyond.

Laramie City, Wyoming Territory, a town of 3,000 inhabitants, is pleasantly situated on Laramie plains, near Laramie River, at an elevation of 7,126 feet above the sea. The Laramie plains are for about sixty by thirty miles nearly level and only interrupted by occasional dry valleys, and covered with sand having a scant growth of grass and some other plants.

From Laramie City to North Park our road will take us southwest, up Laramie valley and around the base of Jelm Mountain to Cummins City, or else our route would cross the Laramie River three miles further up stream. By the former route we would pass through fifteen to eighteen miles of good pineries, (the *Pinus Contorta*) across the Medicine Bow Mountains and six miles further to Berry's at the entrance to North Park. Following the road by the Upper Ford we pass over a well-worn road through more open woods. On this route the stratified rocks present a fine section as we leave the plains, of which the following is an approximation:

1. 200 feet of white beds crowning the hill-top.
2. 1000 feet of red beds.
3. 36 feet of white gypsum with occasional crystallized laminæ.
4. 100 feet of yellow beds.
5. 100 feet of red and grayish beds.

The gypsum beds above named would be exceedingly valuable if nearer market.

Our route across the Medicine Bow Mountains is at an elevation of probably 8000 to 9000 feet above the sea, and of easy grade. The prevailing rock is a red granite, sometimes schistose and sometimes graphic, but on a part of the route is very much decomposed and at one place there is apparently a broad vein of white quartz. The approach to North Park is by a long sloping valley, along which flows a clear stream. At the entrance to the North Park is a gray banded gneiss traversed by occasional quartz veins. These rocks are seen for three miles along the valley from the granite of the mountains to North Park.

North Park is about fifty miles north and south, by thirty miles wide, east and west, and entirely surrounded by mountains. Southwardly over the Park we cross several good-sized clear streams of water, including the Canadian, Michigan and Jack's Creeks. Illinois Creek lies just west of the last and they all are confluents of the North Platte, which stream they join in the northern portion of the Park near Independence Mountain.

The exposed rocks in North Park are chiefly stratified sandstone and shales of recent age, probably none are older than the cretaceous. Owl Mountain is a high ridge of chiefly such rocks, projecting northwestwardly into the Park from the east and resting against the igneous rocks in the rear.

The Medicine Bow Mountains extend from about 100 miles north, passing southwest for one-half their extent, then trending nearly south to a point east of Teller City (the chief mining town located at the southeast corner of North Park) where they connect with the "Continental Divide" which trends off west toward Muddy Pass, forming the southern rim of the Park. They then pass off northwardly forming its western rim.

Spurs of these Mountains approach the North Fork of Platte River, north of the Park, and the Medicine Bow range approaches it on the east.

The Park is about fifty miles long thirty wide, and, according to Clarence King, has an average elevation of 8,500 feet above the sea. It is nearly surrounded by lofty mountains, reaching up 3,000 feet above the inclosed valley. It is covered chiefly with a dense growth of wild sage (*Artemisia*).

On our route from any point we can see snow-clad mountains on nearly every side. These snowy peaks impart a pleasant coolness to the various waters flowing through the valley. The water power of the streams flowing out from the mountains is sometimes great, that of Jack's Creek especially so. Its width fifteen to twenty-five and thirty feet, flowing very rapidly, falling in many places five to ten feet per 100 feet or 200 to 300 feet per mile on its mountain course. Strange as it may appear these streams contain but few fish, but just across the "Continental Divide" fish are abundant.

GENERAL GEOLOGY.

The Colorado Range and the Black Hills are archean. The Medicine Bow Mountains and the main Continental Divide are also archean. Through these archean rocks, igneous rocks of volcanic origin have pushed themselves up. Clarence King informs us (in Geol. Survey of 40th Parallel) that those on the south rim of the Park are trachytic, those flanking the western slope of the archean on the heads of Michigan River and Jack's Creek, he terms "Rhyolite," and further says: "From the meridian of 114 W. to California the Rhyolitic rocks 'cover a greater area than any other of the volcanic family, and in age are Post- 'miocene, and were characteristic of the opening of the Pliocene." Mr. King defines Rhyolite as "a ground mass of fine-grained mingling of fragmentary crys- 'tals of Sanidin (glassy feldspar) and crystalline grains of dark quartz, the color 'generally dark. At the head of the Illinois Creek the ground mass is lighter, 'and includes larger crystals of feldspar and fragments of quartz. Hornblende 'also occurs in small crystals. The middle of the ridge south of North Park is 'of Trachyte, which Zirkel calls a *granite-phorphyry.* The east wall of the Park 'is lined with Rhyolite. Basalts occur west of the Trachyte. Rabbit's Ear Moun- 'tain and Buffalo Peak are of Basalt."—King, 40th Parallel Survey.

King refers the chief formations of the North Park basin to the Tertiary, leaving exposed at several places near the outer rim the underlying cretaceous.

The above, from King's Report, includes about all that has been written concerning the geology of this interesting region. Other surveys seem to have passed it by, but we infer that there were great disturbances and eruptions during the development of these trachytes.

Mt. Richthofen (probably the same as Lead Mt.) stands at the point of meeting of two distinct trends of the Rocky Mountain archean rocks. Within this angle occurs an extensive outpouring of rhyolite rocks; they flank the base of the archean for twenty-five miles, rising highest against Mt. Richthofen, when the volume of eruption was the greatest. In this vicinity the granitoid rocks are deluged by dark colored rhyolites.

Virginia City, Nevada, and the adjacent mines are on or near the extreme western extension of the great Rhyolite overflow; the southern and southeast portions of the North Park lie along its eastern limit and just here there have been many mines opened within the past two years.

The line of junction of the Archean (granite, gneiss and mica schist) rocks with the volcanic (rhyolites and trachytic porphyries) rocks is about north and south, and near this junction are occasionally seen dolerytic dykes, whose strike is also north and south. The principal veins also extend in a north and south line parallel with the strike of these rocks, and they are nearly everywhere ore-bearing, and in some places rich in silver ore. The minerals in these veins as found may include: Sulphuret of silver; Ruby silver and other silver ores; Copper and iron pyrites; Oxide of copper and of iron.

Complete analysis may result in the discovery of other interesting ores and minerals. Calcite, Dolomite, Fluorite and Quartz are found at most of the mines. The veins vary from one foot to twenty feet in width, but those worked on are generally from two to five feet wide.

Passing up Jack's Creek from Teller, we find at Teller a dark trachytic porphyry traversed by doleryte dykes, having a north and south strike, but dipping to the west at an angle of 60 degrees. Similar rocks are found as we pass up the creek for three miles generally presenting the general appearance of metamorphic porphyries, but some have a decided schistose character. Beautifully banded and contorted gray gneiss is found a little way up from Teller.

At the "Gaslight" mine work was done on a coarse, gray porphyry twenty-five feet wide. Porphyry walls appear on the west with dolerite on the east. The gangue rock shows quartz in drusy cavities, with sulphuret of iron disseminated in the veinstone of quartzose rock. Both calcite and dolomite occur here in crystals.

The adjacent porphyry here is a gray with rather large light gray crystals. This mine was discovered in June, 1879, by Jno. and A. Lefevre, formerly from Missouri. It was the first mine struck on Jack's Creek and when sixteen feet down was sold for $20,000. In 1882 it was again sold when sixty-five feet down at quite an advance.

Above the "Gaslight" dolerite extends for a mile or more to the Pennsylvania mine, and the New El Dorado. At the "Yellow Jacket" mine the work was prosecuted on dolerite with poor success. White and green fluor and pyrites occur on the wall rock. At the "Pennsylvania" mine at forks of Jack's Creek, the walls are still dolerytic, with streaks of pyrites, carbonate and fluorate of lime and quartz and some silver.

The next mine, just above the last, is the "New El Dorado." It lies directly on line of contact of the volcanic rhyolites and dolerites with the gneissoid and schistose rocks. The vein, four and one-half feet wide, bears north and south, dipping a very little to the east and with ore well disseminated in quartz. Its east wall is dolerite, the west is quartz. Some galena has been obtained here.

The "Constellation" due north of the last and across Jack's Creek, high up the mountain, is supposed to be a continuation of the New El Dorado. The rocks are similar. Ores from this mine are a dark gray with sulphurets evidently rich in silver.

From the New El Dorado to the Josephine the gneissic rocks show numerous beautiful foldings with bands of light and dark laminæ, and between these two lobes these rocks can be continuously seen. These gneisses were also found to abound in red garnets.

The "Josephine" is probably a continuation of the "Endomile," but they are 1,000 feet apart and the former several hundred feet higher on the mountain.

The "Endomile" appeared to be the richest vein and information since received confirms the opinion then advanced. The course of the vein is north and south, depth worked June, 1881, was thirty-five feet, and width at that depth four and one-half feet dipping slightly to the east. [Recent letters give a width of forty-five feet to the lode at 300 feet depth with distinct walls and rich ore].

At the centre of the vein a soft opening appeared, six inches to one foot wide, and carrying ore. A soft ore yielded by assay $217.80 per ton. West of the centre the ore-mass does not appear rich, but contains a good deal of pyrites. East of the centre the gangue is rich in sulphurets for two and one-half feet, the richer portion carrying ruby silver.

Fluor spar, both of violet and green tint, is abundant in the vein, occurring in vertical vein masses. Where the fluor chiefly abounds the ore is not so rich. A mass of ore thirteen inches wide shows fifty per cent. of ore thickly disseminated, yielding probably ten per cent. of ore which would assay over $400 per ton. A banded schist appears on the eastern wall, the western wall including much pyrites. Assays from this vein range all the way from $80 to $800 per ton. [The assays were made by Devlin and Shelton].

A number of other less important mines were visited, but the work was yet in its infancy. No smelting or machinery then. The deeper the rock has extended on the Endomile, the richer the ore has appeared. The geological relation of the rocks seems favorable, the strike and course of veins about the same, nearly north and south. The Endomile, the Constellation and Gaslight and some others show evidence of being true fissure veins. We need look here for no carbonates. Most of the mines are owned by the North Park and Vandalia Mining Company, Dr. G. W. Bassett, of Vandalia, Illinois, being President, and D. C. Holcombe, of Peoria, Illinois, Secretary.

About the year 1870 some mining was done on Independence Mountain by Jno. Lefevre and others, probably forty to fifty men in all. The Utes notified them to leave and not to remain over two sleeps; Lefevre and one other left, the others remaining were all killed. The Indians resided in the Park until 1878. In 1879 Antelope and his band were in the Park, remaining but a short time, but did not come up into the mountains where the miners were. They burnt the woods, doing great damage.

The first ranch started in North Park was Pinkham's in 1876, Walden's next, on Michigan River, in 1879, and Mendenhall's on the Canadian in 1880. In 1881 there were fifty or sixty ranches in the Park.

The first mines in the Teller District were discovered in 1879, and for a while there was a rush of miners, but most of them soon left and in part of 1879 and 1880 there were only five miners on Jack's Creek. These were Lefevre, Payson, Halstead, Latham and Fuller. The first house was built at the mines in 1879 and first house in Teller City in May, 1880. In June, 1881, Teller City had a population of about six hundred and one newspaper. Charles Smith was the discoverer of the "Endomile." Discoveries have been made all the way from Rabbit's Ear Mountain to Illinois Creek, but no real mining except on the east side of the Park. Mining has been done all the way from 9,000 feet elevation near Teller, up to the snow line, chiefly under the shadow of the thickly timbered mountain sides.

The wild game is fast leaving. In 1880 elk, antelope and black-tailed deer were continually seen. In 1881 the antelope could be commonly seen in the Park but were getting shy. The others had retreated to the mountains.

The Medicine Bow Mountains and those east and south of the Park are generally clothed with a dense pine growth (*Pinus contorta*). In many places the ground is covered with masses of fallen dead timber, sometimes even equaling one-fourth as many trees as those remaining erect, and making the way entirely impassable. Fires are sometimes very destructive. Three years ago the Utes set fire to the woods and thousands of acres of good timber were destroyed. Several times I saw as much as a thousand acres of dead standing trees, which gave a very desolate appearance to the landscape.

At one place I observed the pathway of a former snowslide. The avalanche had swept every tree even from its roots in its pathway from mountain top to valley, and was apparently not less than a quarter of a mile wide.

The pineries afford the material of which the houses are built, the shafts cribbed and long straight poles are hauled out fifteen to twenty-five miles into the park and used for fencing the ranches.

In Wet Mountain valley the aspen (*Populus tremuloides*) abounds and affords excellent fuel. Ascending the mountains over 9,000 feet elevation, the pine gives place to the spruce and fir, the *Picea engelmanus* being abundant. These grow to a large size and stand thick on the mountain sides. With these, and reaching high up the mountains, we find a dwarf huckleberry (*Vaccinnum myrtillus*). Around Teller we observed the strawberry, raspberry and currant. The wild sage (*Artemisia frigida*) and greasewood stand thickly over the North Park and abound on the Laramie plains. Several species of native grass, some very much resembling our blue grass, are abundant in the Park and on Laramie plains.

Of plants common to either Missouri or Kansas, I observed not over a dozen, including a *Delphinum*, the strawberry, *Cleome integrifolia*, *Malvastum coccinneum*, *Oxytropus lambertii*, *Dodecatheon meadea*, *Sysirhynchium bermudiana*, *Allium juncus*, and *Triticum repens*. There may be a few more.

Fremont in his second Report Across the Plains and Mountains in 1843 speaks glowingly of the flora in crossing the Laramie Plains and Medicine Bow Mountains. And he spoke the entire truth, for it is of remarkable beauty. The *Del-*

phinum, *Dodecatheon* and *Oxytropus* on the Laramie Plains and in the Park, the beautiful blushing *Lewisia* and the *Ocerothera Marginata* with its large white petals, the *Gillia aggregata* and others of the Medicine Bow range are very beautiful. Several species of *Psoralea*, the *Oxytropus* and others were very prominent in the North Park, and the plants in the caves and on the mountain sides are very interesting. Among the latter the *Aquilegia Cerulea* is most prominent, tall and very showy, and of the purest white and azure blue.

The *Berberis repens*, with its holly-like leaf and red berry is abundant in pine woods, and is said to afford the berry of which the "Vinegar Bitters" is made. The *Thlaspi alpestris* and *Trollius laxus* were found blooming beside the snow banks. The *Cleome integrifolia* very abundant in Kansas and Nebraska, also found on the Laramie plains but not in North Park. The *Primula parryi*, a very handsome plant, was found at the edge of a stream at 9,000 feet elevation.

The following is a partial list of plants observed and collected hurriedly. Many of them were collected at a moment's stop on a trip of fifty miles per day. [For their determination I am under many obligations to Dr. George Engelman of St. Louis.]

LIST OF PLANTS.

NAME.	Cheyenne to Sherman.	Laramie Plains.	Medicine Bow Mts.	North Park.	Teller.	Mountains S. of Park.	REMARKS.
Ranuculus Cymbalaria.				*			
Trollius laxus.			?		*	*	To snow line.
Aquilegia cerulea.			*		*		
Delphinum.	*	*		*	*		Several sp.
Berberis repens.			*		*		
Corydalis Montana.			*				
Arabis retrofracta.					*	*	High up.
Vesicaria ludoviciana.					*		
Vesicaria Montana.				*			
Cardannia cordifolia.					*		
Erycimum asperum.			*				
Thlaspe alpestre.			?		*	*	High altitude.
Cleome integrifolia.	?	*					In Kan. to E. line.
Viola ——.					*		
Arenaria fendleri.	*			?			
Calandrina pygmæa.					*		
Malvastrum coccinneum.	*						In Kan. & N. Mex.
Linum perenne.				*			
Geranium fremonti.					*		
Geranium richardsoni.					*		
Thermopsis Montana.				*			
Trifolium longipes.		*		*			
Trifolium parryi.					*	*	High altitude.
Oxytropus lamberti.		*		*			
Rubus ——.					*		
Geum triflorum.				*	*		
Fragaria Virginiana.					*		Common in Mo.
Potentilla fruticosa.				*	*	*	
Potentilla anserina.	*		*		*		

NAME.	Cheyenne to Sherman.	Laramie Plains.	Medicine Bow Mts.	North Park.	Teller.	Mountains S. of Park.	REMARKS.
Rosa avicularis.					*		
Saxifraga bronchialis.					*		
Sedum rhadiola.				*			
S. stenopetalum.				*			
Lewisia rediviva.			*	*			Hills of N. Park.
Epilobium angustifolium.				*			
Oenothera marginata.			*				
Mammillaria vivipara.				*			
Lonicera involucrata.					*		
Sambucus pubens.					*		
Erigeron trifidum.					*		
Helianthus.				*	*		
Chænactis douglasii.				*			
Artemisia frigida.		*		*			
Pencedamum.					*		
Vaccinnum myrtillus.						*	High up.
Arctostaphilos uva-ursi.			*				
Primula parryi.						*	
Androsace septentrionalis.			*				
Dodecatheon meadea.		*			*		Found in Mo. & Ill.
Pentstemon humilis.				*	*		
P. glaucus.					*		
Castillæa pallida.					*	*	
Mertensia lanceolata.					*		
Eritrichium glomeratum.	*	*					
Phacelia sericea.				*			
Phlox coespitosa.		*		*			
Gillia aggregata.			*				
Eriogonum umbellatum.				*	*		
Rumex venosus.	*						
Polygonum bistortum.				*			
Alnus viridis var. alpinum.					*		
Pinus contorta.	?		*		*		
Picea engelmanni.					*	*	
Abies ——.					*	*	
Juniperis communis var. alpina.	*		*			*	
Sysyrhynchium bermudiana.				*			Common in Mo.
Veratrum album.					*		
Streptopus amplexifolius.					*		
Allium.					*		
Allium.		*					
Juncus baticus.	*						
Elymus sitarion.				*			
Triticum repens.	*	?		*			Common in Kan.
Stipa spartea.	*	*					

PLEASANT HILL, MO., June, 1882.

THE LOUP FORK GROUP OF KANSAS.

CHAS. H. STERNBERG.

This formation received its name from the Loup Fork of the Platte River, Nebraska, where it was first studied by Dr. Hayden, the eminent United States geologist. The rocks in Kansas consist chiefly of hard gray sandstone, or pudding-stone conglomerate, with beds between of loose, yellowish sand, or soft gray marl, the lime of which appears to be a sulphate, and was doubtless derived from the chalk of the Niobrara Cretaceous, that lies beneath. The experiment has often been made of burning this marl for building purposes, resulting invariably in various colored slags. There are also found beds of red clay and silica. Near Fort Wallace the hills are topped with thick masses of dendrite, the upper surface consisting often of chalcedony or " moss-agate."

Near Colyer, on the U. P. R'y (K. D.) on the high divide between the smoky Hill and Saline Rivers, Mr. Joseph Savage, of Lawrence, has discovered quarries of red, yellow and ribboned jasper belonging to this formation. At South Benner, in Rawlins County, are beds several feet thick, of fine silica, having a satin-like lustre. I had supposed from the exceeding fineness of the dust, and from the fact that it polishes the metals, that it was diatomaceous earth, but the microscope fails to show anything organic in it, only angular scales of transparent quartz.

My party left Buffalo Park, Gove Co., on the 20th day of July, 1881, and reached the fossil beds of Decatur Co. on the 23rd inst. Our first camp was on South Sapper Creek, ten miles southwest of Oberlin. Here we were very fortunate, obtaining a great many specimens of mammalian vertebrates in the soft beds of marl, sand and gravel. They occupied the spaces between the compact strata of sandstone and conglomerate. From two localities half a mile apart, we procured a number of bones and teeth of rhinoceroses, horses, mastodons, etc. One perfect skull of a rhinoceros was found with under-jaw and atlas vertebra in position. The rest of the skeleton had been dug out, evidently by other explorers, judging by the number of broken ribs that lay on and through a great pile of *debris*, near the bank in which we found our specimen. I suppose, as is common with explorers, that they took the long bones, vertebræ and arches. This skull was preserved in grayish sand, that could be easily removed with a knife. When it was a quicksand bog along the borders of the great Loup Fork Lake, the huge animals, with many others, became entangled, and dying left their skeletons which have been preserved so many ages, hidden from the sight of the denizens of that country who never supposed that they had repeatedly walked over the remains of these tropical beasts.

We found in the same locality in a space six feet wide, and about fifty feet long, a number of other specimens, including jaws with teeth, and bones of two species of rhinoceros, bones and teeth of horse and mastodon.

Four species of the rhinoceros have been described by Prof. E. D. Cope from the Loup Fork Group of Colorado and Kansas under the genetic name of *Aphelops*. I quote from the Bulletin of U. S. Survey: "The dental formula is, Incisors $\frac{2\ 1}{1\ 1}$, Canines $\frac{1}{1}$, Premolars $\frac{4\text{-}3}{3}$, Molars $\frac{3}{3}$, Digits 3-3. Nasal bones with persistent suture, weak—not supporting horn. This genus occupies a position intermediate between *Aceratherium*, Kauf., and *Rhinoceros*, Linn. It agrees with the former in the presence of incisor and canine teeth, and in the absence of indication of nasal horn, but differs from it in lacking the fifth digit of the anterior foot. In the last respect it is identical with *Rhinoceros*, differing from it in characters already mentioned." We procured specimens of the *Polydactyle* horse in this locality, as well as part of the lower jaw of a *Mastodon*. It resembles Prof. Cope's *M. Productus*, described in Lt. Wheeler's report as from the Loup Fork Group of New Mexico. "In this species the underjaws are prolonged into a beak, which bears two powerful tusks." I imagine that they might have been used by the animal for digging up succulent roots, in the vast swamps through which he wandered. Although mastodons have been described in Europe with inferior tusks they are certainly unique.

In the vicinity of our first camp, we worked several days and procured about two hundred teeth, a number of perfect bones from various species and individuals. In one place the bones and teeth were scattered and evidently worked in by a stream, as they were packed in between pebbles in a kind of mortar, the bed resembling the so called "concrete" of the west. Many of the bones were water-worn, and they lay through the matrix without any system. A rhinoceros tooth often close to that of a horse, or of some other species and bones of different species, are indiscriminately mixed. These animals had doubtless died on the shore and high water had rolled the bones along with pebbles; the water holding in solution chalk and sand that had cemented them together, when they found a resting place in the deep waters of the lake. The specimens were often so closely wedged in between the pebbles that it was hard work to get them out without breaking them.

Another camp was made on Beaver Creek near Cedar Bluffs, north of Oberlin, where some beautiful collections were made of bones and teeth of the horse, camel (?), rhinoceros and a carnivore. One set of underjaws of a horse had most of the teeth in position. The canines were about the size of a small goose-quill. We got also three perfect toes, *i. e.*, the metatarsals, of one limb. The central one was twice as large as the lateral ones. A number of small bones, and teeth of various species were washed out of a denuded knoll, the material of which seemed to be composed largely of chalk. The bones were white, and the teeth showed the plications of the colored enamel. Near this camp we found the under-jaws of a young mastodon, showing the milk dentition. It was in loose soil, grass-roots penetrated the specimen in various directions, consequently it was impossible to save them in perfect shape.

On South Beaver, Rawlins County, we found a locality (through the kindness of the surveyor of the county) rich in fossil land turtles. We collected about twenty specimens representing different stages of growth; some quite small, showing the elegant markings of the shells, ridges and grooves following the outlines of the plastron plates. Some specimens were nearly perfect, lacking, however, the skull. A number of nearly perfect limbs and arches were obtained. They were found in a narrow gulch where the water had cut through twelve or fifteen feet of white sandy marl. The specimens were sticking out on either side of the perpendicular banks. During October, at the Museum of Comparative Zoölogy, Cambridge, I was able to get some of the specimens into very respectable shape, though the specimens have still fragments with them, and it requires time and patience to fully restore them. I believe they have been described by Prof. Cope under the name of *Xerobates cyclopogius.* They are but little petrified, which is the case with all the Loup Fork fossils. I have always found that fossils partake largely of the characters of the rocks in which they are preserved. If it is hard and dry the specimens are well preserved and the breaks are usually angular and rarely mended. Specimens are generally well preserved in loose, dry sand, in chalk, and in hard clay concretions. The older the formation the more perfect is the petrifaction. In some cases the bone is entirely replaced by silica. Where the matrix is largely composed of clay it cracks and crumbles on exposure to the atmosphere and it is very difficult to save the specimens unless they are preserved in concretions impregnated with iron. In recent formations, unless the bones are perfectly dry, they usually crumble easily, and it is hard to mend the fragments, the cement used is apt to tear loose and take part of the bone (especially spongy bone) with it. Further, if any fragments have been left in the field the difficulties of restoring the specimen are greatly augmented.

One trouble the explorer meets with in northwestern Kansas is from the fact that so few fossil beds are exposed, the slopes of the hills are so gradual that the greater part of the country is covered with grass and soil. The south sides of streams are the ones usually denuded. I suppose this is because the streams, flowing as they do in a northeasterly direction, cut the southern sides, and in addition the higher bluffs protect that side from the south wind and the sun so that snow and moisture remain there longer, giving Jack Frost a chance to break off great masses of rock which, rolling down the bluffs, cover their sides and prevent the growth of grass to some extent. On the southern sides of the Sappa and Beaver Creek are often seen bluffs a hundred feet or more in height with bold escarpments rising one above the other, while between them are beds slanting backward of the soft fossiliferous marls. Where the marls are perpendicular caves are often cut in them by rain finding a crevice in the hard cap above, to rush through and wash away the softer rock.

In one of these caves Mr. Wright of my party found where an Indian had been buried and took away a few glass beads. He found it rather dangerous work getting down from the over-hanging rocks into the mouth of the cave and still harder to get back again. I believe I may take to myself the credit of being the first to explore these beds in northwest Kansas. For, though collections of mammalian bones had been found by Profs. Marsh, Mudge and others in the conglomerate beds lying above the chalk along the Saline and Smoky Hill, thus indicating what would likely be the result of an exploration in these beds, those gentlemen were too much interested in the Niobrara reptiles and birds to spare the time for extended explorations in a formation where at best it was uncertain whether any very valuable or new material would be found. While exploring the Niobrara of the Smoky Hill in 1877 an old-time hunter named Abernathy (who was killed by the Indians on the Sappa in 1878) told me of a large mastodon skull that he had seen projecting from a ledge of rocks on Sappa Creek. I had little faith at first in what he told me, but at last becoming more convinced by his oft repeated assertions I followed his lead, and after traveling seventy-five miles I found by his directions the mastodon skull, which proved to be a large land turtle shell. I remained some time and collected eighty land and fresh water turtles, besides some valuable bones of mammals, which are in the hands of Prof. E. D. Cope, of Philadelphia.

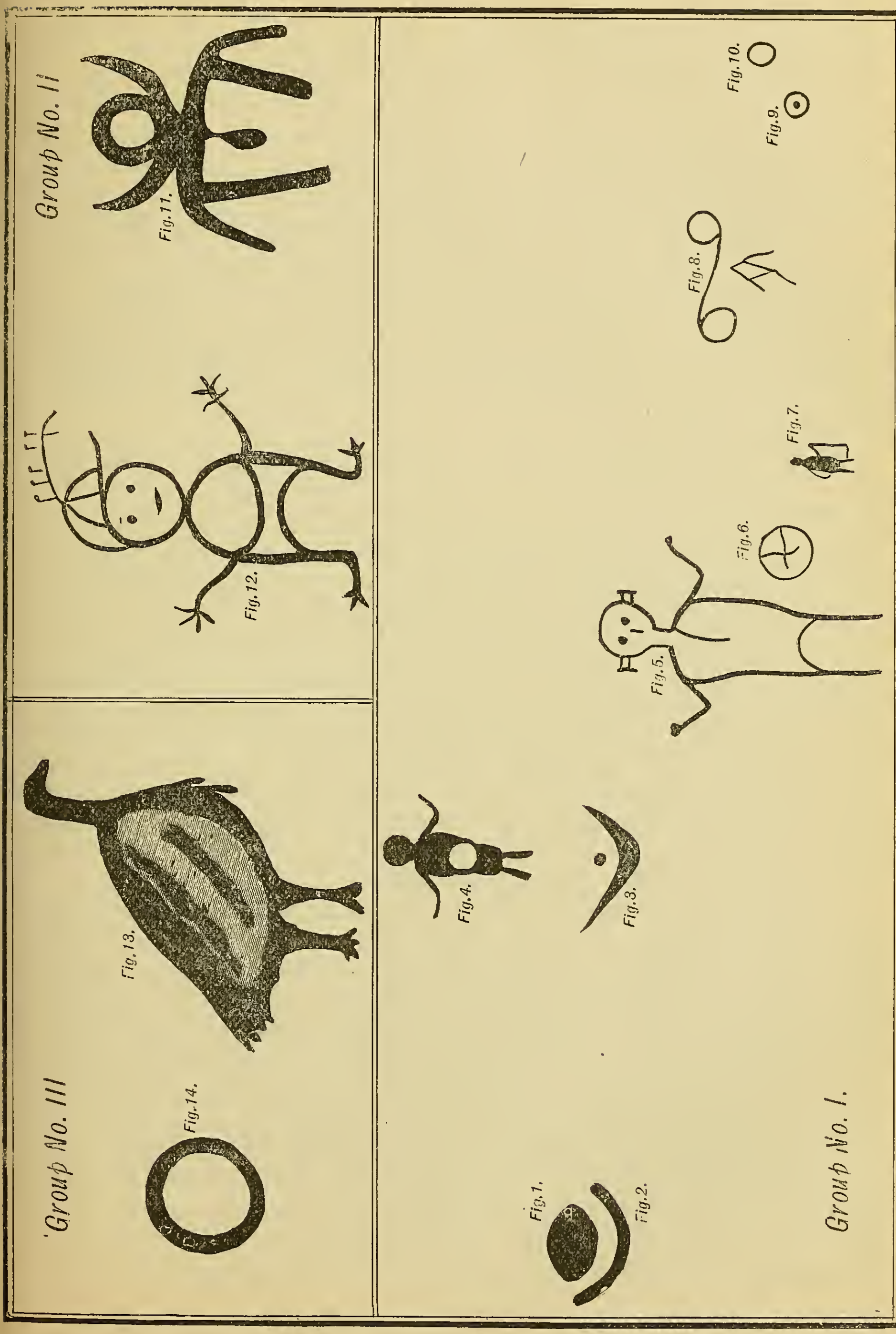
ARCHÆOLOGY.

INDIAN PICTOGRAPHS IN MISSOURI.

CHAS. TEUBNER, JEFFERSON CITY, MO.

During a visit to Columbia, Boone Co., Mo., last fall, I learned that the bluffs on the Missouri River below Rocheport, which is situated in the extreme southwest corner of the same county, contained a number of pictures painted in red on the face of the cliffs, the supposed work of Indians. Trustworthy informants assured me that these figures were known to the oldest inhabitants, and I found several who saw them thirty five or forty years ago. Lately, in passing through Rocheport, I concluded to take a look at them, and therefore made my way to the farm of Mr. L. Torbett, about four miles east of Rocheport, where, as I was informed, they were located. Mr. Torbett's farm also contains eight or nine mounds, some of large size. His house is built on one of them, the smokehouse on another, and there are two more in the rear and to the right of the house. The site of the house is a commanding one, and affords a fine view of the surrounding country, while at the same time the neat cottage, with its sloping lawn dotted over with stately forest trees and the green mounds in close proximity to the house, present a pleasing appearance from tne road.

Receiving a hearty welcome from Mr. Torbett and his excellent wife, and after refreshing the inner man with a substantial dinner, I was supplied with a guide in the person of L. Torbett, Jr., a bright little lad, and together we wended our way eastward from the house, hundred yards or more, and then turned south through a small corn field, at the edge of which a short path led down a steep


Group No. I.
Fig.1.
Fig.2.
Fig.3.
Fig.4.
Fig.5.
Fig.6.
Fig.7.
Fig.8.
Fig.9.
Fig.10.
Group No. II
Fig.11.
Fig.12.
Group No. III
Fig.13.
Fig.14.

ravine, densely overgrown with trees and vines, from which we soon emerged to find ourselves on the banks of the great turbid river. Following the banks a distance of one hundred yards down stream we came upon a spring, which made its appearance some thirty feet above the surface of the river, at the head of the alluvial and cliff deposit, lying in a steep slant against the cliffs. Coming out of a cave-like opening, it rushes in a series of zigzag leaps over moss-covered rocks into the river. The volume of water is large enough to drive a good sized flouring mill. The face of the cliff from the outlet of this spring extends upward nearly one hundred feet, the top overhanging six or eight feet, giving the whole a concave appearance, which accounts for the preservation of the pictographs. At the height of forty-five feet, immediately over the spring, is the largest group of pictographs (No. I). About five feet beneath the figures a narrow ledge extends along the cliff which served as a foothold for the artists. The ledge is accessible from points east and west of the pictographs, but it requires a person of no ordinary nerve to climb up to it.

The relative position of the figures in group 1 corresponds with those on the cliff.

This group seems to indicate the record of some important event, as the human figures express wonder, though the other figures are such as to leave one in doubt as to their significance. Commencing at the west end of group 1 we come to Fig. 1, of oval shape, 8x10 inches in diameter, surrounded by Fig. 2, a semicircle, which measures 14 inches across the ends, and is 2 inches wide. Fig. 3 somewhat resembling an Australian boomerang, measures 15 inches across the end and is one and one-half inches wide near the angle; the dot above it measures a little more than an inch; Fig. 4, length 13 inches; Fig. 5, length 25 inches; Fig. 6, diam. 4 inches; Fig. 7, length 6 inches; Fig. 8, diam. of circles 4 inches, distance apart 8 inches; Figs. 9 and 10, diameter 2½ inches, 6 inches apart. There are several more figures to the right of and belonging to this group, but they were grown over with American ivy (Ampelopsis Quinquefolia) to such an extent that I found it useless to try to sketch them.

A few rods west we find group No. II at about the same altitude containing two very striking figures. Fig. 11 is very distinct, about 7 feet above a ledge easy of access, and measures 13 inches each way. Fig. 12 represents a man, with an ornamental head dress and frog-like extremities, also expressing surprise. Some 300 yards up the river group No. III is located, with three more figures, one being nearly obliterated; of the remaining two, Fig. 13 is a good representation of a turkey almost life size. The other, Fig. 14, is a circle of 16 inches in diameter. These last figures are fifteen to twenty feet above any foot-hold, and could not have been reached without the aid of a ladder. The paint used was the so-called "keel," which had been ground up and mixed with water or fat, and applied with the fingers, or a rude brush.

ANCIENT REMAINS IN MARION COUNTY, KANSAS.

MELVIN O. BILLINGS.

Marion, Kansas, is situated on the northwest quarter of Section five, Township twenty, Range four, east of the sixth principal meridian, near the confluence of the Cottonwood River and Muddy Creek, a portion being in the valley between the streams and a portion on the hill east of the Muddy.

That this was at some time a far more densely populated city, is evidenced by the fact that in excavating almost every well, cellar or cistern, relics of an ancient inhabitancy are found and we are honoring this "Buried Race" by building our prominent buildings, churches, schoolhouses and best residences, near and over their principal monuments, their mounds. The relics of aboriginal inhabitancy may be divided into three classes, Mound-Builders, Crematers and Modern Indians. Of the first class only it is our intention now to write.

The mounds from which we denominate this class "Mound-Builders" are situated on high ground around the junctions of streams adjacent, in irregular groups averaging eight mounds to the group. Inside of three miles each way from Marion there are five of these groups. These mounds measure from ten to sixty feet in diameter and from one to three and one-half feet in height. In none so far examined have been found human remains. The larger ones consist of earth, stones, pebbles, broken implements and utensils of all kinds, shells and scraps of bone, all of which seem to indicate that they are only heaps of kitchen scraps and camp debris. The smaller mounds seem to be the remains of adobe huts or wigwams, mostly of clay which bear the appearance of having been partly burned; in these are found ashes, charcoal, broken pottery and a few broken bones, but they do not contain the profusion of articles which the large ones do. Some of these small mounds, after being subject to the plow and weather, are covered with flint chippings and and broken flint implements, showing that they were the workshops of arrow makers or the place where the refuse of this character alone was deposited. All mounds contain more or less shells, quartz, pebbles, concretions and peculiar little stones that to-day would interest a boy as being "funny." The small mounds are circular while the large ones have on the southeast side a spur about one-fifth the size of the mound. This is not the exception but the rule. As to the use of these large mounds with their spurs we have no theory. We are simply stating the facts as they are.

The fire beds, so named for want of evidence of their being graves, are relics of the same people, which is clearly proven by their contents being identical. One of these beds is described by Judge West in this REVIEW, No. 2, Vol. IV. Another found three-quarters of a mile above the junction of the Cottonwood and Muddy Creeks, on the creek bank exposed by gullying, is of the same shape as the one described by the Judge, *i. e.*, conical, and measured in depth six feet—width, where clay and soil meet, three feet nine inches: from bottom to where clay and soil meet, three feet—width, at bottom, five feet one inch; contents: flint chips, broken pottery, worked bone, shells, pebbles, ashes, charcoal and a fine arrow point, the only whole instrument found.

Other remains of these people are found in cellars, wells and cisterns as befor stated. These are not graves, as no human bones are found therein. They are small masses of debris from camp, apparently, with occasionally broken implements and rarely whole ones. In excavating a cellar in Marion east of Muddy, at a depth of two and one-half feet one of these "places" was found. About thirty five feet west in digging a kitchen foundation, at a depth of ten inches another was found; both containing broken pottery, flints, etc., and the first charred corn. In digging a cistern between the kitchen foundation trenches and at a depth of eleven inches red clay was struck, which had no appearance of having been disturbed. Twenty-six inches of this undisturbed clay was gone through when a darker clay of the same quality was found, also undisturbed to a depth of twenty-eight inches, when a few bits of charcoal and a small amount of ashes were found. This was followed twelve inches, where upon a bed of ashes were found a rub-stone, a fine flint knife, some fragments of pottery, a beaver's tooth and a peculiar stone tablet.

Taking these and the ashes away they were found to have been in a bowl artificially hollowed from the natural limestone formation. Depth of bowl, bed of ashes and relics, nine inches; making a total distance from surface to bottom of bowl, seven feet two inches.

THE TABLET OF THE CROSS.

F. F. HILDER.

In the July number of the REVIEW which I have just received there is an article by Mr. Warren Watson on "The Tablet of the Cross," which contains some errors that I am tempted to reply to. The purpose of the article appears to be a criticism on the value of Prof. E. S. Holden's researches in the extremely interesting field of "The Hieroglyphics of Central America," which that gentleman has been pursuing with commendable earnestness and with promising results. The critic refers to an article on the subject written by Prof. Holden which appeared in the *Century Magazine* for December, 1881. He says: "In the article referred to Mr. Edward S. Holden gives the result of his researches in this field, with so much *eclat* that the reader is almost ready to admit his claim as discoverer of a clue to the difficult problem. This clue is the result of the study of a segment of hieroglyphs from the celebrated "Tablet of the Cross" at Palenque, and this being the fact a grave doubt arises as to the value of his discovery."

Mr. Watson then refers to Stephens' well known work and quotes from it, that the right or east slab of the three which formed the tablet "is broken, and unfortunately altogether destroyed."

He also states that Prof. Holden gives a cut of the entire tablet, the east portion bearing the signature of C. F. Trill, calls the cut a piece of patchwork and says it forces him to seek the source of Mr. Trill's drawings in the works of earlier explorers.

I can assure Mr. Watson that he need not seek so far for it, and that he has wasted considerable labor in making a list of such early explorers, as he can see the veritable missing east or right stone of the Palenque tablet by traveling to Washington, D. C., where it is safely deposited in the National Museum, also that Prof. Holden did not use in that part of his work the drawings of either earlier or later explorers, but had the stone itself under his inspection, with a photograph of it for use in the study.

Further on Mr. Watson says "other drawings are said to exist in various Spanish, Mexican, and Central American collections; but none, other than those mentioned, have been given to the world in any publication accessible to students."

This statement is certainly erroneous, as a very excellent work on the "Palenque Tablet," written by Prof. Chas. Rau, was published by the Smithsonian Institution in 1879, in which is given a very fine illustration of the whole tablet as restored, and a photograph of the east or right slab taken from the stone itself.

To this book I beg to refer Mr. Watson for a full history of the whole tablet and an account of the manner in which the right or east slab reached the National Museum, where it has been since 1858. I also refer him to the "First Annual Report of the Bureau of Ethnology 1879–80," published at Washington, D. C., 1881, in which Prof. Holden gives a very full and lucid account of his labors and the sources from which he obtained the necessary data. I think that before Mr. Watson attempted to criticise work done by such a thorough scholar as Prof. Holden he should have made himself more thoroughly acquainted with the current literature on the subject.

THE TABLET OF THE CROSS.

PROF. OTIS T. MASON, WASHINGTON, D. C.

EDITOR OF THE KANSAS CITY REVIEW:

Dear Sir,—A short article in the July number of the REVIEW affords me the opportunity of renewing our acquaintance too long neglected. I have had the pleasure of reading Professor Holden's article in the *Century Magazine*; but, if he is correctly and fully reported by Mr. Warren Watson, he has done great injustice to the Smithsonian Institution, to Dr. Charles Rau, and to the talented artist Mr. C. F. Trill.

In 1879, the Smithsonian Institution issued No. 331 of its Contributions to Knowledge, entitled "The Palenque Tablet in the United States National Museum, Washington, D. C., by Charles Rau." Among the many useful illustrations in that volume is a reconstruction of the Palenque Group by Mr. Trill, done under the eye and by the direction of Dr. Rau. From this restoration, doubtless, Professor Holden has drawn his material.

Now for the "east inscription, joined to Mr. Catherwood's in a clumsy fashion." I will quote from Dr. Rau: "Among the objects of archæological interest transferred to the Smithsonian Institution, in 1858, from the United States Patent Office, were several fragments composing a large rectangular stone slab, covered with glyphic designs in bas-relief, which had been presented to the National Institute by Mr. Charles Russell, Consul of the United States at Lajuna, on the Island of Carmen, State of Campeche, Mexico. The fragments had been obtained at Palenque, and reached Washington in 1842, * * * . The National Institute received at the same time a letter from Mr. Russell, dated Lajuna, March 18, 1842, in which he stated he had sent to the National Institute per ship "Eliza and Susan," fragments of a tablet from the ruins of Palenque, and by the "Gil Blas" other pieces of the same tablet which made it complete"

Mr. Titian R. Peale asserts that the pieces exactly fitted, and had a cast made of them in 1848, for Baron von Gerolt, Prussian Minister, by Clark Mills. In 1863, Professor Henry charged Dr. George A. Matile to make a new mould, in order to obtain a perfect cast. While thus engaged, Dr. Matile recognized the Smithsonian tablet as one of the three stone slabs which, placed together, bore on their surface the sculpture of the famous Group of the Cross. * * * . The middle slab and that originally joining it on the left have been described and figured by late explorers, but the one which completed the sculptured group, and is now preserved in the Smithsonian building, probably was already broken into fragments before 1832, when Waldeck explored the ruins of Palenque.

Stephens, who was there eight years afterward, certainly noticed its scattered pieces. It has not, therefore, been represented by either of them; but Del Rio and Dupaix, to whom we are indebted for the earliest reports on the ruins of Palenque still saw it in its proper place." I shall not follow all the incidents in the history of the slab. Dr. Valentini, in 1873, on receipt of a photograph, rediscovered the fact that the Smithsonian slab completed the Group of the Cross, never having heard of Dr. Matile. Finally Dr. Rau conceived the idea and executed it in 1879, of presenting the celebrated bas-relief in its original completeness.

Dr. Rau in his succeeding chapters discusses Explorations of Palenque, the Temple of the Cross, the Group of the Cross, Aboriginal writings in Mexico, Yucatan, and Central America, and closes with notes on the ruins of Yucatan and Central America. Finally the work is published under the acknowledgement of S. F. Haven and H. H. Bancroft.

I would say, in conclusion, that I watched Mr. Trill, day after day, carefully bring out his drawing, and so far from exhibiting any clumsiness, I think it was the one thing needful to justify the ingenious conceptions of Dr. Matile and Dr. Valentini.

Dr. Rau's work has been translated into other languages, notably into Spanish, by the Museo Nacional de Mexico, together with a fac-simile of Trill's reproduction.

NOTE.—We have also received notes from Dr. Rau and Prof. F. W. Putnam confirming the above.—[ED. REVIEW.

HISTORICAL NOTES.

PENALOZA'S EXPEDITION TO QUIVIRA.

JOHN P. JONES.

The recent publication of a translation from the Spanish, with notes, of Father Freytas' narrative of Penaloza's expedition from Santa Fe, to the rivers Mischipi and Quivirai n 1662,* has added new material to the history of the valley of the Missouri, and renewed the oft discussed question as to the location of Quivira.

Among the subjects for investigation, especially interesting to the students of history who are investigating that of the Missouri Valley, which this narrative suggests are the following: Did the expedition reach the Mississippi River? If so, at what point? Was the Quivira of Coronado the same as that of Penaloza, and did both expeditions reach the same locality? Did the Province of Quivira lie east of the Missouri River? Who were the people of Quivira, and what Indians are referred to as Escanxaques? How did the word Quivira originate?

As to the point reached by the expedition, the translator of the narrative says in a note to the writer of this article, that he makes a conjecture, and hopes the Missouri antiquarians will be able to determine it. His conjecture is as follows: "The short distance advanced along the river after the bend and the fact 'that the town was on a river entering the Missouri from the east seems tc 'point to the rich lands on the Platte. The high ridge would be the line of bluffs 'enclosing the bottom lands along the Missouri."

It is possible this conjecture is right, but there are difficulties in the way of endorsing it as the true solution of the problem. The expedition consisted of eighty soldiers with officers, and one thousand Indians, well armed and equipped for peace and war, with a train of thirty-six carts well provided with provisions and munitions, a large coach, a litter, two portable chairs, six three-pounders, eleven hundred horses and mules. If we are to believe that the narrator has truly stated the magnitude of the Penaloza's force and accompanying train, we are bound to assume that a journey from Santa Fe to the junction of the Platte and Missouri, would be one of serious difficulty for it to accomplish in the spring of the year, when the rivers on the route would be swollen with their annual snow-

*The expedition of Don Diego Dionisio De Penaloza, governor of New Mexico, from Santa Fe to the Mischipi in 1662, as described by Father Nicholas de Freytas, etc., by John Gilmary Shea, New York, 1882.

flows. None are mentioned however, and the journey is described as one of pleasure and delight. Their route lay eastward for two hundred leagues, through pleasing, peaceful and most fertile fields, without hill or range, which finally ended at a very high and insuperable ridge, near the sea, eight leagues beyond the great city of Quivira. Through these pleasant and most fertile fields we marched, says Father Freytas, during the months of March, April, May and the kalends of June, and arrived at a large river which they call Mischipi, where we saw the first Indians of the Escanxaques nation.

If the expedition had really arrived at the Mississippi, it would be another link in the accumulating evidence, which is tending to show that the river was quite well known before LaSalle explored it, but that they were far from reaching it, we believe the narrative itself shows. The Spaniards probably knew by report that there was a large river called Mississippi, running north and south two or three hundred leagues east of Santa Fe, and consequently were prepared, after traveling as far as they had, to call the first great river they came to by that name. By holding a course eastward from Santa Fe they had probably rambled among the tributaries of the Arkansas, until they reached the parent stem, not far from where the Verdigris and its several branches enter from the north and east. That it was the Arkansas rather than the Mississippi or Missouri, several statements in the narrative tend to prove.

The most positive that can be quoted is probably that in which the narrator says they forded it in the night. After having been joined by the Escanxaques who numbered 3,000 warriors (probably 300) they marched along the river for two days and camped opposite the city of Quivira. During the night the Escanxaques slipped off and attacked the city, upon learning which Don Diego ordered the army to cross the river which they did by fording. That this could not take place on the Mississippi, nor on the Missouri near the mouth of the Platte in the month of June, I think no one will deny, while it might have taken place on the Arkansas.

The palatable plums and large, fine grapes of extremely good flavor, are fruit much more likely to be found south of the Arkansas in early summer than in the vicinity of the Platte, while the planting of their fields twice a year as mentioned by Father Freytas, their houses of cane covered with straw, their gifts of Indian corn, beans and pumpkins, all indicate a climate like the region of the Arkansas River in the month of June, rather than the Platte. The very high and insuperable ridge, which ran along the right side of the city toward the north, might have been one of the hill ranges of the Ozark mountains. The very deep rivers of Quivira which the Father describes as suitable to run canals for irrigation are more likely to be found in some of the branches of the Arkansas with their deep cañons, than in the broad but shallow streams of the more northern prairies.

Dr. Shea quotes Father Escalante, a missionary explorer of the last century as expressing the belief that Quivira was the country of the Pawnees. This view is not inconsistent with the theory that Penaloza's expedition found the province on the waters of the Arkansas. To the Spaniards, Quivira was the unknown country, to be sought after by exploring expeditions, and if we accept the theory that the expedition of Coronado in 1542 found it near the 40th degree of latitude, it does not follow that Penaloza, one hundred and twenty years later, found it in the same locality. There is nothing to warrant the belief that any special country, located with boundaries, had ever received the designation of Quivira. It was the unknown, which lay beyond the country inhabited by the Indians that visited Santa Fe, and one locality was as likely to be so designated as another; but admit that it was the country of the Pawnees. Coronado describes the people inhabiting the villages which he visited, as living in huts of hides and willows, and says they changed their abode with the, buffalo. This is a correct description of the nomadic tribes of the Platte country, but does not agree with the customs of the people inhabiting the Quivira of Penaloza, yet I have no doubt that they were different branches of the same tribe. Marquette on his map of 1674 locates one village of the Pawnees southwest of the Arkansas and another south of the Missouri. DeLisle on his map of Mexico, 1703, has the tribe located on two streams entering the Arkansas from the south. On his map of Louisiana, 1718, he has Pawnee villages scattered from the Arkansas in the south, to the region of the Platte in the north. Upon the advent of the French into the valley of the Mississippi the Pawnees were the frontier tribe, that is, they occupied the most advanced locations on the waters that flowed east to the lower Missouri and the Arkansas. One of their villages near the Arkansas was visited by M. Dutisne, of Kashaskia, in 1719. It contained one hundred and thirty cabins, was situated upon a hill shut in by a prairie, by the banks of a stream. From there, it was fifteen days journey to the Padoucas which tribe they fought to the death. There were other villages of Pawnees north and west of the one visited by M. Dutisne.

From the views that I have expressed it will be seen that I do not believe that Penaloza reached the Mississippi, or that the Quivira of Penaloza was the same as that of Coronado, in other words that the former did not reach the vicinity of the Platte River, as conjectured by Dr. Shea. Also that the Quivira of Penaloza was not east of the Missouri River, but on the Arkansas. I do believe the people of Quivira, found by Coronado and Penaloza both, were Pawnees, and that the Escanxaques were the Padoucah's of the French or Comanches of the Spaniards, though there is a suggestion of the Algonquin A-Kan Sea in Escanxaques.

KEYTESVILLE, MO., July 10, 1882.

CABOT'S MAP OF THE WORLD.

CAPT. E. L. BERTHOUD.

(*Translated from No. 251, June 12, 1882. of L' Exploration.*)

Twenty years ago my learned and venerable friend Mr. Ferdinand Denis, my father and myself, had with a genuine geographical appetite of choice selection, studied closely the great world map of the National Library. We had already finished a commentary of it, when we resolved not to pass over one line of a very long "Legend" which accompanies this map. Suddenly one of us cried out, a *discovery*! that is no longer doubtful. Effectively we read in the first column on the left, Note 8, thus written:

"This land was discovered by John Cabot, a Venetian, and Sebastian Cabot, his son, in the year of our Lord and Savior Jesus Christ, MCCCCXCIV (1494), the 24th day of June, at 5 o'clock in the morning. To this land has been given the name of 'First Land Seen,' and to a big island near the said land, has been given the name of 'Saint John,' for having been discovered that same day. —— —— ——."

Thus we see, only two years after the discovery of Columbus, in 1494, and not in 1497, that John and Sebastian Cabot, had reached *terra firma* at the north-east extremity of the New World, not far from the Tierra de los Baccalaos (Land of codfish, New Foundland.)

We did not make much of a fuss over our little discovery; we did not think there was great glory in reading and interpreting a legend that many others could have known also. We, however, communicated our discovery to a savant of the French Institute, who a little less modest than ourselves, took the honor of the discovery upon himself.

Sebastian Cabot's map merits a more critical and deeper study. The date of its publication reaches back to the year 1544. The contour of South America is almost wholly shown, except a portion of Western Patagonia, and the south shore of Tierra del Fuego, whose name is not indicated. The eastern shore of America is pretty well drawn; the western shore stops at California.

The discoveries gathered up in the several expeditions of John and Sebastian Cabot are well indicated in this world chart, which was in course of preparation for many years, and which was given to the engraver only about 1541.

The first expedition of Cabot (after several failures) dates thus: the 24th day of June, 1494. The second one of 1497 was a 300 league cruise along the east coast of North America, that from the region first seen, "Tierra Prima Vista" in the first voyage, to the end of that sea "Mar descubierta par Yngleses" whose littoral was not landed upon.

The third expedition due exclusively to Sebastian Cabot, mentions the encounter of icebergs in Lat. 56° to 58° North, in the month of July, 1498, then a landing afterward on New Foundland.

The fourth voyage, undertaken by Sebastian Cabot alone, mentions his reaching the Latitude of 67° 30′ N. on the date of June 11, 1517, probably in Baffins Bay? —— ——.

Richard Cortambert,
Librarian of the National Library, Paris.

Note. — Capt. Berthoud informs us that he owns Sebastian Cabot's map with the "Phrima Vista Land" marked upon it.—[Ed. Review.

ENGINEERING AND MINING.

THE IMPROVEMENT OF THE MISSOURI AND MISSISSIPPI RIVERS.

HON. R. T. VAN HORN, M. C.

(*Extracts from Speech delivered in the House, June 15, 1882.*)

* * * * * * * *

The problem of the improvement of the navigation of the great rivers of the United States is one involving elements as various as the character of the rivers themselves. What is suited to one is not adapted to another, and the obstacles in one differ from those in another. For example, let us take the Mississippi and its two great tributaries—the Missouri and the Ohio. What is adapted for the Missouri is not applicable to the Upper Mississippi and the Ohio. And when I refer to "Upper Mississippi" I mean above the mouth of the Ohio, and the "Lower Mississippi" that portion below that point. And what is practicable for the Upper Mississippi, the Missouri, and the Ohio is not so for the Lower Mississippi. In the former the difficulty is not enough water for continuous and permanent navigation; in the lower river there is too much water.

The different methods demanded is from the differing characters of the rivers. In the Ohio and Upper Mississippi the beds of the rivers are rocky and gravelly the shoal places being unchangeable from that fact. The problem is to remove these rocky and gravelly shoals and to concentrate the water of the river in defined and permanent channels. The banks, too, are permanent, owing to the tenacity of the soil, and but little subject to abrasion. This is demonstrated in the navigation of those rivers by the fact that pilots run their boats by landmarks from year to year; while in the Missouri they run by the surface indications and bends of the river, landmarks being unknown. The Missouri, from the Yellowstone to the mouth, is an inclined plane of sand, not a rock or gravel shoal in the entire distance, nor a rapid. Its banks are for the entire distance alluvial and are abraded with the smallest force of current and rapidly dissolved. The problem, from this fact, is not to deepen the channel by removing bars, rocks, or deepening shoals after the method in the other rivers, but to prevent abrasion and confine the waters at given points to a narrower channel, when it deepens itself.

It is not my purpose to be tedious as to the characteristics of the river, only to state them broadly, so as to show the methods to be employed. The same plan of appropriations that is employed in the Ohio and Upper Mississippi, is not, for this reason, applicable to the Missouri. In the former given points are selected and appropriations made for each. The same plan has been adopted heretofore in the Missouri, and no good results have followed. The present bill is the first that recognized the true method, and I take this occasion to thank the Committee on Commerce for its wise and statesmanlike action. The appropriation is in bulk, to be applied continuously, so as each year to complete a section of the river in a permanent manner.

Allow me, Mr. Chairman, to briefly sketch the character of the Missouri River. From its sandy bed and the alluvial character of great valley through which it flows its course is serpentine, from bluff to bluff. When the current strikes a bluff, where it meets the rocky barriers that underlie all the bluff formations of that valley, it shoots off by a sharp curve across the alluvial bottom-lands until it impinges on the opposite bluff, to repeat the same indefinitely.

Now, the fact is, that where the river washes the base of a bluff it is narrow and deep, with abundance of water in the channel for the heaviest transportation possible to the business to be done. But when it leaves a bluff to cross the bottom to another bluff, by the abrasion of the banks it is widened, sometimes from 1,200 to 1,500 feet under the bluff to a mile and a half on bottoms. The enlargement of the channel retards the current, creates eddies by the friction interposed by the shoaling process, precipitating the sand and soil held in suspension, and bars and shallows are the result. It is a curious fact that this law of the river results in giving to the river one general feature that characterizes its centre course. This is a succession of pools along the bluffs, with shallower channels connecting these pools, the pools overlapping, or extending uniformly above the point of connection with the cross channels.

Now, the problem is to prevent the excessive widening of these cross-channels, or to confine the abrasion within limits that will produce a depth of channel adequate to the demands of navigation. For example: If the pools have at low water a depth of 20 to 30 feet, as they have as a rule, with a width of 1,500 feet, by confining the cross channel of a mile or a mile and a half with four feet of water to half a mile, we have a channel of 12 feet—the problem is solved. I use these figures as comparative.

Now, can this be done? The engineering skill of the country says it can, and the practical experience and observation of river men agree with the engineers. In fact they see it done in detail every year.

The real facts which call for the improvement of the river arise from the irregular operation of the same principle. If the snags, steamboat wrecks, and other obstructions in the channel of the Missouri had been methodically deposited they would have solved the problem long ago, and to-day we would have had deep and permanent navigation in the river. That this is not overstating the case scores of examples exist along its course where a lodged tree or a sunken boat has radically changed the course and character of the river for miles, in instances improving the navigation of the river exactly as the engineers now propose to do, but when the elements were adverse, carrying destruction and devastation in their wake. In fact it is the accumulated evidence afforded by these accidental obstructions upon which the engineers have based their p an of improvement.

There is only one thing to do to prevent the unnecessary washing of the banks at these points of crossing referred to, and the river will take care of itself. If the banks of Missouri were of the character of those of the Ohio, with its bed of sand, it would have always been the finest navigable river of the continent. Facts exist all along its course for a thousand miles that demonstrate that even its *debris*, where lodged favorably by accident, has done just what it is proposed to do under this appropriation. I cannot state it more simply or more forcibly than by saying that it is proposed to follow the example of the river itself in these improvements. There are places in the river to-day that if the snags in one bend were deposited systematically along a few hundred feet of cross channel, boats for fifty miles would find at all seasons a depth of water ample for all purposes of navigation.

I think I have stated the elements of the problem involved in the improvement of the Missouri River sufficiently broadly to give the h use an idea of the plan, and why the appropriation asked for has been given in bulk to be expended, not in removing bars, rocks or shoals from the channel, but in controlling the vagaries of the current or the waters, and allow them to do at exceptional points exactly what they do in the general channel of the river. There is not a single feature of the river proper to be changed, no interference with its laws or any of its peculiar characteristics. It simply is proposed to leave it as nature would have it if its banks had been less alluvial or capable of a little more resistance to the abrading force of its waters.

The problem, as an engineering one, is based upon the true principle of aiding nature, rather than resisting her forces. It is proposed to let the river take care of its own improvement. Its waters are the force employed. It is not proposed to provide new banks or confine its waters within mud walls—only to concentrate at the exceptional points its waters, that the volume may as elsewhere deepen their own channel.

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I now come to the second problem in the great river system—the Lower Mississippi. I favor the amendment providing for an outlet, and regret that the committee have not incorporated it in their bill.

I regret also, Mr. Speaker, that this question has been allowed to drift into an antagonism that demands the sacrifice of one or the other plan. There is no necessity for this, but on the contrary there is every reason why both should go together.

I have shown that the problem of the upper river was too little water; that of the lower is too much water. Is it not a common-sense proposition that you cannot treat these two problems by the one method? In the one case you have to control the water within the river banks so as to provide at shoal places a deeper channel. In the other it is to get the superabundant waters within the river banks. Will the plan of the one answer for the other? It is simply impossible, because the trouble is in the two cases directly opposite in character.

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We know that the money already appropriated has not been expended because the flood-waters have been in the way. Now, we contend that if the river had more discharging capacity the waters would have been within the banks and that money have been expended for the use intended. And why not open more discharging capacity? What is the cause of the overflows of the Lower Mississippi? It is, stating it broadly, because the mouths of the river are not big enough. This fact comes from two causes, the slow current near the sea, and the consequent precipitation of sand and mud held in suspension. These causes result in narrowing the channel as it approaches the sea. The fact that by actual measurement the inflow at average floods at Cairo is 1,475,000 cubic feet of water per second, and that after receiving the waters of all rivers below, the flow at New Orleans is only 1,100,000 cubic feet per second, tells the story of the disastrous annual overflows. This surplus water must go somewhere, and the only place for it is to overflow the adjacent country. To confine this immense flood within artificial walls, built of the mud the river takes up and carries down to choke up its own discharge, is, I submit, one of those stupendous follies which sometimes fascinate men merely from the fact of their magnitude and from the vast sums of money involved.

That new mouths will draw off the water just in ratio with their capacity is as plain a proposition as that a barrel of water will be depleted by opening the bung-hole. The river below New Orleans, with a fall of one and one-half inches to the mile, has a flow of six feet in a second. The proposed Lake Borgne outlet, with a fall of two and three-fifths feet to the mile, would have a corresponding increase of current and consequent discharging capacity. But only calculating the flow at ten feet per second, with a width of one mile and ten feet deep, its discharge would be 528,210 cubic feet of water per second, or one-third of the whole inflow at Cairo. But the current would be more than twenty feet per second, or a capacity nearly equal to the whole river at Cairo. The mere statement of the figures shows the ample character of the proposed outlet for the drainage of the highest flood ever known.

Why then is this self evident plan opposed? It is upon the assumption that if you let the water out through these new mouths the channel will be shoaled. No other objection having any practical bearing can be made, or can be urged to stand a moment, in view of the difference in cost—the outlet being estimated at $250,000, the other plan at $50,000,000. Is the objection a valid one?

I contend that it is not only without support in fact, but is based upon a false assumption as to what the outlet plan is. These outlets only propose to drain the flood-waters, not to make new river channels. When the river is within its banks now, navigation is just as desired. All the outlets propose is to keep the water from overflowing the banks. How, then, when the river is within its banks, or bank-full, in October, and at its maximum excellence for navigation, can it be destructive to navigation when in precisely the same condition, in March or July? That is all the outlets propose to do—to keep the river at this maximum at all seasons. They are not deep enough, and cannot be made deep enough, to affect the normal channel of the river, or the quantity of water in it. Or in other words, the channel of the outlet is ten feet deep, while the river channel at the outlet is 100 feet deep. How is this outlet to drain the river dry, or shoal it? It simply draws off the flood-waters, leaving the normal channel unaffected. But we are not left to theory. The United States topographical engineers by measurement at crevasses have demonstrated that the operation of these openings actually deepens the channel below the point of outlet. And this is exactly what is claimed for its effect—that the river confined within its banks by its increased current deepens its channel.

It is upon this theory that the Missouri River improvement is based, and I am not illogical enough to deny the operation of the same law in the Lower Mississippi that obtains in the Missouri. But it is upon this very fact that the improvement of the navigation of the Lower Mississippi is based. It is claimed at points where bars interfere, that by works which will confine the waters to lesser space the channel will be deepened. Now, if the water confined to the normal width of the channel on a bar deepens the water, why not the channel be deepened and improved when the whole river is confined within its banks? The statement is the answer. It is the object of all our appropriations, of all our surveys, of all our plans, to keep the river within its banks, natural or artificial. If, as is contended, when we build the banks higher in order to confine the water, it will deepen the channel, will not the same effect result if the waters are confined within the natural banks? It needs no argument; its demonstration is a fact known to every practical navigator of the great rivers of the West.

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I beg the House to remember one fact, that the advocates of the outlet system have only assumed one thing—the mere cost of making it. Every other fact connected with it is from the highest engineering authority ever known in this country; is copied from the official report of the board of engineers of the Army of surveys and investigations made under the authority of Congress during a protracted period of ten years, embracing everything connected with the river at high and low water, as to levees and embankments, navigation, currents, the bed of the river, its floods, and all phenomena. We assume nothing; we have no theories, no experiments, no hypotheses; simply the fact that water runs down hill, that it is not compressible; these re-inforced as to results by ascertained facts by the most thoroughly applied scientific methods.

And what is the plan here proposed? Let me state it simply. As now, the river has below New Orleans a current that moves over a bed with a fall of one and one-half inches per mile. The distance is 120 miles. Ten miles below New Orleans the Gulf of Mexico approaches to within five miles of the Mississippi by an arm known as Lake Borgne. The river thus reaches the Gulf level at a point 110 miles less than now, or in five miles we reach the same level that the river now does in 110 miles. Gentlemen can discount the drainage capacity of thirteen feet fall in five miles in the one case, and the same fall in 110 miles as now, in the discharge of these surplus waters. That is all there is to the proposed Lake Borgne outlet.

Now, the fact to be ascertained is, will it prevent overflow to be restrained or confined by artificial banks? The plan has been tried, and has failed. By both experience and theory it will require artificial banks to be constructed from four to ten feet high for a thousand miles. Is it practicable as to money cost? and if so, will it hold the water? Both must be answered in the negative. We have found that it is difficult to confine even canal waters by artificial banks. How, then, the mighty floods of the Mississippi?

Again, the experience of the ages is that just as you raise the banks of a river you decrease the force of its current, until, as in the case of the river Po, in Italy, the river bed is above the level of adjoining lands. That river, after centuries of leveeing, now runs across the low lands on a ridge. But keeping a river within its natural banks deepens its channel, cutting out its bed to the proper angle of fall to the sea. It requires no science to know this; every washout in the farmer's field illustrates and demonstrates it. The only question of a practical nature in this connection is, can you get outlet enough? I have shown that you can.

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It has been shown by facts, in plain measured feet, that the proposed outlet cannot affect the river channel. Why not make it? It will be observed, Mr. Chairman, that these objections to the outlet are not made as formal engineering ones: they are the mere advocate arguments before the committee: there is another one used among members, but carefully kept from the record. This argument is that the outlet would injure the jetties. This is so new and novel that it is done in a whisper. The old soothsayers were said to laugh in each other's faces when alone. The habit did not die with the soothsayers.

Now, I can speak on this subject without fear of criticism, for from the beginning I favored the jetties, and have not changed. They do not need this disingenuous argument, nor, even if they did, are they sacred or of more importance than the valley of the river. Let us look at this for a moment. It is shown that the river is a hundred feet deeper than the outlet at the point of junction. As the jetties are only twenty-four feet deep there is abundant water for them. We have shown that 1,100,000 cubic feet of water per second pass the point of the proposed outlet. The same high engineering authority tells us that only 83,000 cubic feet per second enters the pass in which the jetties are. So that there is all the jetty pass can carry and a million cubic feet to spare. No wonder this objection passes by a breath and is carefully kept from paper. It is not discourteous to say the objection is not an honest one. It either reflects upon the intelligence of the person to whom it is made, or upon the candor of the one who makes it. No friend of the jetties will put the objection on that ground, for it at once raises the question of good faith and of their utility.

To set this objection at rest, let us refer to the facts upon which the jetty legislation was based and those alone upon which the annual drain for keeping them open is made upon the Treasury. The jetties are based upon the simple fact that water is incompressible; that if you confine a stream of flowing water, of say half a mile wide, so as to make it pass between walls a quarter of a mile apart, the water will find room for its volume by cutting down its bed. That is all there is to the jetties. If the bed is of soft material, like sand or mud, it will cut it out. If it is hard clay or rock it won't, and then it makes a dam. Now the best advice I can give those who urge this objection against the outlet is to be very careful how they handle the subject, for if they once let go the theory on which they got the money to build the jetties, they turn them into a dam, and Congress may discover that a dam raises the flood-line of of the river, and vote money for the outlet to carry off the surplus waters.

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LEADVILLE AND VICINITY.

A recent trip to Lake and Pitkin Counties in Colorado, and a summary inspection of the wonderful mining regions included in them, especially in the vicinity of Leadville, east of, and in the Independence District, west of the Sawatch Range or Continental Divide, leads me to give your readers a brief description of them, although the former, at least, has been the theme of hundreds of writers within the past three or four years.

Leadville is situated in Latitude 39° 15′, Longitude 105° 17′, on the eastern side of the Arkansas Valley, between the Mosquito Range and the Continental Divide, at an elevation of 10,025 feet above the sea at the court house door. The first discovery of ore was made in 1860 in California Gulch, and for several years placer mining was carried on quite successfully, not less than $5,000,000 of gold having been taken out up to 1878. At the time of the Hayden Report of 1873 several valuable lode claims were being worked for gold, while carbon-antes of lead and copper, iron pyrites, zinc blende, etc., were found. A vast body of iron ore was also reported by Hayden, "carrying gold enough to pay moderately," also, "excellent galena carrying silver in the quartzites near the iron vein." No indication, apparently, was observed of the vast quantities of silver ore that have within four years brought the district to the position of the richest mining camp in the world and caused Leadville to leap from a grubbing town of two or three hundred people to a thriving city of nearly 20,000. At that time two mines, the "Printer Boy" and the "Pilot" were yielding less than $50,000 per annum, now more than thirty mines are being worked, producing $13,170,576 in 1881.

The geology of this region is quite difficult to understand except by the most extensive generalization, as will be seen from the following description by Dr. Hayden: "On the summit between Mosquito, Bird's Eye and Evans Gulches broken masses of the quartzites and trachytes seem to have moved down a considerable distance from their places and are deposited in the form of windrows as if there had been glacier movements there. * * * One of the peculiar geological features in this range is the trachytic beds, which appear to be interstratified with the older sedimentary rocks. These igneous layers vary much in thickness, and appear and disappear, reach a thickness of 1,000 feet or more, and diminish in a short distance to a few feet or disappear entirely. And yet upon the outcropping of the great uplifted ridges, or in the deep gulches where not unfrequently 2,000 vertical feet of rocks are shown in their order of superposition, these trachytes seem to have flowed out over the surface of the Silurian quartzites or, in other words, are interstratified among the old silurian limestones and quartzites as if they might be of the same age and have been elevated with them."

S. F. Emmons, Geologist in charge of the Rocky Mountain Division U. S. Geological Survey, in his "Abstract of a Report upon the Geology and Mining Industry of Leadville, 1881," describes more minutely the peculiar geological features immediately about Leadville, as condensed by the *American Journal of Science* for July.

"The Paleozoic rocks of the Mosquito Range have a thickness of 4,050 to 5,600 feet and are more or less folded and faulted. They comprise (1) 200 feet of Cambrian or Primordial, chiefly quartzites; (2) over these, 200 of Silurian (*white* or dolomitic limestone and quartzite); and (3) 3700 to 4200 of Carboniferous, which last have 200 feet of limestone, called the *blue* limestone, at base and 1,000 to 1,500 at top (Upper Measures), with grits (Weber grits), sandstones and shales, partly calcareous, between. In the Kanab section on the Colorado, the Paleozoic has about the same thickness (85 feet of it referred to the Permian); but in the Wahsatch section cited, the thickness is 30,000 feet, 12,000 referred to the Cambrian, 3400 to the Silurian and Devonian, 15,000 to the Carboniferous and 650 to the Permian.

Besides these there are eruptive rocks—porphyries and diorytes—mostly Mesozoic in age. The common kind is the white porphyry, an evenly granular rock, consisting of quartz (70 per cent.), feldspar (the latter occasionally in small rectangular crystals), black mica or biotite, and some muscovite. The rock is partly decomposed, and the muscovite "is the result of the decomposition of the feldspar." Other kinds of porphyry, more granite-like, consist of quartz, two feldspars and biotite, and in one variety horn-blende is present. The dioryte is a porphyritic crystalline-granular variety. The white porphyry occurs to the south of an east and west line through Leadville, and the other kind north of this line. The main sheet of the former which lies upon the surface of the blue limestone forms, at the Four-Mile Creek where is its principal vent, the larger portion of a hill 2,000 feet high, and thence spreads southward reaching nearly to Buffalo Peaks. On Irón and Carbonate Hills it has a possible thickness of over 1,000 feet; but along Evan's Gulch it will scarcely average 100, and even thins out entirely. Other sheets occur between lower strata, and there is a local sheet in the lower quartzite or Cambrian. The intrusive masses of the other porphyries have a wider vertical distribution, "extending up to the Jurassic and possibly even to the Cretaceous." A single section exhibits "fifteen sheets, many several hundred feet thick, between the blue limestone and the top of the Carboniferous." The various sheets of porphyry form an integral part of the sedimentary series; they never reached the surface, but were spread out and cooled between deep-lying strata—laccolith-like, before the mountain-building epoch at the close of the Cretaceous, and therefore before the associated strata were folded or faulted. Archæan rocks make large parts of the Sawatch Range on the west, and of the Front Range on the east, and their areas must have been great islands in the Paleozoic seas. "The Paleozoic and Mesozoic beds are a littoral deposit around the Sawatch Archæan Island and were consequently formed in comparatively shallow waters."

Of later formations, the region contains only the Quaternary; what have existed of Mesozoic strata—probably not less than 10,000 feet—having been removed by erosion and abrasion.

Several faults occur, the more prominent of which have the strike of the rocks, or about N. 60° W. and the upthrow on the east side; and, of these, the Mosquito fault, west of the main crest of the Mosquito Range, amounts on the north to 5,000 feet or more. Besides these there are many cross faults."

On the Pacific side of the Continental Divide the geological formations are similar, but the mountain sides are more precipitous and more heavily covered with loose material of every possible variety, while the upheaval and displacement have been even more complete. The ores so far discovered are principally gold in fissure veins rather than in pockets, but as comparatively little work has been done yet all may take a different phase after more complete development.

The ore of Leadville is described by Mr. Emmons (condensed as before by the *American Journal of Science*) as principally argentiferous galena and its secondary products lead carbonate, silver chloride, and, less abundantly, lead sulphate or anglesite, pyromorphite, minium, zinc blende and calamine. The gangue, or material mixed with or holding the ore, consists of hydrated iron oxides or manganese oxides, silica and clay, all secondary products, the clay coming from the decomposed porphyry. The cavities in the limestone were made by the eroding solutions which introduce the ores; the action commenced at the top of the limestone adjoining the sheet of porphyry, and from this plane worked downward into the limestone. The materials of the ores were taken from "circulating waters, which, in their passage through the various bodies of eruptive rocks, took up certain metals in solution, and, concentrating along bedding planes, by a metamorphic or pseudomorphic action ot replacement, deposited these metals as sulphides along the contact or upper surface, and to greater or less depth below that surface, of beds generally of limestone or dolomite but sometimes also of siliceous rocks." Dikes intersecting the ore-bearing formation "seem to favor the concentration of rich ore-bodies or bonanzas in their vicinity;" but the planes of faults afford no deposits of importance, and evidently for the reason that "their origin is later than that of the original ore-deposits." Thus the intrusion of the igneous sheets preceded the production of the ore-deposits and of the cavities containing them; and the production of the ores antedated the era of great disturbance which closed the Lignitic period or the Cretaceous, and which has continued to be followed by feeble movements until the present time, even since the opening, according to some evidence, of the Leadville mines.

These ores occur, according to the same authority, underneath a porphyry sheet and chiefly in cavities penetrating the lowest member of the carboniferous formation, the *blue* limestone—but occasionally also underneath the same porphyry in the *white* or silurian limestone and the Cambrian quartzite. The ore deposits penetrate into the limestone to varying depths from its plane of contact with the overlying igneous rock, sometimes following courses of natural joints or cleavage planes.

The product of the Leadville mines for the past six months has been about $7,815,000, which if kept up for the whole year will exceed that for 1881. Even this showing would be larger had it not been for the burning of the Grant smelter in June, which necessitated the sending of large quantities of ore to Pueblo and Denver, the returns for which had not been received when the above statement was given out.

The mines over the Range in Pitkin County are being actively worked and the prospect is that the Farwell Company at Independence will find abundant work for both stamp mills from their own mines, as they are driving the Dickerman Tunnel with all the men they can work, are also developing the Mt. Hope Mine and have their larger mill full of ore now; while those of Ide, the Hamilton Company and others promise well. The last named company are not at work on theirs at present, but are securing patents to their placer and lode claims, after which they propose to resume active operations. C.

PHILOSOPHY.

REVIEW OF STALLO'S "CONCEPTS OF MODERN PHYSICS."

DR. ROBERT G. ECCLES.

The thirty-eighth volume of the International Scientific Series is a statement in excellent form of the weak points of Modern Physics. Following the volumes by Cooke, Stewart, Lommel, Lockyer, Wurtz and Young, nothing could be more opportune or better calculated to display the spirit of fairness of the managers and publishers of the Series. The true spirit of science refuses to shield any theory from attack, and firmly believes in the final triumph of the best. The projectors of this literary enterprise have shown, from first to last, a keen appreciation of this spirit and a determination, as far as they could, to foster it. Stallo's "Concepts of Modern Physics" is a further guarantee on their part that they will be impartial to the last while giving the public the best thoughts of the best thinkers concerning the meaning of our multitudinous experiences, common and scientific. The author hews with his axe at the very root of the philosophic side of science. He looks into the minds of scientific philosophers and claims to discover there sources of illusion woven into the structure of the intellect itself. He points out four fundamental assumptions as the byways from the true path into which they tend to turn and lose themselves. These are:

1. "That every concept is the counterpart of a distinct objective reality, and that hence there are as many things, or natural classes of things, as there are concepts or notions.

2. "That the more general or extensive concepts and the realities corresponding to them pre-exist to the less general, more comprehensive concepts and their corresponding realities; and that the latter concepts and realities are derived from the former, either by a successive addition of attributes or properties, or by a process of evolution, the attributes or properties of the former being taken as implications of those of the latter.

3. "That the order of the genesis of concepts is identical with the order of the genesis of things.

4. "That things exist independently of and antecedently to their relations; that all relations are between absolute terms; and that therefore whatever reality belongs to the properties of things is distinct from that of the things themselves." (pp. 137 and 138).

In illustration of the first and second false assumptions he mentions the controversy between the champions of the *corpuscular* and *dynamical* theories of matter. The one side insists upon it that mass or inertia is the counterpart of an objective reality and as it is one of our most extensive concepts all material being has come therefrom. The other side, reasoning with Faraday asks: "What do we know of the atom apart from its forces?" Since we know nothing of matter save through force, they hold forth the view that force is an entity and from it everything has come. Our author tells us that "force is nothing without mass and mass is nothing without force." (p. 161.) He denies that either is a fact in itself and declares both "conceptual integrants of matter." "In both cases products of abstraction are mistaken for kinds of reality." To clearly understand the exact nature of this controversy requires careful thought. Judge Stallo's view of this warfare between the great thinkers of the world is one which I fear can never become universal. Although it is certain that one or both sides may be wrong, yet it is hard to believe that the object sought after by each and which one side imagines it has found in force and the other in mass is totally delusive. That bodies exist, *as such*, in virtue of their relations is quite conceivable, but to say that they exist "*solely* in virtue of their relations" sounds to me like utter nonsense. That "things are known to us solely through their properties; and the properties of things are nothing else than their interactions and mutual relations" as affecting our consciousness, is quite true.

To tell us that "the annihilation of all bodies but one would not only destroy the motion of this one, as Prof. Neumann sees, but would also destroy its very *existence* and bring it to *naught*," taxes our credulity somewhat. If we believe in the impact theory of attraction we might see in the annihilation of all bodies, save one the perfect solution of that one, but by accepting the counter-theory even this difficulty would disappear. Here is the basis of his charge of the fourth metaphysical assumption. Men of science entertain the view that behind such relations as we are cognizant of lies a something so related. What meaning can we attach to the fact of relation unless there is something related? If no one thing exist without the total that one must be the total. On what ground can we claim that a finite total, of any size, is impossible?

Prof. Wm. James, of Cambridge, Mass., in "Mind," April number, 1882, p. 196, in an article entitled "On some Hegelisms," presents the position of our author. He is showing the difference between Hume's Empiricism and Hegel's "Ontological Reveries," (as the judge calls them,) on the principle of totality. "But Hegelism dogmatically denies all this to be possible. In the first place it says there are no intrinsic natures that may change; in the second it says there are no adventitious relations. When the relations of what we call a thing are told, no *caput mortuum* of intrinsicality, no 'nature' is left. *The relations soak up all there is of the thing;* the 'items' of the world are but *foci* of relation with other *foci* of relation *And all the relations are necessary.* The unity of the world has nothing to do with any 'matrix.' The matrix and the items, each with all, make a unity, simply because each in truth *is* all the rest." Does not this sound very like our author's position? Is it quite certain that the present work is entirely free from the effects of the spell which held him in 1848 when "The Philosophy of Nature" was published?

If we study a piece of matter, say sodium, we find it in possession of certain properties or attributes by virtue of its relations. It has weight, color, affinity, ductility, malleability, inertia, motion, size, etc. Take it away from the earth and the farther we go the less its weight becomes. Put it in the dark and it has no color. Keep it from oxygen and such other substances as it unites with chemically and it has no affinity. Vaporize it and it has no ductility nor malleability. Its size is great or small as it is expanded into steam or contracted to a solid. O r judgment of its motion depends upon a relatively stationary standard from which to compare it. As we now view it scientifically the conditions which give it weight, color, affinity, etc , are conditions of motion. Remove one by one the conditions which give bodies their properties and what is left when every condition has been removed? We perceive no substance *per se*. All manifestations are those of inertia and motion. These are themselves but conditions or relations. The corpuscular theorists, we are told, upon this final analysis, choose mass or inertia, and the dynamical theorists motion or force.

Our author says that bodies come to naught when thus treated. He sees relations only. But relations of what? Here is a house. It has windows, doors, floors, walls, roof, stairs, rooms, etc. All these together form a house. We cannot conceive of any less than walls and ground floor as a house. Suppose two men should contend with each other as to which of these two final terms was really the house. Let a third come in and show them that walls could not stand on nothing for a support and that bare ground was not a house, then we would have a fair illustration of the question. Matter is the house. Inertia is the ground floor. Motion is the walls. A certain set of relations form a house. Relations of what? Matter, of course! Not relations of the last two conditions constituting a house either together as Stallo has it nor apart as those he wars with have it. It is not motion and inertia, motion alone, nor inertia alone. At present it is useless to give it a name other than the unknown. To call it by any term of either matter or motion is as senseless as to call matter in our house relations by the name ground, wall, floor or any other term denoting part of a house.

Our order of symbols fail to describe the real whose relations form matter. Faraday perceives that the real is not motion, hence he speaks of it as force, talks of lines of force and makes a *quasi*-material of it. The antagonistic school speaks of it as inert mass and not mere inertia. Both sides look beyond the attribute to a something, they know not what. They mean the same but do not know it, because their points of view differ materially. This common something Mr. Herbert Spencer calls the unknowable. Nature presents itself to us in all its dimensions only by viewing it from opposite sides. I cannot see all of a chair or table, tree or house, even externally, but by viewing from diametrically opposite points. Inertia and motion are the vanishing points of all objectivity. To objective sense here end our symbols. Physical science must stick to inertia *and* motion because it can go no deeper. Ontology may guess at the unknown beyond but without hope of ever reaching it. Psychology is the only hope and

and it may forever fail. External nature we see mediately through the senses. Sensations are immediate possessions. Only the immediate is real. The mediate is composed of a series of transmutable symbols. A common symbol may change into two or more utterly uncontrastable one, as when we feel a moving tuning-fork and hear a sound. One and the same external condition gave me through different channels two sensations as unlike as a sensation of a spiral motion, (to borrow Tyndall's illustration), is unlike the sensation love. It is just as hard to believe that the sensation vibration and the sensation sound are the same as to believe that the sensation motion and the sensation love are the same. In the first case we have some show of proof, in the second none has been had.

In psychology as in physics two contending schools are struggling for the mastery. Monists claim that chemical changes or rhythms of some sort in brain substance constitute sensation and thought. Dualists declare that mind itself is totally aloof from matter and merely connected to it much as a player is to a piano. Both await the proofs of future investigation and speculation. If Dualism is true there is no hope of our ever being able to acquire any knowledge of what lies beyond the vanishing point of matter. If Monism is true we may never be any better off, but it gives a solitary ray of hope that its disciples will use all effort to brighten as ages roll past. According to the latter doctrine every sensation produces or is produced by some mode of motion. A better way of stating it is, that our immediate and real perception is the sensation, and the mediate, and consequently symbolic, way of perceiving it, is as a mode of motion. It is supposed from what we already know of objective things that if I could look into my neighbor's brain when he is thinking, a definite set of movements would appear, ultra-microscopic perhaps, yet movements. Every time he thinks the same thought, the same movements occur.

Now these movements reach me through ether, optic instruments, nerve-threads and gray matter. Each change alters it. When it reaches me through these mediums it is transmuted just as the vibrations of a tuning-fork are transmuted into sound. As sound in no way resembles a vibrating fork, so vibrating brain matter in no way resembles thought. That which totally altered vibrations and changed them into a musical note, totally altered thought and changed it into the symbol of moving matter. The thought with its constituent sensation was the real mode and substance, the motion with the matter it shook was the illusion. The first must be the real. Thought and sensation are immediate. All subjective sensation is immediate. Objective sensation is always mediately derived and necessarily changed by the transmitting medium or mediums. All we know of nature external to ourselves must necessarily be merely symbolic on this account, *until we discover some method of interpreting our symbols into terms of the real.* Only with the vibrations of brain stuff have we succeeded in making this interpretation. The thought is first visible perhaps as the black characters on a page of paper. These being read aloud, are transmuted into a different set of symbols known as air waves or vibrations, these are finally transmuted into sounds of words and sentences.

Now the magician Mind does his work. He takes hold of these symbolic sounds and interprets them into ideas in thought, and the same thoughts with the same feelings as they started. Here we are able to take hold of the immediate state of objective things by becoming able magically to transmute the symbols into terms of the real. From set to set of totally different symbols it traveled to be at last correctly interpreted. Shall we ever be able to do with our eyes resting on a human brain what we now can do with our ears turned to the human lips? It does not look probable that such a consummation can be ever reached. Yet who dare say "never"?

Brain and vibrations, lips and vibrations are all symbols. Our bodies are masses of symbolic relations. All of animate and inanimate(?) nature is the same. We discover a common symbol in them all. Everywhere our mediate perception gives us matter and motion in time and space A few isolated specks called human brains have only just begun to give us light of what this common symbol means. Sensation looks as if there was a possibility that it gave as its objective symbol inertia, and modes of sensation and thought look as if they gave as theirs, modes of motion. Motion and mass are both mere sense illusions, if this is true, and mind only constitutes the all. Matter and mind cannot even be two sides of a common unity as many persons are pleased to view it. "Death is swallowed up of life." Matter is a mere set of objective relations that are absolutely nothing in themselves only as they stand for thoughts and feelings. What a task is before the psychology of the future? To it is bequeathed the work of reading the subjective meaning, first, of brain movements and finally those of all being. If monism proves false then it surely looks dark for the discovery of what it is whose relations as symbols we know. If we cannot get into things through our symbols we are helpless. From the symbolic without we can gain no steps beyond inertia and motion. The noumena must remain an eternal unknowable.

The Judge's special illustrations of his third metaphysical error of science are first the atomic theory and second gravity. The order of experience with matter in a growing child is first the solid and last the gas. His concepts therefore develop in this order. The true order according to our author is the reverse of this. "All evolution proceeds from the relatively Indeterminate to the relatively Determinate, and from the comparatively Simple to the comparatively Complex." (p. 172) The gas he claims is not only comparatively indeterminate but is also the most simple form of matter. He concludes from this, and probably correctly, that we should seek to explain the solid by the gas, rather than the gas by the solid. If we admit molecules at all they should be soft, expansive and contractile ones rather than hard, inelastic ones. When, however, from this ground he reasons that gravity is action at a distance, his positions are utterly untenable. Gravity so far from being indeterminate is the most determinate form of energy we know and instead of being comparatively simple is so complex that theory after theory has failed in attempting to explain it. His attempt to clear himself from Mill's objections to action at a distance clearly shows the complexity of the problem, even on that assumption. He says: "This inability results from the inconsistency of this concept with the prevailing notions respecting material presence. If we reverse the proposition that a body acts where it is, and say that *a body is where it acts*, the inconceivability disappears at once." (p. 145).

The sun then is where the earth is and the earth where the sun is. They envelop each other or are parts of one another, we will suppose he means. Now on either assumption how can gravity be conceived unless by some mechanical theory of relations of one to the other or of parts to a whole. With the theory of the continuity of the total we still require to know how gravity causes a body to move. Is the space between two bodies like a piece of elastic rubber but unlike rubber pulling harder the less it is stretched. *If a body is where it acts then there is after all no action at a distance.* He denies impact and yet reduces his own theory to one of impact. He solves the problem by giving it up. By his own showing then he is guilty of the very metaphysical error he charges upon his opponents. But this abuse of the word metaphysical—this casting it about as a term of opprobrium is useless and vicious. What is gained by telling our opponents that they demand "that the first rudimentary and unreasoned impressions of the untutored savage shall stand forever as the basis of all possible science? Did the savage have no correct notions of nature? Were not his experiences and some of his inferences as sound as the best of ours? Why should these not stand forever as the basis of all possible science? Shall we reject a truth because it was so patent that even primitive savages saw it?

There is really no difference between Hobb's statement that "there can be no cause of motion except in a body contiguous and moved," and that of Stallo that "a body is where it acts." It is different ways they have of putting it. Gravity is a property of matter resulting from mutual interaction and relations. Color, sound, size and shape are the same. With one and all what we seek to know is the exact character of the relations which give rise to them. To assert that "all attempts to reduce gravitation or chemical action to mere impact are aimless and absurd," (p. 163,) is in substance to assert that it is an absolute and insoluble fact instead of a condition outwrought by mutual relations. If gravity is produced by relations we want to know what these relations are. As yet no theory of gravity has been propounded that meets all the conditions of the law. Action at a distance is nonsense, as the Judge virtually concedes. Should we see a tug-boat ahead of a ship pulling it, with neither hawser nor chain between them, common sense would reject with contempt an *actio in distans* explanation from any one. When the valve of a pump becomes the means of raising water from a deep well, we explain it by atmospheric pressure in the water below. How much easier it would have been to call it *actio in distans*—the valve attracts the water because it is where it acts or attracts—*i. e.* on the water and the water in it. This would have been a far easier way of disposing of it, although scarcely as conceivable as nature's abhorrence of a vacuum.

That not one only but several theories of gravity might be framed answering to the conditions of the law so far as these conditions are yet known is quite possible. Although such a theory may be of little practical utility and perhaps be merely a fiction of the imagination, still the presentation of one can do no possible harm and will do some good by tending to keep the distant action philosophers from saying things they may ere long be heartily ashamed of. Mr. Wm. B. Taylor, of Washington, in the Smithsonian Report for 1876, pp. 205 to 282, gives brief descriptions of the Kinetic theories of Newton, Hooke, Villemot, Bernoulli, *Le Sage*, Euler, Herapath, Guyot, Faraday, Sequin, Bouchepom, Lami, Waterson, Challis, Glennie, Keller, Tait, Saigey, Croll, Leray, Boisbaudron, Guthrie and Crookes. None of these answer the conditions. Mr. Taylor resorts to *actio in distans*. On page 211 he gives the six following conditions to which a theory of gravity must correspond or be rejected at once :

1st. "Its *direction* is radial toward the acting mass, or rectilinear—indefinitely. This rectilinear traction is incapable of deflection by any intermediate force. It suffers neither disturbance nor interference from any multiplication of similar lines of action, and admits neither of reflection, refraction, nor of composition.

2. "Its *quantity* is exactly proportional to the acting mass—indefinitely. Corollary: hence, 2b. Its *integrity* of action is complete with every accumulation of additional demand—indefinitely; that is to say, no multiplication of duty in the slightest degree impairs its previous tensions.

3. "Its *intensity* is diminished by recession, in proportion to the square of the distance through which it acts—indefinitely; in a manner somewhat analogous to—but (as modified by the second condition,) radically different from—the action of light.

4. "Its *time of action* is instantaneous throughout all ascertained distances, and therefore presumably—indefinitely. Corollary: hence, 4b. Its *rate of action* (if the expression may be tolerated) is precisely the same on bodies at all velocities—indefinitely. It no more lags on a comet approaching the sun, at the inconceivable speed of 200 miles in one second than on a body at the lowest rate of motion, or than on the same comet receding from the sun at the same velocity.

5. "Its *quality* is invariable under all circumstances—indefinitely. It is entirely unaffected by the interposition of any material screen, whatever its character or extent; or in other words it can neither be checked by any insulator nor retarded by any obstruction.

6. "Its *energy* is unchangeable in time, certainly for the past 2000 years; presumably—indefinitely. Corollary: hence, 6b. Its *activity* is incessant and inexhaustible—indefinitely; the ceaseless fall of planets from their tangential impulses involving no dynamic expenditure in the sun or in other known matter."

True to the mechanical theory the explanation about to be offered begins with atoms. These atoms, however, are very active little things and not at all hard. They were first introduced to the world as probably performing some such function, by Prof. Sir Wm. Thompson, of Glasgow, Scotland. They are the vortex atoms that we heard so much about a few years ago. Helmholtz has shown that vortices in a perfectly frictionless fluid would be eternal. Thompson experimenting with vortices shows that they possess just such qualities as we demand of an atom to have it explain some of the principal properties of matter. When we form vortices in air and make them visible with smoke, it becomes possible for us to see and study their actions. Without the visible smoke they are still there and subject to exactly the same strictures as our author puts upon the hypothetical ones (pp. 43, 44), but ignoring such logic they still swing.

Our frictionless fluid is neither destitute nor incapable of difference. It can have various sizes and shapes of vortices and these are all the differences needed. Relation after relation in time and space can be built up hypothetically among them. Here we have the universal fluid as mass and the vortex as motion. The motion is of the fluid and not of itself. Inertia is potential in every vortex because of the presence of mass. They are in space flying in all directions. By beginning with such a fluid and such atoms we explain the solid by the gas as our author declares we should. But even this is subject to his censure. We have here relations of something and he wishes the relations themselves to be everything. Now such atoms do not gravitate. Let us hypothetically build up from these a gravific molecule. These vortices if supposed to be clashing against each other and rebounding with perfect elasticity will be all that is needed. Preston's modification of LeSage's theory (Phil. Mag. Ser. 5, Vol. 4, pp. 364, 375,) will give us some idea of what would happen under such conditions. We need no such long free paths as he calls for however. They can be comparatively very minute. A number, anywhere from three up, of the largest of our vortices shield each other from the cannonading of myriads of small ones. The shielded faces necessarily rush together. Their elasticity makes them rebound. Back and forth they rush. Natural selection brings from chaos order. Molecules are evolved from rushing atoms in this manner. Myriads of centres of our large atoms are formed having an indefinite permanency because of the orderly rush. We have then molecules that rapidly change from expansion of their substance to contraction of the same in incessant rhythm. Their balanced constraint by the rush of small atoms gives them tangible inertia in every direction. It tends to keep them as a whole in the condition of rest or motion in which they happen to be found.

Such are the gravific molecules demanded by a Kinetic theory of gravity. They are rapidly expanding and contracting pieces whose movements resemble somewhat that of a cosmic system according to the nebular hypothesis, but, while the system requires untold ages to undergo its changes, our molecules pass through theirs in inconceivably minute periods of time. Surrounding these molecules on every side is found the smaller sized atoms in differentiated arrangements totally unknown. These we will suppose constitute the universal ether. Now what would happen to such expanding and contracting molecules pressed in upon every side by walls of rushing ether particles? All those having a common time of change would necessarily be driven together by their own pulsations. Systems of waves would go out from all to all and these waves would be in unison with the molecular beats they came in contact with. A's waves would keep time with

B's rhythms in size and B's waves with A's rhythms. When A is in the crest of B's wave it rapidly expands into the sinus and when in the sinus it contracts into the crest. B does the same by A's wave. What happens? Let a body rapidly expand from a dense toward a rare medium and it will necessarily leap forward toward the rare one. As it contracts in going into the dense one again it does not lose the ground gained. The ether contractions and expansions for waves must of course be of different atoms from the little ones forming the molecule by their rush. We need in other words two ethers, one for undulations and a finer one for the cohesive force of our molecules.

Many known facts in science constrain us to believe in two ethers aside from this theory. When a swimmer turns the narrow part of his hand to the water in his cut stroke and the palm in his back push he does virtually what we imagine our gravific molecules do. When fish with fins and tails and birds with wings propel themselves by presenting a narrow surface forward and a broad one in the back push, they do the same. Our molecules by their movements can go in but one direction and that in an exactly straight line to the source of radiation. Could the first condition of a good theory of gravity be better filled? "Its direction is radical toward the acting mass" As the source of power is in the molecule itself, exactly as you increase the number of such molecules so you will increase the power. It exactly fills the second condition and its corollary. "Its *quantity* is exactly proportional to the acting mass." "No multiplication of duty in the slightest degree impairs its previous tensions." All radiation obeys the law of inverse squares. The crests and sinuses on which the reaction of our molecules depend vary in their power of reaction inversely as the square of the distance from their source. The third condition of the problem here meets a remarkable agreement. "Its intensity is diminished by recession, in proportion to the square of the distance through which it acts." The source of action being in the molecule itself no time whatever is necessary for its manifestation. It is immediate—instantaneous in its power, for all places. On this fourth condition every other kinetic theory hitherto advanced has broken down.

In seeking for the action outside the molecule time was necessary to carry the effects across space. By seeking it within the molecule and giving to all matter a common time of rhythm "its time of action is instantaneous." As the wave determines the acceleration of a falling body "its *rate of action* is precisely the same on bodies at all velocities.

Such molecules as we have depicted are kept saturated with energy in relation to each other. No sooner have they by the outward rush upon the ether sent forth waves at the expense of their energy than it is re-supplied. They receive from the minutest of our ether atoms by clash and give to the larger ones by rebound. They absorb no radiant energy that reaches them, but add more to it. A world of such molecules put between a sun and moon of them would be absolutely transparent. It would not abstract a particle from the radiant force but would add to it in exact proportion to its size. Thus is the fifth condition satisfied. "Its quality is invariable under all circumstances." The fact that the universal ether appears to have no specific heat may be owing to some such condition of things as is here pointed out. The state of things which makes possible the fifth condition, as before explained, gives us also the sixth and last. "Its energy is unchangeable in time. * * * Its activity is incessant and inexhaustible." One difficulty that has beset the undulatory theory of light has been the supposed resistance to planetary motion it would produce. The conditions of our theory of gravity are such that there could not possibly be any resistance to a falling body by its presence for the simple reason that the body could not fall without it. A balloon is not resisted in its rise by the atmosphere. It would not be able to rise without it. The resistance of ether is in a direction opposite to gravity.

This guess at the cause of gravity you will perceive meets one after another of the difficulties hitherto experienced by kinetic theories, but you are not on this account to imagine that the true solution is found. Many a mere fiction has not only answered to known conditions of an order of phenomenal manifestations, as this does, but has also become a successful working hypothesis, which this has not. Such theories if used properly, however, are often excellent scaffolds for the mind to scale upon and build to the true.

In consonance with the philosophic part of this book the author attacks physical science in nearly every one of its great theories. Chemistry and molecular physics suffer the severest at his hands. In the concluding chapter he denies holding the metaphysical belief of the absolute continuity of matter, yet most of the work is taken up with an endeavor to overcome the common idea of its discrete nature. His attack upon hard, inelastic atoms is well timed and sound, but when he from this ground battles Avogadro's Law, Cauchy's finite spaces, Maxwell's kinetic theory of gases and Tyndall's atomic cause of light undulations, it appears as if he stretched his points and made our ignorance do service for knowledge. No living being can frame a theory that will not constantly be seen in new lights with every progress of knowledge. No matter how perfect it may be it is constantly subject to new strains and new explanations because of new and unlooked for relations. Time after time they all must be challenged. It does not therefore follow that if a theory appears to fail at some one point because we have not all the facts, the theory is false. Take the Judge's objections to Avogadro's law for example, and we will see that they are founded entirely on our lack of knowledge of the facts upon which alone a true conclusion can be built. It demands atoms with different qualities, he tells us, while all material atoms, if the foundation of mechanics on which we build is true, should be exactly alike. But these may be evolved articles, we answer. That they cannot be, he says, because of their specific heats. Again, we answer that they may be saturated with energy. Who knows? (Such molecules as we demand for our theory of gravity would completely upset such an objection). We cannot find out. Shall we, therefore, cast aside this law and leave the myriads of facts it has been the means of discovering in utter chaos? False theories have aided prevision to some extent, but only because of the elements of truth attached to them.

A theory that gives prevision in so many directions must be almost or altogether true. Cauchy's explanation of the uneven refraction of all colors of light was a nearer approach to a complete solution of the myriad changes wrung upon waves by varying conditions but as it is strong evidence in favor of the discrete character of matter of course it is objected to. New facts in the case have arisen for explanation. These show that some of us have overestimated the amount of delay in ether and underestimated it in transparent, dense bodies. What of it? Who pretends to have solved the problem of transparency? Is it utterly improbable that the molecules of a piece of glass or of some bisulphide of carbon take part themselves in the undulations going through them? We *know* they delay light far more than ether does.

Give us the finite intervals and attractions in air, glass, and transparent bodies generally and have them conduct light upon their own substance instead of through their pores and the problem is solved. Can Judge Stallo or any other person say that these are not facts in transparency? The Judge says that if sounds of all pitches did not travel in air with equal speed music at a distance could not be heard as such, but would reach our ears as a gamut. Does he not know that with waves of sound as large as we know they are and with molecules of air as small as we know they must be, we would have to hear the music at a practically infinite distance for such a phenomenon to manifest itself? Cauchy has proven that if light is undulatory finite intervals are the conditions upon which the colors of the rain-bow depend. Light must be either undulatory or corpuscular. We know it is not corpuscular. Maxwell's Electro-Magnetic theory though altering our views on some points must nevertheless be undulatory and depend on finite intervals for its explanation of the spectrum.

ASTRONOMY.

HOW TO TELL THE DISTANCE OF THE SUN.—THE TRANSIT OF VENUS, DECEMBER 6, 1882.

EDGAR L. LARKIN.

RUDIMENTARY PRINCIPLES.—If we divide a semi-circle by its radius the quotient will be 3.1415926535. But in a semi-circumference there are:

160 Degrees, divided by 3.1415926535			=	57.2957795139
10,800 Minutes,	"	"	" =	3,437.74677
648,000 Seconds,	"	"	" =	206,264.80625

That is, a radius of any circle contains in terms of the circumference in round numbers 57 degrees, 3437 minutes, or 206,264 seconds. These are among the most important numbers known to mathematicians, and should be committed to memory by all who would learn astronomy or know how celestial measurements are determined. Let us examine this matter closely Take a ball one foot in diameter, place it on a standard in front of a telescope provided with a micrometer, and the globe will subtend a certain number of degrees angular measurement which, let us assume is four degrees. Now move the standard on a right line away from the telescope, and soon the sphere will only subtend three degrees, then two degrees, until finally its distance becomes so great that its angular diameter shrinks to one degree. An importanr circumstance follows—we know that the ball is precisely 57.295795139 feet distant from the focus of the objective, because we have seen that radius contain that many circular units. Again, move the standard until the angular diameter of the ball shrinks to one minute, and it is at once known that the globe is distant 3437.-73677 feet. Still bear the sphere away until its diameter subtends one second, a space only visible in a powerful telescope, and we likewise know that the ball is in distance 206,264.80625 feet or 39.0653 miles.

This is the process of measuring the distance of an object when its linear diameter is known. To reverse the case we will suppose that we have a globe whose diameter is one foot placed on a standard. Let an observer with a telescope retire and view the ball at a distance, and telephone to an assistant at the sphere its angular diameter. Then the party at the standard can tell the distance of the telescope. If the message received is:—the apparent diameter is one minute, of course the distance traversed is 3,437 feet, if two minutes half that distance. But to avoid calculation sines, cosines and tangents of all angles are made use of to abridge the work. If we divide:

3.1415926535 by 180 the quotient is .0174532925
3.1415926535 by 10,800 the quotient is .0002088820867
3.1415926535 by 648,000 the quotient is .000004848136 81

which decimals are ratios of the units of the circumference in terms of the radius, for degree, minute and second respectively, and are termed sines. To determine distances all that is necessary is to use the sines in simple multiplication and division. Thus the diameter of the ball is one foot, and since the observer saw it as one minute, we divide 1 by .00029088820867 having for a quotient 3437.74677 feet distance.

THE DISTANCE OF THE SUN.

If the Sun subtended an angle of one second we have seen how many times greater its distance would be, than its diameter, but the actual angular diameter of the Sun as obtained by many measures is 1924 seconds. Therefore 296,264.-80625 divided by 1924 equals 107.20624 which we positively know is the number of times the distance of the Sun exceeds its diameter. But this gives us no clue to the distance in miles, because we have not yet learned the diameter of the Sun in miles. We know its angular diameter to be 1924 seconds of arc, whence it is clear that if the number of miles in one second is known, the diameter of the Sun in miles and its distance can be told by simple arithmetic.

But men have been striving for 2000 years to find the linear value of one second at the Sun's distance. Really it is the greatest problem ever undertaken by the human mind, it has become of world wide importance, while the nations of earth have taken up the question, organizing expeditions to send to the bounds of the world. As we write, every civilized people is making up parties to journey throughout the earth to make accurate measurement of the transit of Venus across the solar disc on December 6th, next.

Forty expeditions are already announced, while those contemplated by the United States, Italy and Austria have not yet been published. France will send out eight fully equipped parties, four south and four north of the Equator. The United States will have six groups of astronomers in the central line of the transit, while all the permanent observatories in the country will make close watch of the phenomenon. The occasion is worthy the combined effort of mankind, because soon as the precise distance of the Sun is known, the dimensions of the universe become known, for the solar distance is the measuring line used by astronomers to let fall in unheard of solitudes of space.

THE TRANSIT OF VENUS.—The sole object in measuring the displacement on the solar disc, of the planet Venus in transit, is to find the number of miles in one second of angular measure at the distance of the Sun.

In other words how large does the earth look if seen by an observer standing on the Sun, and what is its apparent angular diameter. The diameter of the earth in miles is known with great precision, the probable error being within 200 feet. It is self evident that if it can be ascertained how great an angle the radius of the earth subtends if viewed from the Sun, we shall at once know the value of one second of arc in miles. The method made use of is as follows: Let the line A B be a wall, C and D observers having telescopes, and V a ball resting on a support. Now let C rest his glass on V and he will see it in apparent projection on the wall at B, while D will see V at A.

But the distance from C to D is known, therefore the distance from C and D to V and to the wall can be told in feet providing we know the *relative* distance.

The relative distances between the Sun and planets have been known since the time of Kepler, while the real distance is what men are now searching after with enthusiasm. The relative distances of the planets from the Sun and from each other, are found by measuring the angles described in a specified time by the exterior planets at times of opposition, and those of interior, by the angles presented at elongations. For two centuries it has been known that if we call the distance from the earth to the Sun 1 that of Venus is .723; then the distance of Venus from the earth is of course .277. Now in the diagram the wall is the Sun, V Venus, C an observatory on one side of the earth and D another on the opposite, near as can be. And it is endeavored to have C and D at the extremities of a diameter of the earth that is perpendicular to the plane of the ecliptic. As the latitude and longitude of C and D are known, the arc of the great circle a circumference of the earth passing through them being interrupted thereby, is known. Having the arc we know its chord in miles, which is none other than the straight line through the earth, joining each station. The first step of each party on arriving at their destination is to find their precise latitude by direct observation on fixed stars. Then the longitude is determined by chronometers in conjunction with transits of fundamental stars. At length the eventful moment arrives, the instruments are all in adjustment, and Venus, a black ball, just cuts off a ray of light from the eastern limb of the Sun. The absolute instant of contact in Greenwich time is noted and recorded, the exact point of ingress on the solar edge measured from the north point is also recorded and the transit progresses. This same observation is made from all the stations, accurate results being saved at each for reference.

The precise time of disappearance of Venus from the western limb is also noted, as well as the exact point of departure. Upon reaching home the results are compared. Those observers who were stationed south of the earth's equator will all bring in reports saying that they saw Venus make ingress and egress at points further north on the solar disc than did those remaining at observatories in north latitude.

Thus—if an astronomer at Washington compares notes with the one who went to Santiago, he will find that the southern observer has record of contacts at points farther toward the north point of the Sun than he has. Since these places of contact are accurately measured, the distance asunder of the chords A and B becomes known in seconds of arc. Venus appears to all observers whether north or south of the equator, to traverse straight lines from east to west across the Sun, but these lines are chords of arcs whose sines are found in any table. But the space between the chords corresponds to a known difference in position of observers on the earth, depending directly on the length of the straight line through the earth connecting any two observing stations. Then:

$$.277 : .723 :: 1 : 2.61.$$

That is, the ratio of the distance of Venus from the earth is to its distance from the Sun as 1 to 2.61. Hence the space between the chords on the Sun is to space between two stations on the earth in the same ratio or as 2.61 is to 1. In other words the distance apart of the chords is 2.61 times greater than the diameter of the earth. What we are searching for is the meaning equatorial horizontal parallax of the Sun, or what is the same thing, the angle that would be subtended by the mean equatorial radius of the earth if viewed by a micrometer placed on the Sun. Radii drawn from all the observing stations to the centre of the earth of course are not equatorial, since observers are placed in all latitudes, hence they must be expressed in terms of equatorial radii by computation.

Again, the mean distance of the earth from the Sun is equal to 1, but at the time of the last transit, December 9, 1874, and at the next December 6, 1882, the earth was not, and will not be at mean distance; being near perihelion, with distance less than uuity. And due allowance must be made for this fact in calculating parallax, also an allowance must be noted arising from the motions of the earth and Venus during the time of transit, which complicate matters, making it necessary to introduce algebraic formulas wholly inconsistent with a note like this, only intended to give general ideas. However, when all corrections are made, it is found that at transits of Venus under refined micrometrical manipulation, the space between the chords on the solar disc corresponding to a distance on the earth equal to its mean equatorial radius, is 22.96 seconds of arc. But we have seen that this is 2.61 times greater than the line that would be subtended by the semi-diameter of the earth at the same distance. Whence 22.96 divided by 2.16 equals 8.8 seconds, the long sought number, the *parallax* of the *Sun.* That is if we stand on the Sun and look this way with a powerful telescope and micrometer, the earth will appear as a little ball whose radius subtends an angle of only 8.8 seconds.

Now since the mean equatorial radius of the earth is known to be 3962.72 miles we are nearing the end of a search kept up for centuries, and will soon know the value of 1 second in miles, at the earth's distance from the Sun. Dividing 3962 72 by 8.8 gives a quotient of 450.30909 the number of miles in one second of arc subtended on the circumference of a circle whose radius is the distance separating the earth and Sun.

But we saw that the sine of 1 second is .0000048481368I, which multiplied by 8.8 equals .000042663603928 the sine of 8.8 seconds, since the sines of minute arcs vary directly with the arcs themselves.

In any triangle the sides are in the ratio of the sines of opposite angles; therefore 3962.72 divided by .000042663603928 equals 92,882,917 the number of miles from the centre of the earth to the centre of the Sun. Or the result may be thus obtained: 1 divided by 000042663603928 equals 23,439.18253337 which is the number of times the distance of the Sun is greater than the mean equatorial semi-diameter of the earth, and being multiplied by 3962.72 gives 92,882,917, as before. If this is not clear to beginners, the case may be presented in a still more elementary form. For when we know the value of 1 second, the circumference can be found by multiplying the value by the number of seconds in a circle. Thus: 450.30909 multiplied by 1,296,000 equals 583,600,580 miles in the orbit of the earth which divided by 6.283185307 the ratio of a circumference to its radius gives as in other methods,—92,882,917.

It may be asked, since we know the distance of the sun, why send expeditions to observe the coming transit. The answer is the precise parallax is not known, it being still uncertain within a few hundredths of a second. We do not know whether it is 8.79, 8.8 or 8.81 seconds. The rays of the Sun heat the atmosphere of the earth and produce a tremulous motion in the focus of a telescope just where the micrometer is, and another trouble is that Venus has an atmosphere which refracts a ray of light somewhat rendering uncertain the exact instant of contact with the solar limb. And it is to determine these corrections to the last transit, and also to verify the measures of 1874 with improved instruments that so much time, labor and skill are to be expended. And there is also a higher aim than this, and that is to leave to future astronomers who will behold the next transit, June 8, 2004, all the data possible for the mathematically exact determination of the great problem.

One method of observing the transit is to photograph Venus while on the Sun and then make computation at leisure; a method radically different from that of measuring directly with a micrometer at the time of transit.

A brisk controversy is now being held by astronomers as to which plan has the least objections, the apparent majority as the case now stands being opposed to photography. The British photographic results were conflicting in 1874, the deductions being, Airy 8.79, Tupman 8.81 and Stone 8.88. Other values deduced by direct measures range from 8.78 to 8 84 seconds. From a careful comp rison of all available records of the problem the writer is convinced that the parallax of the Sun is 8.8 seconds.

There are a number of ways of determining this constant in nature without resorting to transits of Venus, the most important being based on the velocity of light and the law of gravity. And these confirm the best results of transits in placing the parallax at 8.8.

This is the most valuable number known to man, since it enables him to measure the distances, diameters, volumes, weights and densities of all bodies in the solar system; and when he has weighed all these, to soar away into the infinitude of space and weigh other suns than ours and tell their distances.

In conclusion we will endeavor to show with what refinement measurement is expected to be made next December.

Thus: by taking the parallax to be 8.8 seconds, the distance of the Sun becomes 92,882,917 miles. Now if we assume it to be 8.81 then the Sun's distance will be 92,777,488 miles or 105,429 miles nearer, that is a hundredth of a second of parallax equals 105,429 miles in the length of a line reaching from the earth to the Sun. But the hundredth of a second is the equivalent to the angle subtended by the diameter of a hair placed at a distance of 800 feet. Young, The Sun, p. 23.

The observers must have micrometers delicate enough to measure these excessively minute distances with precision, or we shall not derive benefit from the transit. However, the Clarks with their elegant telescopes and micrometers will prove equal to the occasion. Such precision would not be necessary were it not for the fact that the distance to the Sun is the line that is made use of to measure all others in celestial space. And even an error of 100,000 miles would not be of such moment if we used the solar distance but once in a calculation. But in most physical researches, it is involved in the ratio of its cube. Thus, if we raise for instance, 3 to its cube we have 27, but if we raise 3.25 to a cube the product is 34.328 an error far too large to be admitted. It is seen then that the minute error of 100,000 miles when cubed becomes formidable.

Thus, we cannot tell the distance of Jupiter, nor its weight, size or density, unless we know just how far it is from the earth to the Sun. Kepler's third Law says: that, the squares of the times of revolution of all the planets are in the ratio of the cubes of their mean distances from the Sun. We can all see how long it takes Jupiter to go around the Sun; then all we have to do is to square this time and extract the cube root, and we have its mean distance. Thus: the earth revolves around the Sun in a time equal to 1; and we observe that Jupiter makes circuit in a period equal to 11.86. The square of 11.86 is 140.66 whose cube root is 5.203, hence we are assured that whatever is the distance of the earth from the Sun, that of Jupiter is 5.203 times greater. Knowing its distance, its mass and volume are revealed by the law of attraction.

It is well then that observers equipped by the Nations of the earth engage in this the most sublime of problems. The transit will begin on December 6th at 8:40 A. M. and pass off at 3:14 P. M. Washington mean time. We have no longitude of Kansas City but making a guess from an ordinary map conclude that it is 18 degrees or 1 hour and 12 minutes from Washington, hence the transit will begin there at 7:28 A. M. the Sun rising at 7:02. This observatory is in preparation to observe the phenomenon. Anybody can see Venus on the Sun with a smoked glass.

NEW WINDSOR (ILLINOIS) OBSERVATORY, July 17, 1882.

METEOROLOGY.

THE CYCLONE AT BROWNSVILLE, MO., APRIL 18, 1882.

W. H. WILLIAMS.

The terrible agent of destruction which visited Brownsville on the afternoon of the memorable day above named was, perhaps, in some respects, the most peculiar of any one of its kind ever seen or felt by the people in this latitude.

During the entire day clouds were seen in all directions in the sky; but they were only light, fragmentary ones, the feathery appearance of which did not attract more than a glance. It was not until 3:45 that the overcast of the heavens began to signal the approach of a storm of great violence.

At that hour the whole surrounding atmosphere began to assume a dull, heavy color and then change to an orange tint, very unnatural and peculiar. For a few moments all objects appeared as if seen through stained glass. Toward the southwest a very dark, heavy, green looking cloud was seen rising just above the tree tops. This cloud was compact in shape, solid in surface and seemed to overspread about two or three hundred acres of land.

The outer edges appeared to be thin and vapory, while the space below the cloud was filled with a kind of light, waving substance, resembling a morning mist. This was constantly in motion, and as the cloud moved toward us this stringy, root-like mass of mist was whirling and twirling in rows about as wide as the compact surface of the cloud. This singular tube like formation and motion was what first created in our mind the alarming impression that the dreaded cyclone was approaching us. The phenomenon was more like water running through glass tubes, than anything to which we can compare it.

It was truly a beautiful sight; yet, no artist could in safety to his life, stop long to study its beautiful conformation. From the center of this collection of revolving streamers there came a balloon-shaped, green-looking cloud, or rather crooked, smoky column, which extended about one hundred feet in the air—this is the cyclone proper.

It kept constantly changing its position, motion and shape; at no time did it look the same as at another; sometimes funnel-shaped, larger at the top, then inverted and larger at the bottom. It came wriggling, jumping, whirling and twisting like a great, green snake, darting out a score of glistening fangs. These antennæ-shaped things were bright and clear, but in a few moments went out of sight behind the enveloping clouds, which were struggling to embrace the cyclone. There had been very little lightning and only a few low rumblings of thunder. Scarcely enough rain fell, from first to last, to lay the dust, and no rain at all during the cyclone. The cyclone was right on us before we noticed any unusual force of wind. The wind had been blowing as much from one point as another. When this cloud had come out clearly to view and transformed itself, as we have related, another cloud, not so large and in no way, save color, like the first, was seen moving from a point far south of west.

The two were approaching with astonishing rapidity. Presently they seemed to be converging, and in a few minutes they met. Before they met the lightning played from the back of one to the other, like fiery serpents. After they met all definite shape was lost. The color of the whole mass was a little darker, and all the clouds and parts of clouds were jumbled up together, and rolling and boiling around in the sky. In a few moments two of the most vivid flashes of lightning I ever beheld descended from mid-sky to the earth. These strokes were about one hundred yards apart, and were simultaneous.

Not until those strokes did the terrible roaring of the cyclone commence. There had been from the first a low rumbling and muttering, but no well-defined roar. This increased for perhaps one and one-half minutes, until it was a deafening sound, something that made by freight trains crossing bridges, only a little sharper. The wind began then to blow very hard, and from the west, but nothing very firm was moved until the cyclone had spun and buzzed over the hill to the southwest of the town, and all at once, whirling and bounding, sprang into the midst of the streets.

After it had passed over and through the streets, indeed, before force of it reached us, and while it was in the midst of the buildings, there was a still darker and greener-colored atmosphere lit up continually by tinges of orange and gleams of red.

Many can testify to the singular appearance of the light emitted from beneath, above and from within the folds of the cyclone.

Houses and fences were not blown down, it is true; some of them were, but in general they were drawn up and twisted around, and then fell back on their foundations. There was not much evidence of any great force of straight wind; only here and there were objects found pointing the same way. As much debris was found thrown in one direction as another.

The path of the cyclone was nearly northeast, and was about two hundred yards wide.

When within one mile of Brownsville it came in a zig-zag course, but before that its main course was northeast, and this direction it kept up until it was scattered. The time of its passage over the city was, perhaps, three-quarters of a minute or more. Its velocity in coming from Montrose to Brownsville—a distance of sixty-two miles—was one and eleven-twentieth miles per minute. Brick houses were seen to rise two feet from the ground and then fall back on their stone foundations, scattering the debris in all directions.

Houses were found twisted at opposite points, strong fences were drawn down in shape of square and triangles; boards, posts, gates, scantlings and stringers were found hundreds of yards off, thrown at all possible angles.

Hardware stores, blacksmith shops, plow-rooms and display houses, were totally demolished, showing no signs of being blown. A safe belonging to George W. Smith was found some forty or fifty feet from where it stood in his office. There were strong currents of attraction towards this cyclone.

Places were found where trees one and on-half feet in diameter were drawn out of the ground, roots and all, while not ten feet away frame shanties remained standing. Scantlings and fence-rails, after whirling around in the air, were thrown off at a tangent and flew like darts through frame buildings, and in some places were found sticking to the depth of two feet in the ground. A flock of geese was drawn up into the cyclone, whirled around, and picked clean of feathers, then scattered in pieces almost everywhere. Plank, grass, shingles, brick bats, dust, feathers, branches of trees, bark, fence-rails, animals, etc., were seen whirling and twisting in the air above the cyclone, as it came down Blackwater and passed over us. In some places large trees were peeled from top to bottom. The cyclone was seen to jump and spin around on the prairies near Brownsville, then rise, whirling and rolling in the air, throwing out those glistening tongues, and coming down again hundreds of yards off.

Wherever it bounded on the ground nothing remained intact. Such are some of the peculiarities of this cyclone.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Below will be found tabular results of observations:

Temperature of the Air.	June 21st to July 1st.	July 1st to 10th.	July 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	70.5	66.8	58.1	65.1
Max	90.3	84.0	80.8	81.7
Min. and Max	80.4	75.4	69.1	75.0
Range	20.	21.7	22.8	21.5
Tri-Daily Observations.				
7 a. m.	77.8	70.2	66.1	71.4
2 p. m.	90.3	85.2	73.7	83.1
9 p. m.	77.7	75.0	69.0	73.9
Mean	80.9	76.8	68.1	75.3
Relative Humidity.				
7. a. m.	.87	.86	.80	.84
2 p. m.	.66	.57	.63	.62
9 p. m.	.87	.76	.77	.80
Mean	.80	.78	.73	.75
Pressure as Observed.				
7 a. m.	28.93	28.91	29.09	28.98
2 p. m.	28.90	28.92	29.05	28.96
9 p. m.	28.91	28.87	29.14	28.97
Mean	28.91	28.90	29.09	28.97
Miles per Hour of Wind.				
7 a. m.	..	..	7.8	..
2 p. m.	..	..	14.0	..
9 p. m.	..	..	8.8	..
Total miles	..	..	2715	..
Clouding by Tenths.				
7 a. m.	4.0	5.4	3.9	4.3
2 p. m.	4.3	2.2	4.7	3.7
9 p. m.	3.0	1.7	3.8	2.8
Rain.				
Inches	——	.40	2.64	3.04

The report here furnished may be divided into two distinct periods as regards temperature. The hot, dry weather continued till July 4th, no rain having fallen in the last decade of June and the temperature reached its highest point, 95° on July 3rd.

The tornadoes which caused such destruction in Iowa did no marked damage at this station. On the night of June 17th, at about midnight, a violent gale struck Topeka and blew off our anemometer cups before any good record had been left of its velocity. Another storm struck us a little after noon July 11th, and for more than ten minutes the velocity of the wind was seventy-two miles per hour. At 6 P. M. the same day the rain fell in torrents, and many of the storms have been accompanied by vivid lightning and heavy thunder.

The lowest temperature was 50°, on the 13th.

Highest barometer on the 20th inst. 29.222; corrected for temperature and elevation, 30.178. Lowest barometer on the 7th inst. 28.750; corrected for temperature and elevation, 29.659.

On the evening of the 5th, at 9:30, a very brilliant meteor fell in the west, starting from about the tail of Leo and moving vertically toward the horizon. It was ten times the size of Jupiter and burned with a greenish-yellow light and with a luminous train.

There was a remarkable rainbow on the 15th, lasting from half an hour before sunset till several minutes after the Sun was below our horizon. Both primary and secondary bows were visible and presented a magnificent spectacle on the ground of dark clouds from the retreating storm.

CORRESPONDENCE.

MOLECULES FROM THE DENVER MINING EXPOSITION.

MRS FLORA ELLICE STEVENS.

By the time this number of the REVIEW is published, the National Mining and Industrial Exposition will have been opened at Denver to the world, and that brave, bragging and bonanza young city have arrived at the utmost pitch of delight.

And I do not greatly blame her, she has a right royal reason for being insanely ecstatic. I have always "laid that flattering unction to my soul," that I had every faith in Denver's and Colorado's possibilities and capabilities, but I confess I was most unprepared for the magnificent, massive buildings erected for the exhibition, and the comprehensive plan upon which this is to be worked. The brain and the purse have found here one of those rare occasions in which they may labor in sympathetic and perfect fellowship; as to the results achieved if questioned I give the laconic answer, "come and see." We have a right to a large amount of pride in this wonderful West of ours, when the youngest State in the Union will not merely conceive the idea of a National Mining and Industrial Exposition, but put it into such execution that one will only blush through pardonable pleasure.

The money for the buildings has been entirely subscribed by Colorado citizens; so let us see what these are like, and we shall know how to gauge the liberality displayed. The main hall is 500 feet long, and 310 feet wide, with four wings, each 210 feet square. It is of brick of the very best character. A magnificent dome surmounts the centre of the building, while two graceful towers finish each wing. Within, the sides are fairly honey-combed with galleries, but the main space of the ground floor is left free for the exhibit of ores and machinery. The buildings have cost $300,000, and an annex is now in process of erection for the agricultural exhibit. This is the "stuff" western men are made of.

The grounds devoted to the exposition consist of forty acres at the southern terminus of Broadway, Denver's most fashionable driving street; a smooth, level and wide thoroughfare leading all the way from the city out to the grounds, which have a lovely view to the west, of the Rocky Mountains, whose foot-hills are but fifteen miles away. A narrow-gauge railway, with easy, delightful coaches runs from Curtis Street—in the heart of the city—to the grounds, and one can go there for the "widow's mite" of our times—a nickel. Both the Denver and New Orleans, and the Denver and Rio Grande Railroads run near the Exposition place, so that the traveller from the east, if he comes up the southern way, has a comprehensive sweeping view of the whole structure before he has fairly entered the city.

With so much said in regard to the breadth and enterprise of spirit which has conceived the idea of and completed the erection of buildings which would be noticeable anywhere on the continent, but which are absolutely wonderful in this the newest of the States, one's attention is naturally called to the causes which led to the exhibition, and the character of the exhibits.

The principal cause for this movement, I gather from the circular issued by the executive committee, to have been a desire to remove the ignorance concerning the resources of the western country, that yet prevails to a considerable extent in the east; to stimulate invention, and bring capital more directly than it possibly has been face to face with opportunities for investment, and with skilled labor in the several provinces of industry to which the exhibition will be devoted.

The area of the Western territory directly interested in mining aggregates 1,196,084 square miles, almost one-third the area of the whole United States, together with Alaska; therefore it is pertinent that mining, its ores and machinery, and the sciences directly connected with it, hold the primary place in the exhibits.

Nothing perhaps will be of greater interest than the immense masses of ores to be exhibited. The largest single mass will come from Arizona; it is of native silver, and weighs seven tons. A mass of soda will be sent from Wyoming, weighing five tons, which will be even greater than the one shown from the same mine at the Centennial. A silver specimen of 2500 pounds, comes from Pitkin, Colorado, and three lumps from San Juan county, Colorado, will average the same. A gold cube also will come from a Pitkin County mine, worth $150,000. New Mexico will send several "chunks" of silver ore of 2,500 pounds; while from the Wood River district of Idaho, probably a dozen will be shipped, averaging 1,000 pounds. The Robert E. Lee, of Leadville, will place on exhibition a mass of horn silver of 166 pounds, which is a great curiosity aside from its intrinsic value. The Horn Silver mine of Frisco, Utah, will also furnish an immense mass, but its definite size is not yet ascertained. The cost of getting out of the mine of a single mass to be exhibited from Gunnison county, Colorado, will be $500.

It must be borne in mind too, that these are merely samples, selected to give an idea of the ore to be shown in bulk, and they are but a small part of the great and interesting masses to be seen at the buildings during the next two months.

California will exhibit a great many specimens of gold ores; copper and silver will come from the new discoveries of the Corriza mines near El Paso, Texas; Utah has en route three car loads of mineral exhibits; Gunnison county, Colorado, will send specimens of anthracite coal equal to any in Pennsylvania, and the same county has for exhibition some very fine specimens of marble. Wyoming will do her "level best" with a copper display.

Exhibits too are promised from all the mineral producing Eastern States. Indeed, so wide is the interest excited in the scheme, that thirty states and territories, and it may be even more, will be represented either by their ores, their agriculture, or their manufactures.

In Power hall there will be three lines of shaftings, one for light machinery $2\frac{7}{16}$ inches in diameter, with 150 revolutions per minute; the others $2\frac{15}{16}$ inches in diameter, with 200 revolutions. For the machinery exhibited will be in active operation, so that a person may learn here in three days more of the practical workings of a mine, reduction of ore, etc., than he would gain perhaps in going about among them for a month.

Quartz mills, air compressors, drills, retorts, reverberatory roasting furnaces, reverberatory smelting furnaces, pans and settlers for amalgamating, concentrators, etc., all in active operation, will be in the hall; in fact everything necessary to convert the ore into bullion, whether it be of the free or refractory character.

Choice specimens, in cases, of a geological, metallurgical or other scientific nature are promised, and many at the time of writing have already arrived from some of the most eminent scientists in the country, and will form one of the valuable features of the display.

The agricultural exhibit will consist principally of contributions from the western states and territories, and will no doubt be worthy of the rest of the exposition.

The Fine Art gallery is one-third of a mile in extent. It is under the charge of the president of the Denver Art School, himself an artist, an excellent critic and one of the best engravers in the country, J. Harrison Mills. Applications for space here have been made from the leading artists of the United States, while a number of pictures will come from abroad. Keramics will be liberally considered in this department, the Cincinnati and other schools furnishing fine contributions, Miss Louise McLaughlin and other eminent designs also to be represented. So that this department is not to be lightly considered, but promises to be one of interest and beauty, much beyond all that it had been imagined possible to gather together so far west.

The industrial exhibit will have the character of all such exhibitions, with perhaps a leaning to machinery and implements used in mining. Space has been secured for hundreds of rare, useful and costly manufactured articles, of which one could not give half the names, or they would fill the pages of this magazine.

It is not a scientific fact, nor an industrial fact, nor an agricultural fact, unless we may be permitted a pun, and count it as an attraction hard to *beet* that President Arthur, the Marquis of Lorne and Princess Louise, and a host of other notables are coming; and I hope many readers of the REVIEW, who will see that we have reason to be properly ecstatic.

BOOK NOTICES.

KNIGHT'S NEW MECHANICAL DICTIONARY; Edward H. Knight, A. M., LL.D. In four parts, 240 pages each; 2,500 illustrations. Houghton, Mifflin & Co., Boston. $2.00 for each part.

This is intended as a supplement to Knight's American Mechanical Dictionary, published five years ago, which was pronounced by all the students of technology or mechanics the most perfect work of the kind ever issued, and covers the period from 1877 to 1882. During this period the progress made in the development of the mechanic arts is unprecedented in the history of the world. Not only in such striking and wonderful achievements as relate to the telephone, phonograph and electric light, toward which popular attention is naturally drawn, but in every department of applied mechanics, there has been developed a fertility of resource in the adaptation of means to ends quite as marvelous and equally important in practical results. Achievement has outrun the most sanguine expectation, and with such rapidity that even the most recent records are found to be very deficient in supplying the special information most desired.

The two great exhibitions, at Philadelphia and Paris, with each of which the author was officially connected as delegate or commissioner, and as a member of the respective juries, have brought forward a world of new matter; and the records of our own patent office, as well as the testimony of our technical journals, bear witness to the fact that at no period has invention been more fertile, more brilliant, or more important.

This fact and the success that the former volumes met with in all parts of the world, has induced the publishers to issue another volume, thus continuing the record from the date at which the former work went to press, but carefully avoiding repetition, and aiming to furnish not only a satisfactory supplement to the original work, but a book which shall have an individual and separate value as a complete record of half a decade iu the history of invention. From this fact it is evident that this volume forms an indispensable supplement to all works of reference upon mechanics now extant, as none of them cover the period mentioned.

The description of tools, instruments, mechanics, processes, engineering devices, etc., are full and exact, more so than ordinary, from the fact that the author was formerly an examiner in the U. S. Patent Office, and thus acquired a critical habit of looking into the mechanism and merits of devices presented for patenting.

The same method has been adopted in dealing with the subject matter in both works. First, each article appears in its proper alphabetical place, thus fulfilling the function of a dictionary in affording direct response to inquiry. Second, the items of information thus distributed throughout the work are classified in special indexes of the art, profession, or manufacture to which they pertain. The book thus fulfills the function of a Cyclopædia, which is a collection of treatises.

"An index to a dictionary" may seem a novelty or even a superfluity to the reader of this notice, but when he comes to examine this work he will find that the value of a work of reference depends largely upon its index Doctor Knight has invented a system of what he terms "Specific Indexes," by the use of which the inquirer is guided straight to the information he is in quest of, even though he may be entirely ignorant of the name of a thing, and have but the most vague and general notion of its use. This is accomplished by grouping under the general title of each Science, Art, Trade or Profession a list or "Specific Index" of every article in the book bearing any relation to the subject in question. The titles of these Indexes are in turn grouped at the beginning of the book, so that by a glance one may determine which clew to follow.

Besides the use above mentioned, these Specific Indexes afford the reader an excellent opportunity for investigating thoroughly all that pertains directly or indirectly to any special subject, by using the index under the title of that subject as a sort of starting point, and following out its various branches through all their ramifications.

Special attention is called to a new and valuable feature in the work, by means of which exhaustive information upon any subject is placed within easy reach. The author has made a complete Index to Technical Literature, covering a period of five years, and embracing all English and American technical journals published from 1876 to 1880 inclusive. Under title of each subject may be found a complete list of every article which has apppeared during this period in the columns of these periodicals, and as every subject of importance has been thoroughly discussed therein, it is evident that the whole range of recent investigation is placed at easy command. This Index cannot fail to meet with the heartiest appreciation among those who have experienced the labor and difficulty attending an exhaustive search upon any line of inquiry.

The work treats of many thousand subjects, and is illustrated with over 2,500 carefully prepared engravings and numerous full-page plates, and for general typographical excellence, quality of paper and printing it is unsurpassed. It may be bound uniform with any edition of the Knight's American Mechanical Dictionery, or with any Cyclopædia or other book of reference of the usual size and shape. Sold only by subscription in four sections, containing 240 pages each.

ORIENT SUNBEAMS, OR FROM THE PORTE TO THE PYRAMIDS; by Samuel S. Cox, 12 mo pp. 407, G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson, $2.00.

All of Mr. Cox's books are readable and instructive, combining humor and solid information to an unusual degree, though, perhaps, not remarkable for either quality. He has been a considerable traveler and has had many years of literary experience, so that his volumes hit the average taste very happily; much more so than those written solely to amuse or only to inform the reader.

From his earlier life, when he acquired the *soubriquet* of "Sunset" from an exceedingly glowing and fervent description of an evening sky in a daily paper, where such articles were phenomenal, to the present time he has had a kind of Persian tendency to sun-worship, as the titles of his books, "Winter Sunbeams," "Arctic Sunbeams," "Orient Sunbeams" show. The present volume is a companion volume to "Arctic Sunbeams," and is, in fact, a continuation of his account of the same trip, beginning at the Bosphorus, where the other left him, and describing his journey "from the Porte to the Pyramids, by way of Palestine." To use the words of the author, it takes the reader through the holy places of Mohammedan, Hebrew and Christian to that land of old renown, Egypt. It indulges in observations upon the present condition of the empire of Othman and its principal and most interesting dependencies. Within this shining crescent of travel, Ephesus, Damascus and Jerusalem are, of course, included. All this is done in a skillful, piquant manner, and many of the scenes described are handsomely illustrated.

CELEBRATED AMERICAN CAVERNS; by Horace C. Hovey, with maps and illustrations. Octavo, pp, 228. Robert Clarke & Co., Cincinnati, 1882. $2.00.

This volume will carry with it some additional interest to many of the older residents of Kansas City from the fact that the author, Rev. Mr. Hovey, formerly lived and preached here, but aside from any such local effect it will be received with enthusiasm by all who take an interest in the wonders of nature. For years past Mr. Hovey has devoted his leisure time to exploring the great American caves of Kentucky, Indiana, Virginia and New York, and the pages of *Scribner, Harper's Monthly* the *Scientific American*, &c., have been illumined (so to speak), with numerous articles on the Mammoth, Wyandotte and Luray caves from his graphic pen.

This handsome volume contains not only the most complete descriptions of all of these that we have ever seen, but also of numerous other caverns in the

United States, together with chapters upon the structure, varieties and contents of caverns, followed by a condensed account of cave dwellings, sepulchers and temples all over the world. The illustrations are excellent, and the book is certain of an extensive sale.

THE GREAT PYRAMID; by S. H. Ford, D. D., L.L. D. 12mo. pp. 208, St. Louis, 1882.

The great pyramid of Ghizeh has, from the days of Herodotus to the present time, furni hed matter of interest for travelers, poets, astronomers, architects, divines, archæologists and engineeers. In modern times many attempts have been made to give the dimensions, attitude, openings, internal arrangements, and even the geographical position of the Great Pyramid, peculiar symbolical meanings, though Birch, who is regarded as the greatest of living English Egyptologers, says that "these ideas do not appear to have entered into the minds of the constructors of the pyramids," and Rawlinson thinks that their builders "employed the measures known to them for their symmetrical construction, but had no theories as to measure itself and sloped their passages at such angles as were most convenient, without any thought of the part of the heavens whereto they would happen to point."

Dr. Ford, however, has given the subject a vast deal of study, and is entitled to the credit of having, at least, worked out an ingenious theory and of supporting it with earnestness and plausibility. In addition to the astronomical and chronological facts indicated by various external and internal measurements, he believes and essays to prove that the designers of this especial pyramid were divinely guided to erect a structure which in every part symbolizes some great feature in the Christian religion. Whether we admit his conclusions or not, we cannot fail to be impressed with his earnestness, the logical bearings of the facts and arguments he adduces, and the fitting adaptiveness of the scriptural quotations and illustrations that he brings forward. Scarcely any reader who examines with any care his facts, biblical comparisons, etc., will fail to partake of his enthusiasm. The work is embellished with numerous illustrations, and is appropriately dedicated to the author's wife, Mrs. Sallie Rochester Ford, who has been intimately associated with the Doctor in all his investigations of the subject.

ADVENTURES IN THE FAR WEST AND LIFE AMONG THE MORMONS. By Mrs. C. V. Waite; 12mo. pp. 311. C. V. Waite & Co., Chicago: 1882. $1.oc.

This is a narrative of actual experience in crossing the plains in 1862, when it required a whole season to accomplish it, and of life among the Mormons for a number of years. Mrs. Waite is a careful and accurate observer and wields a skillful pen. Her book is attractively written and at the same time gives a great deal of information in regard to the Mormon habits, customs, rules of life, religious rites, etc., that is not readily found elsewhere. The chapters upon Mormon Mysteries, The History of Woman, An Inside View of the Peculiar Institution and The

Secret Orders, are especially rich in this respect. Mrs. Waite is the wife of the author of "A History of the Christian Religion to A. D. 200," that has attracted a great deal of attention, and is a writer of taste besides possessing keen powers of observation.

THE PRESENT RELIGIOUS CRISIS. By Augustus Blauvelt; 12mo. pp. 196. G. P. Putnam's Sons, New York. $1.00.

A graduate of Rutgers College at New Brunswick, N. J., and of Hertzog Theological Seminary, connected with the same institution, the author of this book took up the study of the Bible for the purpose of vindicating the traditional Protestant conceptions about it and religion against all the assaults of modern unbelievers. Unfortunately he undertook to do this by merely invoking ordinary evidence and reasoning, and the result was thus: "He has come more and more distinctly to perceive that the traditional Protestant conceptions about both the Bible and religion, instead of being scientifically defensible even down to details, require a revision and restatement of the most revolutionary nature." These he attempts in the present volume, which is but the first of a series, the second of which will be called the "Religion of the Jesus," and the third "Supernatural Religion." How well he may succeed is for the reader to judge. For our part we neither like the tone of the writers, his manner of stating his case nor his line of argument, although he makes a show of exceeding liberality and draws largely upon other writer for his facts and illustrations.

OTHER PUBLICATIONS RECEIVED.

THE ELEMENTS OF FORESTRY, by Franklin B. Hough, Ph. D. Kin and Clan, a lecture before the Historical Society of New Mexico, by Prof. A. E. Bandelier. The *Record*, a monthly magazine devoted to classical literature and historical criticism, C. V. Waite & Co., Chicago, Ill. The *Grain Cleaner*, monthly, Clifford F. Hall, Moline Ill., Vol. V, No. 5. The Isthmian Canal, by L. U. Reavis, with an introductory letter by Capt. Silas Bent, St. Louis, Mo. First Annual Report of the Committee of the Archæological Institute of America, on the American School of Classical Studies at Athens. Notes on the Habits of Some Western Snakes, by H. A. Brous, M. A , M. D. The *Journal of Comparative Medicine and Surgery*, a quarterly journal of the anatomy, pathology and therapeutics of the lower animals, Vol. III, No. 3, W. L. Hyde & Co., New York, $2.00. Natural History of Pettis County, Mo., pp. 19, by F. A. Sampson, Sedalia, Mo. General Notes on Anthropology, Prof. Otis T. Mason. A Science Based on Assumptions, pp. 16, Hon. W. D. Kelley. Second Annual Report of the Astronomer in charge of the Horological and Thermometric Bureaus in the Observatory at Yale College, 1881–82, by Leonard Waldo.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

NOVEL REVERSIBLE WINDOW.—A recent invention provides a window, the sash of which slides up and down in the usual way with counterweights passing over pulleys A portion of the length of the window jambs is a pivoted swinging frame, so that both sashes may be run up into the frame, and swing out horizontally or reversed, as desired. The swinging frames are mounted on hollow pivots provided with cross-pintles and rollers, over which the sash-cords pass. A spring catch in one of the side frames, operated by a lug on a rod, engages a notch in the sashes. The cords have an apertured plate to prevent twisting. The swinging frames are grooved to receive the sashes.

FIRE-PROOF CURTAIN FOR THEATRES.—A recent German invention has been gotten up by Herr Von Falkenhausen, for separating the stage from the auditorium in theatres in the event of the breaking out of a fire. The curtain, which is closed at the sides and open at the bottom, is secured at the upper end to a perforated water-pipe. The other end is rolled upon a roller stationed above and in front of the water pipe, so that when the water is turned on the weight of the wet curtain nearest the water-pipe will tend to unroll the curtain until it falls down.

ELECTRIC FLAT-IRON.—This novel flat iron is chambered out near its smoothing face, forming a cavity for the reception of an electrical resistance, the latter being connected by suitable wires with a galvanic battery. The face of the flat-iron is heated by the radiation from the electrical resistance. A layer of non-heat-conducting material is placed above the cavity in the iron to confine the heat to the face of the iron.

WOOD-PRESERVING COMPOSITION —A late invention mixes in the following proportions, viz: Linseed oil, one gallon; common salt, four ounces; saltpetre, two ounces; turpentine, one pint, and applies while hot. It is used for oiling fellies, and at the same time producing tightly-fitting tires. May also be applied to buckets or casks which are to stand in the sun, to prevent shrinkage or warping.

ELECTRIC INCANDESCENT LAMP.—This invention consists in a novel mode of affixing and sealing luminant carbon loops and their circuit wires vacuum-tight in the globes of electric lamps viz: first, immersing the tubes and wires in molten metal, and causing the same to rise in the tubes and around the wires; second, retaining the column of metal in said tubes and raising them out of the molten mass; and finally allowing the charge in the tubes to solidify.

EDITORIAL NOTES.

THE session of the American Association for the Advancement of Science, at Montreal, commencing August 23d, will be unusually interesting from the fact that several eminent scientific men from abroad are expected to be present, among whom are Dr. Wm. B. Carpenter, Mr. Herbert Spencer and Moncure D. Conway, of London; Dr. Samuel Haughton, of Dublin; Prof. H. Renard, of Brussels; Prof. J. Szabo, of Buda-Pesth, and Prof. Stephanesco, of Bucharest. Excursions to Ottawa and Quebec, Lake Memphremagog and Newport, Vt., besides numerous social entertainments, will be given to the members.

WE observe frequent references in the daily papers to the propriety and importance of filling the office of State Superintendent of Public Schools by the election of Prof. J. M. Greenwood, of this city, and we unhesitatingly state that in our judgment no better selection could be made, whether scholarship, experience or ability is needed.

PROFESSOR OTIS T. MASON, of Columbian College, Washington, D. C., the Secretary of the Authropological Section of the American Association for the Advancement of Science, is desirous of receiving communications and papers upon the subject, including inquiries into the origin, antiquity and primitive condition of man, his zoologic characteristics and relationships, arts and æsthetic customs, sociology and religion, to be presented to the Association at the Montreal meeting, this month.

DR. CHAS. H. STERNBERG, who has contributed to the REVIEW a number of articles on the Geology and Palæontology of the Western States and Territories, has recently returned to Cambridge from an exploring tour in Texas, and is now engaged in preparing the specimens secured for the Peabody Museum, at Harvard College.

GEN. JNO. A. HALDERMAN, of Kansas, U. S. Minister to Siam, has recently placed the Kansas City Academy of Science under obligations by sending to its library a full set of the Consular Commercial Reports.

WE have received from Prof. E. T. Nelson, of the Ohio Wesleyan University, a copy of the Third Annual Report of the Museum, by which it appears that it is in a flourishing condition. In such hands it cannot fail to become in a short time a very valuable collection.

A GOOD, soft coal, smoke-consuming furnace for heating residences, churches, stores, &c., is one of the great desiderata of the West, and it is becoming quite certain that Mr. C. C. Hare, of this city, has met the want in his "Bituminous King." The principles involved in its construction are undoubtedly correct, and he claims that its economy, cleanliness and efficiency have been fully proven.

GEN. HARTRANFT proposes to construct an electric railway in Fairmount Park, Philadelphia, after the plan of that now in successful operation in Berlin.

TEN prizes of $1200 each are offered by the Agricultural Bureau at Washington, for the best results reported by manufacturers of Sorghum sugar, and two of the same amount for similar reports by manufacturers of beet sugar.

C. F. MCGLASHAN, of Santa Barbara, California, has invented a system of railroad telegraphy by which moving trains can keep in constant communication with each other and with stations. Two wires are used in transmitting the electric current, instead of one. Wheels or brushes attached to the moving train touch these wires carrying the current from one wire to an instrument in the car and returning it to the other wire, along which it passes until its destination is reached, when it is connected with a ground wire and completes the circuit through the earth. Its advantages are obvious, but if none were assured except that of lessening the danger of accidents, its adoption by railroad companies should be only a question of how soon it could be done.

We have examined an invention by H. C. Train, of Kansas City, for separating gold from dirt in placer mines, and also to work at the tail of a quartz mill. It consists of an improvement in dry placer amalgamators, and its claims are set forth in the following specification: "My invention relates to improvements in machines for washing and extracting gold from auriferous deposits and crushed quartz, and separating the dirt from water after the gold has been extracted; and the objects of my invention are, first, to provide a means by which all the fine as well as the coarse gold can be brought in contact with amalgam-plates and saved; second, to separate the dirt from the water in which it has been washed, so that the same water may be used over and over again, with little or no waste, in places where sufficient water for sluice-washing cannot be had; third, to operate the whole mechanism by one shaft and the same motive power." The invention has been examined carefully by practical miners, and has been pronounced successful in its operations.

The manufacture of water pipes was commenced on the 10th ult., at the Kansas City Pipe Works, about two miles below the city. These pipes are made on mandrels of different sizes, from three to twenty inches in diameter, by rolling around them sheets of iron heavily coated within and without with melted asphalt. When cool these pipes, now about half an inch thick, will bear a pressure of 350 pounds to the square inch, and the material of which they are composed being practically indestructible, they seem to present a cheap and effective substitute for the ordinary iron pipes.

The Pharmacists of Kansas, at their late meeting in Topeka, elected the following officers for the ensuing year: President, F. E. Halliday; First Vice President, W. C. Johnson; Second Vice President, Geo. Slosson; Secretary, A. E. Barnes; Assistant Secretary, Frank Frisby; Treasurer, W. A. Stamford. Papers were read by Dr. R. J. Brown, F. Frisby, H. W. Spangler and Prof. G. E. Patrick.

The Archæological Institute of America has, in imitation of France and Germany, established an American school of Classical Literature, Art and Antiquities at Athens, Greece. This enterprise has received the support of all the principal eastern universities and colleges, and Prof. W. W. Goodwin, of Harvard University, has been appointed Director for the first year, which commences October 2, 1882. It is hoped that through the co-operation of these colleges with the Institute, much practical benefit will be rendered to students in the above named subjects.

ITEMS FROM THE PERIODICALS.

It is gratifying to learn that the *Saturday Herald*, the best society paper in the State, is gaining strength steadily, as it deserves to do, from the earnest devotion of its faithful editress to the objects of its publication.

The *Milwaukee Sunday Telegraph*, of June 11th, contains an extended account of the principal instruments of the Washburn Observatory at Madison, Wis.

At most of the mining camps in Colorado extensive preparations are being made for a full representation of their respective ores and minerals at the Denver Exposition this month.

THE *Popular Science Monthly* for August presents a feast for all classes of readers, as the following table of contents shows: The Physiology of Exercise—II., by Emil du Bois-Reymond; National Necessities and National Education, by Benjamin Ward Richardson, M. D., F. R. S.; Acoustic Architecture, by William W. Jacques, Ph. D., Progress of the Germ Theory of Disease, by Prof. Tyndall; A Gigantic Fossil Bi d, by Stanislas Meunier, (illustrated); The Book-Men, by Hon. T. Wharton Collens; About Elephants, by Dr. Andrew Wilson, (illustrated); The Chemistry of Sugar, by Prof. Harvey W. Wiley; Transcendental Geometry; by Alfred C. Lane; My Spider, by W. H. T. Winter; Sudden Whitening of the Hair; How Plants Resist Decay, by W. O. Focke; The Topmost Country of the Earth, by Lieut. G. Kreitler; Sketch of Baron Adolf Eric Nordenskiold, (with portrait); Entertaining Varieties, Editor's Table, Literary Notices, Popular Miscellany and Notes.

PROFESSORS JOSEPH LE CONTE and W. B Rising, of the University of California, have been during the past six years investigating the alleged present formation of metalliferous veins in progress at Steamboat Springs, in Nevada, and at Sulphur Bank, California, and are now publishing their conclusions in the *American Journal of Science*. That for July, 1882, contains article second of the preliminary discussion, and the final result is promised in a later number.

MR. G. H. KINAHAN, in the London *Monthly Journal of Science* for July, antagonizes Mr. Darwin's "Vegetable Mould and Earthworms," by attempting to show that several influences are more effectual than worms in heaping up earth and mould upon surface stones, viz.: ants, winds, vegetable growth, etc.

AMONG the most interesting articles in *Van Nostrand's Engineering Magazine* for July, is one upon The Problem of Aerial Navigation as affected by recent mechanical improvements, by Wm. Pole, F. R. S., the conclusion being that "manageable balloons may form a feasible and useful addition to the present means of transport and are therefore worthy of the attention of the engineer."

Harper's Magazine for August is a brilliant number. It opens with a fine frontispiece, a full page illustration by Abbey, engraved by Closson. We note especially two bright Summer articles—both splendidly illustrated —"Some Western Resorts," by John A. Butler, and "The Cruise of the 'Nameless,'" by Barnet Phillips. For hot weather reading the description by Capt. J. W. Shackford, of the "Icebergs and fogs in the North Atlantic," will be found decidedly cooling.

THE *American Antiquarian* is now in its fourth volume and is, both from the fascinating subjects treated of and the skillful management of its editor, becoming more widely known and better sustained with each volume.

FROM the catalogue of the University of the State of Missouri for the year ending in June, 1882, we learn that there were five hundred and ninety-one students in attendance and seventy-seven graduates from the Academic, Law, Engineering, Mining, Agricultural, Normal and Medical Departments —the largest number of graduates ever sent forth from the University in one year, and the largest whole number of students for any year except the one preceding.

JNO. K. HALLOWELL, formerly of this city, who recently published a very careful and complete account of the mining and other resources of Boulder county, Colorado, is now in the Gunnison country, exploring and writing it up for the *Denver Republican*.

THE August *Atlantic Monthly* has two features which will specially commend it to general attention, namely, a fine new steel portrait of Mr. Emerson, which is remarkably satisfactory, and which is accompanied by an admirable article by W. T. Harris, of Concord, Mass.; and a Supplement containing a

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ANTHROPOLOGY.

WHO WERE THE MOUND-BUILDERS?

F. F. HILDER.

The March number of the Kansas City REVIEW contains an article by Dr. J. F. Snyder, under the above head, which commences with the following paragraph:

"The conviction is daily gaining strength that the race of Indians found in occupancy of this country when it was discovered by Europeans were the people, or the immediate descendants of the people, who built the mounds; and students of American Archæology now agree that mound-building was practiced by some of the tribes down to a comparatively recent date."

This statement is very indefinite, so much so, that as a student of archæology I cannot accept it without considerable qualification. The ancient people or tribes who for want of a better name have been styled the mound-builders, have left traces of their occupation on a vast expanse of territory, extending from Lake Superior to the Gulf of Mexico, and from the Alleghany Mountains to the country west of the Mississippi. Webster gives the definition of the word

Race, "A family, tribe, people, or nation believed or presumed to belong to the same stock."

And in a foot note says, "The American or red race containing the Indians of North and South America." This all-embracing definition is probably the sense in which Dr. Snyder uses the word. If so, he will doubtless find few archæologists to differ with him.

Whatever may have been the origin of the mound-building people, there is very little doubt that they were distinctively American in form and feature. Although the color of the skin varies considerably, as must be the case on a continent extending through one hundred and twenty degrees of latitude, physical peculiarities exist from which it may be inferred that all the peoples of America belong to a single race bearing some resemblance to the Mongolian nations of the Old World; but that race is and has been divided into so many nations and tribes, exhibiting such striking contrasts and wide disparities, that the term race as applied to the successive occupants of any particular territory becomes altogether too vague to be of any special significance. Prof. J. W. Powell says*: "When America was discovered by Europeans it was inhabited by great numbers of distinct tribes, diverse in languages, institutions and customs. This fact has never been fully recognized, and writers have too often spoken of the North American Indians as a body, supposing that statements made of one tribe would apply to all. This fundamental error in the treatment of the subject has led to great confusion."

So far as the term "race" is used in its widest sense I agree with Dr. Snyder, but I contend that the ancient people who built the gigantic mounds and earthworks of the Mississippi Valley, and who left behind them so many evidences of their skill and taste, although they too were probably divided into several tribes, were a very different people from the barbarous hunters and warriors who lived on the shores of Lake Superior or who ranged through the forests and prairies of that part of the continent which we now call Ohio, Illinois, Indiana, Iowa, and Missouri, when first visited by European explorers. Dr. Snyder must, to some extent at least believe this to be the case as he uses as illustrations of the condition of the Indian tribes at that date, the Mandans, Choctaws, and Natchez, all of which, but more particularly the two last named, were far in advance of the barbarous tribes by whom they were surrounded and who are supposed by most ethnologists to represent descendants of remnants of the mound-building nations. Therefore, if Dr. Snyder means that the nomadic hunting tribes who occupied the territory above named when discovered by Europeans were the direct or immediate descendants of the people who built the great mounds I certainly differ with him. It is true, as he states, that mere opinions in matters of science are not sufficient to influence the convictions of thinking men, but the conclusions of careful students are always acceptable as exemplifying the effect produced on different minds by the same evidence; however much we may at times differ from them they are always entitled to respect as honest expressions of opinion. I have therefore selected the following extracts from the published writings of some of the gentlemen who are named by Dr. Snyder as supporting his views:

Squier and Davis say,[1] "The earthworks and the mounds and their con-

* First Annual Report Bureau of Ethnology, page 74.

1 Ancient Monuments of the Mississippi Valley, page 273.

tents certainly indicate that, prior to the occupation of the Mississippi Valley by the more recent tribes of Indians there existed here a numerous population, agricultural in their habits, considerably advanced in the arts, and undoubtedly in all respects much superior to their successors."

Also,[2] "We may venture to assert that the facts thus far collected point to a connection more or less intimate between the races of the mounds and the semi-civilized nations which formerly had their seats among the Sierras of Mexico and upon the plains of Central America and Peru."

Lewis H. Morgan says[3]: "The mound-builders had disappeared at the epoch of the European discovery and cannot be classed with any known Indian stock."

Also,[4] "From the absence of traditionary knowledge of the mound-builders among the tribes found east of the Mississippi an inference arises that the period of their occupation was ancient. Their withdrawal was probably gradual, and completed before the advent of the ancestors of the present tribes or simultaneous with their arrival."

Dr. Joseph Jones says,[5] "The most important inference appears to be that the mound-builders and stone grave races of the Mississippi Valley had a common origin or near affinity with the aboriginal inhabitants of Mexico and Central America.

Also,[6] "It is impossible to assign the monumental remains of Tennessee to any specific date or to any known nation of North American Indians."

C. C. Jones, Jr., says,[7] in speakingof mounds in Georgia: "The location and physical peculiarities of some tumuli and enclosures, the character of the remains found in and near them, the presence of stone idols and metallic ornaments and the traditions of modern Indians, who regard them with commingled ignorance and wonder, unite in claiming for them not only a marked antiquity, but also, a striking resemblance to the monuments of the Mississippi Valley."

Also,[8] in speaking of a great mound on the Etowah River: "To the eye of the observer as it rests for the first time upon its towering form, it seems a monument of the past ages, venerable in its antiquity, solemn, silent, and yet not voiceless, a remarkable exhibition of the power and industry of a former race. With its erection the modern hunter tribes, so far as our information extends, had naught to do."

Also,[9] "The fact has been distinctly attested by early travellers that the Indians of this region never worshiped idols. We have further testimony that they not only never manufactured these symbols of pagan worship, but emphatically disclaimed all knowledge of the people by whom they were made. Who,

2 Ancient Monuments of the Mississippi Valley, page 301.
3 Houses and House Life of the American Aborigines, page 193.
4 Houses and House Life of the American Aborigines, page 219.
5 Explorations of the Aboriginal Remains of Tennessee, page 78.
6 Explorations of the Aboriginal Remains of Tennessee, page 157.
7 Antiquities of the Southern Indians, page 134.
8 Antiquities of the Southern Indians, 137.
9 Antiquities of the Southern Indians, 146.

then, were these mound-builders, and who the artificers that chiselled these rude stone images, which did not fall down from Jupiter?

I think after a careful perusal of the above quotations it will be admitted that the writers do not arrive at exactly the same conclusions as Dr. Snyder respecting the connection between the mound-builders and the modern tribes of Indians.

With respect to the building of burial mounds by the modern Indians, there is no disputing the fact that it has been practiced by some of the tribes down to a comparatively recent date, and I do not know that any archæologist of repute has ever doubted or denied it.

E. G. Squier says,[0] "It is certain that the existing tribes of Indians often buried in the ancient tumuli, and occasionally erected mounds."

I do not think Dr. Snyder arrives at correct conclusions respecting Mr. Squier's report on the Aboriginal Monuments of New York, in the second volume of "Contributions to Knowledge," of the Smithsonian Institution. Dr. Snyder says: "Mr. Squier describes mounds and earthworks extending from Canada to the Susquehanna which were found to contain ornamental pottery, pipes, stone axes, hammers and discs, and other stone-age implements, identical in shape and materials with similar specimens found by him in the Ohio mounds, and bone-awls and needles, together with iron axes, glass beads, cast copper hatchets, kettles of iron, brass, and copper, and other articles of European manufacture."

I find that Mr. Squier selects only four examples out of all the collection he made from the above mounds as resembling those found in Ohio and these are such that they might have been common to any people who used stone implements.

Further on Dr. Snyder says, "The building of these mounds he was forced to assign to the Iroquois within comparatively recent dates; though in every essential particular they were exactly like the older mounds in central Ohio."

For the sake of comparison I will quote a few paragraphs from the work in question.

Mr. Squier says,[1] "We have no satisfactory evidence that the race of the mounds passed over the Alleghanies, the existence therefore of a few tumuli to the east of these mountains, unless in connection with other and extensive works such as seem to have marked every step of the progress of that race, is of little importance, as it will hardly be denied that the existing races of Indians did and do still occasionally construct mounds of small size."

Also,[2] "The ancient remains of western New York except so far as they throw light upon the system of defence practiced by the aboriginal inhabitants and tend to show that they were to a degree fixed and agricultural in their habits,

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0 American Archæological Researches, page 135.
1 Aboriginal Monuments of New York, page 107.
2 Aboriginal Monuments of New York, page 10.

have slight bearing upon the grand ethnological and archæological questions involved in the ante-Columbian history of this continent."

Also,[3] "Misled by statements which no opportunity was offered of verifying I have elsewhere though in a guarded manner, ventured the opinion that the ancient remains of western New York belonged to the same system with those of Ohio and the west generally"

I do not find in any of the above paragraphs evidence that Mr. Squier endeavors to convey the impression that he considered a similarity to exist between the ancient mounds of Ohio and the New York works, but on the contrary their tendency is toward an opposite conclusion.

Fully admitting that modern tribes of Indians erected burial mounds I can see no connection between the erection of a few insignificant tumuli such as that described by Catlin over the remains of the Omaha chief and his horse, and the building of a great truncated pyramid like that at Cahokia, covering acres of ground and containing, as has been estimated twenty millions of cubic feet of earth, or the construction of the wonderful series of earth-works in Ohio with their regular outlines, true circles and accurate squares. The one is just such a memorial as might be raised by the rudest tribe of savages in honor of a deceased chief; the others must have been the work of a people essentially different in their habits and existing in a widely dissimilar condition of society.

Dr. Snyder says, "The mounds of the Mississippi basin are in no essential particular different from those seen on the plains of Europe or the steppes of Asia."

The definition of the word mound is, "An artificial hill or elevation of the earth," consequently in such simple structures there can be no essential difference wherever they may exist, but the term is a misnomer when applied to such structures as the great truncated pyramids of Cahokia and Seltzertown and many others of their class, with their graded avenues, terraces and regularity of form, to the so-called sacrificial mounds, or to the wonderful earth-works of Ohio; these structures are not only essentially different from the tumuli so profusely scattered over Europe and Asia, but they serve to distinguish the ancient people of the Mississippi Valley from all others on this continent.

Professor D. Wilson says, "The so-called sacrificial mounds are a class of ancient monuments altogether peculiar to the New World and highly illustrative of the rites and customs of the ancient races of the mounds."

It is unfortunate that the name mound-builders has been applied to these ancient people, as it is apt to create a false impression with respect to the distinctive character of their works, and to add to the confusion which exists in so many minds on all subjects appertaining to the aborigines of America.

I think that Dr. Snyder in his efforts to prove that the ancient people were mere barbarians, makes some assertions that are open to criticism; he says, "The builders of the mounds knew nothing of astronomy or mathematics," also "They lived in temporary huts of frail, perishable materials and had not advanced

3 Aboriginal Monuments of New York, page 11.

to the art of constructing stationary abodes of clay or stone." While we have no evidence either affirmative or negative respecting their knowledge of astronomy, I think there is strong presumptive proof that they had made considerable advance in the direction of mathematics. In speaking of the Ohio earth-works Squier and Davis say,[4] "There is one deduction to be drawn from the fact that the figures entering into these works are of uniform dimensions which is of considerable importance in its bearings upon the stock of knowledge among the people who erected them. It is that the builders possessed a standard of measurement and had some means of determining angles. The most skillful engineer of the day would find it difficult without the aid of instruments to lay down an accurate square of the great dimensions of those above represented measuring as they do more than four-fifths of a mile in circumference. We do not only find accurate squares and perfect circles, but also as we have seen, octagons of great dimensions."

These remarks apply to a series of works in Ross County, Ohio, which are in sets of one square and two circles, each side of every square measuring 1,080 feet and the diameter of each circle 1,780 feet, all of them accurate mathematical figures. It will be very difficult to explain how these works could have been erected unless the builders possessed some mathematical knowledge. Stoddard, in speaking of one of the Ohio works says,[5] "This work manifests a degree of mathematical skill not possessed by the aborigines and by few only of those deemed intelligent whites. To suppose it the invention of any other than a skillful mathematician requires a greater extent of credulity than is allowable among men of sense and reflection."

I think the characterizing their dwellings as "temporary huts of frail perishable materials" is an error, as there are still existing in many places in Missouri traces of towns and settlements where the vestiges of their habitations may be seen by hundreds, while in very many instances, without doubt, similar remains have been obliterated by modern agriculture. There are now no traces existing of ancient habitations in the neighborhood of the great Cahokia mound in Illinois, but Brackenridge who visited it in the year 1811 found them in abundance; he says,[6] "I everywhere observed a great number of small elevations of earth to the height of a few feet, at regular distances from each other and which appeared to observe some order; near them I also observed pieces of flint and fragments of earthen vessels. I concluded that a populous town had once existed here, similar to those of Mexico described by the first conquerors." Such traces certainly indicate that the dwellings were not temporary huts of frail, perishable materials, but they are exactly such remains as would exist, of houses built of adobe or sun-dried brick, after exposure to the rains and frosts of centuries in our variable climate; that they used such bricks I am in a position to prove, as in exploring an ancient town site in Scott County, Missouri, I exhumed a large quantity of frag-

4 Ancient Monuments, page 61.
5 Stoddard Sketches of Louisiana, page 347.
6 Brackenridge—Views of Louisiana, page 174.

ments of them, made of well-tempered clay, bearing impressions of the straw or wild hay with which they had been mixed.

I speaking of the great mound at Seltzertown, Dr. Dickeson, who is quoted by Squier and Davis,[7] alludes to the use of sun-dried bricks in its construction: "The north side of the mound is supported by a wall of sun-dried bricks, two feet thick, filled with grass, rushes and leaves. Angular tumuli mark the corners which were formed of large bricks retaining the impression of human hands."

Dr. Foster also alludes to the use of clay for building,[8] "Professor Swallow has observed the imprint of human hands in the clay which enters into some of the ancient structures in the region of New Madrid."

Dr. Snyder says that "there is no foundation for a belief that they lived under any form of political government or had any formulated mode of worship, or entertained religious sentiments more elevated than the grossest superstition;" and adds "This summary sketch accurately depicts the status of the mound-builders, and is a correct representation of the condition of the southern Indians when first discovered." From all that I have been able to glean by personal research and from writers on the subject, I think he has been too hasty in arriving at such conclusions respecting both the mound-builders and the southern Indians.

C. C. Jones, Jr., says,[9] "Among the Natchez the machinery of temples, idols, priests, keepers of sacred things, and sundry religious festivals was most elaborate. The preservation of the eternal fire engaged their utmost solicitude. The Sun (chief) ruled with despotic power and served in his person to unite the privileges of king and high-priest. There were observed more emphatically than among any other southern tribes, the distinctions of rank. The common people were to the last degree submissive to the nobility consisting of Suns, nobles and men of rank."

This is certainly an opposite condition to living "without any form of political government or formulated mode of worship," and this is one of the nations or tribes that Dr. Snyder himself puts on a level with the ancient mound-builders, and I think with some degree of reason, as I believe it quite possible that some of their descendants may have existed among these and other southern peoples.

Dr. Snyder concludes his article with a quotation from the "Ancient Copper Mines of Isle Royale," by Prof. N. H. Winchell. As that paper has been answered by Mr. J. P. Maclean in "The American Antiquarian," who says "It is remarkable for its erroneous statements and its misapprehension of facts;" I shall merely notice a few inaccuracies that have escaped Mr. Maclean's notice which afford additional evidence of its unreliability as an authority.

Prof. Winchell devotes more space to the question of the identity of the mound-builders, than to the ancient copper mines, and uses the same line of argument as Dr. Snyder relating to the building of mounds by modern Indians; making quotations from several authors to support his position, one of which reads as

7 Ancient Monuments, pages 117-118.
8 Pre-Historic Races, page 113.
9 Antiquities of Southern Indians, page 22.

follows, "Beck's Gazetteer" (page 308) states that "a mound of the largest dimensions has been thrown up, within a few years, in Illinois, over the remains of an eminent chief." When a writer gives the name of a book and the number of the page, and uses inverted commas, it is generally supposed that within those quotation marks he uses the exact language of his authority; how Prof. Winchell has followed this rule is best exemplified by giving the correct quotation, which reads thus: "Beck's Gazetteer," (page 308),—"One of the largest mounds in this country has been thrown up on this stream, within the last thirty or forty years, by the Osages, near the great Osage village, in honor of one of their deceased chiefs." The stream referred to by Beck is the Osage River, which is n Missouri, not in Illinois. Beck says it was erected thirty or forty years ago, and as his "Gazetteer" was published fifty-nine years ago, this would make the age of the mound nearly a century, instead of a few years. The quotation as made by Prof. Winchell is therefore totally at variance with the book quoted. Even if it had been correct, Beck is known to be very unreliable as an authority, which is proved in this instance by the fact that in the hope of finding "one of the largest mounds in this country" as described by him; Mr. O. W. Collett, of the Missouri Historical Society, some time since, thoroughly searched the banks of the Osage River for miles, in the neighborhood designated by Beck, without being able to find the slightest evidence that any such mound ever existed.

Prof. Winchell devotes considerable space to prove that the Indian tribes, at the time of their first contact with white men, made use of copper, a fact which no one has denied, and makes a number of quotations and references, as he says, "in regard to the use of copper and the *mining* of it by American aborigines." I have read the quotations carefully, but without finding a word in any of them respecting mining.

Again at page 614, he says, "Thus at a distance of from 800 to 1,000 miles from its origin, Cartier in 1555, and Champlain in 1610, encountered Indians who informed them of the *manner of mining* and of manufacturing copper implements." Neither Cartier or Champlain, in their narratives say anything about "the manner of mining," on the contrary they say the Indians told them they gathered the copper in lumps.

Col. Whittlesey says,[0] "Detached and water-worn lumps of copper have been found in great numbers in the gravel, clay, and loose materials that cover the rocks, from the days of the Catholic fathers to this time, not only in the mineral regions but over a large space, to the southward of it." Pieces of drift copper have been found in many places in Wisconsin, and one weighing five or six pounds is recorded as having been found in the drift gravel in Medina County, Ohio. It was from such sources that the modern Indian tribes obtained their supplies of copper, there is not a particle of evidence to connect them with the ancient mining operations, or to prove that they had any knowledge or tradition concerning them. Col. Whittlesey states that all the evidences prove that the

0 Ancient Mining on the Shores of Lake Superior, page 1.

ancient mines had been abandoned hundreds of years before the French became acquainted with the northern tribes.

The problems that American archæologists and ethnologists have before them for solution, are so many and so difficult, and the amount of work to be done is so large, before they can unravel the mysteries of pre-historic life on this continent, that it is very unfortunate that the clouds of misapprehension and error should be rendered more dense by careless and incorrect quotations and unsupported statements. In some quarters there is a disposition to over-rate the culture and conditions of social life among the ancient inhabitants of the Mississippi Valley, while in others there is a tendency to err in the opposite direction. Both parties in their desire to maintain their favorite theories are only too apt to ignore many difficulties and to attempt to settle disputed points by baseless assumptions. It is only by preserving a middle course between these extremes and by devoting our energies to arrive at the truth, irrespective of preconceived opinions, that any work can be done that will yield scientific results worth preserving, or that will aid us in giving an intelligent answer to the question "Who were the Mound-Builders?"

THE TABLET OF THE CROSS.

WARREN WATSON.

EDITOR KANSAS CITY REVIEW:

In the August number of the REVIEW Prof. Mason and Mr. Hilder take me to task for presuming to doubt the views of Messrs. Rau and Holden on the Smithsonian Tablet; and, if I permitted their articles to pass without some rejoinder, their courteous strictures would go far to convict me of inexcusable ignorance concerning the subject.

I desire to say, then, that the learned and valuable speculations of Dr. Rau are quite familiar to me; that they render extremely probable the prior views of Matile and Valentini; but that they identify beyond a doubt the Smithsonian Tablet as the right lateral slab of the Cross group I must respectfully deny. The fact is the restoration of the complete Tablet as set forth by Dr. Rau would not be received in court as evidence without further proof of its authenticity. Who procured the Smithsonian fragments? From what portion of the ruins were they taken? Did all the fragments come from the same locality? When were they procured? How and when did they come into the possession of Mr. Russell? These questions seem to be pertinent to the inquiry, yet none of them are answered by Dr. Rau except in a rather perfunctory manner. He finds the Tablet at Washington; he discovers that in 1842 it was consigned to the Patent Office as "the fragments of a Tablet from the ruins of Palenque;" that it bears a striking resemblance to the right portion of the Kingsborough's plate of the complete Tablet and that it fits almost exactly the center stone as pictured by Waldeck, Stephens and Charnay. These are strong facts, but our information regarding the genuine Tablet is of such a nature that these facts, instead of deciding the question, entangle us all the more hopelessly. Waldeck (1832) intimates that the Tablet was entire when he visited the ruins, but he only depicted the central stone and the right lateral slab; but it was certainly complete at the earlier visit (1831) of Galindo. Stephens (1840) states that "the stone on the right is broken and, unfortunately, altogether destroyed; *most of the fragments have disappeared;*" and he goes on to say that "from the few" fragments found he did not doubt it contained a similar inscription to that on the left. Charney (1858) found the two lateral slabs containing hieroglyphics "*in place in the sanctuary of the temple;*" reiterating this statement twice with a circumstantiality of description that bewilders one who has just read the testimony of Stephens or been told that "by travelling to Washington" he may see one of these identical slabs. It cannot be possible that Stephens, Charnay and Rau are all correct. It might be possible that the missing slab was not so completely destroyed as Stephens thought and that the fragments seen by him in 1840 were gathered up in 1842 and shipped to Washington; but in coming to this conclusion we must ignore his statement that "most of the fragments" had disappeared.

Between Charnay and Rau there is a gulf that no suppositions can cross unless we conceive that some Central American Antiquarian has duplicated Dr. Rau's restoration by the help of other "fragments of a Tablet from the ruins of Palenque."

RELICS OF A RACE OF MOUND-BUILDERS IN CALIFORNIA.

With the exception of those who have made the subject an especial study, but few people are aware of how thickly the relics and traces of former habitations of a long-forgotten and prehistoric race are scattered all over the Pacific coast. For archæologists the subject is a decidedly interesting one, furnishing as it does an endless field for investigation and speculation. These traces are particularly numerous in the southern portion of our State, and in that section the researches of scientific men have met with an especially rich reward. Numerous parties, under the auspices of various organizations, have at various times gone over portions of the field and made many and important discoveries. But to the careful searcher there is yet a large and unexplored region which will amply repay any labor expended in that direction. On the borders of the Colorado Desert traces of former habitations are to be found in the presence of enormous heaps of broken crockery, and trails worn so deep in the solid rock that thousands of feet continually passing to and fro must have consumed ages before the pathways assumed their present form, and many other indications may be seen going to show that at some remote period that now desert waste must have sustained a vast population.

One locality in particular on the Mojave desert deserves especial mention. In an utterly dry and desolate section, far from any apparent inducements for the settlement of even the wandering desert Indians, are twelve mounds or cairns of loose rock, piled up to an elevation of some five or six feet. The rocks of which these mounds are composed must have been carried for a great distance, as none like them are to be found in that neighborhood, and a vast amount of time and labor must have been consumed in the apparently useless task. What these monuments represent, or what may be concealed beneath them, is entirely a matter of conjecture, and no doubt a thorough prospecting of them would amply repay any curious scientist. Their remoteness of location has, so far, prevented any one from making any thorough examination of these interesting relics of the past. The Indians of that desert claim to have no knowledge of the purpose or origin of these cairns, but say they have always been there, and that their forefathers knew as little about them as they themselves.

The researches so far made into the remains of this prehistoric people have been almost entirely confined to the southern seacoast and the islands off the shore. Of these islands, San Nicolas, Santa Cruz and San Miguel have proved especially rich in relics. Many tons of stone implements, knives, lances, arrowheads, bowls, mortars, etc., have been excavated and sent to museums in various portions of the world. All these islands—Santa Cruz, Santa Rosa, San Miguel, San Nicholas and Anacapa—bear traces of having at some distant day been densely populated, though what manner of men they were and what their history is entirely a matter of conjecture, since, as far as known, no traces of any attempt at carving or writing by means of hieroglyphics have ever been discovered.

At Point Duma, in the extreme south western part of Ventura County, the traces of a large settlement are to be seen. Here the debris from the ancient dwellings has formed a large and deep deposit, covering a great extent of ground. The burial places of the former inhabitants have been discovered, and in many places excavated, and large quantities of the stone implements therein found have been taken away by enthusiastic and professional relic hunters. Coming further up the coast, at Point Rincon, nearly on the boundary line between Ventura and Santa Barbara Counties, are to be found perhaps the most extensive evidences of a former settlement that exist anywhere in this State. Here, for a space of upward of two hundred acres, the entire surface of the ground is covered with a deposit of refuse left by the former inhabitants, varying in depth from two to fifteen feet. This debris is composed of powdered shells, bones of all sorts of animals, mostly in a calcined condition, the remains of former fire-places, and by no means the least, vast quantities of human remains. In the entire section it is almost impossible to dig to any depth without striking human remains in more or less quantity, and all bearing evidence of having been interred for an incalculable period, many of the bones crumbling to pieces on being touched, while others are in a fair state of preservation.

The locality of some of the graves is marked by rocks or whalebones, and some sort of care was evidently taken in the burial of the occupants, in some instances a sort of rude box of large flat stone being made to do duty as a coffin. It is in these more methodical tombs that the richest deposits of stone relics are found. In the majority of cases, however, the dead seem to have been thrown promiscuously into the ground, though in one locality the singular circumstance was observed that the bones of children were invariably accompanied by those of an adult, a fact fruitful of speculation. One interesting fact connected with these remains is the regularity and remarkable state af preservation of the teeth found, and also the somewhat singular circumstance that these teeth are almost invariably worn smooth on their upper surface, thus proving that their possessors must have been compelled to eat much more than the traditional "peck of dirt" in order to have produced such a uniformity of surface. It was at this place that sometime since a farmer plowed up a relic which to all appearances would seem to have been intended as a tombstone, with an inscription upon it. This consisted of a large flat bone of a whale. Portions of the surface had been hollowed out and these excavations filled with asphaltum, with which the coast abounds. In this asphaltum, when soft, the tiniest white shells had been imbedded in various patterns, and with such method as to warrant the supposition that some meaning was sought to be conveyed. Unfortunately the bone was in such a state of decay that it fell to pieces, and no effort was made to save more than one or two of the larger fragments.

Acting on the supposition that this was probably the headstone of some important personage, and that a rich deposit would reward the discoverer of his resting-place, many excavations were made in the locality, but nothing of interest was found, the bones having, in all probability, been shifted a considerable distance from its original locality in the course of ages. Numerous parties have, at different times, made the deposit at Point Rincon the scene of their researches, and in nearly every instance have been well repaid. As a matter of course the age of this deposit can only be conjectured, but every indication points to the belief that the race who inhabited the coast antedate all other inhabitants of this continent. One remarkable fact has been noticed, and that is the entire absence of any metallic objects, or any signs of any having been used, showing these aborigines to have been in ignorance of anything of the sort.

At a point on the coast about thirty miles north of Point Rincon, and near the little village of Goleta, is a place called More's Island. This is an elevated plateau, surrounded by lowlands, and which, at no distant period, was an island. Here it had been long known that there were traces of former inhabitants, but no systematic search was ever made until the Wheeler expedition paid that place a visit a few years since, when, in a short time, they exhumed and forwarded to the Smithsonian Institution no less than ten tons of relics of all kinds.

Crossing the Santa Ynez range at Santa Barbara, a region is reached where no one would expect to find evidences of any former population, as the country is as wild, unproductive and inhospitable as can well be imagined. Yet, in some of the remote cañons of the mountain range, and in places almost impossible of access, extensive burial places and remains have been found and many valuable relics unearthed. At the San Marcos Hot Springs, at the northern base of the Santa Ynez Mountains, are also extensive remains, and excavations made there have been well rewarded. Continuing on through the northern portion of Santa Barbara County may be found many traces of this long-obliterated race, and many places with good indications may be found which have never, as yet, been subjected to an investigation. Notably is this the case in the Santa Maria Valley, and in some portions of San Luis Obispo County.

One interesting fact concerning the implements found is the extreme hardness of the material used, and the almost utter impossibility of working it with even modern stone-cutting tools. Many large bowls and mortars have been found which have been worked from a solid block by some unknown means to an even thickness all through, and of so perfect a regularity of outline as to excite the wonder and admiration of all. When it is borne in mind that the material of these bowls is of the hardest and flintiest description, the perseverance and skill of the savage artificer, as well as the means used, are a wonder. Quite a profitable business is now and has been for years done by various parties in prospecting the country for these aboriginal relics, as such things find a ready sale at the various museums, as well as with many private collectors of antique objects.

In connection with this subject some mention of the famous "Painted Cave" at Santa Barbara may not be out of place. An old Indian trail across the Santa Ynez Mountains leads up the mountain side from one of the oldest of the settlements of the padres—the Indian orchard. Some bee-hunters, several years since, discovered not far from this trail an aperture in the rocks, which could only be reached by clambering down a rope suspended from the rocky ledge above. However, the cave was reached, and found to be a hollow in the rocks of considerable size, with a sandy floor. But the most remarkable thing was the presence of a variety of inscriptions painted upon the rocky sides of the cavern, and which have given rise to all manner of conjectures as to their meaning and origin. So far, however, no satisfactory clew to their meaning has ever been found.—*San Francisco Chronicle.*

Sir Walter Armstrong, at Craigside, near Newcastle, England, has utilized a brook to run a dynamo-electro machine by means of a turbine water-wheel, and so manages to secure electricity enough to keep thirty-seven Swan lamps in a state of incandescence in his house. In this case the motive power costs nothing, and electric lighting in this way is an exceptional luxury.

Mr. Buttgenbach, of the Lintorf lead mines, near Dusseldorf, has devised a disintegrator which separates zinc blende and pyrites ore with great nicety. By specific gravity this can not be effected, but the difference in the cohesive force of the two minerals enables Mr. Buttgenbach to crush the zinc ore to a fine sand and leave the pyrites in its original volume, so that they can be separated by a sieve.

CHEMISTRY AND PHYSIOLOGY.

ALCOHOL AND ITS EFFECTS.

REV. L. J. TEMPLIN.

The earliest authentic account we have of the use of intoxicating liquors as beverages is in the case of Noah, who, it is said, planted a vineyard and became drunken on the wine made from the fruit thereof. From that time down we have frequent accounts of the use and effects of various kinds of intoxicating liquors among many nations and tribes of people. The most common source of these drinks in ancient times was the grape; but the palm tree, pomegranate, and melon have been extensively employed for this purpose in both ancient and modern times. In recent times the various cereals have come into very general use for this purpose. Various other substances, as fruits, milk, etc., are frequently employed for the manufacture of intoxicating drinks. It is only by a process of fermentation that the intoxicating principle is generated, as none of it is ever found in any living substance. In the process of decomposition of any organic substance containing sugar in the presence of water, it passes through three distinct stages; the alcoholic, the acetic, and the putrefactive. It is the business of the brewer and distiller to check the process when it has reached the first stage, and so manipulate their liquor as to prevent any further fermentation. Intoxicating drinks were in use many centuries before any correct knowledge of the true nature of the intoxicating principle was obtained.

The Arabian alchemists discovered that if wine was kept at the boiling point for a few minutes it lost its intoxicating power. The intoxicating principle, whatever that was, had escaped. But this powerful agent was invisible, hence it was regarded as a spirit—the spirit of wine.

About the middle of the eleventh century Avicena caught this subtle agent and gave it a visible, bodily form. Chemists called it "alcohol." This term comes from two Arabic words, Al the, and Kahol, a fine, impalpable powder. The ladies of the east were accustomed to employ such powders at their toilet. The term "alcohol" seems to have been applied to any powerful, subtle agent, but its modern use is confined to the intoxicating principle or strong drinks—the spirit of wine. The process by which this agent is developed is now quite well understood. If starch be moistened with water in which a little ferment, as yeast, has been dissolved, and subjected to a temperature of one hundred degrees of heat it will be changed to grape sugar. But if the temperature be maintained in the presence of a ferment it will be decomposed and its elements separated into carbonic anhydride and alcohol. The gas speedily escapes into the air and the alcohol remains dissolved into the water. By distillation this is separated from the principal part of the water, the remainder of which may be removed by certain chemical processes and absolute alcohol obtained. It was once believed that alcohol was the product of distillation, but it is now known that this process only separates the alcohol that has already been generated by fermentation. The alcohol in general use contains from seven to fifteen per cent of water. Pure alcohol is a transparent fluid having a specific gravity of 796, water being 1000. It has a very pungent taste, boils at 170° and has never been frozen. It inflames at 300°, burning with a pale blue flame, emitting no smoke, little light but much heat. This agent is a powerful solvent, readily dissolving most of the resinous gums and vegetable extracts. Chemically, alcohol is composed of three gases in the following proportions :

Carbon	51.88
Hydrogen	13.70
Oxygen	34.42
	100.

The amount of alcohol that is found in the different kinds of intoxicating drinks varies with the different classes and kinds of liquors. The following exhibits the proportion of alcohol and proof spirits found in the different kinds of fermented liquors.

	ALCOHOL.		PROOF SPIRITS.	
Port Wine	23	per cent.	46	per cent.
Madeira	22	"	24	"
Sherry	19	"	38	"
Champagne	12½	"	25	"
Cider	7	"	14	"
Porter	4¼	"	8½	"
Ale	6½	"	13	"
Small Beer	1¼	"	2½	"

From this it will be seen that these drinks contain from one fortieth to nearly one-half of proof spirits. The proportion of alcohol found in the various kinds of distilled liquors is—

Brandy	53.39	per cent.
Rum	53.68	"
Gin, common	51.60	"
Gin, Hollands	55.44	"
Scotch Whisky	54.32	"
Irish Whisky	73.70	"
Common Whisky	42.95	"

Of this class of liquors we find from over two-fifths to nearly three-fourths to consist of alcohol. Besides the water mingled with the alcohol there are other ingredients found, especially in the fermented liquors, as the hops in beer, juniper in ale, acids in wine and cider, etc. It is a common opinion that the effects of these various drinks on the human system are modified by the presence of these foreign substances; but it is quite doubtful whether these extraneous substances in the quantities in which they are used, ever have any marked effect on the system. The various effects resulting from the use of the different kinds of drinks is more likely the result of the different degrees of dilution with water that characterize them, or of the manner in which they are taken. If taken in considerable quantities at once the effect will necessarily be more marked than if the same quantity is taken gradually so that it may be gradually taken up and disposed of by the system. In treating of the effect of alcohol on the human system no distinction will be made as to the kinds of liquors which contain the alcohol used. These effects are produced by two different processes, a chemical and a physiological one. Its most important chemical property is to arrest and prevent decomposition in all organic bodies, whether animal or vegetable. For this reason it is largely used for the purpose of preserving natural history specimens in the cabinets of scientists. In its antiseptic properties it is excelled only by creosote, carbolic acid and arseniate of soda; but it has advantages over all these and is more generally used. When taken into the stomach with food it prevents the decomposition of the food under the action of the gastric juices, and hence it tends to retard digestion and is detrimental to health.

But as digestion must proceed that life may be preserved, this evil power must be disposed of in some way. It is a well established fact that the digestive powers of the stomach have no control over this powerful agent. As it cannot be digested and as the digestion of food cannot proceed in its presence nature pro ceeds at once to banish the unwholesome intruder.

Instead of being digested, alcohol is taken up by absorption by the capillary vessels of the stomach and introduced directly into the blood by which it is carried to all parts of the system. It is evident therefore that alcohol cannot be re garded as food in the ordinary use of the term. But it has been observed that if a portion of alcohol be taken at regular and frequent intervals the weight of the body will be increased. Numerous carefully conducted experiments prove this to be true. This fact has led many eminent physicians to believe that alcohol when taken into the stomach acts as a food. But this phenomenon may be accounted for in more strict accordance with the facts without giving it this interpretation. In order to a full understanding of this point it is necessary that we turn aside a little and inquire into the manner in which food is made beneficial to the system. Every organized being is composed of innumerable minute vesicles termed "cells." These cells are constantly dying and being conveyed from the system while their places are being supplied by others formed from material derived from the food eaten. This process of composition and decomposition, of birth and death, is constantly going on in all parts of the physical system. When a particle of material has served its purpose in the system it loses its power to further serve the purposes of the system, and its further presence is detrimental to health. The highest state of health is secured only by the prompt removal of this effete matter. Thus it appears that we live only by a constant process of dying. Alcohol in the living system, as everywhere else, antagonizes the natural tendency to decomposition. Hence the dead matter that, under the healthy action of the system, would be speedily excreted from the system, is retained longer than it should be. The result is the weight is increased, but it is by the retention of the old matter that should be cast off and not by the addition of new material obtained from the alcohol. Another argument in favor of the nutritious nature of alcohol is based on the nature of this substance. All forms of food substances may be arranged in two general classes, viz: nitrogenous and carbonaceous. The former of these goes to make up the various tissues of the animal system, and the latter results in the development of animal heat and carbonic anhydride. Now as alcohol contains so large a proportion of carbon it was placed at the head of the list of respiratory food substances.

This theory, advanced by so high an authority as Baron Liebig, and looking so plausible on its face, gained at once general acceptance. But it was not long till Dr. Prout demonstrated by experiment that the amount of carbonic acid exhaled from the lungs was directly diminished by the presence of alcohol. Dr. Davis, of Chicago, next took up the question of the development of animal heat from alcohol, and by carefully conducted experiments he demonstrated the fact that so far from the heat of the system being increased under the influence of alcohol it was actually diminished. After taking nutritious food into the stomach the temperature of the body is increased, but after taking alcohol in any form or mixture the temperature soon begins to fall and continues depressed one to two degrees below normal for two or three hours, the extent and duration of this depression being in exact proportion to the amount taken. The world has long labored under the delusion that both the temperature and strength of the body were increased by the presence of alcohol in the system. Dr. Davis's experiments with a very delicate thermometer proved the first a mistake, and an application of the dynamometer showed the last to be an error. The common error on this subject arises from the state of perverted sensibility resulting from the alcohol that has been imbibed.

The individual will assert with great positiveness that he is warmer or stronger while under its influence than at other times, but an application of the proper tests proves his mistake. But it is this appeal to his sensibilities that has misled the world on this subject for generations. In order to a full understanding of this matter it is necessary to inquire more particularly into the effects of alcohol on the human system.

If an application of alcohol be made to any part of the body and continued for sometime it will be found that the sensibility of that part has been diminished. The nerves with which the poison comes in contact are paralyzed to some extent, thus reducing their sensibility. And this leads us to inquire more fully into the real nature of alcohol. The almost universal opinion is that alcohol is a stimulant and the exhilaration resulting from its use is offered as a proof of this view. What is a stimulant? There are three classes of medicinal agents that produce different chemical changes in the system and so sustain a different relation to the production and expenditure of vital force. One class operates to produce an increased expenditure of vital force without in any way affecting the supply of that force. These are called stimulants. Of this class cayenne pepper, ammonia and guaiacum will serve as examples. A second class increases both the amount of the vital force and its expenditure; these are termed tonics. Iron, quinine, and the active principle of the barks of poplar, willow and dogwood, and of tea and coffee may be taken as samples of this class. A third class retards the chemical changes of the system and so reduces both the production and expenditure of vital force. Dullness, stupor, impaired sensibility and unconsciousness are the results of this class. It is evident that alcohol belongs to this last group The narcotic or anæsthetic effect of alcohol on the nerves and brain renders the individual less sensible of all outward impressions. This diminished susceptibility renders the patient less sensible of heat and cold, weariness and pain.

It has long been noticed as a paradox of human action that the same person will claim that the same alcoholic drink will warm him when cold, cool him when hot, rest him when weary and sooth him when afflicted. It has long been claimed that when a person becomes weary a portion of alcohol will renew his vigor and remove all sense of weariness. If exposed to heat or cold he feels the effects of these extremes less acutely if he has imbibed a portion of alcoholic liquors. Now this sense of weariness, the pain felt in the presence of heat or cold are but sentinels that nature has kindly placed to warn us of the vital powers by these adverse conditions.

When alcohol is taken under such circumstances it adds nothing to the strength or the resisting power of the system; simply renders it less sensible to the evil that is going on—it bribes the sentinel, so to speak, to give no farther warning while the ruin of the system is wrought. The sense of weariness is taken away but the exhaustion goes on all the same. The sense of cold or heat is removed, but this does not prevent the individual from dying with sunstroke on the one hand or freezing on the other; but these fatal results are only hastened.

"But," it may be asked, "if alcohol is not a stimulant why is a man often excited to great nervous and mental activity while under its influence?"

This follows from the anæsthetic nature of the poison. When taken into the stomach, as stated above, the alcohol is taken up at once and conveyed unchanged to all parts of the system. Its first effects are felt at the extremities of the nervous system. These nerve extremities under the paralyzing effects of this narcotic poison lose their power of action and become inert. The vital force that has been sent out from the great nerve-centre—the brain—to be expended at these extremities, finding the nerve fibers inactive—the wires down—is returned toward the nerve-centre, producing increased activity in that organ, resulting in exhilaration and increased nervous activity there. As the effects of the poison move back along the nerve fibers, approaching nearer and nearer the brain, this exhilaration increases till in many cases it becomes uncontrollable mental excitement. But after a time if the dose has been sufficiently large, when all the outposts have been taken, the enemy enters the very citadel of the mind and lays its paralyzing touch on the brain itself. This high state of mental excitement is quickly changed to one of stupidity and sottishness. Thus the very symptoms relied on to prove that alcohol is a stimulant, when correctly interpreted, only prove it to be a deadly narcotic. The delusions in regard to the true character of alcohol and its effects upon the system, that has prevailed not only among the common people but also among physicians and physiologists has led to errors in practice that have been fraught with unmeasured woe to our race, and has been a sad commentary on the declaration of the wise man that "Wine is a Mocker." But with the increase of light on this subject may we not hope the evils resulting from the misuse of this powerful narcotic poison will speedily cease to afflict mankind.

HUTCHISON, KANSAS.

THE WILL-O'-THE-WISP.

Not often has "dry" Physical Science to do deal with the phenomena which figure in folk-lore. Such an exceptional case is afforded by the nocturnal occurrence known to the learned as *Ingis fatuus*, and to the unlearned in different countries as Jack-o'-Lantern, Will-o'-the-Wisp, Wild- (or rather World-?) fire, Friar's-Lantern, *Feu Follet*, Heerwisch, &c. The exception deserves the more notice as modern chemistry and physics have by no means succeeded in finding a satisfactory explanation of the facts. Facts they undoubtedly are. The *ignis fatuus*, though by no means common, has still from time to time been observed by competent witnesses, and occasionally by several persons in company. Nor is such evidence disputed: let any man of sober habits and ordinary truthfulness state that he saw a Will o'-the-Wisp at such and such a time and place, and the most skeptical of our orthodox *savants* will listen with calm interest, and, though he may question the narrator closely as to the circumstances of the case, he will by no means proclaim it *à priori* impossible, or throw out any insinuations concerning "dominant ideas."

If we examine and compare the most recent and trustworthy records of this phenomenon, we find it described as a light which appears in calm, mild nights, chiefly in summer or autumn. It is most commonly observed in swampy or marshy places, or where much organic matter is undergoing decomposition. Dr. Phipson[1] describes it as most common in England, "in the peaty districts around Port Carlisle, in Cumberland," on the Continent "in the damp valleys between the pretty little university town of Marburg and that of Cassell, and more certainly still in the graveyards outside the town of Gibraltar." The light in question is generally single, though sometimes two wisps are said to have been seen to-

1 Familiar Letters on the Mysteries of Nature. London: Sampson Low & Co.

gether. It glides or bounds along at a variable speed, sometimes maintaining the same vertical level, but at other times rising, falling, and overleaping hedges, trees, etc., and may often be tracked to a distance of a couple of hundred yards from the spot where it originates, or rather where it is first observed. It is recorded as in many cases moving *toward* a pool or swamp, and there disappearing. The light is said to be sometimes globular, spheroidally elongated, or pear-shaped, about the size of "two fists," and varying in color and brilliance, being sometimes visible even in the light of a full moon.

So much for points authenticated by the accordant testimony of trustworthy observers. Popular tradition adds much more. The spectators are said to have sometimes received sudden blows or shocks. According to an old German story, some village children having irritated a Wisp by crying out—

"Heerwisch ho, ho, ho!
Brennst wie Hafer stroh!"

it pursued them into the house, and stunned every person present by blows with its fiery wings. Folk-lore, indeed, distinctly personifies the Wisp, and ascribes to it the intention to mislead the solitary traveller and entice him into a swamp or pond.[2] This view or superstition is by no means extinct, as will appear from the following extract from "Light" (June 24th, 1882, p. 296). A contributor of that journal, who uses the *nom de plume* "Miror," gives the following account as narrated to him by an old cottager:—

"'When I was a ploughboy, at Purbeck, I was sent to the blacksmith, who lived some distance off, with some harness to be mended. The blacksmith was at chapel; this delayed the work, and it was not till half-past nine in the evening that I could start for home. It was pitch dark, and as I went along a Jack-o'-Lantern came hopping before me. It was not above the size of your two fists. I was quite aware that Jack-o'-Lanterns came to lead you out of your path, so I kept my foot in the rut all along the country road, till *he*, the Jack-o'-Lantern, hopped over a gate where there was a pond close by, and tried to entice me there.'

"At the above very evident testimony of evil intention the boy was overwhelmed with fright, and taking to his heels rushed, he knew not where, till he came to a house. There they took him in, and one of the inmates accompanied him over the fields, and put him on his way home.

"'I had not gone far,' continued the old man, 'before another Jack-o'-Lantern came hopping before me, and tried to entice me to a swamp which lay on one side of my way; but I knew where I was, and went straight for home, half dead with fear. Never again would I go to that blacksmith's of an evening.'

"'If he had not kept his foot in the rut,' broke in the old woman, his wife, 'it might have been all over with him. When a Jack-o'-Lantern gets you in the water, then he sniggers; he laughs, you know. I've heard my father say that scores of times.'

2 We cannot help here remarking that mediæval tradition personified certain phases of the nightmare, as the terms Incubus and Succuba sufficiently testify.

"Thus we see the old woman brought forward the testimony of her father also, with respect to the traditional shady character of the Jack-o'-Lantern, or Will-o'-the-Wisp, or *Ignis fatuus.*

"You call the Jack-o'-Lantern *he*,' I said. 'You talk as if you thought it knew what it was about; and by luring you into danger it had an object in view, and not a good one.' "Just so," said the old man. I said I was inclined to agree with him.

"On the man's assenting to the woman's assertion that 'when a Jack-o'-Lantern gets you into the water, then he laughs,' I pressed the question, 'Do you really mean to say that they are really *heard* to laugh—that they make the noise of laughter?' 'Yes,' was the reply. 'But how,' I rejoined, 'can people know that they laugh when those who are led by them get drowned, and do not live to tell it?'"

It is curious that "Miror" speaks of this his own objection—fatal, as it appears to us—as "rather lame special pleading on my part." It must not be forgotten that the occurrence is said to have taken place at Purbeck. Now in the counties of Dorset and Wilts the tendency to personification is very strong, and the country people speak of many things as "he" which in the Metropolitan District and the Northern Counties are always referred to as "it."

A very full and definite account of the appearance of an *Ignis fatuus* is to be met with in a modern work[3] reviewed in our current issue. Some passages of White's narrative we quote. The inhabitants of Itapua, a small town in the Plata States, situate on the River Parana, were during the author's stay alarmed by "a mysterious light that appeared almost every night in the second plaza, situated on the high river banks, but where, nevertheless, the ground was in some parts a temporary swamp, from the rains settled in the hollows. In this plaza were posted the line soldiers' barracks, and to the guard bivouacking round their fire at night it first manifested itself. My friend Lieut. Morcillo, the officer in command, soon got to hear of it, and, scenting trickery, issued notice that he had given his soldiers orders to fire upon it whenever and wherever it became visible. The soldiers, as they became more accustomed to the *Ignis fatuus*, began to style it the "Plazera." Singular to relate, no sooner did the light burst forth than it was heralded throughout the town by a universal chorus of howls from the mangy curs in Itapua. In order to elucidate the mystery Lieut. Morcillo and myself visited the plaza for several nights in succession, accompanied by three or four soldiers with loaded rifles and ourselves armed with revolvers. The military were posted round the square, and we waited from ten o'clock till twelve or one in an atmosphere bathed in the brilliancy of a full moon. Only twice was it seen by me, but then very distinctly; the first time some little distance off, but the second quite close. On the first occasion the light started up from the ground with the brightness and speed of a rocket, and then again descended to the earth with equal velocity but less splendor: on the second we

3 Cameos from the Silver Land, by E. W. White, F. Z. S. London: Van Voorst, Vol. ii., p. 447.

caught sight of it as it directly, but gently, approached along the road, upon which, running to intercept it, and stumbling at every step over rough and swampy ground, we managed to arrive within three yards of the glowing vision as it slowly glided on at a level of about five feet from the earth. It presented a globular form of bluish light, so intense that we could scarcely look at it, but emitted no rays and cast no shadows; and when about actually to grasp the incandescent nothingness, suddenly elongating into a pear-shape tapering to the ground, it instantly vanished; but on looking round up it rose again within fifty yards, but this time we could not overtake it, as it bounded over a hedge, then over trees, and finally disappeared in an impenetrable swamp. According to the testimony of the soldiers, on another occasion, they beheld it rise from the swamp and perch for some minutes on the top of the roof of a neighboring rancho without walls, after which it pierced the roof and subsided in the ground beneath; but in our case there was no deception, and moreover we noticed that it never appeared on a windy night nor after rain." The author adds, in comment, "Although the marsh-gas theory presented itself to my unwilling mind, it would have to be strained considerably to be able to account for all the attendant circumstances."

We will now attempt an examination of the various hypotheses proposed for the explanation of the Wisp.

Trickery may at once be set aside as out of the question. The movement of the light is totally unlike that of a man carrying a lantern. It is at times much swifter, overleaps objects which a man could not surmount, and plays often over water, and at heights of from twenty to fifty feet in the air. Neither can we consider that it is produced by the reflection of a light thrown from some neighboring house. Fire-works are equally out of the question. Not to speak of the slowly progressive movements of the Wisp sometimes observed, it is in the highest degree improbable that any trickster would convey a quantity of pyrotechnical appliances into solitary moorlands, woods, and peat-bogs, in order to alarm some stray traveller.

Another hypothesis, advanced by certain very learned authors, such as Ray, Willoughby, Kirby, and Spence,—ascribes the Wisp to luminous insects. Dr. Dereham and Dr. Phipson combat this view on the ground that such insects "rise far higher in the air than does the Wisp, and present the appearance of hundreds of little specks of light." This argument seems scarcely valid; luminous insects are in all probability more numerous than is ordinarily supposed, and vary considerably in their habits. Not all are high flyers, nor are they all gregarious. The apparent size of the light may be considered a fatal obstacle, since no known English insect emits a light of the size of "two fists." But a light seen on a dark night by a superstitious and terrified ploughboy will very naturally be described—and that without any conscious or intentional exaggeration—as much larger than it really was. The circumstances that the Wisp is chiefly seen in calm weather and during the summer season are in favor of this supposition. But we have some positive testimony to advance. The Rev. Dr. Sutton, of Norwich, informed Dr. Kirby that when he was curate of Ickleton, in Cambridgeshire, in 1780, a farmer of that place, of the name Simpringham, brought him a mole-cricket (*Gryllotalpa vulgaris*), and told him that one of his people, seeing a *Jack-o'-Lantern*, struck at it and knocked it down, when it proved to be the insect in question. Mr. Main ("Mag. of Natural History," n. s., i., p. 549) was told by a farmer that he had encountered and knocked down the luminous object, which he described as being exactly like a "maggy longlegs" (*Tipula oleracea*), an insect, we must add, especially abundant in boggy and marshy lands. Dr. Dereham, the opponent of the insect theory ("Phil. Trans.," 1729, p. 204), describes an *Ignis fatuus* which he had personally witnessed as flitting about a thistle—a very likely action for an insect, though unlikely for a volume of inflammable gas or for an evil spirit. Mr. Sheppard informed Dr. Kirby that when travelling one night from Stamford to Grantham, on the top of a stage-coach, he observed "for more than ten minutes a very large *Ignis fatuus* in the low marshy grounds, which had the same motions as a *Tipula*, flying upward and downward, backward and forward, sometimes as settled, and sometimes as hovering in the air." It is remarked that in this case the wind was very high, so that a vapor would have been carried forward in a straight line, which was not the case. We are well aware that the insect-theory is not free from difficulties. Thus the question at once arises, Why is this phenomenon so rare? It is also to be asked whether the light given off by insects is sufficiently strong to be visible at such distances as the Wisp is said to have been?

The orthodox theory at the present day—that of spontaneously inflammable gases, hydrogen phosphide, marsh-gas, and possibly hydrocarbons given off by decomposing animal or vegetable matter, is open to even more formidable objections. The presence of the spontaneously inflammable variety of hydrogen phosphide has never yet, we believe, been analytically demonstrated among the gaseous matter given off from marshes, pools, and cemeteries.

In Brande's "Dictionary of Science, Literature, and Art," (ii., p. 191), the Wisp is ascribed to "the issue of marsh-gas from the earth. This gas, being ignited either accidentally or intentionally, continues to burn with a flame sufficiently luminous to be well seen at night." The writer admits, at the same time, that no natural production of spontaneously inflammable gas has ever been observed. Dr. Phipson gets over the difficulty of ignition by assuming that the gas given off consists of marsh-gas through which a small proportion of hydrogen phosphide is diffused. But an emission of inflammable gases from the earth or the water, however ignited and however composed, will not account for the phenomena in the majority of cases on record. In proof of this let any one perform the simple experiment of stirring up the mud at the bottom of a dirty ditch or pond, and ignite the marsh-gas given off by means, say, of a piece of taper fixed at the end of a fishing-rod. The gas will burn immediately over the surface of the ditch or swamp, but the flame will not travel away for considerable distances, overleaping hedges, stiles, trees, or buildings, or playing over thistles. Further, it is found that the Wisp is most common in calm, fine weather, when the barom eter is high. But gases pent up in the soil, in marshes, etc., will be most readily evolved when the barometer is low! Rainy and windy weather is not unfrequently foretokened by the rise of bubbles of gas from the bottom of ponds and marshes. We can readily understand, however, that a light produced by inflammable gas might, if the supply was large and constant, hover over an extensive marsh or graveyard. But in such cases it would not be one and the same portion of luminous matter flitting up and down, but a succession of fresh bubbles, jets, or puffs of gas becoming ignited in turn. This accords ill with the facts as reported by observers; they generally speak of a single continuing light.

Another hypothesis refers the phenomenon to electricity. We always find that the less any person knows about electricity the more easy he finds it to account for any unexplained facts by its agency. Luminous appearances of electric origin are certainly well known, such as the "Castor and Pollux," which appears at the extremities of the masts of ships during stormy weather. Similar lights have been noticed, especially in mountainous regions, attaching themselves to umbrellas, lances, alpenstocks, etc. But these phenomena seem essentially distinct from the true *Ignis fatuus*, which, as we have already said, is characteristic of fine weather, and moves about instead of attaching itself to pointed objects.

In all probability several distinct phenomena have been confounded under the name of *Ignis fatuus*, and further careful observation is required for their respective discrimination. Those persons who live in or visit regions where the Wisp occurs might do good service by noting all the circumstances of each case at the earliest possible opportunity. The nature of the soil, the barometric pressure, temperature, the wind, and in short the entire character of the weather, should be recorded, and an attempt should be made to take the spectrum of the light.

It appears that the mediæval and popular notion of the Wisp—a conscious and evil-disposed being—is again brought forward by persons of education. "Miror," whom we have already quoted, whilst accepting the hydrogen phosphide hypothesis, asks further—"May not, however, Spirits of a low and malicious order, bent on mischief, when they find a natural medium in the dark, under circumstances favorable to their malice, make use of this gas, found in marshy places, to suit their purpose? Or may not an evil Spirit, fond of marshy places, have the power to turn an *Ignis fatuus*, that has its rise from natural causes, into a devious course for an evil purpose?" We reply that there is no satisfactory evidence of purposiveness, good or evil, in the movements of the Wisp.—*London Journal of Science.*

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, July 29, 1882.

Laennec observed, "the curability of consumption is not above nature, but art possesses no means as yet to arrive at that end." It is to nature that those afflicted with tubercular consumption, or predisposed to that malady turn for relief by seeking for an air of the greatest purity. Where find that genial atmosphere? The doctors prescribe several health stations, and though differing in respect to situation, agree that the main conditions are purity and uniformity. Indeed the best means to oppose to the terrible malady, consist in a residence on the borders of the sea, in a mild climate, practicing a generous regimen, and taking every precaution against chills and coughs.

At present the assistance of nature is demanded under the form of a residence on high mountains; by this is not necessarily meant excessive altitudes, for immunity against phthisis can be secured at altitudes the most various. Altitude also varies with latitude; for example:—in the Andes, consumptive patients are ordered to stations 3,500 yards above the level of the sea, while at Mexico, invalids are sent to reside at similar heights. Consumption is extremely rare in the Pyrenees; in Switzerland it is never met with above an altitude of 1,100 yards; in the Hartz and the Black Forest, it is next to unknown at a height of 560 yards. Exemption is here due perhaps more to the kind of life led by the natives than to elevation. Altitude cannot alone be the cause, for phthisis is common at Andermatt and Splugen, in Switzerland, while it is unknown at Klosters, which has about the same height.

Again, many consumptive patients find relief in sea voyages; now if the level of the sea and elevated health stations produce the same beneficial effects, it is due to these extremes having a common trait—great purity of the air. There is absent what exists in centres of populations so prejudicial to delicate lungs, for where phthisis is not exempt from bad sanitary influences, there its ravages will be most terrible. A pure atmosphere, dry, and protected as much as possible from winds; a dry soil and a sparse population, these are the conditions sought by the consumptive, and which exist in the Upper Engadine and in the Davos Valley. The latter is the first favorite and resembles much the health resorts in the Andes. Saint Moritz is less in request. Davos, from being a pretty village has become a leading winter residence, has about the same altitude as the Mürren so well known to Interlaken tourists—about 2,000 yards; it owes its reputation to the remarkable tranquillity of its atmosphere. The climate resembles a good deal that of the Pontresina—in the neighboring valley; but when the mountains become covered with snow, generally in November, new conditions come into play, modifying in a remarkable manner winter. Thus, the sky is cloudless, the sun's rays powerful, though unable to melt the snow; there are no warm currents of air, and the valley being well protected against winds, a uniform calm reigns till spring. It is being superiorly protected against sweeping winds, that gives Davos the advantage over Engadine; there are no glaciers in the vicinity as at Pontresina, and it is warmer than the valley of the Inn. At the end of December at Davos, when the snow ceases to fall, the atmosphere becomes still, cold, dry, and tonic. In the night, when the stars shine so brightly, the temperature falls several degrees below freezing point; during the day the sun's rays are so intense, that patients can remain several hours outside, but must at once return to their apartments the moment the sun commences to set. The only drawback against Davos is its drainage, that the local authorities will find it their interest to remedy. An invalid after wintering in the mountains, cannot at once, when spring arrives, descend into the plains; a residence at an intermediary station will be necessary. It is well to add, that the wintering in the mountains does not suit many cases of well-defined consumption; the remedy is admirable for individuals suffering from some accidental affection of the lungs, but in other respects possessing a good constitution; it is also excellent for persons with hereditary predisposition to phthisis, but with whom the disease has not yet appeared; for those even in the preliminary stages of the malady. But under no circumstance ought patients to be sent to this winter station who labor under the fever, and who are of a nervous and excitable temperament. Davos suits chronic bronchitis in children, nervous asthma, anemia, and nervous fatigue generally. As further proof that altitude has not in itself anything curative, the Russians send their pulmonic patients to the Steppes. Arcachon, near Bordeaux, on the borders of the Bay of Biscay, has a well deserved reputation as a winter health resort. Uniformity of temperature even is not a safeguard, for in Ceylon, which possesses a climate remarkably uniform, consumption largely exists.

At the present moment astronomers are much puzzled at a red spot on the disk of Jupiter, it remains fixed since the three years that it has been observed; the spot is four times longer than the length of the earth, is of a pale brick red, upon a luminous white ground, terminating in a point east and west. Jupiter possesses a very extensive atmosphere, for the spots, very varied, that are perceived on his disk, disappear a long time before arriving at the border where the revolution of the planet carries them. Spectrum analysis also confirm the presence of an atmosphere. The pressure is so great on the surface of Jupiter, as to resemble what our air would be if liquified. Perhaps when the red spot in question goes away, it may reveal a little of the real aspect of Jupiter.

M. Faye maintains that comets' tails consist of matter driven from the substance of the comet itself, like smoke. M. Flammarion replies that such is contrary to the observed laws of gravitation. Comets, he thinks, are bodies which become highly electrified on approaching the sun; their substance becomes diffused, producing the phenomenon upon space, and opposite to the sun, of great luminous excitability, so as to extend millions upon millions of leagues but without involving any loss of the comet's substance. The same authority again expounds his views on the habitability of planets. Our planet, remarks M. Flammarion, resembles a cup, too small to contain life, which manifests itself in all imaginable and unimaginable conditions, even developing to its own detriment, as in the case of parasitical life. The soil, water, air, all is full of being, of embryos, germs, and fecundity. Life literally overflows everywhere, transforming its manifestations, following time and place, seeking ever new theatres of action. Why then ought planets not be such theatres? Mars for instance, has many analogies with the earth; it possesses an atmosphere, thick it is true, containing, as ours, watery vapor in suspension; it has polar snows, continents, seas; seasons akin to ours, but double their duration. But the planet Mars appears to have neither great oceans nor great continents; it has rugged coasts, complicated by inland seas, islands, peninsulas, straits, capes, gulfs and canals. It may be inferred too, that comparatively, there is less water on Mars than the earth.

M. Bonley does not deny that cold kills trichines in hams, but some academicians still hesitate as to using such affected meat. As a general remark, meat submitted to cold preservation is not consequently bad, and does not possess the objections incident to raw meat so much prescribed for weakly children. Respecting this latter subject, Dr. Vulpian remarks, it is sanctioned by experience, though incapable of scientific demonstration. Pounded raw meat then, favors digestion and restores strength.

Monsieur Cadet has measured the number of red and white globules in our blood; the average number in the one twenty-sixth of a cubic inch, is 5,200,000; it can reach as high as nearly 7,000,000; the number of white is 8,000 or one for every 650 red globules. In the blood of adults the red globules are regular in form and nearly equal in diameter; rarely are small globules found, as is the case with the blood of new born infants and giants; the blood of the new born is richer in red globules than that of adults. Eating and digestion augment the number of white globules; fasting increases the red, not in the absolute sense, but by inducing a greater concentration of red globules in the liquid of the blood.

The Academy of Sciences has been occupied with the fractional differences existing as to the exact position of the axis of the earth, and the consequent difference in position of the stars as determined by astronomers from different standpoints. Messrs. Faye and Folie consider that these problems are intimately associated with the constitution of the globe. Is the latter a crust, covering a centre of liquid fire; is it a perfectly solid mass; or, has the globe a kernel of solid matter, bathed in a fluid substance, the latter in turn being surrounded by a crust?

M. Callas has examined the properties of the new drug *resorcine*, proclaimed to be a sovereign remedy for rheumatism. It possesses the same properties as phenic and salycilic acids; it is less toxical than the former, and is a stimulant for the central nervous system. As an anti-rheumatic, it presents no special claims.

Madam Dr. Schipiloff attributes cadaverific rigidity to the acidification of the fibre of muscles. This opinion, at one time current, is now abandoned, since alkaline injections, that ought to neutralize acids, do not prevent that rigidity.

MINING AND ENGINEERING.

ENGINEERING: PAST AND PRESENT.

ADDRESS OF ASHBEL WELCH,

President of the American Society of Civil Engineers, at the Annual Convention at Washington, D. C., May 16, 1882.

I do not propose this evening to undertake any general survey of the engineering field. For such a survey, I refer you back to Mr. Chanute's address of two years ago. I shall not attempt to glean after him. But I shall speak of several disconnected subjects of present interest, and give some reminiscences showing the contrasts between the past and the present; and in such reminiscences I shall disinter the buried memories of some of the great engineers of the past.

When we look around on the engineering works recently completed, or now in progress or in contemplation, the first thing that strikes us is their extraordinary magnitude.

Prominent among them is the St. Gothard tunnel, passing for 48,900 feet, or more than nine and a quarter miles, through the base of the great Alpine chain which has hitherto been so formidable a barrier between southern and central Europe, a thousand feet below the vale of Urseren and the villages of Andermatt and Hospenthal, and 6,500 feet, or a mile and a quarter, below the eternal snows that cover the crest of the mountain. The cost was about $12,000,000, or nearly $250 per foot lineal. This tunnel is nearly 9,000 feet, or a mile and two-thirds longer than the Mt. Cenis tunnel, by far the longest previously built.

Such stupendous works have been made practically possible by the compressed air drill, and the high explosives now used. In my active engineering days, rocks were drilled for blasting only by the power of human muscle, either by one or two men churning a hole in the rock with a heavy rod some six feet long, or by one man holding and slowly turning a short drill, and another man driving it into the rock with a sledge hammer. Then came the steam rock drill, then the compressed air drill. The compressed air not only does the work, but it ventilates, and its sudden expansion cools the tunnel or the mine where it is used.

The first, or one of the first tunnels in this country in which the rock was drilled by compressed air, was Nesquehoning, by Mr. J. Dutton Steele. Since then many have been made by the same means, one of the most memorable of which is the Musconetcong tunnel, a mile long, made under the direction of Mr. Robert H. Sayre. This difficult work gave occasion for the valuable treatise on tunnels by Mr. Drinker, who was in immediate engineering charge of it. The Hoosac tunnel, 24,000 feet long, after a long continued struggle, was completed several years ago, and is now in use.

Among the tunnels now being constructed is one half a mile long under the plateau of West Point, and another 4,000 feet long through the hard trap rock of Bergen Ridge, at Weehawken; both on the line of the road now in construction on the west shore of the Hudson. Nearly all the debris from the latter is raised through shafts.

The project is now under serious consideration of making a tunnel some twenty-one miles long under the Straits of Dover. A few years ago such a project would have received only a laugh of incredulity.

The admiration of the world has not yet abated for the boldest of arched bridges yet built, that over the Mississippi at St. Louis, with its steel arches of 500 feet span, its piers of heavy masonry sunk to solid rock more than a hundred and thirty feet below the high water surface of the river, through shifting sands, and during the most fearful floods.

The Brooklyn bridge, 1,595 feet, or nearly a third of a mile long, over an arm of the sea more crowded with commerce than any other in America, and high enough to allow a line of battle ship to sail under it—is drawing to completion, and will be (though perhaps only for a few years, 'till something more stupendous comes), one of the wonders of the world.

Probably the boldest plan for a bridge ever proposed, is that now in contemplation over the Forth at Edinburgh, but of which it is yet premature to speak.

Many very long spans and important bridges are now in progress in this country, such as the one over the Missouri by Mr. Morrison, but time does not permit even a glance at them.

We are now so familiar with the success of suspension bridges for railroads, that we can hardly realize the almost universal disbelief in that success before they were tried. The late John A. Roebling told me before his bridge was finished, that Robert Stephenson had said to him, "If your bridge succeeds, mine is a magnificent blunder." And yet, unexpectedly to the best engineers in the world, the suspension bridge over the Niagara answers the purpose quite as well as the tubular bridge over the St. Lawrence.

The mention of the St. Lawrence reminds us of the great and interesting improvement of that river now going on under the direction of Mr. Kennedy. The original low water channel between Quebec and Montreal, had, in places, a depth of only eleven feet. Now they are increasing the low water depth to twenty-five feet with a width of 300 feet. The work is done with bucket and chain dredges, exceedingly well adapted to the purpose. Some of the buckets are armed with great steel teeth which excavate the solid rock (geologically, Utica slate, but compact rather than slaty in its structure), detaching and bringing up blocks sometimes containing several cubic feet.

If anything of the kind could astonish us in this fast moving age, it would be the rapidity with which, during the past half dozen years, the construction of elevated railroads in New York, and to some extent elsewhere, has gone on. It is of little use to find their aggregate length, for in a few weeks any such estimate must be corrected. There may now be about thirty-three miles of such roads, all double track. The average cost, including stations and equipment, has been about $800,000 per mile.

One of the cases in which a new contrivance effects a great revolution, is that of the elevator. This has been in use for perhaps a quarter of a century at the Continental Hotel in Philadelphia, and in a few other places, but is now coming into general use, and is revolutionizing the mode of building in our great cities, especially in New York. A block of buildings is not now extended along a street as formerly, but is set up on end, and a highway to the different houses or parts of the block, is not horizontally along the sidewalk, but vertically through the elevator shaft. Sky-room is cheaper than earth-room. It is said that a lot on the corner of Wall and Broad streets was recently sold for over $320 per square foot, or at the rate of $14,000,000 per acre! Equal to the surface covered with silver dollars five deep. These stupendous buildings will give engineers and architects much to look after in the way of foundations.

This reminds us of the Holly plan, in limited use elsewhere for several years, now going into extensive use in the city of New York, of dispensing with private fires for heating, and private boilers for generating steam; and furnishing heat and steam power for a considerable district from one great central set of boilers, piled boiler over boiler, tier on tier, for 120 feet in height. This is one of the operations most characteristic of the present time. Nothing is to be done now by the individual, but everything by some institution, or corporation, or central power, or great firm. Man has ceased to be a unit, and become only an atom of a mass. With the disappearance of the things themselves, the dear old phrases "family fireside," and "domestic hearth," are rapidly disappearing.

Mr. Shinn and the engineer, Mr. Emery, have kindly given me some particulars respecting this transportation of heat and power, but I can only refer to one or two points. The first and most obvious necessity is to prevent the escape of the heat. This is done by enclosing the steam-carrying pipe in a small brick tunnel, with a flat cover on the top; and filling the space around the pipe, from the bottom of the tunnel to the flat covering above, with mineral wool, which is found to be an excellent non-conductor. It is made by blowing a jet of steam into a stream or jet of melted furnace slag. The arch and covering of the tunnel are plastered over with asphaltum, to exclude all moisture. The loss of heat is said to be very small. One of the great difficulties comes from the expansion and contraction of the pipes, the range being more than an inch in a hundred feet. This is provided for by making the end of each section, of about 80 or 100 feet, terminate in very flexible diaphragms of thin copper, the diaphragms being supported by stiff iron ribs.

Among the great enterprises in contemplation, is the interoceanic canal, or the interoceanic railroad for large ships. This is not the occasion for expressing any opinion on any of the competing projects. I will only say that if the world is determined to have a sea level canal, it makes a great mistake in not getting fuller information about the San Blas route.

Many things that have been done by this generation seemed beforehand far less possible than the successful working of the ship railway proposed by Captain Eads. The difficulties are certainly very great, but we can see how they may be overcome. The real question is, whether taking into account the expense of overcoming those difficulties, the construction and operation of such railway will be more economical in the end than the construction and operation of some one of the proposed canals.

The last year has been one of intense activity, particularly in railroad construction. A year or two ago money was so abundant, and, therefore, interest so low, and so many capitalists, great and small, were tired of letting their money lie idle, that new enterprises of many kinds were started, especially new railroads, and enlargements of capacity of those already in use. As the money market has approached its normal condition, some of the new projects have been dropped.

It is instructive to look back and trace the connection between the progress of railroads and the financial condition of the country.

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The railroads opened in the United States, January 1, 1880, aggregated 86,500 miles in length, being 40 per cent of all the railroad mileage of the world. Last year we had 93,600 miles, and this year we have just about 100,000 miles. But mere length is a very inadequate measure of their magnitude. The terminal mile of some roads has probably cost as much as five hundred miles of some other roads. At one time, and possibly now, the cost per ton taken, on the first two miles of the road from New York to Pittsburg, was more than the cost of carrying that ton over the next two hundred miles. The increase in aggregate magnitude of all the roads may be almost as much in the enlargement without increase in length of the old, as in the extension of the new. We hear in more than one case of thirty miles of additional terminal tracks being laid at one point.

The diminished plethora of money, and the greater caution now apparent, will, it is to be hoped, moderate the increase of the means of production and transportation, so as to prevent another stagnation.

The investment in railroad property in the United States is set down at about $5,000,000,000, perhaps about one-eighth of the value of all the property of the country, real and personal.

When we speak of the extraordinary magnitude of the engineering works of the present day, we do not forget the pyramids, temples, and fortifications of

Egypt and Chaldea. Some of them exceeded in magnitude anything that has been made since. What makes it more strange is, that the force that produced them was almost entirely human muscle, while now the work is done largely by steam directed by human brain. Two contrasts strike us as we look at the ancient and modern: the one was executed by slaves and conscripts, with little or no compensation; the other by free men, glad to work for the compensation offered. The old was for the glorification of the few; the modern for the use of the many.

The stagnation that followed the breakdown of 1873, and the consequent low rates of transportation, compelled the managers of railroads to reduce the cost to a point previously thought unattainable, by increasing the power of the engines and the weight of trains, by more convenient arrangements, by more service of the machinery, by cheaper construction and repairs, by better machinery and organizations of labor, and many improved appliances for handling, and by the stoppage of leaks generally.

American engineers and managers have often shown that *poverty* is the mother of invention. For example, they used cross-ties as a temporary substitute because too poor to buy stone blocks, and so made good roads because they were not rich enough to make bad ones. American engineers are, or at any rate, were trained on short allowance of money. As that is the best engineering which accomplishes the purpose at the least cost in the long run, American engineering ought to be of the best.

It is doubtless the fertility of resource coming from the necessity of effecting much with little means, which has created a demand for American engineers in other parts of the world. A few years ago the Government of British India sent for an American engineer, and the first thing they asked him to do was to report on their railroads from the American point of view. Our lamented past president, W. Milnor Roberts, was employed by the Government of Brazil, as I judge from what happened after he went there, to train their engineers, educated in European schools, in American modes and ideas.

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Though canal engineering is a thing of the past, its history is instructive. In England it commenced 120 years ago, the first engineer being James Brindley, a millwright. He seems to have known little of what had been done before, and his plans were evidently original. When he proposed to build an aqueduct across the Irwell for the Duke of Bridgewater's canal, his critics said they had often heard of castles in the air, but they never heard before where they were to be put. Brindley built several canals, on one of which was a tunnel a mile and a third in length.

He was succeeded in canal making by such men as Telford and Smeaton and Rennie. Though uneducated, he gained the admiration of scientific as well as practical men. When he wished to study a subject thoroughly, he "laid in bed to contrive," as he expressed it. The secret of his success, therefore, evidently lay in concentration of attention on the subject in hand, and he kept out of the way of anything that could distract his attention.

The era of canal building in England was rather less than seventy years: between 1760 and 1830.

During the last decade of the last century, several efforts were made to connect the detached navigable reaches of some of the rivers in this country, by means of short canals and locks. One of these was undertaken at Richmond under the inspiration of General Washington. Another was at Philadelphia, around the Falls of Schuylkill. But the one of special interest in the history of engineering, was at Little Falls on the Mohawk.

The great thoroughfares between the City of New York and the west and northwest was up the Hudson and through the valley of the Mohawk. The transportation through that valley was partly by three, five, or seven-horse teams over the Genessee Turnpike,[1] and partly by boats on the river. Those boats were like what on the Delaware we used to call Durham boats, which were eight feet wide and sixty feet long, drawing, when loaded, a foot or two, and carrying from ten to twenty tons. They were pushed up stream by two or four men, with setting-poles held on their course by the captain with a long steering-oar.

At Little Falls the descent of river is over forty feet, and, of course, the boats could not pass, but their cargo was carried by the portage of two miles, to other boats above or below. To avoid this canal and locks were built. They were finished in 1794. Jedediah Morse (father of S. F. B. Morse of telegraphic fame) published his great standard *American Gazetteer* a few years later, and in it he quotes the following expression of the public sentiment of the time: "The opening of this navigation is a vast acquisition to the commerce of this State." It was conjectured that these locks (which a man could almost jump across), and similar "great works" west of them, might soon make the little town of Albany the capital of a great empire.

The Mohawk continued to be the principal artery of commerce from New York to the interior, until the opening of the Erie Canal in 1825.

Mr. Weston, "that haughty British engineer," as an old gazetteer calls him, was brought over from England to build the locks at Little Falls and elsewhere. One of his assistants was a land surveyor of Rome, New York, named Benjamin Wright, or Judge Wright, as he was called. When, years afterward, it was decided to build the Erie Canal, Judge Wright, though having only the slender experience he had acquired under Weston, was appointed chief engineer. The skill and good judgment which was shown by this father of American engineering, the few errors into which he and his still more inexperienced assistants fell, the great effects produced by them with the means at their command, and the

1 The migration to the West, (which then meant the Genessee country) was over this turnpike in horse or ox teams; the patriarch of the family and his wife having on their shoulders the same black and white coverlet, and the big brass kettle full of dishes hanging under the hinder axletree of the wagon. Some of their grandchildren now sit in the high places of the Nation.

adaptation of their works to the circumstances of the time, are absolutely wonderful.

One of Judge Wright's principal assistants was Canvass White. His skill early brought him into notice, and he was sent by the State of New York to England to learn what he could, especially about hydraulic cement. Despairing of getting it at any reasonable price, and of making it stand the voyage, then from four to ten weeks, he set himself on his return to finding or making a substitute for European cement.

Led partially by the geological position of the hydraulic limes in England, and partly by what was known of their composition, he explored and tested certain rocks of western New York, and made the first discovery of hydraulic cement in America. The State of New York gave him $10,000 for his discovery. Subsequently he discovered or recognized cement rock in Pennsylvania in the way till then unknown, but now so familiar, by the contact of limestone and slate.

And yet how soon those men, once so widely known, are forgotten. An eminent and excellent engineer, who had paid especial attention to cement, lately told me he never heard of Canvass White.

One of Judge Wright's assistants, but much younger than Canvass White, was John B. Jervis, whose name to-day is one of the most honored on the rolls of this society.

Many of the distinctive characteristics of American engineering originated with those Erie Canal engineers. We practice their methods to-day, though most of their very names are forgotten. As a class, they wrote little. There were then no engineering papers prepared, and no engineering societies to perpetuate them, if they had been prepared. They were not scientific men, but knew by intuition what other men knew by calculation. Judge Wright's counsel was "as if a man had inquired at the oracle of God." What science they had, they knew well how to apply to the best advantage. Few men have ever accomplished so much with so little means.

The mention of cement reminds us of quite a new use of it, lately, under the direction of Mr. Chanute. The Erie road crosses the Genesee River by a high viaduct just above a fall. The bed of the river was wearing away, and would soon destroy the viaduct. An artificial bottom of cement has stopped the wear.

The Erie Canal was opened in 1825. Governor Clinton passed through in a boat on one corner of the deck of which stood a cask of water from Lake Erie, on another corner a cask of water of the Hudson. Gov. Clinton limped from the boat to the public halls, and speeches were made by and to him; and it was a great glorification. The result justified the public expectation. It built up the City of New York, and settled the question of commercial supremacy between that city and Philadelphia.[2]

The success of the Erie Canal soon brought about the construction of many others. They were thought to afford the most economical means of transporta-

2 An old pilot once told me that in his younger days there were three or four ships out of Philadelphia to one out of New York.

tion, and railroads were made, not to carry goods to the final destination, but to a canal or other navigation. After the success of the Liverpool and Manchester Railway in 1830, this opinion was seriously shaken, and in a short time canal construction mostly ceased. Its era in this country was scarcely a quarter of a century, between 1817 and 1835.

Canals to be successful now must be capable of passing vessels of large capacity, must not have too much lockage, and the locks must be worked by steam or water-power; the boats must be moved by steam, either on board, when the vessels are large enough, or, when the vessels are smaller, by locomotive on the bank, or by cable at the bottom, and then the locks must be large enough to hold the fleet taken by one locomotive or cable power; there must be plenty of water, and the canal must connect harbors or navigable waters.

I tried towing by locomotive on the canal bank more than forty years ago. There is, of course, no difficulty in one engine towing several boats, but if the locks are not large enough to pass the whole fleet at once, the delay of all the fleet till each boat is passed separately, counterbalances the economy of steam instead of horse-power. The speed even for light boats cannot be increased to more than five or six miles per hour on account of the wave.

Cable-towing, notwithstanding the reported failure on the Erie Canal, can, with proper boats and apparatus, and with experienced men, be easily performed on the crookedest canal in America, as it is now done in Belgium.

Canal engineering does not avail itself of the engineering resources of the age. Little improvement is made in it: mainly, I suppose, because it is not considered worth improving.

The most remarkable early river improvement in this country was that of the Lehigh. About the year 1817, Josiah White and Erskine Hazard commenced the improvement of this river, and made other preparations to inaugurate the anthracite coal trade. In 1820 they sent to market 365 tons, which was the beginning of the regular anthracite coal trade of America. Now the annual amount will soon reach 30,000,000 of tons.

The descending navigation they made consisted, first, in clearing the channel of rocks and confining the water in the rapids, when low, to that narrow channel by boulder wing dams; second, when the fall was too great for this, in building dams with bear-trap locks; and third, in storing the water in pools, and letting it run only when the coal arks were running.

The bear-traps locks have given the hint for several devices since used, and are well worthy of examination. Near each end of the lock was a pair of gates, each gate reaching across the lock and to the back of the recess on each side, which gates, when not damming back the water, lay flat on the bottom of the lock. The lower gate could be made to revolve through an arc of somewhere about 40 degrees around a horizontal axis coincident with its down-stream edge. The upper gate of the pair, when laid flat, lapped over about half of the width of the lower gate, and revolved through a similar arc around its up-stream edge. When laid flat, the water, of course, ran freely over them. They were raised by admitting the water to them from the pool above head of the lock, through the side wall, when the pressure of the water pressed them up. They were prevented from going too far by shoulders in the recesses. The gates then came within 10 or 15 degrees of being at right angles to each other, the under side of the upstream gate resting on the upstream edge of the downstream gate. They could be held in any position, so as to hold back the water entirely, or let it run over with more or less volume, as required. The arks containing the coal were commonly shot through over the partly raised gates as over so many dams.

Such locks, copied from those on the Lehigh, are now in use on the Ottawa, at the Canadian capital. Many of us at our last convention were shot through them on rafts.

It is well worth inquiry whether these bear-trap gates would not be the best possible, and possibly the cheapest, for letting the water rapidly out of a reservoir for scouring purposes. A full stream could be set running in a few seconds, and the flow could be regulated with perfect ease, and stopped at any moment.

In many rivers it is desirable to dam the stream back at low water, and let it run freely at high water In Belgium, on the Meuse, they use needle dams for this purpose. Another probably better adjustable dam is in use in France. The bear-trap gates, with proper appliances, on a solid platform at the bo.tom of a river, would enable a man on shore to raise a dam across that river, or if raised, to lower it to the bottom, in a few minutes.

I have used this contrivance for a fish sluice in a permanent dam, by which the water ran freely through the sluices when necessary, and at other times was retained at full height.

The coal, on the descending navigation of the Lehigh, was sent to market in arks consisting of six boxes, sixteen feet square and twenty inches deep, coupled by hinges, the whole carrying about 100 tons.

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About fifty years ago, Professor Henry made a series of brilliant discoveries in electro magnetism, one of which was, that by means of a current through a wire, a signal could be made and information given (by ringing a bell, for example), a long distance off. Years afterward, Steinheil, Morse, Wheatstone and others, applied Henry's discovery to the actual conveyance of information; Morse's apparatus, as it seems to us Americans, being by far the best. The wonder to us now is, why Henry himself did not apply his discovery, and why others did not sooner do so. The answer is found in a very important phase of human mind. The habit of mind into which the scientist is liable, perhaps likely, to fall, is to look at scientific result as his ultimate end. Such result arrived at, the same habit of mind is to use it only to attain further scientific result. Hence, men of science so rarely are benefited pecuniarily by their own researches. Hence, also, it frequently happens that engineers who have kept at their studies without practice till too late in life, are so often less successful than those of far less science, and, perhaps, less intellect, but who have been early trained to apply to practical use what science they have.

Iron ship-building has had almost its entire growth within the last forty years.

In the spring of 1845, I visited a small iron ship-yard, then quite a new thing, at Birkenhead, on the south side of the Mersey. The proprietor, in his green flannel roundabout, showed his modest establishment, and explained some of the processes. That proprietor became afterward well known to the world as Sir John Laird, the great iron ship-builder, and especially to this country as the builder of the *Alabama*. The operations of that enterprising craft came near involving us and our cousins across the water in a very serious conflict. This was averted by the moral courage and enlightened patriotism of Grant and Hamilton Fish on this side, and Gladstone and Clarendon on the other, who, not having the fear of demagogues before their eyes, agreed upon arbitration instead of war. All honor to the statesmen who took this great step in Christian civilization.

They were just beginning to build the first dock wall on the red sandstone bed rock of the Mersey; now they have 159 acres of dock-room enclosed. Then Birkenhead was a small village; now it has more than 100,000 inhabitants. America is not the only country that moves.

Mr. Chanute, in his annual address, two years ago, spoke of the first propeller boat used in America. That propeller fell into my hands; and I towed the first fleet of boats ever towed by a propeller tug on this side of the Atlantic, from Philadelphia to Bordentown, in October, 1839. Now, our harbors are full of them. The first propellers ever built in this country, and, as far as I know, the first iron hulls, were the *Anthracite* and the *Black Diamond*, built on the plans of Captain Ericsson, and employed in carrying coal through the Delaware and Raritan Canal. The first sea-going propeller built in this country was the frigate *Princeton*, built on Captain Ericsson's designs, under the direction of Captain Stockton. It was a full rigged sailing ship, the intention being to use steam only as auxiliary.

It should not be forgotten that John Stevens, almost eighty years ago, built a small propeller boat, with two propellers, or "circular sculls," as he called them, and ran it about the harbor of New York. It is wonderful how near his blades approach the angle which experience has shown to be the best. He used a small locomotive boiler, as it would now be called, such as was reinvented by Booth, a quarter of a century later, at Liverpool.

The rapid progress of the country, and the activity of the age, are more strikingly shown by the records of the Post Office Department, than by the increase of population—from three to fifty millions since the revolution—or than by any other statistics I know of. During several years of the time that Benjamin Franklin was Postmaster-General, he personally kept the whole accounts of the department, and all in one small book, and settled with the postmasters and mail carriers. There were then about, perhaps, twenty or thirty dead letters a year, now there are four millions. It now takes eight clerks constantly employed to open them, and I remember that it takes fifty clerks to take charge of one class of them. Franklin kept one small book, which lasted three years, now there are

150 or 200 books, each half a dozen times as large, filled each year. Then the work was done by Franklin for $600 a year, now by 700 clerks, for, perhaps, a million a year.

Within my memory, some of the sciences with which engineers have specially to do, have grown from infancy into at least adolescence.

For example, geology was a collection of interesting but isolated facts, and unverified theories, now it is a science. It used to be considered terribly heterodox, and a young man who cared to stand well with good people found it safest to say nothing about it. To read geology was next to reading Tom Paine. A learned and excellent divine once confidently informed me that all the supposed plants and animals found in the rocks were merely stones that happened to come out in that shape. Now geology has an important connection with the instruction in theological seminaries.

Business and population depend on geology. A geological map of England enables one to locate its occupations and the denser populations. An outcrop of gneiss, extending southwest from New York, forms the limit of tide in the rivers, and fixes the location of Trenton, Philadelphia, Wilmington, Baltimore, Georgetown, Richmond and other cities to the southwest.

When I studied chemistry at school the components of compound bodies were given in percentages. For example, limestone was 48 per cent., oxygen 12 per cent. carbon and 40 per cent. calcium. Of course, nobody could remember such proportions. Nor did it give the proximate elements of the compound. The atomic theory, as it was called, was known, but chemists were cautious about accepting it. They had not yet learned to distinguish between the *theory* of atoms, and the *fact* of equivalents.

One of the most surprising feats of modern science is seen in the daily predictions we have of the morrow's weather. Time was, and many of us remember back to it, when predictions were made, and by intelligent people, too, from the phases of the moon, from weather breeders, from the weather on certain anniversaries, and the like.

More than a century ago Franklin pointed out the fact that northeast storms begin in the southwest, two or three days earlier at New Orleans than at Philadelphia. Much information was afterward accumulated, and scientific investigations were from time to time made by many able men. About forty years ago Prof. Espy, of Philadelphia, announced his theory, that rain is caused by the rarefaction and consequent upper movement of the mixed air and vapor into a colder region, where the vapor is condensed and falls into rain, and that this rarefaction produced by the heated surface of the earth, or by fire or otherwise, causes the denser air to flow in from every side, so that the wind blows toward the rain. All this has been since verified. But this sanguine philosopher did not get the credit he really deserved, but drew upon himself the ridicule of the world, by claiming for his discovery more than it could accomplish, especially by proposing to raise the Mississippi by setting fire to the woods on the Alleghany Mountains, when the hygrometer showed much moisture, and so getting the upward current required to make it rain, just as it commonly rains after any great fire, or the eruption of a volcano, or a battle.

Espy visited Princeton to confer with Prof. Henry. I was present at the interview. Henry, while he thought Espy's main principle quite correct, got very much out of patience with him for several hasty conclusions from statements which, to Henry's cautious, scientific mind, did not seem at all conclusive.[1] After he was gone, Henry chalked out the plan which he afterward, with the co-operation of Guyot and other able men, so successfully carried into execution, of simultaneous observations all over the country, and a daily chart of highest and lowest pressures, and other things about which my memory is less distinct. As everybody knows now, it is the traveling of these lines from west to east, at an average of about thirty miles an hour, that enables the weather predictions to be made.

Our rapid progress involves the frequent undoing of what has only recently been done in the most costly manner. We have seen expensive buildings erected in the City of New York, and then in two or three years torn down to give way to something greater or different. The Alleghany Portage Railroad, of which my brother, Sylvester Welch, was chief engineer, W. Milnor Roberts being one of his assistants, was considered for some years one of the wonders of the world; the improvements in the locomotive and the increased strength of the rails afterward enabled engines to cross the Alleghany without the inclined planes used on that road, and that splendid work, on which so much thought had been expended, was torn up. It is folly to build for the far future.

This reminds me that in a paper written 1829, read before this society two or three years ago. Mr. Moncure Robinson estimated that the tonnage over the Alleghany Mountains at that point might in time reach 30,000 tons per annum. I suppose that the tonnage now over the mountain, on the Pennsylvania railroad, exceeds six millions.

One of the bold and remarkable works of the day is the submarine sewer at Boston, to carry the sewage under an arm of the harbor and across an island far to the seaward. They have discovered, what unfortunately many others have not, that little is gained by emptying sewage into a harbor or into a small river, and so transferring the nuisance from one point to another, or distributing it all over.

Sanitary engineers have been contending each for his own favorite system of sewering and draining cities. Mr. Hering, in his paper read at the convention at Montreal, impressed upon us that no one system is absolutely good or bad, but either is good when adapted to the circumstances, and bad when it is not. Municipal corporations often think that the remedy for unhealthiness is, of course, sewerage, just as some doctors in old times gave their patients calomel without

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1 My attention was drawn to this subject by the conference between Espy and Henry, and while travelling in Ireland, I asked my very bright, and on the subjects within his range, intelligent car driver, which way the storms there came from? Evidently he had never thought on that subject, but, adopting on the instant a meteorological creed, answered quick as thought: "The storms, sir, come from which ever way the Lord Almighty chooses to send them."

regard to what was the matter with them, or what kind of constitutions they had.

One of the startling propositions of the day is to bring the waters of Lake George and the upper Hudson by an open canal to supply the City of New York. When somebody asked Brindley what rivers were made for, he said: "To feed navigable canals." The answer now would be: "To supply great cities with water."

Among the subjects to which the attention of the society is now especially turned are Standard Time and the Preservation of Timber. As we expect reports on these, I shall not further refer to them.

One of the most remarkable of modern implements, one whose powers seem almost miraculous, is the diamond drill, which bores into the hardest quartz conglomerate and even into chilled iron. It seems to be capable of much wider application than it has yet had.

The attachment of a car to a moving wire rope, in the way proposed by Col. Paine, without injury to the rope or risk to the car, will probably revolutionize the mode of traction in very many cases.

Within the last year or two the load on each wheel of a freight car has been increased from 5,000 pounds to 8,000 pounds, an increase of 60 per cent. According to Dr. Dudley's observations on the Pennsylvania Railroad, an increase of 60 per cent. on a wheel made an increase in wear per million of tons of a little over 30 per cent. We may expect that this recent increase will increase the wear at least 30 per cent.; that is, the rails on a heavy traffic road that would have lasted with the old machinery ten years, will now last 7.7 years. But with the heavier weight on a wheel, the residuary part of the rail after it is worn down to the limit of safety, must be much stronger than formerly required, in order to bear the heavier weight. Suppose the diminution of the consumable part of the rail on this account to be 20 per cent. (which would be only 4 or 5 per cent. increase on the whole rail) it reduces the duration to 6.16 years with the same traffic. But as the traffic has increased much more rapidly than was expected, it is now probable that the rails on our heavy traffic roads will not last half as long as they were expected to last three or four years ago. If a rail will last a dozen years where actually used, it would not pay to add more than about 30 per cent. to its cost to make it last two dozen years, but it would pay to add 45 per cent. to its cost to prevent its duration from coming down from a dozen to half a dozen years. Steel rails were made fifteen years ago with twice the endurance of those made now. Under the new circumstances, it is probable that it will before long be economy for roads with the heaviest traffic to pay the railmakers a price that will enable them to make rails as durable as the best ever made.

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The subject of tests for large members of metallic structures is now receiving our earnest attention. If I should speak of its necessity it would only be to repeat what is said in our memorial to Congress. I will only again call attention to one point; that is, that the process of manufacture of a large piece of iron or steel may be so different from that of a small piece, and therefore the quality of the two be so different, though both may be made from the same stock, that the strength of the larger cannot be inferred, but only guessed at, from the known strength of the smaller. In the larger there is more likely to be permanent opposing strains that destroy a large percentage of its strength. A remarkable instance of opposing strains, caused by treatment in manufacture, was pointed out some time ago by Colonel Paine. He found that wire coiled before it was set could not be even straightened without straining the sides beyond the limits of elasticity, and that such wire had nothing near the strength of that coiled straight. As the strength of a large metallic member of a structure cannot be tested by any machine within the reach of individual means, and as to obtain the best results requires the combined skill of several classes of experts, the aid of Congress is invoked to provide a suitable machine, and to create a board of experts whose varied skill shall plan the best experiments.

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Undoubtedly the progress of the age, which is so largely engineering progress, does on the whole greatly increase the welfare of mankind. By making the forces of nature do the hard work, the labors of the toiling millions are lightened many fold. The laboring man now works with brain and eye more than with muscle, and his business is now to apply some principle of science. This raises him intellectually. He now has time for improvement. Comfort and refinement, and even luxury, are brought within his reach. The forces of nature having become obedient to the will of man, they are made to produce for him not only plenty, but conveniences and luxuries formerly undreamt of. By the present facilities the races of men are brought into contact with each other. Those races are being assimilated, and the prejudices and hatreds of the past are fading away. Supreme power among men is more than ever in the hands of the most enlightened, and they are sending civilization and Christianity into the regions most benighted. The light of Heaven is beginning to shine into the Harem and the Zenana. And the time seems to be hastening when there shall universally prevail "peace on earth" and "good will toward man."—*Van Nostrand's Magazine.*

COLORADO MINES.

Leadville Smelters.—The production of the Leadville smelters, during the month of July, shows 3,604 tons of base bullion, which, after deducting for dross and the precious metals contained in the same, would leave at least 3,500 tons of lead. Every month so far this year has shown a gain over the corresponding period of last year. During the fore part of the year, one month showed a product of 4,000 tons, the output of the Leadville reduction-works. There is now very little question but that the product for the year will aggregate between 40,000 and 43,000 tons. The shipments of lead during the first six months amounted to 21,898 tons, and up to date to 25,500 tons. There have also been shipped to Pueblo, Kansas City, and other smelting centers more than 30,000 tons of ore to date, this year. At an average of 10 per cent of lead in these ores we have a grand total production of lead of 28,500 tons. How long this production will be maintained, it is difficult to predict. It shows, however, the important part Colorado, and particularly Leadville and its tributary camps, occupy in the mining world, in the production of lead, at the present time.

Little Pittsburg.—The official report for the week ended July 31st shows: Ore shipped, 112 tons; settled for, 719 tons; balance shipped and unsettled for, 91 tons. During the month of July, 522 tons of ore were shipped and 719 tons settled for.

MONARCH DISTRICT.

From the Leadville *Herald* we take the following notes on this district: The Madonna smelter is running very successfully, and turning out a car-load of bullion daily. The smelter is using only the ore from the Monarch Company's mines, which produces a moderate grade of bullion, but will increase the grade by mixing in ore from the Monarch and other high-grade mines. It is the intention of General Tuttle, manager of the company, to increase the capacity of the smelter by the addition of two fifty-ton stacks in the fall. The company's mines are looking exceedingly well. The main drift, which has been run to connect with the upper workings, shows ore all the way, and it is estimated that the ore-reserves are sufficient to furnish the smelter with a two years' supply of ore.

The Fairplay, located just above the Madonna smelter, has developed a body of high-grade sulphuret ore, the extent of which has not been defined. The Eclipse has during the past week caught ore in the tunnel which has been run to tap the ore-body about 250 feet below the upper workings, and about fifteen tons of ore have been taken out in driving the tunnel. The main shaft, now at a depth of about 185 feet, also shows good ore in the bottom. The ore-bodies previously developed on the forty-five-foot level are still untouched.

Several new and promising discoveries have been made on Limestone Mountain, to the west of the Madonna group; but as yet their extent is not definitely known. The district generally shows considerable activity, and the indications are, that it will assume a prominent place as a producer.

MOSQUITO DISTRICT.

Sunny South.—Ore of remarkable richness has been discovered since the recent reported strike. This property is developed by a tunnel which has been run in on the lead for a distance of 70 feet. At 65 feet, an inch streak of ore was cut, which rapidly widened, and on sinking on it for a depth of six feet, the pay-streak increased to two feet of solid ore. During the sinking, twenty-eight sacks of ore was taken out, which, on being tested at the London mine, the native silver being thrown out, yielded returns of 385 ounces in silver and 20 per cent in lead.

PITKIN COUNTY.

Independence District.—This camp is only thirty-five miles from Leadville on the opposite side of the Continental Divide, and at about the same elevation. The discoveries already made and the geological features of the region give promise of similar results. The Farwell Company has stamp mills full of ore and is making some excellent strikes on the Mt. Hope side of the gulch. The Minnehaha Company has made a very rich strike between the Farwell mines and the Hamilton Company's lands. The Hamilton Company is still delayed by conflicting surveys, but as soon as these points are settled and the property actually patented, active operations will be commenced and heavy work done all through the winter.

PUEBLO COUNTY.

Colorado Coal and Iron Company.—This Company is now turning out 125 tons of Bessemer steel rails per day on a contract made last year for 30,000 tons, the contract price being $70 per ton for a part and $65 a ton for heavy sections. It is expected that the product will soon be increased to 150 tons per day.

SUMMIT COUNTY.

Robinson Consolidated.—A dispatch dated August 9th says: Work was begun to-day on the Robinson Consolidated mine. Three great pumps are handling the water splendidly.

ARTESIAN WELLS IN COLORADO.

Commissioner Horace Burch, who was appointed by the Agricultural Department, at Washington, to select the sites for two experimental borings for artesian wells in Colorado, made a trip to the prairie land in the eastern portion of the State to-day. He was accompanied by Senator Hill, the originator of the artesian well bill, and several railroad officials. The party went to the plateau divide between the headwaters of the Republican River and the South Platte, 112 miles from the city, on the line of the C., B. &. Q. Railroad. The geologist commissioner of last year reported this section of country as giving the most promising indications of a high-water strata. One well will be sunk about a mile from Akron, in a country heretofore dry and arid. Contracts will be immediately let for 2,500 feet. It is thought that a strong flow will be tapped within 1,000 feet. The second well will probably be located near Kit Carson, on the Kansas Pacific Road. The contracts on both wells will have been completed by snow fall.

It will be remembered that the original $30,000 appropriations for artesian well explorations in Colorado was squandered under LeDuc's management. He started a well near Fort Lyon, and paid a heavy royalty to experiment in sinking with a diamond drill. When a depth of only 800 feet had been reached by the bore the appropriation was exhausted. It was estimated that the same result could have been had under contract for $1,500. Senator Hill obtained the last appropriation from the agricultural fund, and is confident of discovering the flowing well belt. If successful a vast expanse of country now barren and uninhabitable will be converted into lands for agriculture and stock raising.

MISSOURI COPPER MINES.

We have frequently had occasion to refer to the great mineral resources of this State, which as yet have attracted comparatively little attention abroad. For years Missouri's iron, coal, lead and zinc mines have been worked in a quiet sort of a way, but with great profit. Three mining regions only have been brought prominently into notice since mining first assumed the proportions of an industry, namely, the Rich Hill coal fields, the Joplin lead and zinc mines, and the iron ore beds in central and southeast Missouri. But the growth of mining has been steady, if not rapid, and every new development encourages the hope that Missouri will finally rank head and shoulders above any other State in the Mississippi Valley as a producer of the useful metals. Coal, zinc, lead and iron have been mined on a large scale for years, and copper, in small quantities, in different parts of the State. Now, however, appearances would seem to indicate that the mining of copper, so long neglected, will ultimately assume a magnitude that will place Missouri among the leading copper-producing States of the Union. The richest and most promising copper fields at this time are located in St. Genevieve County, south of St. Louis. In presenting a brief history and description of these mines we are indebted for data to a report of Prof. W. B. Potter, of the firm of Potter & Riggs, engineers, on the principal mine in the county—the Cornwall—and to a paper presented by Mr. Frank Nicholson, M. E., to the American Institute of Mining Engineers.

Copper ore was first noticed in St. Genevieve County in 1863, but it was not until 1868 that explorations were begun, Mr. Harris being the leading spirit. After considerable prospecting on the section where the outcroppings had been noticed the work was abandoned without result. In 1872 Messrs. Harris, Rozier & Co. obtained a lease on the Grass mining property for twenty-five years, paying 10 per cent royalty. In 1876 a Chicago firm, Hitchcock, Wilson & Co., began work on a hill opposite that on which copper was first discovered and after a year's fruitless labor the firm failed. The Chicago company's mine was bought in by O. D. Harris, who now owns the Grass and Chicago mines and operates them under the name of the Cornwall Copper Mines. In 1880 the Cornwall mines erected works for making raw mattes and in 1881 refining works were added. From 1876 to 1879 two other mines were opened in the neighborhood of the Cornwall mines, Swansea Copper Mine and the Herzog Copper Mine. These three mines all belong to the same formation, and a study of one reveals the characteristics of all.

The Cornwall mines are located ten miles from the town of St. Genevieve, and the ore occurs in two nearly horizontal sheet deposits, in what is pronounced by Mr. Nicholson to be the second of the magnesian limestone of the Lower Silurian formation. The principal developments in the Cornwall have been made in the upper deposit, while the lower level is chiefly worked at the Swansea mines. Still, the limited amount of prospecting done makes it possible that there are other levels.

Mr. Potter says: "The upper sheet-deposit seems to follow very nearly the bedding of the limestone, and varies in thickness from a few inches to three or four feet. Though varying greatly in thickness, the ore-sheet is remarkably continuous. Occasionally it is wanting in a very small area; but such barren ground is easily worked around, and may be utilized for pillars in the support of the roof. A layer of sandstone, quite thin and irregular, seems to be in most places the immediate associate of the ore, and this at times is found to be altered to a hard ferruginous quartzite, carrying more or less copper. Layers and nodules of chert occur in the limestone at times, making the ground a little hard; but as a rule the latter rock is easy to mine. It is worked out to the parting at the top of the course, which gives an easy plane to break to. This makes the drifts (varying with the position of the ore-sheet in the course) from three and one-half to six and one-half feet high, the average being about five feet.

"The ore itself consists essentially of the sulphurets, copper pyrites and a small amount of the richer 'purple copper.' These minerals have in the upper deposit been somewhat decomposed by the action of percolating surface waters. There is in this deposit a remarkable absence of iron pyrites, which in the other mines is so common an associate of copper pyrites. This must be regarded as a very favorable circumstance, since iron pyrites degrades copper ore not only in richness but in purity, arsenic, antimony, nickel and cobalt being (one or more of them) always found to some extent in this mineral. The ore is in fact remarkably pure."

Prof. Potter, in discussing the question to what extent these deposits can be relied upon to supply ore in the future, states that, though they are not fissure veins, they are sometimes, like the St. Joe and Desloge deposits, of very great extent, and developments already made on the upper Cornwall deposits present evidence enough to show that "the ore extends over a very wide area, and is safe to hold out with any demand likely to be made upon it for a long time to come."

Concerning the cost of mining and treating the ore and the profits of the business, Prof. Potter presents some instructive figures:

Five tons of dressed ore at furnace	$105 55
Smelting the same and producing refined copper	65 62
Total cost, per ton, refined copper	$171 17

Or per pound of refined copper:	CENTS.
Mining, dressing and transportation	5.28
Smelting and refining	3.28
Total cost per pound, refined copper	8.56
Value of refined copper in St. Louis	16.00
Net profit, per pound, copper	7.44

The value of refined copper has averaged over 18 cents for the past year or so, but 16 cents has been taken as a satisfactory average in the estimate above.

The ore taken from these mines runs about 20 per cent copper, according to Prof. Potter, and about 18 per cent according to Mr. Nicholson.—*Age of Steel.*

A COAL PROBLEM.

The production of anthracite coal last year reached about 28,500,000 tons. This amount is something above the average, but will, in turn, be surpassed by the output this year. It is estimated that not less than 30,000,000 tons will be mined before next January, and the annual production hereafter, under ordinary circumstances, is not likely to fall below that amount. These figures are more significant than they appear to be at first sight.

It is not too much to say that the exhaustion of the anthracite coal-fields of this country is in sight. There are deposits in Rhode Island and Virginia, and small quantities elsewhere; but by far the largest part of the anthracite beds lies in seven counties of Pennsylvania. Four great fields are recognized, their respective areas being 159, 92, 194 and 38 square miles—total 483. To this limited tract the United States looks for its anthracite coal. How much was there in it when mining began, scarcely sixty years ago? How much has already been consumed? How long will what remains last?

The thickness of the beds ranges from thirty to sixty, or perhaps seventy-five feet. But the coal measures are not consecutive or of equal value. Some of them are so thin as to be at this stage valueless. Faults are numerous. The gigantic crushing powers which nature exerted while the coal was forming squeezed some veins out of existence. Others can be mined only with great difficulty. Taking it for granted that the coal land in all underland with workable seams, and knowing the number of tons per foot thickness per square mile, the original contents of the fields may be calculated. It approximated 9,800,000,000 tons. But it must be remembered, not only that much of this coal is not available, but also that the present methods of mining are very wasteful. Even from the richest mines only a small part of the coal is taken. Much of that left behind can never be secured hereafter, no matter how high the price may become.

A writer in the New York *Sun*, who has investigated the subject with some care, says that the best engineering science assumes that only one-third of the coal in first-class seams—the deepest and most faultless—only one-fourth of that in second-class seams, can be sent to market. But making the most liberal estimate possible, and taking the product of all the fields, as it has been actually worked out, at 151,000 tons per foot thickness of seams per square mile, the marketable contents of all the Pennsylvania anthracite fields when mining began did not exceed 3,275,000,000 tons. The *Coal Trade Journal* two years ago stated the amount of anthracite marketed to the close of 1878 at 307,000,000 tons. The output of the last three years brings the total close on to 400,000,000 tons, or one-eighth of all the coal originally at hand.

In determining how long the remainder will last, the annual consumption, and the possibility of greater economy of production, must be taken into account. In 1820 there was used 365 tons, or barely one ton a day for the United States. The next year the consumption reached 1,000 tons, in 1822 it amounted to 3,700, and so on. In 1829 100,000 tons was passed, the sales that year reaching 112,000; in 1842, 1,000,000 was for the first time exceeded, and in 1864, 10,000,000 tons. Taking 30,000,000 tons for the annual consumption hereafter—and that amount will doubtless be exceeded—the various fields will hold out as follows, allowing each the present proportionate output: Southern or Schuylkill basin, 204 years; Shamokin, 141 years; Mahanoy, 75 years; Wyoming, 70 years; Lackawanna, 64 years; Lehigh, 23 years. "In less than forty years," says the *Sun* writer, "if coal be produced at the rate of 30,000,000 tons per annum, anthracite will be an article of luxury, and the price it will bring in the markets will exclude the poor people of this country from the use of this best of fuels."

It is hardly too much to say that the waste which characterizes the methods of mining now pursued is outrageous. In England and other European countries every pound of coal is taken from the seam, as surely as gold miners take out every particle of quartz within reach. The Pennsylvania system of "pillar and breast" mining, long ago discarded abroad, takes out a cube of coal, and leaves the next cube to support the rock overhead. In many cases half of the contents of the vein is thus abandoned. Waste in other ways reduces the yield of the seam still further to not over one-third of its contents. When coal grows scarcer mere selfishness, even if no considerations of the public good, will occasion closer work, and thus put off the day of the consumption of Pennsylvania's last pound of anthracite. But while waste of bituminous coal is bad enough, that of anthracite is inexcusable.—*Globe-Democrat.*

Thousands of persons assembled at the termini of the St. Gothard tunnel to witness the inauguration of one of the most splendid and universally beneficial engineering achievements of this century. This tunnel is about nine and a quarter miles long, being about one and two-thirds miles longer than that of Mt. Cenis. It runs in a straight line from the village of Goschnen, on the Swiss side, to the Italian frontier locality of Afrolo, thus placing Lucerne and Milan in communication by rail.

ZOOLOGY.

MIGRATIONS OF BIRDS OF PREY.

WILLIAM HOSEA BALLOU.

The question has been broached in the *American Field* concerning the migrations of hawks in flocks. It would seem to be a mooted point, if the variety of opinions of correspondents are to be taken into consideration. So far as my own investigations extend, the matter has never been broached in books, and therefore offers a wide field for study. The question of the certainty of the migration of hawks in flocks was established in my mind in 1874. I was then a resident of the village of Mexico, New York. The village is situated in Oswego County, 400 feet above, and several miles distant from Lake Ontario. Along the shores of Mexico Bay is a great wooded tract in which are swamps, outlets of streams, and occasionally a wide sand beach, or high bluff. In the winter it is the most prolific resort of the snowy and great horned owls I ever visited. Of the first mentioned species I captured fifteen alive in traps during the winter of 1874–5, and a number of the second mentioned. In the spring time I have spent hours along the shore watching the return of birds. First came the crows in literal thousands, taking in the whole range of the shore-line in their noisy efforts to find a crossing-place. Then the ice broke up; great banks disappeared slowly in the sand, and the huge cakes, acres in size, were drawn into the broad mouth of the St. Lawrence. And then—well, one day I sat by the blue waters watching the sublime in nature, and the return of spring. There was a sudden sound that seemed to come from the clouds. The eye was no match for the distance. The sound was multiplied to many cries, whistles, and noises. Slowly a picturesque scene burst upon the view. Away up, just at the limit of vision, was a great moving maelstrom of winged creatures, wheeling, gyrating, crying, and slowly settling. As they came down I recognized among the assemblage of thousands, many species of hawks. I hid in the brush and waited developments. As soon as they came within range, I made an onslaught with my double-barrel breech-loader, firing rapidly, and with terrible effect. The birds seemed powerless to resist, famished with fatigue and hunger. Many settled on the trees, and others continued their slow flight in both directions along the shore, like their predecessors, the crows, in search of a crossing-place. It was three days before all had gone except those destined to remain and breed. On examination of my bag, I found the sharp-shinned, coopers, sparrow, red-tailed, red-shouldered and broad-winged hawks. They were thin in flesh, and looked very much reduced by long flight. Since that time, I have been the witness every spring of a similar spectacle at some point along the lakes, though never of such magnitude.

The next scene takes us westward along the Freshwater System to Evanston, Illinois, on the shore of Lake Michigan. At that place the shore projects out into the lake for some distance, terminating in Gross Point. Here are heavily wooded groves of oaks and a natural rendezvous for all kinds of birds. Last fall there were heavy fogs. Late in October, I noticed the presence of many hawks in the vicinity. They followed the pigeons there and began accumulating. They were so shy that I only secured a half dozen, among which were a pair of duck hawks. One afternoon the fog cleared away, the sun dried the trees and the earth, and made all nature beautiful. About three o'clock that afternoon, I was attracted by the screams of many hawks. They began wheeling over Gross Point, circling around, and gradually passed upward untill not less than 500 formed in the ring. It was a clear day, and my vision was unobstructed. When they had attained a great elevation, there was a sudden halt, and then began a rapid flight to the southwest, evidently toward the Mississippi by way of some river route.

The above furnishes satisfactory evidence of migration of hawks in flocks, and the method of the same. A number of instances have been furnished by the patrons of the *American Field* substantiating the data presented.

Northern hawks migrate south in the winter and southern species come north in the summer. The Swallow-Tail Kite migrates north—well into this State in chase of grasshoppers. Near Cairo I have watched several of them for hours, descending from their lofty gyrations to chase the insect and after obtaining a full craw return to the clouds as if to digest their booty. The Mississippi Kite also makes summer journeys northward.

The instances above related seem to demand some explanation. I therefore present the following table of migrating birds[1] of prey and quasi migrants, as a basis of discussion:

REAL MIGRANTS.

PIGEON HAWK, *Æsalon columbarius.*
SPARROW HAWK, *Tinnunculus sparverius.*
OFSPREY, *Pandion hallicætus carolinensis.*
COOPER HAWK, *Accipiter cooperi.*
SHARP SHINNED HAWK, *Accipiter fuscus.*
RED-TAILED HAWK, *Buteo borealis.*
WESTERN RED-TAIL, *Buteo calurus.*
RED-SHOULDERED HAWK, *Buteo lineatus.*
BROAD-WING HAWK, *Buteo Pennsylvanicus.*

QUASI MIGRANTS.

GREAT GRAY OWL, *Ulula cinerea.*
SNOWY OWL, *Nyctea scandica.*
HAWK OWL, *Surivia funerea.*
AMERICAN GOSHAWK, *Aster atricapillus.*

1 The nomenclature adopted is after Prof. Robert Ridgway in his new catalogue of North American Birds, published by the National Museum at Washington.

Duck hawk, *Falco peregrinus nævius.*
Caracara eagle, *Polyborus cheriway.*
White-tailed kite, *Elanus glaucus.*
Swallow-tailed kite, *Elanoides forficatus.*
Mississippi kite, *Ictinia subcærulea.*
Rough legged buzzard, *Archbuteo lagopus sancti-johannis.*
Bald eagle, *Haliætus leucocephalus.*
Mexican Goshawk, *Asturina nitida plagita.*

The first table includes hawks which regularly and annually migrate, never remaining far north save in exceptional cases. The second table comprises irregular or quasi migrants, which journey north in summer from their southern limit, or south in winter from their northern habitat. The first series of birds are compelled to migrate. They live more or less on small birds, reptiles, frogs, etc. The reptiles and frogs hibernate, and the small birds migrate south, compelling the hawks to follow them to obtain a subsistence. It was intimated above that they follow the pigeons in their migrations south. Such, indeed, is the case, and many an unwary bird falls prey to their voracity. The principal rendezvous in the United States of their flocking for migration south, I have reason to believe, is at Point aux Pelee, Canada. This point extends perhaps fifteen miles into Lake Erie. Just a short distance out in the lake is Point aux Pelee Island, extending several miles toward the American shore; next beyond, in the same direction, is Gull Island, then Middle Island, then the large Kelly's Island, and finally a long point running out from the western side of Sandusky Bay. Alongside of this north and south range is another comprising the East Sister, Old Hen and Chickens, and the three Bass Islands. Here, then, is a double range extending across Lake Erie, terminating at Point aux Pelee and forming the most accessible route south for all migrants. As the myriads of small birds congregate at Point aux Pelee to effect a crossing of a great body of water, we find every species of the regular migrating hawks mentioned above, on hand, ready to snatch a helpless booty and slaughter a vast number of victims. At this remarkable location I camped a month with the United States corps of engineers, in the fall of 1876, and spent hours—I may say days—watching with an awe which only a lover of nature can feel, the long line of birds passing on to the States. As well think of counting the sands of the sea as those birds; day and night, through storm and calm, the armies swept on in almost endless train. I pause in the hurry of business at times; and the memory of such a scene carries me, in imagination, back to the lonely, uninhabited and desolate point of sand, miles from civilization, where, in solitude, and alone with the infinite, I saw His creatures pass like swarms of insects, obeying His eternal laws.

It seems pertinent at this time to follow the birds of prey on their southern flight and examine their conduct south. I was enabled to accomplish this essential journey. The Corps of Engineers were ordered south on the Mississippi River. We camped at Cairo and surveyed a great area around, including the bottom lands of Kentucky and Missouri. Here over one hundred species of small birds wintered. Here, too, were immense robin roosts, the extent of which can only be realized by actual observation. The bottom lands along the Mississippi and Ohio Rivers are green in winter with canes. Among these the robins settle at night, in numbers beyond estimation. The roosts afford a plentiful living for birds of prey which fill the woods day and night with discordant cries and owlish hoots. So far, the migration of regular migrating hawks is accounted for on a food basis.

The regular journeys of these birds may now be considered. The owls mentioned in the list, come down from the north to get their share of the rabbits. The snowy owls live principally in winter on the little grey rabbit. The latter spend their nights in traversing frozen swamps for wild berries which grow there and remain in a frozen state during the cold weather, and for the soft bark of alders. I find that rabbits and hares are more abroad nights than days, and consequently afford an easy victim for the owl. The snowy owl is also fond of fish and greedily devours the carcasses found on the lake shores in winter. This species is shot from the piers in the city of Chicago where it watches for such prey, floating on the surface or cast upon the shore.

The bald eagle is included in this catalogue on account of its following a steady course for prey half the length of the continent. They are especially found following large streams in winter for fish, and I have known one to ride on a single cake of ice on the Mississippi River a full hundred miles, snatching up whatever fishes came in his way. These migrations are wonderful on account of the great distances traversed, and the apparent ease with which the flight is made.

All south-moving migrants of the birds of prey are destroyers of game. They gorge on quails and prairie hens, which huddle together in the extreme cold for mutual warmth. They snatch the unwary duck, exhausted in its weary search for wild rice and mollusks. They fearlessly enter the barnyards, and bear away the poultry, fattening on well provided grain. They know no heights, no distances, no mountains, no obstacles, and everything that hath flesh, powerless for defense, they boldly seize as lawful prey.

All north-moving hawks in summer generally prey upon larger insects, mainly grasshoppers and locusts. They include the kites, of Southern United States, and goshawks. The exception is the caracara eagle, which has a fondness for carrion and fish. For perhaps two weeks in summer the kites may be seen in Southern Illinois in lofty aërial flight, making an occasional descent upon the grasshopper.

The conclusions which may safely be drawn from this article are: That certain hawks mentioned migrate in flocks at great elevations. That such migrations have escaped naturalists heretofore on account of the elevations.

That certain birds of prey mentioned are quasi migrants on account of the irregularity with which they migrate, and their doubtful movements at such times.

That most birds of prey are destructive to game birds, songsters and certain game mammals.

And finally, that all migrations of all migratory birds of prey are conducted on a basis of food supply and not from any insufficiency of feathering or delicacy of structure.—*American Field.*

ASTRONOMY.

METEORIC SHOWER OF AUGUST 10, 1882.

WILLIAM DAWSON.

It is believed by those who make a study of the matter, that about the 10th day of August the earth passes through a body, or stream, of meteoric matter by which an unusual number of meteors are then developed. So I kept watch most of the time from 8:30 to near midnight to see what for a show of meteors would be visible. In the three hours near eighty "falling stars" were seen. Making allowance for intervals used in recording the time, position, magnitude, e.c. I have no doubt that one hundred or more were developed in the region observed, which was the southeastern part of the sky, including probably one-eighth of the entire hemisphere. It seems likely that they were as numerous in one part of the sky as another. Then, perhaps, eight hundred meteors—all large enough to be easily seen—made their appearance in the upper, or visible, half of the heavens. Applying this calculation to the other half—below my horizon—we get 1,600 for the probable number of meteors developed in three hours.

It is believed that the earth was about two days in passing through the meteor stream. But the outer parts of it are probably thinner than the central—which I suppose was the part traversed by the earth during the 10th. But we will aim to stay within bounds, and suppose the earth to occupy twenty-four hours—say from noon of 10th to noon of 11th—in traversing the main, or average part of the meteoric body. Then we have eight times the number in three hours, equal to 12,800 for the number of meteors which the earth encounters while going through this body of meteoric matter. It may be observed that in twenty-four hours the earth travels 1,600,000 miles.

Some fifteen or more of the meteors observed on the 10th were as bright as stars of the first magnitude, all having trails of light behind them. A few indeed were much brighter—nearly as bright as Venus; making their sudden appearance and flashy trails almost startling. The direction of their motion was generally south to southwest. One or two, however, moved in the opposite direction, and *soon* after another had gone south. Two or three moved across the other tracks nearly at right angles. The motion of nearly all was quite rapid, and the paths were short say from 5° to 20° in length. Occasionally a bright one appeared soon after another one, and nearly in the same place. Watch was kept on the 11th till near 11:00 P. M.; but the show was much less interesting than on the night previous. Near twenty meteors were seen, nearly all of inferior brightness, though four or five were bright enough to have dim trails behind them.

So far as yet developed, the current year is the epoch of sun-spot maximum for the current period: and April 17th probably the day on which the greatest number of spots were visible. On that day I counted 175 spots on the Sun. The night previous will be remembered as the time of the great aurora, so elegantly written up, and published in the Review, by Prof. E. L. Larkin, of New Windsor, Ill. On the 16th I counted 160 spots in eight groups; but the air was not so good as the 17th, which doubtless prevented several of the least ones from being seen. I did not make repeated observations through the day—the 16th—and thus missed seeing the phenomena of most interest. But I congratulate friend Larkin, whose energy was crowned with such grand success. In January (this year) I only observed the Sun on five days. The spots were pretty well distributed through the month, and no indication of any great show was seen. The greatest number was fifty-seven in five groups, on the 30th. In viewing the Sun I nearly always use a magnifying power of 100 with reflecting-prism-eyepiece, on 4.6-inch objective by A. Clark & Sons. I generally observe about eight or nine o'clock in the morning.

In the fore part of February, about thirty spots were visible. On the 8th I counted 100; most of them in SW. quadrant. After the middle of the month they waned a good deal, and only seven were seen on the first of March. They increased to about seventy-five on the 19th; then fell off to thirty by the last of the month. April soon developed great solar activity. On the 14th seventy-five spots were counted through very poor air. My record says: "Four spots quite large; many others very prominent." Then came the outburst alluded to above, when one or two spots were easily visible without any telescope. And yet this show—especially in number of spots—is small as compared with the preceding sun-spot maximum, in 1870. For, on August 27th that year, I counted 640 sun-spots with the 100 eye-piece and 950 with a power of 200; and through a rather poor air at that. On April 30th eighteen little spots constituted the show, with pretty good air. Next day a large spot appeared at the east edge. The Sun's rotation made it appear to move across the solar disc and disappear at the west edge in twelve days. May 17th, 150 spots, one of them 10,000 miles in diameter, and visible to the naked eye. Two weeks later only three spots visible. Another fortnight brought on seventy-five—all in one group SW. of centre, except ten. The show held on pretty well till about the 9th day of July, when four *little* spots were all that marred a clear whiteness of the Sun's face. But in six days a number of *new* spots had formed, making a row of four groups across the Sun. Quite a show continued for three weeks. But on the 7th day of August (inst.) only three *little* spots lingered very close to the west edge of the Sun. As they would pass the Sun's margin by the morrow, there was a fair prospect of August

8th being clear of sun-spots. But a small one had on the east edge; and in forty hours two large spots had developed near the center of the solar disc; which indicates unusual solar activity. The Northern, or Polar Light, may always be looked for soon after an outbreak of this kind—although it was much less in extent than some others which have occurred at different times. So, on the night of the 11th an aurora appeared in the north. About this time another good-sized spot had come on at the east edge of the Sun. On the 13th it had grown to large dimensions, but on the 15th, had broken up into five smaller ones.

SPICELAND, IND., August 17th.

BOOK NOTICES.

THE ELEMENTS OF FORESTRY: By Franklin B. Hough, Ph. D.; large 12mo. pp. 381. Robert Clarke & Co., Cincinnati, O., 1882. $2.00.

For a number of years Doctor Hough has occupied the position of Chief of the Forestry Division in the Department of Agriculture, at Washington, and has consequently had excellent opportunities for familiarizing himself with the subject of his book, even if he had not had an especial fitness for the work before his appointment. He has undertaken to give in a plain and concise manner practical information concerning the planting and care of forest trees for ornament or profit, also suggestions regarding the creation and care of woodlands with especial adaptation to the wants and conditions of the United States.

The work is admirably illustrated on all points, and the order of the chapters is natural and logical. Beginning with definitions of technical and scientific terms, he takes up in turn Soils and their preparation; Effects of slope and aspect; Climate and meteorological influences; Reproduction from seed; The various modes of propagation of forest trees; The structure and functions of various parts of growing trees; General views in regard to forestry; Acts of Congress relating to timber rights; European plans of forest management; Ornamental planting; Hedges, screens and shelter belts; Cutting and seasoning of wood; Fuel charcoal and wood gas; Causes and prevention of forest fires; Protection from other injuries; Insect ravages; Processes for increasing the durability of timber and improving its quality, etc., etc., closing with a valuable chapter upon Tree-planting in Kansas and Nebraska.

To this latter subject the author has given particular attention, having spent considerable time in the west a few years since studying the meteorology, climate and soil of those States.

We regard the book as eminently practical and valuable to the people of the prairie regions west of the Mississippi where it should and doubtless will have a wide circulation.

National Religions and Universal Religions: By A. Kuenen, LL. D., D.D.; 12mo. pp. 365. New York, Chas. Scribner's Sons. For sale by M. H. Dickinson. $1.50.

Works upon religious subjects have become within the past few years very attractive and salable, which is due largely to the discussions between theologians and scientists, causing a popular demand for more light upon this and all kindred topics. Darwinism has extended to all branches of science, including the science of religion, and while not all students regard the religious history of the world as the "expression" of a natural process of development "yet there are many who do so regard it and who are finding evolution everywhere.

Dr. Kuenen is a Professor of Theology at Liden who was requested to deliver the Hibbert Lectures for 1882, at London and Oxford, and whose work has been put into English by Rev. Ph. H. Wicksteed in a manner creditable to himself and satisfactory to the author.

The general tenor of the book is to show that the spread of any form of religion beyond the limits of a single people and over many and diverse nations gives it the character of universality as opposed to a national religion. His class of universal religions comprises Christianity, Buddhism and Islamism, though some writers exclude the last named. In discussing the subject he begins with Islam; concerning the origin of which we are best informed and of which we have the most accurate and complete records He admits that the Koran (or Qorán as he spells it) clearly shows what Islam is, but asserts that Mohammed's development of it is confused and obscure; that Mohammed proclaimed the *one* Allah, thus combating the polytheism of the great majority of the people of his day, but that aside from this Islam was largely the individuality of Mohammed modified by his contact with Judaism; that the prophet of Allah is a reproduction of Israel's great leaders and the Qorán a counterpart of "the book" or finally, that Islam was the "kernel of Judaism transplanted to Arabian soil." As to its universality he asserts that despite the fact that it spread all over Arabia, then over a territory surpassing the Roman Empire in extent and still holds a certain sway over 175,000,000 people, it lacks depth, elasticity, comprehensiveness, it is but a side-branch of Judaism, made by an Arab for Arabians, levelled to their capacity and adulterated by national elements calculated to facilitate their reception of it.

We have thus given a meagre outline of the author's manner of treating this branch of the subject. The remainder of the book is given to a similar consideration of the popular religion of Israel, the priests and prophets of Yahwch; the universalism of the prophets; the establishment of Judaism; Judaism and Christianity; Buddhism with a concluding comparison of the three religions of the world as respects their universalism, the mutability of the Christianity as its commendation and the future of Christianity.

No work of recent date covers so much ground so thoroughly, none manifests more minute and accurate knowledge of the subject and none is presented in more readable and fascinating style. Dr. Kuenen is especially fortunate in his translator.

Annual Report of the Regents of the Smithsonian Institution for 1880: Octavo, pp. 772. Government Printing Office, 1881.

As heretofore, the Report is a careful and detailed account of the operations, expenditures, and condition of the Institution for the year 1880, prepared by the Secretary who is also Chief Director. This occupies one hundred and eighty pages and is followed by an appendix comprising five hundred and sixty pages devoted to a record of scientific progress. The introduction to this is by Prof. Baird; the chapter upon Astronomy by Prof. E. S. Holden; those on Geology and Mineralogy by Prof. G. W. Hawes; Physics and Chemistry by Prof. G. F. Barker; Botany by Prof. W. G. Farlow; Zoölogy by Prof. Theo. Gill; Anthropology by Prof. O. T. Mason. These papers are very complete and valuable, and most of them have been published in pamphlet form and distributed long since.

The remainder of the volume is made up of miscellaneous papers on various subjects. Among them is a very interesting account of the Luray Cavern in Page County, Virginia, fully illustrated.

The paper, print, and general make-up of the volume are better than usual, and if the Reports could by any possibility be published promptly, instead of two years after date, they would be warmly welcomed by the scientific public.

Report Upon the U. S. Geographical Surveys West of the One Hundredth Meridian: By Capt. Geo. M. Wheeler, U. S. A.; quarto, pp. 420. Government Printing Office, 1881.

The volume in hand is the third—supplement—Geology, and is an exceedingly handsome book, well printed and illustrated. The writer is Prof. John J. Stevenson, Ph. D., and the immediate subject of the report is geological examinations in Southern Colorado and Northern New Mexico during the years 1878–9. To this is added an appendix upon the Corboniferous Invertebrate fossils of New Mexico prepared by C. A. White, M. D.

OTHER PUBLICATIONS RECEIVED.

Proceedings of the Ohio Mechanics' Institute, Vol. I, No. 3, July, 1882; quarterly, $1.00 per annum. Report of the Commissioners of the 9th Cincinnati Industrial Exposition. The Change of Life in Health and Disease, P. Blakiston & Son, Philadelphia, Pa.; 75c. Proceedings of the American Association for the Advancement of Science, 30th meeting, August, 1881. The Leading Industries of Kansas City, pp. 192, octavo. The *Peoria Medical Monthly*, Aug. 1882; $1 per annum. Knight's New American Mechanical Dictionary, Part I, $2. Professional Papers of the Signal Service, viz: No. I, Total Eclipse of the Sun, July, 1878, by Prof. Cleveland Abbe; No. II, Isothermical Lines of the United States, 1871 to 1880, by Lieut. A. W. Greeley; No. III, Chronological List of Auroras from 1870 to 1879, by Lieut. A. W. Greeley, U. S. A.; No. IV, Tornadoes of May 29th and 30th, 1879, by John P. Finley, U. S. A.; No. V, Information Relative to Construction and Maintenance of Time Balls, compiled by Winslow Upton; No. VI, Reduction of Air-Pressure to Sea Level at Elevated Stations West of the Mississippi River, by Henry A. Hazen, A. M. The Palenque Tablet (Smithsonian contribution 331), by Dr. Chas. Rau. Report of the Chief Signal Officer, U. S. A., 1879. The Isthmian Passage *via* the Tehuantepec Route, by L. U. Reavis, with an Introductory Letter by Capt. Silas Bent. Proceedings of a Convention of Agriculturists, January 10 to 18, 1882, at Agricultural Department, Washington, D. C. Proceedings of the Davenport Academy of Natural Sciences, Vol. III, Part 2, 1882. Commercial Report of Consuls of the U. S., No. 19, May, 1882. Bulletin of the Essex Institute, Vol. XIV, Nos. 1, 2, 3, and 4, 5, 6. Articles upon Anthropological subjects contributed to the Smithsonian Reports from 1863 to 1877, by Chas. Rau, M. D.

NOTE.—Several of the above will be fully noticed hereafter.—[ED.

SCIENTIFIC MISCELLANY.

ARTIFICIAL BUTTER.

GEO. LANZENDOERFER.

I noticed in your Saturday's edition an article about artificial butter. Allow me a few lines of explanation as a chemist and one who, in his native country, has had frequent opportunities for an insight into the manufacture of artificial butter. The idea of finding a cheap substitute for butter without reducing its value as an article of food was started by Napoleon III, who intended in the first plan to help the working classes of Paris, for even then the price of butter had advanced two to four francs a pound. He invited Mege-Mouries, a chemist, to make a trial in that direction, who succeeded so well that in 1869 the first artificial butter factory was started at Poissy. The Franco-German war stopped operations for awhile, but in 1872 the Societe Anonyme d' Alimentation was started with a capital of 800,000 francs, to take hold of Mr. Mege-Mouries' discoveries. This concern started factories in Paris and Nancy, the former producing to-day 120,000 pounds of artificial butter daily. Other factories started in Munich, Frankfort-on-the-Main, Dresden, Berlin, Vienna, etc.

The United States have been particularly successful in this branch of industry. The factories here not alone supply the domestic wants, but also govern prices to a great extent of the European, particularly the English markets. Favored by a cheap and excellent raw material the American manufacturers are enabled to produce an article in the way of artificial butter which excels all other in quality, taste, etc. As a general rule, any fat and oil will produce butter; that is, all fats may be, by different manipulations and chemical agencies, so prepared that they will appear like butter in taste and flavor, and be suitable for food.

Naturally, and in the first line, beef tallow, coming from the same animal as butter, will be used. Of the beef tallow, that which is found near the kidneys and lungs is the most desirable, which, after being carefully freed from all fleshy particles (of course, only fresh tallow is used), is washed in clean water until the water drains off perfectly clear. Hereafter the fat is chopped fine and afterward melted and crystallized. This done to separate the stearine from the fat, as otherwise the butter would be too hard. We now have a beautiful, clear oil, which is churned with milk. In the whole process cleanliness is to be strictly observed, for otherwise the butter, when ready, would not keep. The painstaking cleanliness with which this artificial butter has to be prepared, apart from that it contains nothing injurious, recommends it for an article of food. All particles of milk must be carefully removed from the finished butter by washing and kneeding, and to save this labor manufacturers prefer to use milk already freed from caseine. After the butter is ready thus far it is colored with annatto, to which are added certain chemicals to give it the flavor and taste of butter. The fat of an ox of average size will produce forty-five to fifty pounds of butter.

There are many articles of our daily food, such as conserves, mustard, catsup, fruit butter, mince meat, etc., which certainly are not prepared in a cleaner, if in as clean a way. Yet they are in daily use without any scruple. As I remarked above, any oil or fat will produce artificial butter, provided it is free from strong smell and taste. Besides tallow, lard, olive oil, poppyseed oil, etc., may be used, but as these oils are dearer than tallow they have not taken its place, particularly as the operations to make the oils into a consistency of fat is very troublesome and expensive. Some months ago, however, I made trials with cottonseed oil, in which I succeeded very well, so that I hope to see it used extensively very soon in the artificial butter manufacture.

Last year I analyzed several lots of dairy butter which contained so much foreign fats as to convince me that they were artificial butter. I must admit, however, that the taste as well as the odor were excellent, and not to be distinguished from genuine butter; and although it was midsummer and very hot, the butter was compact and firm and well made. The manufacturing, therefore, must have been done very carefully and cleanly.

I hope that the above may assist in dispelling the aversion of our people against an article destined by its cheapness and wholesomeness for a valuable substitute of one of our most needed articles of food.—*Philadelphia Times.*

THE TELEGRAPH AND ELECTRIC LIGHT IN EGYPT.

The mounted portions of the telegraph troop Royal Engineers, consisting of about seven officers, one hundred and eighty-four non-commissioned officers and men, and sixty-five horses, with two field-telegraph equipments complete, and the field-pack of the Royal Engineers, including one officer, thirty-three non-commissioned officers and men, and twenty-six horses, under the command of Major Sir A. Mackworth, marched from Aldershot on Saturday last (August 5th,) *en route* to the Southwest India Docks, London, where they will embark to-morrow (August 13th,) in the steamer *Oxenholme* for conveyance to the east.

The telegraph steamer, *John Pender*, which arrived at Alexandria with a sufficient supply of cable on board for the projected line between Suez, Port Said, and Alexandria, was recently engaged in important work for the Eastern Telegraph Company between Lisbon and Land's End. Immediately on the decision of the Government, and from the urgency of the case, she was ordered to Alexandria.

A portable steam-engine has just come out for working an electric machine.

Izzet Effendi, Director of the Telegraphs, sent a staff of employes on the 3rd inst. to lay and open a cable between Jeddah and Souakim.

The *Superb* used her electric light on the night of the 9th inst. from where she lies, off Count Zizinia's house, but whether it was an advantage or otherwise is an open question. From the distance she had to throw the rays it was impossible for those on board to use the light so as to be of the greatest assistance to our sentries. The officer in charge of the picket said that several times the electric light was thrown on his own men, who thus were themselves exposed to view, and at the same time were unable to penetrate the darkness beyond. This is manifestly turning a valuable appliance into a source of danger, and it shows the inutility and even peril of using the electric light indiscriminately. Arrangements have been completed for throwing the electric light over the enemy's lines from Ramleh.—*Electric Review.*

ARTIFICIAL QUININE.

The progress of organic chemistry has been rapid of late. To artificial indigo and citric acid is now added artificial quinine. The sulphate of this alkaloid is in enormous demand, especially in tropical climates, but its enormous cost, we believe about 16s. an ounce, is a barrier to its extended use. The announcement, therefore, that M. Maumené has discovered a means of effecting its synthesis is one of great importance. The alkaloid ($C_{40}H_{24}N_2O_4$) is said by the author to be obtained in a very pure state by a simple process, in which the newly discovered H_2N is employed. Full details of the operation are promised in a short time.—*Mechanical World.*

Says the Boston *Journal of Chemistry*: "Mr. Poirot, having observed that the immense tracts of worm-wood (sage brush) upon the American plains are free from insects of every description, in experimenting with the plant as a preventive of phylloxera. He finds no difficulty in cultivating the worm-wood, and he proposes to mix the stalks with manure, or simply bury them in the ground in the neighborhood of the vines. His suggestions have been sent to the Phylloxera Committee of the French Academy."

CORROSION OF IRON UNDER STEAM PRESSURE.

An occurrence not uncommon in steam engines, is the destruction of the cast-iron directly exposed to the action of the steam, so that it can be readily cut with a knife, like black lead. This destruction is not confined to cast-iron alone, but to wrought-iron also, for many through bolts, such as follower bolts in pistons, are eaten away to such an extent that it seems as though they had been exposed to the action of acids.

The cause of the troubles noticed, which are not mentioned as any recent discovery, is generally attributed to the lubricating oils, or the tallow used for lubrication. It is asserted that the methods of refining these leaves a residue of free acid that in time acts as above stated, and the remedies urged are the substitution of pure fat, such as suet in a natural state without having been rendered.

As a matter of fact, all true animal fats—solid fats—contain three acids, margaric, stearic and oleic, and these are active, so far as regards their acid constituents at ordinary temperatures. Every engineer is aware that the mere presence of cold tallow, on brass work for instance, turns green, from the deposition of verdigris—which is the "rust of brass"—upon it. This free acid theory is an assumption of our own, for chemists do not recognize the existence of the free acids named, in fats, but assert that they are only liberated in the process of soap-making or saponification of the fats by contact with an alkali. However this may be, it is difficult to account for the destruction of metal surfaces in the manner named, and the prompt action of animal grease upon copper or brass, unless free acid is present, for it presents all the appearance of it.

It would seem, therefore, that the methods of preparing lubricating compounds are not directly at fault, but that under certain conditions, such as heat and moisture, decomposition of the structure may be set up with injurious effect. These conditions are present in the steam engine. At a pressure of seventy-five pounds—not at all uncommon nowadays—the temperature is 308°, which, if not enough to set up destructive distillation completely, may partially effect it or in such degree that the surfaces of iron are attacked.

It has been found that pure suet unrendered causes as much injury as commercially prepared fats, though all irons are not as readily corroded as others; some escape entirely.

Recent practice substitutes mineral oils properly prepared for animal fats, and though it would seem that in them not enough body existed to properly lubricate surfaces under heat and friction, they are found to answer well and stop corrosion. This result is probably assisted by the judicious admixture of a certain proportion of animal fat with the mineral oil. However this may be, it is certain that reliable testimony points to the success of properly prepared mineral oils, for cylinder use, and so far as testimony can go, the fact is established.—*Mechanical Engineer.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Below will be found tabular results of observations:

Temperature of the Air.	July 20th to July 31st.	Aug. 1st to 10th.	Aug. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	62.0	61.8	61.6	61.8
Max	83.2	82.4	86.7	84.1
Min. and Max	72.5	71.6	71.9	72.0
Range	21.2	21.1	24.0	22.1
Tri-Daily Observations.				
7 a. m.	69.0	66.6	68.3	68.0
2 p. m.	80.6	78.9	86.2	81.9
9 p. m.	72.1	69.0	72.0	71.0
Mean	73.5	71.1	74.1	73.0
Relative Humidity.				
7. a. m.	..	..	..	..
2 p. m.	..	..	..	..
9 p. m.	..	.	..	..
Mean	..	..	..	..
Pressure as Observed.				
7 a. m.	29.10	29.04	29.06	29.07
2 p. m.	29.09	29.04	29.03	29 05
9 p. m.	29.05	29.03	29.04	29.04
Mean	29.08	29.04	29.05	29.06
Miles per Hour of Wind.				
7 a. m.	5.7	6.6	6.8	6.4
2 p. m.	9.7	13.6	14.0	12.4
9 p. m.	9.2	8.5	9.8	9.2
Total miles	2490	2211	2202	6903
Clouding by Tenths.				
7 a. m.	4.8	4.5	1.7	3.7
2 p. m.	3.9	3.8	2.9	3.5
9 p. m.	4.3	2.7	1.2	2.7
Rain.				
Inches	.98	.54	.0	1.52

MEASUREMENT OF WATER.

To measure water roughly in an open stream, take from four to twelve different points in a straight line across the stream, and measure the depth at each of these points, and adding them all together, divide by the number of measurements taken. This quotient will give you the average depth which should be measured in feet. Multiply this average depth in feet by the width in feet, and this will give you the square feet of cross-section of the stream. Multiply this by the velocity of stream in feet per minute, and you will have the cubic feet per minute of the stream. The velocity of the stream can be found by laying off 100 feet on the bank, and then throwing a board into the stream at the middle, note the time passing over the hundred feet, and dividing the 100 feet by the time and multiplying by sixty gives the velocity in feet per minute at the surface. The velocity at the center is only eighty-three per cent of that at the surface, and so only eighty-three per cent should be calculated. For example, suppose the float passes 100 feet in ten seconds, then divided by ten and multiplied by sixty (seconds in the minute) gives 600 feet per minute, as the velocity and eighty-three per cent of this gives 498 feet per minute, as the velocity of the stream at the center, and the area of the cross-section multiplied by this will give you the number of cubic feet per minute in the stream. This, of course, is only a rough way of calculating, but it is often used, and is a good and simple way to obtain data to select a wheel by.—*Craig Ridgway & Son.*

EDITORIAL NOTES.

Prof. W. J. McGee has contributed a valuable paper to be read at the meeting of the American Association for the Advancement of Science. The object of this paper is to show in the language of a writer who gives a digest of it, that, to whatever latitude a polar ice-field may extend, precipitation can take place only along its outer margin, and that the temperature of its central portions must sink too low to sustain appreciable quantities of aqueous vapor. By an ingenious system of calculations, he finds that the accumulation of ice is in proportion to the vapor tension, and that, if the thickness of ice at any latitude is known, that at all other latitudes can be readily computed. For instance, if it be assumed that in latitude 40° the ice be three miles thick, with the temperature 56.5; in latitude 50°, temperature 41.7, it would be 1,733 miles; in latitude 60°, temperature 30.2, 1,103 miles; and so on, until in latitude 90°, temperature 2.3, the thickness of ice would be but .315 of a mile. There can, therefore, be little or no ice at the pole. If it were not for this law, if the law were inversed, that the ice-cap should be thickest at the pole, it might be sufficient to displace seriously the earth's centre of gravity. Ice-streams have motion, as rivers of water have. When the slope of the channel increases, the depth decreases and the motion is more rapid at the surface than at the bottom. The velocity decreases in proportion to depth; that is, the shallower the ice-stream the more rapidly it descends. Ice may be bent to any shape by gradual pressure, as a hot iron bar; but breaks, with a clean fracture, when sudden weight is applied. When, therefore, a plate of iron or a stone is placed on ice, it sinks in, and the ice, by the pressure, rises over and covers it, as if the ice were so much pitch. A volume of ice can thus be pressed forward by the simple weight behind it, though the outer line of the ice-stream may be on a level, and the upper portion be pushed on faster than the bottom, which is kept back somewhat by friction against the earth. The great forces producing glacier motion are gravitation, in the passage down slopes, and heat, which, by varying the size of the ice crystals, makes a greater pressure on those portions which absorb the most heat. The surface receives more heat than its base.

Judge E. P. West has been making a scientific excursion up the Missouri River, and in a recent communication speaks of an important discovery at Weston, Mo. He says:

"On the 8th day of September, 1875, Dr. Parr opened one of the numerous mounds near Weston, and was rewarded by finding in it a human skeleton buried horizontally at full length, and near the head a vase or vessel of antique pottery of the capacity of about one gallon. The vessel contained within it the bones of a fish and some shell beads. It was broken in several places, but remained around the cast of clay within, and with great patience and skill was reconstructed by Dr. Parr, and it now exhibits its original form and markings as distinctly as if it had never been broken. It is what is known as the basket type of pottery, *i. e.* the marking on the outer surface has the appearance of the vessel having been molded in a basket made of grass or small willow twigs for that purpose; and from this fact it has been inferred that pottery of this type was so fashioned; but, from an examination of numerous specimens of this class, and especially from the vase found by Dr. Parr, I have reason to believe that this style of pottery was not so molded, and that the surface marking is only one mode of ornamentation, traced with great patience upon the vessel. The frontal bone of the individual found by Dr. Parr is of the true type of others I have found in the Missouri bluff mounds and described in former articles. It is a type well and strongly marked, and not to be mistaken by those who have once seen it. But what gives to Dr. Parr's find its chief interest is the fish bones found in the vase." * * "It has been the custom of barbarous and semi-barbarous people to inter with their dead the means of subsistance on their long journey to their supposed future abode in another state of being; and they select for this purpose those articles of food they are habitually accustomed to using. The accustomed food of such a people is that which is most accessible to them. During the lacustrine time fish was more accessible than terrestrial animals, for the former must have been very abundant while the latter was probably very scarce. Time moved on, the lacustrine era ended, conditions changed, and terrestrial animals became more plentiful, and more accessible than fish, and, consequently, became the accustomed food of our modern tribes, as fish had been the principal food of the lake shore dwellers, or mound-builders of the Missouri River bluffs. Our modern tribes would never have thought of burying a fish with their dead, and it is probable that the older lake shore dwellers rarely, if ever, used terrestrial animals for this purpose."

The American Association for the Advancement of Science held its annual meeting this year in Montreal, Canada. This Association holds the same position to science in this country as the British Congress of Science does in England. The meeting for this year was an important one, and the next number of the Review will contain a full digest of the proceedings and papers.

The Germans will send out four parties to observe the transit of Venus over the Sun's disc, December 6, 1882. This transit will be visible in a greater or less degree to a large part of the world, except to Eastern Europe, and to Asia, and wholly visible to the eastern portion of North America and to South America. The observers sent out by the German Government will be stationed at Hartford, Conn.; Aiken, S. C.; Bahia Blanca, in the Argentine Republic, and Punta Arenas, on the Straits of Magellan. They will not use photography, but will observe the contacts, while their main dependence will be upon heliometer measures of the place of the planet upon the Sun's disc during the transit. The heliometers used are the same employed in 1874, having an aperture of about three inches.

ITEMS FROM PERIODICALS.

THE *North American Review* for September has the following table of contents: Political Assessments, Oaths in Legal Proceedings, Tornadoes and Their Causes, Architecture in America, Constitutional Protection of Property Rights, Earth-Burial and Cremation, and The Geneva Award and the Ship-Owners. The articles for this number are thoughtful, and some of them possess unusual merit. The article on Political Assessments will be widely read and do good, as it brings to light the nefarious workings of this drag-net thrown out from Washington. The paper on Tornadoes and Their Causes contains some valuable matter, but fails to give the causes as fully as the reader would like. Sergeant John P. Finley, who has done more than any other living author in investigating these fearful meteors, is not even alluded to in the article. This REVIEW holds on its even way through the years always occupying a high plane of thought.

Harper's Magazine for September contains the following articles: A Summer at York, The Weibertrene, The Visit of the Vikings, In Surrey, Spanish Vistas, Love Will Find Out the Way, Some Recollections of Ralph Waldo Emerson, A Doctor Spoiled, Marit and I, The Mississippi River Problem, A Garden Secret, Shandon Bells, with the usual departments and other matter. The number is good as usual, and the articles on Emerson and the Mississippi River are noteworthy.

THE *Atlantic Monthly* for September has the following articles: Two on a Tower, Darkness, American History on the Stage, Evil in Greek Mythology, Doctor Zay, A Geological Ramble on the Weald, Studies in the South, Tears of Isis, The Nation of the Willows, The House of a Merchant Prince, The Last Chance of the Confederacy, William Rufus, Mozley's Reminiscences, Lecky's England in the Eighteenth Century, Leland on the Gypsies, Political Science, Mrs. Kemble's Memoirs and the Contributor's Club, with Book Notices. The *Atlantic* has lost something of its ancient prestige, on account of enterprising rivals. The present number is quite full, and the table of contents is very good. The article entitled "Studies in the South" gives some valuable information of the present condition of that portion of the country. The articles, "American History on the Stage" and "A Geological Ramble on the Weald," are interesting.

THE *Century Magazine* for August has a full table of contents which is exceedingly rich and varied. This magazine lies on a high plane of thought, and is very stimulating to all who are engaged in intellectual pursuits. The articles are generally written by experts in their several departments, and form valuable contributions to the subject. The illustrations are in the best style of art, and are generally well selected. The number for August is called the Mid-Summer Holiday Number and will be a treat enjoyed by all who love good things, in the way of literature and art.

KANSAS CITY

Review of Science and Industry,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. OCTOBER, 1882. NO. 6.

PROCEEDINGS OF SOCIETIES.

THE THIRTY-FIRST ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Montreal meeting of this Association was a remarkably successful one for several reasons, among which were the large number of members present, the unusual attendance of distinguished scientists from abroad, the unaccustomed surroundings of the old French city and its sisters of Quebec and Ottawa and the charming hospitality and attentions of their citizens. The trip thither and the excursions subsequently tendered were by no means the least attractions of the session and were thoroughly enjoyed by all.

While it may be out of place to describe the beauties of the majestic St. Lawrence, whose lovely islands, calm and peaceful meadows and farm lands and rather monotonous scenery call up vividly the Acadian pictures of Longfellow, and while the exciting and thrilling shooting of the rapids of the Long Sault and of Lachine, and the charms of the Falls of Montmorency, of Rideau and of Chaudiere, and even the unequaled view from Mount Royal (*Monte Real,*) itself, may be better adapted to the letter-book and the sketch-block of the tourist, one cannot resist saying that science could hardly have been evolved and promulgated among more delightful environments. Scientifically speaking, the choice of Montreal was a good one, for, aside from the fact that just twenty-five years ago the Association met there and the retrospect was fitting and flattering to the older members, the geological and mineralogical features of the region are most interesting, the buildings where the sessions were held, McGill College, most spacious and suitable, and finally, Principal Dawson himself, the President of the Association, is one of the most distinguished *savans* of the age.

The formal opening of the session took place at William Molson Hall of McGill University, on Wednesday, August 26th.

The commodious hall was crowded to overflowing with the members and their friends, among whom were a large number of ladies. Shortly after ten o'clock the officers of the Association entered the hall amidst the applause of the audience, and took their seats upon the platform. Prof. George J. Brush, of New Haven, Conn., the retiring President of the Association, took the Chair, and among those on the platform were:—Dr. J. W. Dawson, the incoming President; Dr. T. Sterry Hunt, Chairman of the Local Committee; Mayor Beaudry, Bishop Bond, Peter Redpath, Dr. W. B. Carpenter, London, Eng.; Dr. Kowaleskwy, Moscow; Prof. Szabo, Hungary; Hon. Justice Charles Dewey Day, Chancellor of the University; Rev. Canon Henderson, Rev. Principal MacVicar, Sandford Fleming, Rev. Dr. Haughton, Dublin; Mr. Ormsby, Dr. John Rae, Dr. W. H. Hingston, Dr. Thorburn, Rev. Canon Baldwin and many others.

Prof. Brush called the meeting to order, and introduced the honored President, Dr. Dawson.

Principal J. W. Dawson, F. R. S., F. G. S., C. M. G., then took the Chair amid applause, and spoke as follows:

Ladies and Gentlemen of the Association:

I need hardly say how highly I esteem the honor you have done me in my election as your President for the present meeting. The unanimous election of a body like this to such an office is, in my judgment, the greatest distinction to which any scientific man on this continent can aspire, and I value it accordingly.

I have no doubt, however, that in the present case, the choice was in some degree determined by the wish to do honor to Canada, and to give to this meeting a character as thoroughly international as possible.

But this view of the reasons for the election by no means detracts from its value. On the contrary, it places the presidency of this Association on a broader basis than that of any other office extending over all this wide continent, and thus including all that belongs to the powers that reign both at Washington and Ottawa. Science from her serene height thus overlooks all national boundaries and comprehends this whole world in her scope of vision.

It becomes your office, therefore, for the time being, to merge the character of citizens of the United States or Canada in that of cosmopolitan men of science. This is what I propose to attempt in endeavoring to perform the duties to which you have called me; and you will, therefore, kindly regard me as not a Canadian, nor an American, in the narrower sense of that term, but as the President of a society which, in meeting here, assumes a continental and international character.

The Lord Bishop of Montreal was then called upon to ask the Divine blessing upon the Association's meetings.

Dr. T. Sterry Hunt, Montreal, Chairman of the Local Committee, then rose and addressed the assembly, welcoming, on behalf of the Local Committee, all those present to the city of Montreal. On this occasion there arose before them many interesting memories of the past. Some five-and-twenty years had now passed away since the American Association for the Advancement of Science had held their first meeting in Canada, in this very city of Montreal. Of the members of the then Local Committee only three were with them to-day,—their new President, Dr. J. W. Dawson, Dr. W. H. Hingston, and the speaker. Looking back that time seemed a day of small things. Those who saw Montreal then saw a little city of 50,000 to 60,000 souls; to-day His Worship the Mayor held jurisdiction over some 150,000 persons. The Association then numbered about 400 members; to-day it had no less than 2,000 members, so that it would be perceived that the Association and the city had grown together, and the infant college of which Dr. Dawson had then just assumed the helm, had grown to be a great and noble university. Its museum and rare collections, then so small, now required a separate structure to themselves. The Association which held session to-day was popular, and justly so, for it went from city to city diffusing its knowledge broadcast throughout the land irrespective of race or nationality. After referring to the German Society the speaker went on to speak of the British Association, which last year celebrated its fiftieth anniversary under the Presidency of Sir John Lubbock. The American Society came after those two in point of age, and after it followed the French Association now about ten years old, and which last year met away out in the heart of Africa, where it numbered upward of a thousand members. Our own American Association began as an association of geologists and naturalists in 1842, the speaker joined it in 1845. Its inception was thus independent of the British Association for the Advancement of Science, but the leaders of the latter body led the American scientists to recast their association and give it the name it now holds. This was done at Philadelphia in 1848, and he boasted of one of the earliest members forming it, of which so few were spared to be with them to-day, and yet it was only thirty-four years ago. There had been an interruption during the civil war, so the Society only counted this as its thirty-first anniversary. The United States and Canada were counted in the great work of science as one. At the time of the Geological Survey many scientific men were attracted to Canada from the other side of line 45°. Prof. Hall had been much associated with the Survey and it was judged proper, in 1857, to have the meeting at Montreal. The late Sir Wm. Logan, then Chief of the work, was Chairman of the Local Committee, and he (Dr. Hunt) acted as Secretary. It was a matter of regret that the duties of the present director of the Survey required his presence in our far western Province. The citizens would be proud to show their guests the Mountain and Island Parks, the Churches, Museum and other points of interest. The Canadian Pacific Railway would convey such as wished to visit Ottawa on Saturday next, where the

Geological Survey and other points of interest could be seen. The Richelieu & Ontario Navigation Company's steamers would take others to Quebec, and on Thursday, the 31st, the South-Eastern Railway would take such as desired to go to Lake Memphremagog. He concluded by saying that their only wish was that all the members of the Association might carry away with them the impression that the citizens of Montreal, one and all, felt the high honor of their visit to the city and would do everything to make their stay in the city as pleasant as possible.

Mayor Beaudry was then introduced and extended the welcome of the city to the members of the Association in graceful and appropriate words.

Dr. Thorburn, of Ottawa, said that a public meeting had been held in that city, and means taken to give a proper welcome to the members of the Association. The capital had many attractions, and he was sure the members would be pleased with their visit.

Dr. Dawson then said,—It falls to me, gentlemen, to acknowledge on behalf of the Association, the welcome with which you have given it. In doing so, I have the advantage of knowing from personal observation the zeal and energy which have been displayed by the members of the local committee, and the enthusiasm kindled by the occasion in the minds of the citizens generally. The occasion is undoubtedly one worthy of the interest it has excited, not only in this and neighboring cities, but in Canada generally. By its selection for the meeting of this Association, Montreal becomes for the time the scientific capital of North America, from which will go forth decrees more potent than those of parliaments, and to which will be turned the eyes of all interested in the progress of Science and the Scientific Arts. You do well to esteem highly the position thus conferred and to sustain it in the future by the actions of your own local institutions.

The fact that we can congratulate ourselves on this occasion in the presence of so many and so eminent men of science from the other side of the Atlantic is due to the exertions of the Local Committee and to the liberality of the citizens of Montreal. I had the honor in 1856 to be the spokesman of a delegation which went to Albany to invite this Association to hold the meeting in Montreal in 1857, which has been referred to. That meeting was a most successful one, though, no doubt, far inferior in numbers to the present. It benefited this Association and the interests of science and gave a stimulus to the cause of scientific education and research in Montreal, the effects of which still remain. May the present meeting be still more agreeable and useful. Of the leading men of science who took part in the meeting of 1857 many have passed away; Henry, Logan, Bache, Pierce, Munro, Billings and Morgan are among these. But many of the men who then stood high in science are with us to-day, and you now welcome a large number of men who have since that time risen into eminence, and of still younger men whose names will yet be widely known. To such young and rising men you should, and I know do, extend a welcome as hearty as to those who are their seniors and are better known to you. You welcome here to-day a much larger body than that which you received in 1857. This is evidenced not only by the larger number of members, but by the increased number of sections. In 1857 there were two sections and a sub-section. Now there were no less than nine sections meeting simultaneously. I have only to add, on behalf of the Association, that the ordinary meetings of the sections, and those evening meeting addresses which will be advertised, are open to all who may desire to benefit by them; and that the membership of the Association is open to all suitable applicants on very easy terms. Such entertainments and excursions as have been provided by the Local Committee or by local institutions and private individuals, are of course limited by the invitations they may issue, but I have no doubt they will be made as extensive as the circumstances will permit. Dr. Dawson also read a letter from His Excellency the Governor-General regretting his absence.

The Permanent Secretary, Prof. F. W. Putnam, stated that the financial report of the year had been printed. A large number of donations had come in for reprinting volumes of the past proceedings of the Association, among others one from Gen. William Lilly of $1,000 toward the expense of reprinting Volume XXVI of the Proceedings, and since he had come to Montreal he had received another contribution of $150 for the same purpose. Some 160 papers had already been entered for this meeting and referred to the various sections.

Dr. Hunt announced that the promenade in the Art Gallery would take place on Monday evening, after Prof. Bell's lecture, instead of on Tuesday evening as announced. He expressed regret at the absence of the Hon. Justice Mackay, President of the Art Association.

DECEASED MEMBERS.

Prof. Putnam then read the following list of members reported deceased since the last meeting of the Association, viz:—Zachari Allen, Providence, R. I.; J. G. Barnard, New York City; Geo. L. Blackie, Nashville, Tenn.; Albert H. Briggs, Springfield, Mass.; Mrs. Mary H. Campbell, Crawfordshire, Ind.; Frederick Collins, Washington, D. C.; J. M. Crank, Wolfeville, N. C.; Charles F. Crocker, Lawrence, Mass.; E. A. Dalrymple, Baltimore, Md.; Caleb G. Forsslier, New Orleans, La.; J. Goldsmark, New York; Geo. W. Hawes, Washington, D. C.; Thos. Potts James, Cambridge, Mass.; Lewis H. Morgan, Rochester, N. Y.; Chas. H. Payne, Saratoga Springs; J. Duncan Putnam, Davenport, Ia.; W. B. Rogers, Boston, Mass.; E. Root, Amherst, Mass.; W. Sheppard, Drummondville P. Q.; David P. Smith, Springfield, Mass.; Chas. Spenzig, St. Louis, Mo.; A. R. Thompson, New York; W. S. Vaux, Philadelphia; J. C. Watson, Ann Arbor, Mich.; Mrs. G. O. Welch, Lynn, Mass.

NEW MEMBERS.

The General Secretary, Mr. W. Saunders, then announced that the Standing Committee recommended for membership the gentlemen forming the Local Committee and 169 other applicants, who, on motion, were duly elected members of the Association.

On the suggestion of the President, the English and European scientists attending the meeting were elected members of the Association.

President Dawson announced that the annual meeting of the British Science Association opened on the same day as this meeting, and suggested that a message of greeting and congratulation should be cabled to it from the American Association, a suggestion that met with the approval of those present.

The meeting was then declared adjourned, and the Association resolved itself into the various sections which met in their respective apartments for organization. The proceedings were the same in all of these sections, and consisted of the election of one Fellow from each section to represent it on the Standing Committee during the ensuing year; also, the election of the Sectional Committees, which are composed of three Fellows from each section together with the Vice-President and Secretary, and which select the papers to be read and make other arrangements for the meetings of the sections respectively; the election of the Nominating Committee, composed of one member or Fellow from each section; the election of three members or Fellows from each section, to act with the Vice-President and Secretary of that section as a sub-committee to recommend to the Nominating Committee, the Vice-President and Secretary of such section respectively for the next meeting of the Association.

EVENING PROCEEDINGS.—THE RETIRING PRESIDENT'S ADDRESS.

Notwithstanding the inclemency of the weather the spacious Queen's Hall was completely filled on the occasion of the public address of the retiring President of the Association, Prof. George J. Brush, of New Haven, Conn. Among the audience was a large representation of the *elite* of Montreal. The new President, Dr. Dawson, occupied the chair, and on the platform were the past Presidents, the present Vice-Presidents and invited guests.

PROGRESS OF AMERICAN MINERALOGY.

Prof. Brush's address consisted of a sketch of the progress of American Mineralogy, of which the following is a condensed report:

After remarking that the change in the constitution of the Association effected at its last meeting had relieved the retiring President from attempting a general review of the progress of science during the past year, he said: During the last quarter of the eighteenth century, while great activity existed and rapid advance was made in the study of chemistry and mineralogy in Europe, almost nothing was accomplished in this new country. It is true that students in other departments of science, especially members of the medical profession, in the cities of Philadelphia, New York and Boston, attempted to arouse an interest in mineralogy, believing that the diffusion of a knowledge of this science would be of the utmost importance in the material development of the country. There were, however, no text books to aid the inquirer. There were no collections of minerals to stimulate the student. In the absence of these it was almost impossible that an interest in this science should be fostered, or that a spirit of investigation should be awakened.

As the first distinct beginning of the science, I may mention an association formed in 1798 in the City of New York, which assumed, as they expressed it, "the name and style of the American Mineralogical Society." It announced as its object "the investigation of the Mineral and Fossil bodies which compose the Fabric of the Globe, and more especially for the Natural and Chemical History of the Minerals and Fossils of the United States." The distinguished Dr. Samuel Latham Mitchell, who seems to have been a man of universal genius, was at once its first President, its Librarian, and its Cabinet-keeper. The committee of the society issued a circular in which, while expressing themselves, "desirous of obtaining and diffusing by every means in their power a correct and extensive knowledge of the mineral treasures of their country, they earnestly solicited their fellow citizens to communicate to them on all mineralogical subjects, but especially on the following, viz:

1. "Concerning the stones suitable to be manufactured into *gun-flints;* where are they found? and in what quantity? 2. Concerning *native brimstone or sulphur* or the waters or minerals whence it may be extracted? 3. Concerning *saltpetre:* where (if at all) found native? or the soils which produce it in the United States? 4. Concerning mines and ores of *lead:* in what places? the situation? how wide the vein? in what kind of rock it is bedded."

This warlike demand seems to call more for the discovery of the materials for national defense than for the advancement of science, and besides being a commentary on the spirit of the times, gives a rather humorous impression of their strangely inadequate conception of the science of mineralogy, and its possible bearings on practical life. But in justice to them I should add that it is further announced that "specimens of ores, metals, coals, spars, gypsums, crystals, petrifactions, stones, earths, slates, clays, chalks, limestones, marbles, and every fossil substance that may be discovered or fall in the way of a traveller, which can throw light on the mineralogical history of America, will be examined and analyzed without cost; sufficient pieces, with the owner's leave, being reserved for placing in the society's collection." I have quoted the circular almost verbatim to give you some idea of the genuine though crude longing for knowledge felt by our early mineralogists, and also of the generous spirit in which they worked.

A still more forcible picture of the ignorance of the time is given by the elder Professor Silliman in 1818. "Notwithstanding the laudable efforts of a few gentlemen," he says, "to excite some taste for mineralogy, so little had been done in forming collections, in kindling curiosity and diffusing information, that only fifteen years since (1803) it was a matter of extreme difficulty to obtain *among ourselves* even the *names* of the most common stones and minerals."

Such, then, was the state of knowledge in mineralogy here at the commencement of the century. A few American minerals, collected by travelers from time to time, had before this been taken to Europe for identification, but among these were discovered only two minerals new to science. The Moravian missionaries found at St. Paul, in Labrador, the beautiful species of feldspar called by Werner *labrador-stein*, which in more modern times we know under the name of *labradorite*. Klaproth, the most eminent analytical chemist of his time, discovered that the so-called fibrous barytes from Pennsylvania was the sulphate of the then newly-discovered earth strontia. He thus, for the first time, identified the mineral species *celestite* which was subsequently found in various localities in Europe.

Although little had been accomplished in America previous to 1800, the first quarter of the new century was destined to show great development here in the study of mineralogy. During the early years of this quarter several collections of European minerals were brought to this country by American gentlemen who had availed themselves during a residence in Europe of the best opportunities for acquiring a knowledge of the science from the great masters of the subject in Germany and France. About this time also several colleges in the country had instituted chairs of chemistry and mineralogy, and a commencement was thus made in teaching these sciences in the higher schools. As the result of these influences the number of persons interested in mineralogy was largely increased, and an active search for minerals was initiated throughout all of the older United States and to a considerable extent also in Canada.

So energetically were these explorations followed up that in 1825 a catalogue of American minerals was published by Dr. Samuel Robinson, with their localities arranged geographically, and giving only such as were known to exist in the United States and the British Provinces. It formed an octavo volume of over three hundred pages.

That much credit was due to *many* workers during this period, both in the field and in the laboratory, there can be no question, but among them all I find four men standing forth so prominently as leaders, that I have thought it would be well for us to recall briefly something of the character of these men and their labors for the advancement in mineralogy in this country. These mineralogists were Dr. Archibald Bruce, who was born in New York in 1777 and graduated at Columbia College; Colonel George Gibbs, of Rhode Island; Professor Parker Cleveland, of Bowdoin College, and Professor Benjamin Silliman, late Professor of Chemistry, Mineralogy and Geology in Yale College. After sketching the labors in this branch of science of these eminent pioneers, the lecturer went on to say that it will be inferred that the developments and discoveries of minerals, during the first twenty-five years of the century, were due entirely to individual enthusiasm and private enterprise. Up to this time no aid had been received from either State or National governments, and in looking over the work accomplished during this period we are filled with wonder and admiration at the energy and rare devotion to science exhibited. The larger portion of the continent was an unbroken wilderness, and the facilities of communication even in the settled parts of the country were of the most primitive character. Yet at the present day, with our means of rapid transportation, many naturalists would hesitate to undertake the long journeys then made for purely scientific purposes.

The public mind was finally awakened to the importance of the work which these explorers and investigators had carried on single-handed. Government now came to the aid of Science. In 1824, one State Legislature, that of North Carolina, authorized a geological survey to be made. This example was followed in 1830 by Massachusetts and soon after by New York, Pennsylvania, Virginia and other States, and also by the national Government, until as is now well known, the whole territory of the United States and Canada, either has been or is in the process of being surveyed. Several of the State surveys published independent volumes on the mineralogy of their respective States, and these surveys have been a powerful auxiliary in extending our knowledge of the occurrence of minerals on this continent. The opening of mines and quarries throughout the country has also furnished abundant material for study.

Proceeding to call attention to some of the developments made in the field in which American mineralogists have worked, he said: It was thought by many scientists in the first half of this century that our rocks seemed likely to afford less variety of mineral contents than the rocks of Europe. Further study, however, and more careful and extended observations encourage us to believe that our mineral riches, even in variety of species, will compare favorably with those of other continents. Already fully one-half of the known mineral species have been found here. The present number of known minerals is variously estimated to be from seven hundred to one thousand. There have been described, as occurring here, nearly three hundred supposed new American minerals. Of these, perhaps one-quarter are new to science and the remainder have either been proved to be indentical with species already described, or their characters are so imperfectly given that further investigation is needed to ascertain what they are.

After speaking particularly of some of these new minerals of most interest to science, he observed:—While the service done for mineralogy by our geological surveys is gratefully acknowledged, we feel we have a right to demand much more from them in the future. Mineralogy has been too largely looked upon as a guide to the discovery of useful ores and minerals and not as a matter for scientific study; fortunately during the past decade the discoveries in optical mineralogy, and their importance in the determination of the constituent minerals of the crystalline rocks, have led many geologists to again recognize the desirability of a knowledge of our science. Much will be accomplished if those in charge of geological surveys will direct competent persons to make observations, not only on the main mineral constituents of rocks but also on the manner of occurrence of individual minerals. The careful inspection of quarries and mines is greatly to be desired.

It is too true that many of the most interesting discoveries already recorded seem to have been due more to the result of fortunate accident than of systematic and intelligent exploration. If our trained mineralogists, instead of devoting most of their attention to the examination of specimens in cabinets collected by others, would give more time to personal observation in the field in the study of the order and manner of occurrence of mineral species in place, our knowledge would doubtless be greatly promoted. Again, if our wealthy amateurs could be induced to spend their money as freely in the exploration of promising American localities as in the importation of costly European specimens, we might hope for many important discoveries, and they could have the satisfaction not only of gaining novelties for their collections, but incidentally they would do much to foster science.

In order to keep pace with the progress of the science, we need many more workers who will devote themselves especially to mineralogical research, and we need more of the spirit of the early workers. It is my belief that the number of persons at present interested in the study here, either as amateurs or investigators is relatively less than in 1825. The mineralogy of to-day is a very different subject from the mineralogy of the commencement of the period over which we have so hastily glanced.

ORGAN RECITAL.

Immediately after the close of the address Dr. Davies gave an organ recital that had the effect of detaining a large number of musically inclined persons in their seats. The following programme was rendered in masterly style:

1—Romansa, for violin and organ . . . . Beethoven.
2—Andante Cantabile from Concerto Op. 64. . . . . Mendelssohn.
3—Selection from "Carmen" . . . . Bizet.
4—Andante and Scherzo "Reformation" Sy . . . . Mendelssohn.
5—March et Cortege, "Irene" . . . . Gounod.

At the conclusion, by general request, Dr. Davies played a selection of national airs, winding up with God Save the Queen.

THE RECEPTION.

In the meantime the delegates, and such as had received cards of invitation, flocked into the assembly room, to attend the reception extended to the members of the Association by the local committee. Across the end of the spacious apartment was extended a refreshment table, where cooling ices and lemonade were dispensed by active waiters. The lamps were draped with rose-colored shades, softening the glare and adding to the general effect. There were a large number of ladies present in elegant costumes, most of the citizens present having brought their wives, and for a while introductions were going on in every part of the room. As soon as the ice was broken, the hum of conversation, continually broken by gay laughter, was incessant, and abstruse subjects seemed for a while to be abandoned for the novelty of trivial tropics.

Among the citizens present were Sir Francis Hincks, W. S. Consul-General Stearns, Reverend Principal Henderson, Dr. Howard, Aldermen Mooney and Kennedy, G. W. Stephens, Dean Baldwin, Canon Ellegood, Rev. Robert Campbell, Peter Redpath, D. A. Ansell, Louis Lesage, John Stirling, J. H. Joseph, Thomas Workman, T Sterry Hunt, Professor Johnson, Rev. Dr. Stevenson, Dr.

Hingston, S. E. Dawson, Alex. Buntin, G. A. Drummond, Dr. Scott, John Kennedy, Hugh McLennan, W. B. Lewis, J. J. Maclaren, Q. C., John Lovell, Richard White, W. O'Brien, D. Morrice, R. A. Ramsay, W. Angus, G. B. Burland, J. A. U. Baudry, T. Foster Bateman, W. Taylor, T. D. King, Dr. Trenholme, Dr. Turgeon and others.

The reception lasted about an hour, after which the company began to disperse.

PROCEEDINGS OF THE SECTIONS.

We are gratified to be able to give to our readers in the following pages a very full report of the proceedings of the several sections, with pretty complete and accurate abstracts of many of the best papers read, an account of the excursions participated in by the members, and many other items of interest that will probably not be found in any other journal of this class.

We are indebted to Professors Putnam, Mason, Lovewell, Bassett and Ward, Rev. H. C. Hovey and to Mr. Cook of the Montreal *Star*, for material furnished and attentions rendered, and we shall remember with pleasure the brief personal intercourse had with Principal Dawson, of McGill University, Dr. John Rae, of London, Prof. H. C. Bolton, of Hartford, and others who had in the past contributed articles to the REVIEW, but whom we had never met before.

ASTRONOMY.

TRANSIT OF VENUS.

Section A met in the Wm. Molson Hall, to hear the reading of a paper on "The Transit of Venus," by Prof. J. R. Eastman. The author of the paper is Mr. Wm. Harkness, the Chairman of the Section, who was unavoidably detained at Washington on important business. The paper went on to say that transits of Venus usually occur in pairs, the two transits of a pair being separated by only eight years, but between the nearest transits of consecutive pairs more than a century elapses. We are now on the eve of the second transit of a pair, after which none other will occur till the twenty-first century of our era has dawned upon the earth, and the June flowers are blooming in A. D. 2004. When the last transit season occurred, the intellectual world was awakening from the slumber of ages, and that wondrous scientific activity which has led to our present advanced knowledge was just beginning. What will be the state of science when the next transit season arrives, God only knows. Not even our children's children will live to take part in the study of the astronomy of that day. The scientific history of past transits was then noticed at length. When the Ptolemaic theory of the solar system was in vogue, astronomers correctly believed Venus and Mercury to be situated between the earth and Sun, but as these planets were supposed to shine by their own light, there was no reason to anticipate that they would be visible during a transit, if indeed a transit should occur. Yet singularly enough, so far back as 807, Mercury is recorded to have been seen as a dark spot upon the face of the Sun.

We now know that it is much too small to be visible to the naked eye in that position, and the object observed could have been nothing less than a large Sun-spot. Upon the establishment of the Copernican theory it was immediately perceived that transits of the inferior planets across the face of the Sun must occur, and the recognition of the value of transits of Venus for determining the solar parallax was not long in following. The idea of utilizing such transits for this purpose seems to have been vaguely conceived by James Gregory or perhaps even by Horrocks, but Halley was first to work it out completely, and to him is usually assigned the honor of the invention. His paper published in 1716 was mainly instrumental in inducing the Governments of Europe to undertake the observations of the transit of Venus in 1761 and 1769, from which our first accurate knowledge of the Sun's distance was obtained. When Kepler had finished his Rudolphine tables, they furnished the means of predicting the places of the planets with some approach to accuracy, and in 1627 he announced that Mercury would cross the face of the Sun on November 7, 1631, and Venus on December 6th of the same year. The intense interest with which Gassendi prepared to observe these transits can be imagined when it is remembered that hitherto no such phenomena had ever greeted mortal eye. He was destitute of what would now be regarded as the commonest instruments. The invention of telescopes was only twenty years old and a reasonably good clock had never been constructed. His observatory was situated in Paris and his appliances were of the most primitive kind. By admitting the solar rays into a darkened room through a small round hole, an image of the Sun nine or ten inches in diameter was obtained upon a white screen. For the measurement of position angles a carefully divided circle was traced upon this screen and the whole was so arranged that the circle could be made to coincide accurately with the Sun. To determine the times of ingress and egress, an assistant was stationed outside with a large quadrant, and he was instructed to observe the attitude of the Sun whenever Gassendi stamped upon the floor. Modern astronomical predictions can be trusted within a minute or two, but so great did the uncertainty of Kepler's tables seem to Gassendi, that he began to watch for the expected transit of Mercury two whole days before the time set for its occurrence. On the 5th of November it rained, and on the 6th clouds covered the sky almost all day. On the 7th toward nine o'clock the Sun because distinctly visible, and turning to its image on the screen the astronomer observed a small black spot upon it. He at first took it to be a Sun-spot, and shortly he was surprised to see it had suddenly disappeared. After continued observation Gassendi concluded, as he saw the spot on the Sun move, that it was really the planet, and he called upon his assistant to mark the Sun's attitude, but that individual had deserted his post, and it was only within a few minutes before its going down, and in spite of the unfortunate circumstances, that an important addition was made to our knowledge of the motions of the innermost planet of the solar system. Although successful in observing Mercury Gassendi was deprived of the pleasure of seeing the transit of Venus, as it took place in the night. Transits of Venus can occur only in June and December, and as the two transits of a pair always happen in the same month, if we start from a June transit the intervals between consecutive transits will be eight years, one hundred and five and a half years; eight years, one hundred and twenty-one and a half years; eight years, one hundred and five and a half years, and so on. This is the order which exists now. The path of Venus across the Sun is not the same in the two transits of a pair. For a pair of June transits, the path at the second one is sensibly parallel to, and about twenty minutes north of, that at the first, while for a pair of December transits the parallelism still holds, but the path of the second one is about twenty-five minutes south of that of the first. The paper went on relating all the efforts made by Lansberg, the Belgian astronomer, and others, and the fact that about the most valuable information on the subject had been discovered by Horrocks, a young curate of twenty, who resided near Liverpool in 1631. The years sped rapidly by, and as the transit of 1761 approached, Halley's paper of 1716 was not forgotten, but his plans were taken up and discussed. Delisle was the first to point out the exact conditions of the transit and the circumstances upon which the success of the observations would depend. The Sun causes Venus to cast a shadow which has the form of a gigantic cone, its apex resting upon the planet and its diameter continually increasing as it recedes into space. All the phenomena of transits are produced by the passage of this shadow cone over the earth, and as each point of the cone corresponds to a particular phase of a transit, any given phase of a transit will encounter the earth and first become visible at some point where the Sun is just setting, and will leave the earth and therefore be last visible at some point where the Sun is just rising. Between these two points it will traverse nearly half the earth's circumference and in so doing will consume about twenty minutes. The transit of 1761 was visible throughout Europe and was well observed by astronomers. England sent expeditions to St. Helena and to the Cape of Good Hope; and English astronomers observed at Madras and Calcutta. French astronomers went to Tobolsk, Rodriguez and Pondicherry, and Russians to Tartary and China, and Swedes to Lapland. No less than 117 stations were occupied by 176 observers, and of these 137 published their observations. The various experiences of several astronomers were then fully discussed and the transit of 1882 was referred to. Astronomers met in Paris last year from Europe, and after discussion the system of photography, which had been suggested, was condemned as being useless. The United States were not represented at this conference and therefore the experience from America was not obtained. He then referred to the efforts which were being made by the United States Transit of Venus Commission in this regard, and thought that they favored the photographic system. He hoped that the astronomers in America would do all their duty in the matter in the interests of posterity.

EVOLUTION OF THE EARTH.

Rev. Samuel Haughton, D. D., Fellow of Trinity College, Dublin, read a paper Monday morning in Section A on "New Views of Mr. George H. Darwin's Theory of the Evolution of the Earth,—Moon System, considered as to its Bearing on the Question of the Duration of Geological Time." He said: It has been tacitly assumed, even so far back as the times of Newton and Clairvant, that the earth and planets have passed through a liquid condition (owing to former great heat) before assuming this solid condition which some (at least) of them now possess.

Laplace, in his nebular hypothesis, also assumes the former existence of this liquid condition, and it is openly assumed by all geologists who believe that the earth consists of a solid crust (more or less thick) reposing upon a fluid or viscous nucleus.

It has been asserted by Sir William Thompson, following out the views of the late Mr. Hopkins, that the present condition of the earth taken as a whole, is such that it must be regarded as being more rigid than glass or steel, probably more rigid than any terrestrial substance under the surface conditions of pressure. The following conditions show that it may be fairly douted whether the earth or any planet ever existed in liquid conditions.

1. The possibility of the equilibrium of the rings of Saturn, on the supposition that they are either solid or liquid has been more than doubted, and the most prbable hypothesis respecting them is that they consist of swarms of discrete meteoric stones.

2. It is difficult to understand the low specific gravity of Jupiter and the other outer planets, on the supposition that they are either solid or liquid, for we know of no substance light enough to form them. The force of this argument could not be felt before the revelations of the spectroscope, because at that time there was no proof that the whole universe was composed of the same simple substances, and those very limited in number. If the outer planets consist of discrete meteoric stones, moving around a solid or liquid nucleus, the difficulty respecting their specific gravity would disappear.

3. The recent researches connecting the November, the August and the other periodic swarms of shooting stars with comets tend in the direction of showing that comets in cooling break up into discrete solid particles, each no doubt having passed through the liquid condition , and that probably the solar nebula cooled in like manner into separate fiery stars, which soon solidified by radiation into the cold of space.

4. Mr. Higgins' recent comparisons of the spectroscopic appearances of comets and incandescent portions of meteoric stones, showing the presence in

both of hydro-carbon and nitrogen compounds, confirm the conclusions drawn from the identity of the paths of comets and meteoric-periodic shooting stars.

5. Mr. H. A. Newton, in a remarkable paper read before the Sheffield meeting of the British Association, 1879, showed the possibility (if not the probability) of the asteroids being extinct comets, captured and brought into the solar system by the attraction of some one or other of the outer large planets, and permanently confined in the space between Mars and Jupiter, which is the only prison cell in the solar system large enough to hold permanently such disorderly wanderers.

In the same paper, Prof. Newton threw out the idea that some of the satellites of the large planets might also be of cometary origin. From all these and other considerations, it is therefore allowable to suppose that the earth and moon when they separated from the solar nebula, did so as a swarm of solid meteoric stones, each of them showing the temperature of interstellar space; *i. e.*, something not much warmer than 460° F. below the freezing point of water.

Mr. George H. Darwin has shown admirably how the earth-moon system may have been developed from the time when the earth-moon formed one planet, revolving on its axis in a few hours to the present time, when the earth and moon (in consequence of tidal friction) have pushed each other asunder to a distance of sixty times the radius of the earth. Dr. Haughton then entered into a lengthy and most careful study of his paper, and illustrated it on the blackboard. He concluded by saying that the remarkable expression found by Mr. Darwin is not peculiar to his special hypothesis of a viscous earth, but can be deducted equally well from the totally distinct hypothesis of an absolutely rigid earth retarded by the tidal action of a liquid ocean.

PHYSICS.

INSTRUCTION IN PHYSICS.

In this section Vice-President Mendenhall read a paper on "Instruction in Physics," of which the following is a synopsis:

Out of respect for sciences as old as science itself, we have freely accorded the first rank, as far as a designating letter may be able to imply it, to our veteran co-laborers, the mathematicians and astronomers. This separation of physics from astronomy and mathematics, as well as from chemistry, mechanics, etc., must be considered as temporarily convenient for the purpose of specializing the powers of the Association. We were mistaken in supposing that science had only advanced through contributions—the result of original research in our laboratories and libraries; even were so narrow a view taken, the existence of such an atmosphere would in itself be a blessing, as fostering a love for research whereby talent was fostered.

It was desirable to bring about a more accurate knowledge concerning the elementary principles and propositions of the science of physics for general diffusion among the masses of educated people; this diffusion was not now taking place to any great extent. The subject, considered as a whole, naturally divided itself into two parts, pertaining respectively to higher, and elementary instruction. A few keen-sighted men, combining in themselves happily the student and the teacher, recognized the fact that thorough instruction in physics demanded the use of laboratory methods, such as had been utilized for some years in chemistry, and were rapidly coming into prominence in every department of natural science. Among these was notable that of Professor Pickering, whose establishment for purposes of instruction at Boston must be regarded as an epoch in the history of this progress. With that also might be linked, though coming at a little later date, the well known establishment of Professor Mayer at Hoboken. A report on the teaching of Chemistry and Physics in the United States by Professor Clarke, of Cincinnati University, was recommended to all interested in the study of the present condition of this work. Professor Clarke classified the various courses as follows:—1st. Full course, including higher mathematical physics, advanced laboratory work and research. 2d. Full course, with mathematical physics and elementary laboratory work. 3d. Course in general physics, involving a previous knowledge of trigonometry and including laboratory work.

The other courses, ten in number, are elementary.

The report contained statistics from nearly four hundred universities, colleges, agricultural colleges, and schools, scientific or otherwise; out of the whole number, there were thirty-three institutions where the instruction in physics fell within the limits established above. Of these, four were of the first rank, two of the second, and twenty-seven of the third.

A great teacher has told us that we studied nature in books, and when we met her face she passed unrecognized. There sprang up a new method, the use of the text book fell into disrepute, it was as if all men were to cast aside their maps, globes, histories, books of travel, etc., and start out to obtain a knowledge of the world by visiting its different portions. The underlying principle of the new method was correct, but it was a mistake to give it unrestricted application.

The course of study in physics for the undergraduate collegian should include a sufficient training in mathematics to enable him to apply his knowledge with ease and facility to the more common physical problems; a thorough and exacting course of text book and lecture work, to be supplemented by a course in the laboratory in which greater attention should be paid to the quality rather than quantity of the work done. There was great need of reform regarding instruction in physics in the school; although American text books were numerous, none have properly combined in their making the experience of the class-room with the critical knowledge of the scholar; text books, it was true, might be imported from Europe, and they in the main were vastly superior to our own, but even these failed to supply the need; co-operation was required, this might be accomplished through the National Educational Association.

PROF. BELL'S INSTRUMENT FOR DETERMINING THE LOCATION OF BULLETS IN THE HUMAN BODY.

Section B held its meeting this morning in the William Molson Hall, the large room being taxed to its utmost capacity with members of the Association eager to hear Prof. Alex. Graham Bell's paper upon the electrical experiments to determine the location of the bullet in the body of the late President Garfield; and upon a successful form of inductive balance for the painless detection of metallic masses imbedded in the human body. Prof. Bell being introduced to the mee ing said that the subject he had chosen for his paper recalled the time of excitement and painful suspense attending the time when the chief executive of the United States lay nobly bearing prolonged suffering, and all the world watched by his bed, and hoped and feared. In cases similar to that of the late President, the great object was to find the location of the bullet. In the past the only way in searching out a bullet was by probing with the knife and lance among tender tissues and in fatal points. Science in the position it held at the present day could surely do something to replace these barbarous operations, and to see if something could not be done to prevent this dangerous system of groping among quivering muscles he applied himself to work.

The same problem had been considered by Professors Newcomb and Hopkins. It was perhaps natural for him as an electrician to attempt to apply electricity to the solution of the problem and for him personally to resort to the telephone. The idea he had was that the question could be satisfactorily solved by the joint use of the telephone and the induction balance. At the time he set to work on this problem he had in his mind the result of some investigations he had conducted in England. He exhibited several modifications of the induction balance, which he described as two electric coils connected and at some distance apart. He read in the newspapers of some experiments which had been made by several electricians to determine the presence of the metals, the results of which were that it was found that a magnetic needle in motion is retarded in its rotation by being passed over copper bodies. When the President was shot he immediately opened a series of investigations with the magnetic needle, and he found that a disc of lead brought under a revolving magnetic needle caused a deviation of it. A bullet, however, had no noticeable effect on the needle. His investigations in that way were consequently given up and he set to work with the induction balance. He connected a telephone with one pole of an induction balance and when the other came in contact with or near to a metallic body, a perfect battery being formed, an electric current was sent through the connections, and a noise could be heard in the telephone. The difficulty was to give the greatest hearing distance to the telephone, to find an instrument which would cause a sound at the greatest distance possible from the induction balance. He tried several experiments to find a solution to this difficulty, and telegraphed for the advice of scientific friends, both in America and England, but was unable to make an instrument which would pronounce an audible sound with the metal bodies sought for, further than one and a half inches from the induction balance.

He succeeded in perfecting an instrument which allowed a distance between the metal and the balance of five centimetres. In this instrument the primary coil was of a conical shape and the secondary coil fastened on the apex. A very considerable improvement was discovered soon afterward, when, at the suggestion of Professor Rowland, he applied a condenser in the primary circuit. The result was wonderful. On bringing a bullet near the inductor, the telephone emitted a sound resembling a high, shrill whistle; in fact, the condenser appeared to act as a resonator. It was with the instrument in this condition that he made the first experiment with the late President's wound, the result of which had never been published. The instrument on the occasion was out of order, and emitted an uncertain spluttering sound which they could not stop, and consequently the experiment was a failure. He then turned his attention to another system of induction balance consisting of two round plates, one placed over the other and in a wooden case. It was with this instrument that he made the second experiment with General Garfield on August 1st. The trouble with this instrument was that the slightest motion caused a deflection in the plates, giving a continuous sound in the telephone. The instrument was so delicate also that the chandeliers and iron fire-place in the room affected it. On passing the instrument over a portion of the body above the thigh a distinct sound was heard, and although the instrument was raised a foot above this area it was affected, although not the same extent as when it was closer to the body. Subsequent events proved that the bullet was not lodged in that area and he could only account for the action of the instrument by the fact that the patient lay on a steel wire bed. The difficulty in the instrument of the movement of the plates was effectively removed by imbedding them in a mass of paraffine, and this is the instrument as perfected and with which the bullet was discovered in the body of civil war veteran. He was still pursuing his investigations and hoped yet to bring the instrument to a much greater state of efficiency.

A modification of the instrument, in which the plates were in a hoop large enough to pass over the limbs for determining the location of bullets lodged in the extremities, he exhibited. In concluding, he said that lead was the metal of all for acting with electric apparatus and warmly expressed the wish that in future bullets should be made of silver or iron. His work in this direction had been purely a labor of love, and he could not have had a higher inducement than working to alleviate sufferings.

COLOR BLINDNESS.

Prof. E. L. Nichols, of Richmond, Ky., read a paper on the duration of color impression upon the retinr. The essayist, by a modification of the method of Plateau, had determined for six different portions of the spectrum, the rate of revolution which must be imparted to a disc, with several narrow open sectors, in order to produce an unbroken visual image of the spectral region viewed through the disc. The rate of revolution which may be taken as a measure of persistence of vision was found to be a fraction of the wavy length, and of the intensity of the ray. The results of the experiment described may be represented by a series of curves with wave lengths as apeses and duration of the impression upon the retina as ordinates. These curves show a certain vision flance to the curves for the relative luminosity of the different spectral regions, as measured by Francis Hofer, Herordt and Hood. The way in which the two curves differ is such as to suggest that these measurements are not efficient to prove that perhaps the duration of impression is inversely proportioned to the luminosity. The difference between the curves was in the higher values for the more refrangible rays; in the curve for the duration of impression. This curve corresponds of necessity to a very faint spectrum. The change which the curve for luminosity would undergo, were the intensity of the ray decreased, would, owing to the greater activity of the violet nerves of the eye at less intensities, cause that curve to approach much more nearly, if it did not coincide with, the curve for duration of impression. It was also found that the curve differed greatly in the case of different observers, and to a less degree from time to time for the same eye. The interval of darkness which may be allowed to intervene between exposures of a given duration, without interfering with the apparent continuity of vision, and its variation when the length of exposure varied, was also determined. The exposure varied from 12-1000 second to 786-1000 second, and the interval of darkness was found to vary, but in less degree.

Prof. Stevens said that the results of Prof. Nichol's investigation were of the greatest importance, as the scientific men of the world who have so long been anxious to form a theory on the question of color blindness have by it been directed to a course of investigation which promised to settle the question.

THE DIATONIC SCALES.

The next paper was by Dr. P. H. Vander Weyde, on the diatonic scale, obtained in the chromatic scales of equal temperament of 12, 19 and 31 tones in the octave, with exhibition of novel scale indicators and correcting key-board, seemed to be of the greatest interest to the ladies present. The essayist maintained that in our common tonal system of twelve tones in the octave for the so-called chromatic scales of seven tones fitted into the diatonic scale, and from sensitiveness, one between each of the whole tones, the fifths are impure, being a little too low, but the thirds are much out of time, being considerably too high. Another system is possible of nineteen tones in the octave, thus giving besides the seven tones of the diatonic scale twelve other tones, of which two fit between each of the five whole tones and one between each of the two semi-tones. This system gives, however, results inferior to that in use by calculation. When, however, we divide the octave into thirty-one equal parts we obtain four tones between each of the five whole tones and two between each of the two semi-tones, which gives with the seven tones of the diatonic scale thirty-one tones. This system will give also pure thirds and also fits exactly in the adopted system of rotation.

CHEMISTRY.

CHEMICAL LITERATURE.

Chemical Literature, by Dr. H. C. Bolton. He traced the history of chemical literature from the earliest known manuscripts to the beginning of this century, described the characteristics of minor works at different epochs, the discoveries they chronicled and their influence on contemporaneous science.

He dwelt briefly upon the chief works of the Arabians, who a thousand years ago defined chemistry as "the science of combustion, the science of weight and the science of the balance."

In the middle ages literature and science were cast in an ecclesiastical mould. Scientific treatises were the production of monks, and emanated from cloisters. Among the distinguished philosophers who mastered widely separated branches of learning and wrote treatises which 300 years ago were regarded as masterpieces of science, and formed the text books of students of alchemy, should be named Alain de Little, Roger Bacon, Raymond Lally and Albertus Magnus. The collected works of the last named fill twenty-one folio volumes. In the sixteenth century alchemists began to publish the results of their study and industry, with the natural consequence that in the succeeding century a prodigious number of alchemical works were issued in Germany, France and England; some recorded valuable experiments, but the majority contained "a crude mass of incoherent propositions and wild assertions, a mixture of poesy and insanity," all combined to produce literary monstrosities as fascinating to the student of chemical history as they were profitless to the practical worker in modern science. After noticing a large number of works on chemistry and kindred subjects published between the years 1600 and 1700, the opening of a public laboratory for instruction at Altdorf, Bavaria, under the direction of Prof. J. H. Hoffmann, and in the same year a similar institution at Stockholm under the guidance of Urban Hiurne, were referred to. Lexicons and dictionaries early became a feature of chemical literature, the early Greek MSS. contained "vocabularies of the sacred art." The dissemination of the views of Lord Bacon about the middle of the seventeenth century, gave a great impulse to scientific investigation and the "splendid fiction of the new Atlantis," was practically realized in the foundation of the "Royal Society for improving natural knowledge." After referring to the learned men who, in 1645 forced from London to Oxford by civil war, there laid the foundations of an edifice destined to rise higher, endure longer and to shelter a nobler offspring than the most sanguine could have foreseen, mention was made of some of the earliest periodicals devoted to chemistry.

The modern period of chemistry was characterized by the opposing forces, a tendency to dispersal and an effort to collect the widely scattered publications. On the other hand, laborious authors collected and set in order this dispersed material forming massive hand-books too wieldy for use. In this connection he wanted to bring a matter of the utmost importance to the attention of the meeting. It was the question of compiling an index of the various works of chemistry, tracing its course from its rise in Egypt to the present day. He had attempted to show in his address how interesting a study the history of chemistry was to the students of the science and in fact that it was absolutely necessary that the thorough chemist should have a knowledge of it and be familiar with the theories which were discussed centuries ago. Time and time again the necessity of preparing an index had been discussed, but nothing done.

The applause with which the address was received having subsided, Prof. Arthur Elliott, of Columbia College, suggested that immediate action should be taken, as the matter was of the utmost importance. He consequently moved, and it was unanimously resolved by the meeting, that the Chairman should appoint two of the members to act with himself as a committee to discuss the feasibility of preparing an index.

MECHANICAL SCIENCE.

THE IMPORTANCE OF EXPERIMENTAL RESEARCH IN MECHANICAL SCIENCE.

Prof. W. P. Trowbridge, the Chairman, took for the subject of his annual address "The Importance of Experimental Research in Mechanical Science." He maintained that when Mechanical Science is divested of the subjects in it which have given rise to so much discussion, it is considered by many to have resolved itself into only a few axioms and theorems. So many of the disputed theories being now disproved, and no controversy over the science now going on, we can hardly help regarding mechanical science as completely understood in all of its branches; and as there is no bright prospect of brilliant discoveries regarding long disputed questions opened out to the young student of Mechanical Science, he does not pursue his investigations with the energy and perseverance which characterized his predecessors. This is not as it should be. The truth is, Mechanical Science is only now beginning to offer itself to men in a state from which they can work with prospects of success, it having had torn from it all of the mistaken theories which hid it from them, and prevented them from putting it to much use. The epoch in which we live has shown marvelous and unexpected results, but there is still open a very wide and promising field of research for the student of Mechanical Science, in the wide range of the arts and engineering. In these days of engineering achievements safety and cost both depend on the knowledge gained by experimental research. He thought it very humiliating for American engineers that in their calculations they had to work on data derived from abroad. Besides this being calculated to bring discredit on America for the want of scientific energy, it was likely to be disastrous in its results in another way. The very condition of things on this continent are different from those abroad, and the material connot be the same, so that the calculations are really made out on wrong hypotheses. This want of experimental research in America should not be charged to the engineers, as they do not possess the necessary and expensive appliances and cannot afford to buy them, besides wanting the requisite time. At any rate he did not very highly estimate researches by private institutions, and he thought it was a reproof to the Governments that they had not taken the matter in hand. All of the data at the disposal of the engineers is half a century old, and they had no accurate data for determining the strength of the new irons and steels, a matter of the utmost importance, when iron is being so largely introduced into the construction of buildings. He considered that the Governments were acting unfairly to the engineers. These gentlemen cannot design without relying on the data they are in possession of as to experimental researches, and although they use their own experience, he expressed the fear that some day some of them would be led astray in their calculations by incorrect data, and bring on themselves ruin. Now steam and hot air were being used so much for heating purposes, he thought it absolutely necessary that there should be some data regarding the capacity of iron piping, but no experiments have been made, and disastrous results may be expected. The world in its march onward will soon demand, in fact, is demanding that something should be done in this direction. There is a movement in the world to overcome all of the obstacles in the way of general progress, and public opinion will have to be accommodated. Stronger ships with machinery that will make them fairly fly through the water will have to be built, powerful engines will have to be designed, which will rush trains along at a speed not now imagined possible, and that over bridges constructed with the least possible expense. This will in crease the risks and responsibilities of the engineers, and they will be compelled to ask for public aid. A great work has lately been done by science in sanitary matters, but most of the investigations have been carried on out of America. He would suggest that the Government should be asked to inaugurate a thorough series of experiments. There would undoubtedly be great trouble in obtaining the services of the right men for the work, as it is on them that the success of the undertaking would depend. Prof. Trowbridge concluded with a highly eulogistic reference to the scientific investigations carried on by Dr. Haughton, of Dublin College, present at the meeting.

AERIAL NAVIGATION PRACTICABLE.

Mr. Joseph L'Etoile, of the Department of the Interior, Ottawa, read a paper on "A Review of the Subject of Atmospheric Current, Electricity and Gases, with a view to Practical Aërial Navigation by means of Balloons." The paper was illustrated with a proposed balloon of fish-like form with a screw at one end and a rudder at the other end. He said that the system of practical ballooning means that a balloon should ascend without loss of ballast and should descend without waste of gas. The balloon of the future should be given the shape of a fish provided with a propeller, a rudder, with gas and air pumps and three gasometers, one for gas, one for air and one for making the change of temperature in the balloon caused by the solar warmth, or moisture in the air, so that by these means the balloonist or aëronaut can control his air-vessel as easily as the engineer his steamboat or locomotive. It is well known that when a balloon shoots up, the gas dilates, the gasometers or gauges tell the changes, and the balloonist adjusts to circumstances. A balloon built on this new plan can ascend or descend slowly, thus giving time to meteorological instruments to mark accurate changes. Charts could be made, and balloonists would know the routes of travel in the air, day and night, at any season of the year. To give an idea of the possibility of establishing those charts, the following may be *apropos*. For instance, a balloon sailing from America to Europe should keep within the lower region, when sailing from Europe to America, it should sail in the high region. Why so? The reason is that cold air is heavier than warm air, consequently the cold Arctic currents prevail in high altitudes especially in the northern Europe and America.

Prof. J. Burkitt gave some explanation as to a new invention which was made in the shape of a steam engine indicator.

AERIAL NAVIGATION.

In section D, Mr. W. H. Lynch read a paper on "The Future of the Balloon as a Practical Means of Aërial travel." He said that the two systems of aërial navigation, by utilizing the flying principle, are quite opposed to each other. In the flying machine the wings or propellers are required to act upon the air to at once lift the dead weight of the machine, and to propel it or direct its course. The balloon on the contrary, is itself a lifting power, lifting itself and carrying foreign weight that may be a force to direct or propel it. To make fly a machine that is heavier than the air there is needed to merely lift it a greater part, if not all, that it can carry of the weight of force necessary to affect or effect its motion. A machine that is lighter than the air will at least rise of itself and carry more or less surplus weight of force that may be required to make it do something more than merely rise. We do not forget that the self-lifting machine is in one respect at a disadvantage with the inert or dead weight machine. To be lighter than air means to be bulky and to offer in motion great resistance to the air, while what is heavier than air is more compact and its motion more easily caused or directed. This one advantage of the flying machine over the balloon counts, however, but little, so long as it cannot both lift itself and carry the little extra weight of the force required to propel it. The balloon will carry no mean weight besides its own, possibly passenger or freight weight, and the extra weight of a force that may direct or even propel the whole. Strange to say, the principle of the flying machine that has never given any practical results in aerostation, and indeed has given little or no promise of future practical results, seems for some years to have been more in favor of scientists than has been the balloon principle, from which most important, not to say exceedingly promising results have been obtained. When it comes to serious suggestions of possible means of future aërial travel, confidence in science, inventive talent and mechanical skill is lost, and he who is sanguine of the future is by many of the good and wise looked upon as a fit subject for mild ridicule. In answer to the question, from which principle may the best results be expected? we may note that the dead weight principle has given no promise that we shall get from it, alone at least, any practical result. The balloon principle has already given us so much that no one may positively negative the opinion of Glaisher, that it is the "first principle of some aërial machine that remains to be suggested."

The peculiar disadvantage of the balloon, that of bulkiness, may be minimized, and the flying principle itself may doubtless be utilized to its full value in its application to the direction or propulsion of the balloon. There has been almost no progress lately in this matter. The fact that little has been accomplished here, while there has been great advance elsewhere, is taken as a proof that little may be looked for, but we think this a mistaken supposition. The growing interest and faith in the future of aërial travel is well seen by the attention paid lately by scientific journals to the question. As societies for the advancement of aëronautics have been established in Britain, America, France and other countries, there is reason to believe that our knowledge of this most difficult department of science will be more extensive in the near future, and he believed that aërial navigation would yet become a success.

GEOLOGY AND GEOGRAPHY.

REPORT OF PROF. E. T. COX.

Prof. E. T. Cox, Vice President of the section, was formerly Professor of Geology in the State University of Indiana, and removed to San Francisco four years ago, since which he has traveled and made extensive explorations in Arizona, and latterly in Senora, Mexico.

Prof. Cox stated to the section that the labor he had been engaged in during the past four years had been of a character to take him away from practical geological work. For the last year he had been a portion of the time in Mexico, out of reach of all scientific journals and libraries from which to obtain the necessary information to make a regular address such as would represent the progress of geology during the present year, but at the request of the members present he gave them a familiar ex-*tempore* address on the general character of the geology of the Pacific States the mineral deposits of the region, placer gold mining, and gave some account of the anthracite coal field which exists 120 miles east of Guymas, on the Zaqui River, in Sonora, Mexico.

BITUMEN IN THE OHIO SHALE.

Prof. Edward Orton, of Columbus, Ohio, read a paper entitled "A Source of the Bituminous Matter in the Ohio Black Shale." Dr. Orton said that the three beds of bituminous shale of Huron, Cleveland and Newbury have many points of structure and history in common. They are all marine in origin, and they were all formed in quiet waters, and not upon shore lines. They carry from 8 to 22 per cent of organic matter, and this gives them their color and renders them combustible to a more or less degree. There is scarcely a summer in which some of the shale banks of southern Ohio do not take fire. It is this same organic matter obviously to which they owe their character as oil producing shales. They have already been turned to account for the production of oil, and it is scarcely to be doubted that the great stock of carbon which they contain will at some time be utilized by man. This organic matter has been referred both to animal and vegetable sources for its origin, and both of these divisions of the living world have certainly contributed to it. He considered this accumulation of bituminous matter as the result of the growth of sea-weeds in marine basins. In examining in a microscope some borings from a well he found at depths of 996, 1016 and 1044 feet, a number of minute translucent discs, resinous in appearance and unmistakably organic in origin. On examining the black shale from Columbus, he also found it charged with forms similar, or perhaps identical with these. A number of other organic forms are associated with the spores in the black shale. In fact a flora and fauna of considerable interest are coming to light in these hitherto neglected strata.

After a lengthy discussion the section adjourned.

GEOLOGY AND GEOGRAPHY.

The first paper was by Principal Dawson, President of the American Association for the Advancement of Science, on "The Successive Palæozoic Floras o Eastern North America, and more especially of Canada." The paper gave a sketch of the characteristic species of plants of the Permo-carboniferous, coal measures, millstone grit and lower carboniferous, and of the upper, middle and lower Erian (Devonian), with special reference to the collections made by the author from these several formations; and discussed, also, the remains of plants found in the Siberian and older formations.

Remarks were made upon the subject by Dr. Newberry and Prof. White.

Prof. J. W. Whiteaves followed with a note on the occurrence of *Siphonotreta Scotica* in the Utica formation, near Ottawa, after which Mr. Samuel Lockwood read a paper on "A Mastodon Americanus, found in a Beaver Dam near Freehold, N. J." The author gave an account of his finding and exhuming the remains of a mastodon in the peat of a meadow, which he conjectured might have been the bed of an ancient beaver dam; in fact, beaver sticks were found overlying the skeleton, indicating that the dam was made after the death of the mastoton. The tusks of the animal crumbled on approach to the air; he supposed them to weigh about 400 pounds. It was thus shown that this mastodon was contemporary with the modern beaver, also with the autochthonic man. Mr. Lockwood though this particular animal was geologically quite modern. He described three special finds of mastodon remains within a few miles of each other, on the New Jersey coast—one from a drift-covered swamp close to the sea, and two other instances of relics obtained out to sea. These he adduced as peculiar evidence that the shore of a portion at least of the New Jersey coast had subsided, and from it he inferred that the subsidence had encroached some miles upon the land.

A NEW GEOLOGICAL SOCIETY.

Immediately following the adjournment of section "E" a meeting of geologists was held, to consider among themselves the organization of an American Geological Society, in no way to conflict with the American Association for the Advancement of Science, and to hear correspondence from eminent men throughout the country on the subject. The Committee, which had been formed about a year ago, submitted its report, which consisted of a series of communications from leading scientific men, almost all strongly advocating the scheme, particularly that portion of it relating to the publication of a geological magazine. After some discussion, principally of a nature favorable to the undertaking, it was decided to adjourn to the Molson Hall, as the room then being used was required for other purposes. This was accordingly done and a private session was held.

BIOLOGY.

BIOLOGY OF AMERICAN MOLLUSKS.

The Vice-President, Prof. Wm. H. Dall, read his opening address, taking for his subject the "Biology of American Mollusks" and what knowledge has been acquired regarding them. The study of mollusks, he first remarked, was at first æsthetic rather than scientific, and to this day its popularity is chiefly fostered by the satisfaction of the sense of beauty derived from a contemplation of the exquisite shells produced by some members of this branch of the animal kingdom. The almost purely artificial classification of shell-bearing mollusks by Linnæus was so convenient that later on great difficulty was experienced in changing it, and confusion in the nomenclature yet puzzles the student. Thos. Say was the pioneer conchologist of America, and in 1816 published the first scientific article upon the shells of the country. For many years American students of conchology were occupied in the description and iconography of our native mollusks as an inevitable preliminary to the study of geographical distribution and other more philosophical branches of the subject. The molluscan fauna of the land and fresh water shells of North America is now very well known, although something yet remains to be done in the Southern States. With marine forms the case is different. The fauna of Canada and of the eastern coast of the United States had been worked very thoroughly by resident naturalists, and Carpenter, Cooper, Gabb, Hemphill and others had given a pretty good knowledge of the western coast, except the Alaskan coast. The mollusk fauna of the Arctic Coast is also well known. On the southern coast, especially about the Gulf of California, the knowledge is by no means thorough.

The speaker then referred to the rich finds of shells, recent and fossil, made in Colorado, Nicaragua, Laramie and elsewhere, and drew attention to the importance of the discoveries in the recent deep sea dredging. The anatomical features of the adult mollusks, except in a few groups, have been much neglected and are of no first importance. The soft parts of even our common oyster are differently described by different naturalists, and monographed by none. The instinctive and mental phenomena which may be exhibited by living mollusks have not yet been subjected to an investigation. A few persons merely had described actions which, on mature consideration, might be held to exhibit mental processes of a certain kind.

The speaker had lately put on record certain observations which seem to indicate the possession by some species of the genus *Helix*, of the power to recognize a call or sound and distinguish it from other calls or sounds of a similar character, and since then he has received several less exact communications seeming to confirm this conclusion. It can hardly be doubted that in a group containing so many animals of a high degree of organization, such as the cuttles and squids, for instance, mental processes of a tolerably complex nature must be carried on in many cases. This subject has, as yet, received no attention. Another important branch of the subject is the modification of organic life by physical causes and the perpetuation of modifications by natural and sexual selection. Mollusks occupy the middle ground between the higher groups of life, where natural selection has its freest play, and those lower categories where its operations are veiled or inefficient. Investigation of the laws of variation among mollusks is therefore especially desirable.

The influences of natural selection are most evident, as they should be, in those mollusks which, by their terrestrial habitat, are brought into the closest contact with enemies of relatively high intelligence, such as birds and other vertebrata. The selected characteristics are chiefly of color. The grey and dull appearance of species inhabiting arid regions is well known. The speaker then described many of the shells noticeable for their varieties and complexities of color, and the causes of these differences, as far as known. Among marine forms, the struggle for existence, after the embryonic stages are past, is much less violent. This arises partly from the much more uniform conditions of life in the sea, partly from the general abundance of food contained in the sea water, and partly from the lesser intelligence of enemies which are chiefly fishes and predacious mollusks. Food has without question great importance, especially in determining certain tints of color. The speaker gave instances of the effect upon shells, in modifications upon them. Certain shells, said he, pick up and attach to their upper surfaces bits of dead coral, stones and fragments of shell, until they were entirely covered. Viewed from above, as they must be for the most part, by fishes and carnivorous mollusks, nothing but dead and refuse material is visible. It is evident that this system of clothing themselves by shells must be a great protection, both from enemies, which would pass them by, and from accidental concussions. This must be confirmed as a habit by natural selection. The character and disposition of the load has become so uniform in many cases, as almost to take rank as specific characters.

ANTHROPOLOGY.

SOME PHYSICAL CHARACTERISTICS OF NATIVE TRIBES OF CANADA.

The address of the Vice-President of the Anthropological Section, Dr. Daniel Wilson, F.R.S.E., was read in his absence in Germany, by Prof. Otis Mason, of Washington, the Secretary. The subject was "Some Physical Characteristics of Native Tribes of Canada." The following is a summary:

In inviting attention to some of the physical characteristics which distinguish certain native races of the Dominion, and especially to the significance of certain typical head-forms it is important to keep in view the prevalence throughout the American continent of various artificial modifications of skull-forms. This strange custom is probably at the present time carried on more systematically among the different tribes of Flathead Indians of British Columbia than in any other region. The practice of moulding the human head into abnormal forms has been found alike among the civilized races of Peru, the ancient lettered architects of Central America and Mexico, and among barbarous tribes both to the east and west of the Rocky Mountains. Among the Chinooks and other Flathead tribes of this continent, and also, I believe among the ancient builder-races of Yucatan and Peru, certain head-forms were recognized as an attribute of the ruling cast. One of the first examples of mediæval compressed crania, which attracted special attention in Europe was a skull found, in the year 1820, at Fuersbrunn, in Austria. The well known traveler, Dr. Tschudi, conceived that the skull was brought to Europe as a curiosity, and then thrown aside.

It thus appears that the practice of artificially compressing crania belongs both to the Old and New World. It is now recognized that the artificial head-forms characteristic of divers tribes of North and South America vary greatly. The predominant natural form of the more southern tribes of North America appears to have been globular. The type of head-form of the Indians of Hochelaga, first met by Jacques Cartier in 1535, we can judge from the crania recovered from their cemeteries. The palisaded Indian town of Hochelaga occupied, in the 16th century, the site where we are now assembled, and in the museum of McGill College may be seen examples of the crania. It is a noticeable fact in reference to the entire population of the western hemisphere that the ethnical diversities are slight when compared with those which pertain to the older continents. Great as is the superficial resemblance which seems to pervade the diverse tribes of the American continents some of the underlying differences are noted from the first. Columbus failed not to note the marked distinction between the fair complexion of the Guanches and the reddish olive of the ferocious Caribs.

While it is interesting to notice that the aborigines of Canada differ in certain physical characteristics from those especially of the Southern States it is true that the tribes of North and South America approximate in many characteristics. Humbolt remarked that "the nations of America, except those which border the polar circle, form a single race, characterized by the formation of the skull, the color of the skin, the extreme thinness of the beard, and the straight, glossy hair," and until very recent years this was accepted by every one. Among typical Canadian skulls, those of the Hurons of the region lying around Georgian Bay have a special value The race was exterminated, or driven out of the country by their Iroquois foes, in 1649, the crania recovered from their old cemeteries giving a fair illustration of the physical characteristics of the race.

Of all known races of the New World, the Eskimos alone presented, at first, a seemingly marked diversity from the other aborigines, traceable far more to Arctic conditions of life than to any ethnical peculiarities assigned to them. Malte Brun, Robertson, Humboldt, Morton, Meigs, Gliddon and Agassiz all concur in excepting the polar tribes, or Eskimos, from the assumed American race peculiar to this continent. Latham says of the Eskimos :—"Physically, he is a Mongol and Asiatic; philologically, he is American, at least in respect to the principles upon which his speech is constructed." One branch of them, the Labrador Eskimos borders on our own eastern settlements on the St. Lawrence. Then there are the East and West Greenlanders, and to the north of them are the Eskimos, of the west coast, north of Melville Bay, styled by Sir John Ross the "Arctic Highlanders." This widely scattered race is broken up into small tribes and isolated bands, dispersed for the most part over a coast line extending from Labrador to Behring Strait, upward of 5,000 miles. They are hunters and fishers. The deer, polar bear, wild goose, swan, and other birds are alike objects of the chase, but they primarily depend on seals and cretaceous animals. The Eskimos in one respect, occupy a peculiar position on this Continent. They are the only race common to the Old and New World, and if we accept the conclusion arrived at by the author of "Early Man in Britain," they constituted an Old World race to all appearance before the New World had come into existence.

Prof. Boyd Dawkins has reviewed the manners and habits of the Eskimos, a race of hunters, fishers, and fowlers, comparing their habits to those of the cave men of ancient Europe. The implements and weapons of both prove that their manner of life was the same, and what strikes him as the most astonishing bond of union between the cave-men and Eskimos, is the art of representing animals, and after noting those familiar to both, he says, "all these points of connection between the cave-men and the Eskimos can, in my opinion, be explained only on the hypothesis that they belong to the same race. The Eskimo's phisiognomy is of a poor Mongolian type. The nose is flat and cheek bones are very prominent, the tendency in the skull is narrow and long." The reasonable limits of an address to this section of anthropology are exceeded, and the various points of differences to the aborigines of the Dominion illustrative alike of the physical characteristics of our native Canadian tribes, and of some special points of significance in relation to their arts are only glanced at. One deduction, however, may be worthy of future consideration. If it be a fact borne out by much independent evidence that from the extremest northern range of the Arctic Eskimo, southward to the Great Lakes, and beyond this, especially to the east of the Alleghany Mountains, amid considerable diversity of ethnical characteristics, the dolichocephalic type of head prevailed; whereas among more southern tribes, such as the Osages, Ottoes, Missouris, Dacotas, Cherokees, Seminoles, Creeks, and many others, including the Florida Indians, the short, rounded, or brachycephalic head appears to have been universal; this seems to point to a convergence of two distinct ethnical lines of migration from opposite centres. In this as I believe, the evidence thus derived from physical characteristics confirms what is indicated by wholly independent evidence of language, traditional customs, and native arts.

A SCHEME OF ANTHROPOLOGY.

Prof. Alex. Winchell, of the University of Michigan, Ann Arbor, Michigan, presided. There was a large attendance of members.

The first paper read at the morning session of this section was by Professor Otis T. Mason, of the Columbian University, Washington, U. S., on "A Scheme of Anthropology," of which the following is a summary:

Science progresses by observation, by the classification of phenomena, by the deduction of the laws of nature, and by inquiring into the origin and correlations of its objects. The amount of progress at any moment is indicated by the condition of the nomenclature. In every department of knowledge it is now deemed necessary to investigate origins or beginnings. The science of man must have its three stages of development—description, science, and law. These three stages are (1) the phenomenal, observational, descriptive; (2) the classifying, discriminating, analytical; (3) the synthetic, deductive, predictive stage. No branch of study is altogether worthy of the name of a science that has not passed through these three steps. The natural history of man, as a whole, will be divided into four parts; the first relating to the origin of man. Whatever view we take of man's origin in the first being, it is probable there existed in embryo the promise and potency of his future. The second part is the descriptive, including facts and objects necessary to correct inferences. The third part embraces all that has gone before, and finally all attempts to study the phenomena of human progress must end in understanding the law of that movement, so that it may be useful to the man of action in the future.

The gathering of crania, skeletons, implements of stone, bone, clay, shell, etc., the consideration of their position and the truthful report of what is observed constitutes the first lesson in priscan history. The pursuit, however, has little claim to be called a science as yet. There are hundreds of men and women, archæomaniacs, ransacking the earth and wasting fortunes merely to satisfy a morbid desire for collecting. The work was, however, by a few done well. Time has dealt rudely with ancient man and his works. In the study of archæology, anthropology is involved. The anthropology of the present commences with the study of man as a member of the animal kingdom. It is only since the publication of Mr. Darwin's Origin of Species that diligent inquiries have been made into the method of man's origination. We must measure, weigh, scrutinize, dissect men ere we can arrive at any safe deductions regarding their animal nature. Then, we consider the science of mind. The observation of human thought, the careful collection of facts gathered from all races and ranks of men, are essential to a wide psychology. The consideration of language, the instrument of precision by which thought is gauged, the vehicle of thought between mind and mind. The process of thinking is double, consisting first in the creation of thought and second in the expression, expenditure, transfer, commerce of ideas and judgments. The expression and interchange of thought has been the subject of curiosity and research. The science of chronology, the indiscrimination of these characteristics which form the natural barriers between kindreds, tongues, peoples and nationalities.

Out of these studies of race, religion, etc., are to come forth the laws which are of the profoundest importance to the statesman and philanthropist. On this subject of race Lord Beaconsfield was ever dwelling. The sentence in Endymion, which declares that language and religion do not make race is fine writing, but not good ethnology. The next department for consideration is human industry. The happiness of man seems linked with the most perfect conquest of nature. Then we come to the study of the fundamental laws of the various occupations of men, how they grow, relate themselves to races, times and areas. After this, sociology. Companionship is the necessary condition of civilization, co-operation is the constant factor in this variable equation. To properly classify the phenomena of the family, the community, the state, it is necessary that the children should be impartially scrutinized and described. Finally, we are brought face to face with the spirit world, leading us to consider the conceptions of different peoples regarding the unseen causes of phenomena, the organization of society, the acts and ceremonies growing out of the ideas and social classes, the symbols and implements of worship. A science in which every human being is a constituent element will continue to take a deeper hold upon the intelligence of thoughtful people. It will be a sufficient reward for this humble undertaking if it adds anything whatever towards a just, and comprehensive view of anthropology as a whole, and of the varied studies which enter into its prosecution.

The Chairman suggested the application of the word theology to the science of religion as regarded by anthropologists, but Mr. Mason replied that the word was already too much occupied. After some remarks by Mr. C. Roosvelt, of New York, Mrs. Erminnie Smith, of Jersey City, N. J., defended the conduct of those so called archæomaniacs, who, she thought, had been somewhat rudely handled. The Indians themselves had made good collections which would be of value.

THE CROSS AND THE CRUCIFIX.

The next paper was read by Prof. Mason on behalf of Col. Chas. Whittlesey, who could not be present.

The following is a summary: The object of the paper is to call attention to the difference between the cross and the Roman crucifix. Figures, having the general name of crosses, are quite diverse, and are widely dispersed. The symbol adopted by the early Christian churches had an upright part extending above the cross-piece. Among the Greeks the four arms were of nearly equal length. St. Anthony's cross resembles a capital T with a short horizontal part. The Maltese is so much distorted that it nearly loses its right to the name. It has frequently been asserted that the T form was derived from the ancient Phallic worship long before the Christian era, intended as a mitigated expression of an indelicate symbolism. Whatever value should be placed upon this interpretation, neither the form nor the association can be properly connected with the Roman crucifixes, which, like our rope and scaffold, was merely the machinery of executions. A figure precisely in the shape of the Roman cross might be found and not have any religious meaning whatever. On nearly all inscribed rocks of the United States there are characters or figures that closely resemble some of the forms of the cross. In most cases these inscriptions represent the work of the red man Little reliance can be placed on the interpretations, as they are so varied. Whatever they mean we cannot determine their value until there are translations covering not merely symbols and words but well determined sentences having relation to each other.

The Chairman said he understood the gist of the matter to be that the inference held by some that the symbol of Christianity proper existed in prehistoric times. There was no discussion.

Prof. G. H. Perkins, Burlington, Vt., gave a description of a collection of Sioux weapons and articles of dress in the possession of the University of Vermont, and invited members to inspect them.

The same gentleman afterward delivered an address on some "Recent Archæological Discoveries in Vermont." The following is a brief summary: In the locality of Monkton very many hammer stones made of quartz pebbles. Hundreds of these have been found. The great mass of specimens found are of a grey quartzite flaked into knives. Hatchets, hoes, spades, spear-points and other implements. Pestles of very diverse forms of fine work have been found. Celts, amulets, gouges and other fine specimens have been found. Chips and flakes in immense quantities. Cart loads of such flakes exist over perhaps an hundred acres of a farm. These must have been brought to the place as no such rocks exist in places near the locality.

Dr. McGuire, Ellicott City, Indiana, said he had endeavored to discover how the hammers were grooved, and had been successful.

A STONE GRAVE IN ILLINOIS.

The session resumed at 2:30 o'clock P. M. The first paper read was by Mr. Charles Rau, Washington, U. S., on "A Stone Grave in Illinois," the following being a brief summary: There seems to be a general impression that the so-called stone graves, so frequent in some States of the Mississippi Valley, belong to a remote period, at least to a time long anteceding the arrival of the whites in North America. In 1861, while engaged in the investigations into stone graves, he visited the farm of Dr. Shoemaker, near Columbus, Illinoes. There he saw an empty stone grave, until lately the last resting place of a Kickapoo Indian. He could assert that the grave differed in no way from others seen by him in the neighborhood. In the early part of this century, the Kickapoos inhabited the country bordering on the central waters of the Illinois, but they roamed over the whole territory now forming that State and far beyond it. Mr. John D. Hunter, who lived many years among the Kickapoos, says burial is performed differently, not only by different tribes, but by the individuals of the same tribe. The body is sometimes placed on the surface of the ground, between flat stones set edge upwards, and then covered over, first by similar stones, and then with earth brought a short distance. It appears to me that the stone graves owe their origin to the race inhabiting within historical times, or even earlier, the districts where they are found. The method of burial, very simple in itself, was suggested by the facility of obtaining flag-stones suitable for the construction of these primitive coffins, which protected the dead most effectually from the attack of wild beasts. If, finally, due consideration is given to the circumstance that the articles found in the graves in question evince no higher skill than that attained by the more advanced of the historically known tribes of North American Indian, there hardly remains any reasonable ground for not ascribing to such tribes the humbler mortuary receptacles treated in this hasty sketch.

Mr. Hardy, of Indiana, described a mound which had been opened in his neighborhood.

Prof. Townshend, of Columbus, Ohio, mentioned the fact that an old grave had been opened in Ohio. The skeletons of a male and female were in it. Under the head of the male was a stone disc which identified the skeleton with another race of people. It is about fifteen inches in diameter, made of limestone, and thoroughly figured on one side with little squares.

Rev. Joshua Anderson, of Waterbury, Conn., said there was no reason to suppose that the American Indians did not extend back a good many hundred years.

The Chairman said it was not wise to come to hasty conclusions in this matter. In the question touching the identity of peoples who have lived in the different ages, more than the evidence of archæology was required. What the peoples were is shown by that which remains of them, the skeleton, jaws, and bones. The Peruvian skull is distinct from the skull of the North American Indian, and it seemed incredible that the two races represented should have been zoölogically the same.

CHIEF DEITIES IN AMERICAN RELIGION.

The first paper was read by Mr. A. S. Gatschet, the subject being the "Chief Deities in American Religion." He said, "The religions of all tribes discovered in North and South America belong to the category of spirit worship mixed with some lower or higher degree of anthropomorphism. Their deities are clearly nature gods, their worship is not a *cult* intended for merely improving the worshiper, but is propitiation, and propitiation is only another form of human egotism. The majority of these gods are austere, cruel and remorseless for their present objects and powers of nature, and like these they show no moral or sentimental aspects like monotheistic deities. At the time of their discovery, and a long time after it, many American tribes, although possessed of religion, seem to have had no priest, no ceremonial rites, no religious festivals, sacrifices or temples, and this induced some travelers who were unable to communicate in their own language and had not remained long enough to study their customs and ideas with becoming thoroughness to deny the existence of any sort of religion among them. Had they enquired for these burial customs they would at once have detected a belief in a future life, and such a belief is inseparable from religious ideas. A close examination of the initiation rights would have revealed the fact that most of these customs are of a religious character, the term religious to be understood, of course, in a more comprehensive sense than the one the Christian attaches to it.

The best term to depict the real essence or quality of American religion is not that of polytheism, but the one of polydaimonism, which means the worship of many spirits. In the motley crowd of ancient and new gods in American religions, a few only rise to general prominence, and among these few one is considered as the principal deity. The chief god is not always the most popular deity among men, but he is regarded as the most powerful among the gods, many of whom are found to be antagonistic to his rule. Chief deities represent a combination of several powers of nature united into one body. In the mythic stories of the people, this chief god is sometimes the most frequently spoken of; at other times he is placed in the background by one or two more brilliant, and therefore more popular creations of the aboriginal mind, and if his obnoxious or terrific qualities make him less attractive to man, his irresistible power will leave him the object of intense dread." The paper proceeded to investigate the chief duties of

South, Central and North America, of which we have any knowledge that is more than superficial. Among them may be mentioned the Botchika of the Muisca people, U. S. of Columbia, the Viracocha or "water-foam" and the Inti of the Peruvians, the Tezcatlipoca or the "shining mirror" of the Aztecs of Mexico, the Amotkan of the Selish, of Washington Territory and British Columbia, the Manibozko among the Ojibbeways. These gods were all found to be solar gods, while other deities of the same nations appearing in their mythology as rivals to the sun-gods or lunar-gods, the most conspicuous of them being Quetzalcoatl of the Aztecs. In looking over the large number of native American sun myths, investigators are induced to prove the opinion of the Jesuit Father Lafitau, who wrote in 1724:—"The sun is the divinity of the nations of America, without excepting any of those with whom we are acquainted. The more tribes we explore, the more we increase the number of men known to be sun worshipers, but through this inquiry another important result may be gathered with the majority of all tribes worshiping the sun, regarding the sun deity as their chief deity."

This the author of the paper claims to be the principal and highly important conclusion derived from his researches on the subject, and it is only the imperfect state in which tribal mythology is generally brought to our knowledge that hinders us from pushing on our enquiries in this direction. The only mode of getting at the real meaning of Indian myths, is to take them down from the myth tellers in their Indian language, and obtain a careful translation of their texts.

Discussion of the paper was adjourned until after the reading of the paper by Mrs. Erminnie Smith, of New Jersey.

BELIEFS AND SUPERSTITIONS OF THE IROQUOIS INDIANS.

Who can say that the first religious lesson (in embryo) received by primitive man may not have been received from the stern teacher, Death, and that a lifeless body did not first force upon him the conception of a spirit and spirits.

If so, the road must have been a long and painful one, from this first formless antecedent of a religious conviction to the complex system of the religions of civilized man.

But even a belief in spirits does not necessarily imply a worship of spirits or a conviction of their everlasting existence.

What stage in religious evolution had the Iroquois attained when first found upon this continent, and what is their religious state to-day.

Strange as it may appear, it is perhaps easier at this distance in time, with the accumulation of experiences, the better knowledge of their language and methods of thought, and the light gained through their folk-lore and traditions to judge of their past condition than it was for the pioneer who labored under the disadvantages and immense difficulties of deciphering a language so different from any written tongue, with all the invaluable scientific aids of comparative mythology and philology, contributed as they are to-day by every civilized nation upon the globe.

Up to within a half century to present a myth acceptably to the reading world, it must first be divested of its aboriginal setting, invested with a hero and heroine, have a plot and counterplot, or, if its kernel admitted, endowed with a great moral lesson laden with some proof of a universal deluge, or Hiawatha-like teach the doctrine of atonement, and repeat the story of the Ascension. The pagan Iroquois of to-day—and there are many—will tell you that his ancestors worshiped, as he continues to do, the "Great Spirit," and that they like himself held feasts and dances in his honor. But a careful study of their mythology proves clearly that in the place of one prevailing "Great Spirit," the Indian's earliest conception of the white man's God—the Iroquois gods were numerous, for all that which with them inspired reverence, awe, terror or gratitude became deities or human beings endowed with supernatural attributes. "Hih-Nun," the beneficent Thunder God of the Iroquois compares most favorably with the same God as worshiped by other races.

Among the supernatural beings corresponding to good and evil genii, we find the Great Heads with ever watchful argus eyes, and long hair which served as wings to bear them on missions of mercy or of destruction.

The only word for heaven in the different dialects is evidently a literal translation of the Christian idea and signifies "in the sky." The medicine man with his supernatural endowments, worked for the good of the Indian, and it is claimed foretold the coming of white man, but the idea of evil spirits inhabiting living forms only came with the white man and his teachings of literal heaven, hell and devils!

Among the highly civilized Chaldeans, Egyptians and Greeks the success of magic depended upon the ignorance of the masses. The Iroquois witch stories would alone fill a volume. Gifted as are their narratives with such scopeless imaginative powers, and free from the trammels of adapting these stories to any standard of possibility, their absurdity might to the pale face seem incomprehensible were not the atrocities of Salem still fresh in his memory. And the same holds true regarding their stories, explaining to their entire satisfaction the various phenomena of nature many of which are the "burning questions" of the scientific world to-day. But how recently were we all content with solutions now considered untenable. Let us then accept these oral traditions reverently as the stirrings of the infant human mind, in its search after the "unknowable" containing perhaps the germ of a belief, certainly revealing that inherent "something" in man which pre-supposes the existence of the hidden forces, powers, or beings in nature. At first this may be but a mere blind feeling, but as man develops it becomes an idea, then a recognized possibility, finally an article of religious faith.

INDIAN MIGRATIONS AS EVIDENCED BY LANGUAGE.

BY HON. HORATIO HALE.

In this paper the author undertook to trace by the evidence of language, verified to some extent by that of tradition, the course of migration which has been followed by the tribes belonging to some of the leading linguistic stocks of North America. The Cherokees were shown to belong to the Huron-Iroquois stock, but to have received accessions to their vocabulary from some other source. The Huron language was shown to be the oldest in form among the languages of this stock. The migration of the Huron-Cherokee tribes was traced in a course leading from the northeast to the southwest, that is, from the lower St. Lawrence to northern Alabama.

The Dakota stock was next considered. The Tuteloes of Virginia and North Carolina were shown to belong to this stock and to speak a language which is older in its forms than the language of the western Dakota tribes. The Algonkin tribes and languages were next examined, and the evidence was exhibited which shows that their migration probably flowed from Hudson's Bay and Labrador towards the south and west. The tribes of the Chahta-Muskoki family were noticed, and the fact was pointed out that their language, like that of the Cherokees, has apparently received accession from some alien speech. Some reasons were given for supposing that this speech was that of the mound-builders of the Ohio Valley. Traditionary and linguistic evidence was adduced to show that the mound-builders were conquered and partly exterminated by the Iroquois and Algonkins, and that the survivors, mingling with the Cherokees and Choctaws, caused great changes in the languages of these nations.

The fact that the course of migration seems to have been from the Atlantic coast towards the interior was regarded as evidence that the ancestors of our Indian tribes were emigrants from Europe. In support of this opinion, reference was made to the close resemblance in structure between the Barnque and Indian languages. It was further suggested that if the Aryan intruders, entering Europe from the east, encountered and absorbed a population resembling the American aborigines, this fact would account for the great changes which the Aryan speech underwent in central and western Europe. It would also account for a very remarkable change which took place in the character of the intruding race. The Aryans, who in the east have always been a submissive and contemplative race, devoid of the idea of popular government, became in Europe a high-spirited, practical nations and liberty-loving people. The conclusion is that the of modern Europe are a people of mixed race, forming a transition, in physical and mental traits, between the eastern Aryans and the aboriginal Americans.

SOME HITHERTO UNNOTICED AFFINITIES BETWEEN ANCIENT CUSTOMS IN AMERICA AND OTHER CONTINENTS.

DR. J. W. PHENÉ, F.S.A , F.R.G.S., F.G.S., OF LONDON.

The author of this paper explained that as one of the great problems to be worked out, or which at least it is desired should be worked out, by all who have given any attention to the subject, is that of the races and civilizations which once flourished at the southern end of the northern continent of America, and which had evident connections with the more northern parts of what are now the United States, through those great ducts, the Mississippi and other vast river valleys, tending to the latter direction, he had devoted many years to the investigation of the subject. He had read papers upon certain particulars of this subject in the capitals of those countries in which he had found corresponding remains, so far as those particulars applied respectively to such countries. Great difficulty, he said, existed through absence of literary records, possibly lost in the destruction of such evidence by the conquerors of Mexico, the only city and country in which civilization with rude but graphic literature and illustration existed on the face of this vast continent. And the difficulty was increased from the fact that, rude as it was, civilization had then reached a point at which literature became essential, and though now, to a great extent, lost had then actually taken root. Arrested by such barriers, any information which bears on the subject was important, the more so if, as in the present case, such information had been carefully collected by the devotion of years of personal investigation and travel to its acquirement.

The customs which are shown to have existed in the great river valleys of America, though read with difficulty by the light of the strange monuments still existing there, seemed to the author to have had parallel existences on the other continents. In evidence of this he gave illustrations, by drawings and diagrams, of many earthworks and stone constructions which had been examined by him in company with a large number of scientific men, and which agreed in the method of executing the earthworks, of arranging the plans and designs, and in the evidently similar purposes for which they were designed, and to which they had been devoted. It was his intention to avoid all theories whether his own or others, upon the origin of the monuments, the nationalities of their constructors, or their special purposes, though the latter in most cases were apparent. Nor should he in this paper give any account of the American earthworks, except where comparisons with others became necessary, as the whole subject of the American works had been so ably brought before the public by such eminent men as the late Mr. Squire and Messrs. Lapham and Davis in the *Smithsonian Contributions to Knowledge* and other works published under authority at Washington.

The points on which he rested his argument for the affinity of the American mounds and earthworks, and, necessarily, the customs with which they were connected, with those of Great Britain and a large number of similar works in France, Spain, Greece, Asia Minor, Persia and China, were, in the first instance, the existence of relationship to each other, always in the vicinity of rivers, of mounds representing animal forms, and—with some special exceptions—the close proximity of vast works of camps for defense, huge enclosures or oppida for civil occupation, and other evidently sacred enclosures for solemn rites, worship and sepulture. In America these evidences went no further, but in the vicinity of the mounds he had traced in Western and Eastern Europe, and in Asia Minor, and still further East, not only were all these features attendant but the localities also abounded with mythological and traditionary legends, and the retention of strange and weird ceremonies to the present day.

He selected as illustrations of the American mounds, those in the forms of serpents, the alligator (or mythical dragon), and the human form. The serpent was shown, by the late Mr. Squire, to have been executed in two ways, viz:—by the solid continuous serpentine form, and by a series of symmetrical mounds uniformly placed in curves. The reader gave examples of each of these, on diagrams, and explained that they existed in large numbers in Great Britain, similar in proportions and construction to those of the American mounds, which were kindred in form, and accompanying these were, he stated, in every case, extensive areas occupied by similar camps and enclosures for civil occupation, or oppida, and also separate enclosures for worship and sepulture. The characteristic physical, natural and art features were also curiously persistent in each case, a triple imagery having been in very many instances studiously represented, both by places of selection, as the vicinity of triple peaked mountains, and in construction, by triangular chambers and triangular enclosures in or about the head of the animal forms, as well in the American as in other similar mounds. Since his arrival at Montreal he had heard of indications of this having been an Indian burying ground. They appeared often to have selected places of previous occupation, as in the mounds; and the triple hill and triangular piece of land at its base were significant. The works in Great Britain, Spain, France, etc., were found to contain chambers filled with cremative matter, and had studied arrangements for preserving the outlines of the animal forms, as shown in the diagrams, and were generally surrounded with vast lithic arrangements, and each, as a rule, was in the centre of an extensive necropolis of the primitive inhabitants The legends and traditions clustering about these places were always of the same class in the other continents, and almost always had reference to man as the possessor and the serpent or dragon as the persecutor or destroyer, and this whether the tradition was one of uncultured and primitive existence, or of the highest classical art ages and localities; and though such traditions did not exist in America, yet not only did their huge mounds simulate these forms, but there had been dug up from their mounds rude sculptured figures of the human form and also of entwined or coiled serpents, showing that in their construction the same ideas, if not similar legends and traditions, had existed, as those which originated the gigantomaxia of Pergamos.

Amongst their numerous and striking examples of these forms in Great Britain, corresponding with the animal and human forms in America, were some very remarkable and yet but little-known representations of the human form belonging to a rude and unlettered age, perhaps corresponding to that of the semi-barbarous age of Mexico, which are found on the coasts of Devonshire and South Wales sculptured in stone, a very remarkable example of which also existed near West Hoathly, in Sussex, which was traditionally stated to have been worshiped as a potent deity (the Goddess Andras) by the early Keltic inhabitants. In the vicinity of these rude figures in the western and eastern extremities of the South of England, were two enormous *intaglio* representations of the human form, corresponding to the *intaglio* forms at Milwaukee, in Wisconsin, only one of which had been mentioned, and that in a very cursory manner, by writers on the comparison of these works with those of America, while their surroundings had been completely overlooked. The one not referred to was by far the more important, both in size and similarity, being in the exact attitude of the mounds in the human form of the American mound-builders. About midway between these two figures was an equally enormous and well-known representation by *intaglio* of a horse.

These figures were all cut in the chalk hills, and might be said to be protecting deities of the three localities in England most abounding in remarkable and vast areas of camps, oppida or settlements, and places of worship. The whole district from Dorsetshire to Land's End being commanded by the gigantic form in Dorsetshire; that of the miles of stone avenues on both sides of the Medway in Kent, terminated by Kit's Coity House at one end, several *aleés couverts* at the other, with the huge stone figure at West Hoathley and the wood of Anderida to the south, were commanded by the similar gigantic *intaglio* figure in Sussex; and the central and more important districts of Stonehenge, with the primitive and stupendous temple of Avebury, its sinuous avenues of stone, and extensive earth embankments, the great tumulus of Silbury Hill, the avenues of stones near Amesbury, in the style of those at Carnac in Brittany, the large number of camps, the trilithon called the "Devil's Den," and the great dolmen known as "Weyland Smith's Cave," appear under the protection of the "White Horse."

Metallurgy, a great feature with the mound-builders of the Mississippi, was also the peculiar occupation of one, if not of two, of these three districts of southern England and of many of the other localities in which similar works were found in Europe and Asia. And such metallurgy was for all utilitarian purposes confined in every such country in which these works exist to the two metals—tin and copper—and analysis showed the proportions in the amalgamation of those metals to have approximated in America, Europe and Asia. The parallelism went further and was continuous in its track eastward. Brittany, Spain and France on each side of the Pyrenees, and so on to Asia Minor had the same combined features. In the valley of the Meander in Lydia, the vast figure of "Niobe," mentioned by Homer, still existed, sculptured on the side of Mount Tmolus, and, as well as that of "Sesostris" in an adjacent valley, also so sculptured, overlooked the district in which are the multitudinous tumuli near the Gygean Lake; and the fortifications and camps of the acropolis of Sardis corresponded with those already referred to in position and design; and the same features were found at Ephesus, Smyrna and Pergamos in a striking degree, and extended, as shown by careful drawings and diagrams, onwards eastward as far as China. Considering the skill and thought required to plan such enormous figures with any regard to proportion, and seeing that all the figures had similar accompaniments, the author concluded by observing that they seemed to him to have been the result of a practice and culture transmitted with concurrent customs by way of the Pacific from one continent to another.

MICROSCOPY.

HISTOLOGY AND MICROSCOPY.

Prof. Tuttle presided and read his opening address. He referred to a little sub-section of the annual meeting of the American Science Association at its annual meeting in 1869. This was the first organization of such a section. Little was then known of microscopy compared with what is known now. Microscopy was then almost in its childhood. In those days any one who wanted to buy a microscope had to hunt for it. The speaker traced the growth of the section and of microscopy in importance. The work of the section had contributed to vastly increase the knowledge of microscopy in the United States and led to the establishment of an American society of microscopists which promises to do much good. He stated the arguments in favor of the establishment of a separate section of microscopy.

The section then proceeded to organize. Dr. R. H. Ward was elected Fellow of the General Standing Committee, Dr. A. B. Hervey, Dr. L. Elsberg and Prof. R. Hitchcock, members of the Sectional Committee, Prof. J. D. Hyatt, the Fellow of the Nominating Committee and G. D. Mitchell, Prof. T. J. Burrell, and C. C. Merriman, members of the Sub-Sectional Committee, to nominate the Vice-President and Secretary for next meeting.

The Chairman then introduced Dr. Wm. B. Carpenter, of London, and announced that Dr. Carpenter would contribute a paper or two for the section.

THE HOUSE-FLY AS A CARRIER OF POISON GERMS.

THOMAS TAYLOR, MICROSCOPIST DEPARTMENT OF AGRICULTURE.

About eighteen months ago, while dissecting the head of a common house-fly, I observed a very minute, snake-like animal, a species of auguilula, moving out of the posterior end of its proboscis, which was ruptured. It measured about eighty-one hundredths of an inch in length by about two one-thousandths of an inch in diameter. Subsequently I determined to ascertain the interior dimensions of the suction tube, or proboscis, of the house-fly, for the purpose of comparing it with the diameter of this parasite. Placing a fly which I had asphyxiated with naphthaline on a glass slide, and securing it on its back by means of thick gum, I was able to measure the parts and observe all the movements of its proboscis, and found its suction tube to be of sufficient diameter to admit of taking up the spores of cryptogams, trichinæ, the eggs of auguilula, or even the auguilulæ themselves.

Noticing a violent commotion in the abdomen of the fly thus operated on, I became convinced that one or more of the auguilulæ were present in the abdomen, and were the cause of the unusual movements observed. On removing the head of the fly, a lively auguilula was seen moving out from one of the ruptured ends of the œsophagus. The animal was quickly secured, and placed under a glass cover in a drop of water, where it exhibited very eel like or snake-like motions. Shortly a second appeared, when all commotion in the abdomen ceased.

Of the genus auguilula there are upwards of one hundred known species. They abound in the mosses, in damp earth, and on the green algæ found growing on the walls of moss-covered flower-pots. Auguilulæ are very numerous about the roots of vines, plants, and grasses, and are generally found on decaying moist grain—as wheat—on the bark of trees, and sometimes within fruit while growing. One species of them is found in very large numbers in vinegar. The species I have found in the house-fly exhibits different internal structure, in some respects, from any others that I have yet examined. Whether it is identical with that observed in India by Dr. Carter, and more recently by Dr. Leidy, of Philadelphia, to which the name of filaria muscæ, and also by Cabold, the name auguilula muscæ has been applied, I cannot determine in the absence of detailed descriptions and drawings representing members of that species.

The facts above stated suggested to my mind the importance of instituting a series of experiments to ascertain whether house-flies might not be carriers and distributors of germinal virus. I have found in the proboscis of a single house-fly thirteen of the animals already mentioned in a perfectly developed condition, and on the thorax of another I have found sixteen living parasites of the genus acarus. It therefore seems quite possible that other microscopic organisms might be taken up by the house-fly, and again deposited where they might prove dangerous to man. This might easily happen in the case of trichinæ, as trichnosed cut meat is frequently exposed for sale in our markets, where flies abound. Considering the habits and habitats of the house-fly, it will appear evident that should it prove to be a carrier of poisonous bodies, its powers to distribute them in human habitations is greater than that of any other known insect. Under our system of public travel, the common house-fly may be transported from one end of the continent to the other. It may feast to-day in the markets of Washington, and to-morrow in those of New York, and in a like manner it may be transported from a hospital for contagious or infectious diseases to homes in the vicinity, or even in remote localities. It may also be taken from one hospital to another, or from one ward to another within the same hospital, and may plant the germs of disease in exposed wounds, or deposit them in food, or liberate them in the atmosphere breathed by patients affected by diseases of a different class.

Many of the germs of putrefaction—spherical bacteria, for example—are individually not larger than one forty-thousandth part of an inch in diameter, and over 30,000,000 of these in a state of aggregation could pass through the eye of the finest needle; and owing to their minuteness, millions of such germs could easily be carried to a distant city by a single fly. We should take into consideration also the rapidity with which such forms of bacteria multiply. A bacterium which will reproduce by fission (the one dividing into two) in one hour may in twenty-four hours have a posterity of 33,000,000, for a geometrical progression of twenty-four terms, with one for its first term and two for its common ratio, has 33,554,432 for its twenty-fourth term.

To test practically the question whether flies may become the carriers of contagious germs, I instituted a series of experiments. In a glass receiver having a capacity of about five gallons of air, I placed several hundred house flies which had been caught in an ordinary fly-trap. Within the receiver was placed a quantity of the spores of the red rust of grasses, (tricholoma rubra-vera). The flies at first did not seem to esteem the spores as suitable food, but on the morning of the third day I found that the rust was replaced by larvæ and remains of eggs of the common house-fly.

The eggs were deposited and hatched between Saturday noon and the following Monday morning, 9 o'clock, or in about forty-eight hours On the following day I placed in the receiver about a quarter of an ounce of the same description of spores combined with sugar. The flies partook of this confection, consuming the sugar and most of the spores. In about twenty-four hours after the flies had partaken of this mixture I killed and dissected a number of them, and found the small intestines intensely colored, of a deep reddish orange shade, representing the digested spores of tricholoma. I observed in the contents a few well-defined orange spores, but none of them appeared to have germinated.

Fastened between the hairs on the limbs of each of the flies examined I found a number of the spores, and the efforts of the fly to get rid of them only resulted in attaching them more firmly to it. They might, however, be brushed off by objects with which they were brought in contact, while their germinating powers would long outlast the life of the insect itself. It was evident from this experiment that flies were capable of conveying such spores to plants and other bodies. On the other hand, the fact that by far the greater part of the spores were consumed, in the one case by the larvæ of the fly and in the other (*i. e.*, when mixed with sugar,) by the fly itself, shows that this insect may destroy microscopic germs as well as disseminate them, and indicates that in some cases its agency in keeping down their number may more than counterbalance its action in contributing to their dissemination.

In another experiment a quantity of yeast was mixed in water and placed under a glass receiver into which the fly-trap had previously been emptied. The flies partook sparingly of the yeast fungus, and after the lapse of forty-eight hours several of them were found dead, but the rest, amounting to several hundreds, appeared wholly unaffected. On examining the abdomens of the dead flies I found them congested and cheesy; and when the intestinal contents were mixed with pure water, a drop placed under the microscope was found to be strongly charged with both spherical and rod-bacteria and with several kinds of spores, but very few spores of the yeast-plant were seen. Several flies, which were immersed for a moment in yeast water, died in about twelve hours after immersion, while those not so treated sustained no apparent injury, though confined several days in the same chamber. But I do not consider the experiment conclusive as to the injurious effects of the external application of yeast on flies. I propose to test this question more fully at a future time.

The odors of the yeast on the fourth and fifth days, although very obnoxious to the human olfactories, did not seem to affect the health of the flies. In my next experiment, several hundred flies were confined in a glass receiver as before, in which was placed about an ounce of fresh beef thinly cut. A small quantity of pure water was also supplied in a watch-glass. The flies for a while enjoyed the beef and the water. Their consumption of the beef was proved by well defined cavities which they made in it, and the fact that solid tissue was thus consumed by the flies affords another evidence of the facility with which the eggs of auguilulæ, including those of trichinæ, if present in meat partaken of by them, might be passed through their proboscis along with food.

On the fifth day of their confinement I observed that a number of the flies died within the chamber. By this time the meat was in a state of advanced decomposition, and its odors were very offensive.

In comparing the results of this experiment with those of the one last described, it appears that the odors emitted from decomposing beef were much more hurtful to the flies than those proceeding from decomposing yeast. I removed with a knife all the soft surface portions of the beef which were exposed to the flies my object being in part to ascertain whether any auguilulæ had been deposited on the beef by the flies. I also examined the water for auguilulæ, but failed to find any in either case. On two occasions I have observed an auguilula bore through the membrane of the anterior portion of the proboscis of the fly and emerge from the hole thus made. In using a power of about 500 diameters under favorable conditions it will be seen that these animals are armed with a boring apparatus, consisting of from three to four projections, situated on the anterior portion or mouth parts of the animal. The precise form of the mouth parts is not easily defined, and its ascertainment is rendered more difficult by the great tendency of these animals to shrink and become distorted in most of the mounting fluids, or to become too transparent in others. Under a power of seventy-five diameters the general structure is very well defined, but a one-tenth immersion is required to give proper defination of the nervous system. In practice I find that a strong solution of pure white glucose serves the purpose of a mounting fluid better than any of the mounting fluids in general use.

ECONOMIC SCIENCE.

ECONOMIC SCIENCE AND STATISTICS.

The economic science and statistical section met at half past two to hear the address of its Vice-President, Mr. E. B. Elliott, of the Treasury Department, at Washington, U. S. There was a good attendance of members. Mr. Elliott said:—In 1857, at the former meeting held in Montreal, I had the honor of reading a paper on the mortality statistics of the State of Massachusetts. A resolution was presented at that meeting inviting Congress to commence a registry of births, deaths and marriages. A committee was appointed to report on the various registration systems and what was desirable in order to come to some practical end. At the last session of Congress a resolution was introduced into the Senate requiring the bringing about of a co-operation of the General Government with the several State Governments to secure some uniformity. The Cherokee Indians had made a very full census, and the conclusion arrived at was that we might have full tables from them before we had them from some of our own States.

This section enters on its separate action this year. Economic Science and statistics, economics relating to man and his welfare, man, what he is, what he controls, and the surroundings over which he has little or no control. The subjects of this section are scientific, they had to deal with facts. They might, however, attain to questions to which statistical methods are adapted. Facts susceptible of numerical statement and of arrangement into groups, numerical laws based upon and eliciting facts which will admit of, and offering facilities for their trustworthy production in the future, as, for example, the construction of life and annuity tables, and the financial condition of communities. It may be desirable, at some not very distant date. to organize a sub-section to consider the application of the mathematical doctrine of probabilities to statistics. One of the subjects pertaining to this section is that of standard time. Man, until a few years ago, might be considered as stationary, of late moving. There are more than seventy different standards of railway time in this country, and these might be reduced to one, or at any rate, three. The study of the laws of trade was another subject worth attention. The construction of life and annuity tables, the question of finances, and the divisions of time were all belonging to this section. When the Julian Calendar was changed to the Gregorian a very important change was made, but there might still something be done, as for example equalizing the months as near as possible. These were a few topics which might be brought before the section.

MISCELLANEOUS ITEMS.

OPENING OF THE REDPATH MUSEUM.

On Wednesday evening the formal opening of the Peter Redpath Museum took place, and the occasion was embraced by Principal and Mrs. Dawson to hold a reception of the members of the Science Association. Shortly after eight o'clock guests began to arrive, and for an hour and a half carriages were rolling up the University drive to the Museum. Guests were received by Dr. and Mrs. Dawson in the large hall. The number present would be about six hundred, of whom half were ladies. Among the guests were nearly all the principal *savans* attending the Meeting and also the *elite* of Canadian society. From the gallery spectators had a fine view of the brilliant scene below them.

By nine o'clock the various rooms presented quite an animated appearance, the various objects in the Museum being well inspected. Here and there in a quiet corner might be seen some old gentleman who had found a treasure enjoying his intellectual treat. Dr. W. B. Carpenter, of London, exhibited some photographs taken from figures of the *Eozoon Canadensis* which were highly appreciated. The general appearance and arrangement of the building gave great satisfaction, one gentleman being overheard to say that he had seen almost all the principal museums in the States, but no one could boast of a home as good as this. About half past nine the ceremony of presenting the deed of gift took place. Upon a raised platform at one end of the Hall, Principal Dawson took his stand, and with him were Chancellor Day, Mr. Peter Redpath, Mr. W. C. Baynes, Registrar, and Mr. R. A. Ramsay, Treasurer of the University, also Dr. Carpenter, of London, and Professor Hall, of Albany.

The Chairman briefly introduced to the gathering the benefactor of the museum.

Mr. Redpath said: Mr. Chancellor,—I would fain have had ceremony dispensed with on this occasion, but as some ceremony seems to be demanded I am here by invitation for the purpose of transferring to you as the representative of McGill University, in the presence of this distinguished company, all my right, title and interest in the building in which we are assembled. The conveyance without other condition than that the building shall be maintained for the purpose for which it has been erected, will be found in the document which I now place in your hands. The undertaking was not begun without deliberation, and now that we have come to the end under such happy auspices, I see no reason to regret what has been done. I trust that the benefits which it was intended to confer will be realized.

Chancellor Day then said: Mr. Redpath,—It is my good fortune, as Chancellor of McGill University, to be its mouthpiece on this auspicious occasion. In the name and on behalf of that institution, I accept the gift of the Peter Redpath Museum, now formally conveyed to it. It is a difficult task to express in fitting words our sense of the obligation under which you have laid, not only this University, but also the friends of education, in the interesting and important department of science which your liberality is intended to promote. The architectural beauty of this edifice in which we are assembled—its classic design—the elegance and completeness of its finish, make it of itself an education of no small value; while, joined to these excellences, its ample proportions and perfect adaptation to its destined uses indicate the munificence and wisdom of its founder. We trust it will remain for future generations what it now is, a majestic monument, bearing the honored name of him in whom the power of riches has been added to the better gift of a disposition to distribute them with a bountiful hand for the welfare of mankind. Reference was then made to the collection which Dr. Dawson had presented, and the Chancellor proceeded.

The prodigious growth of material prosperity in our age, the marvelous creations of art and industry which cover the face of the civilized world, and the consequent increase in dangerous luxury have in them a voice of warning. History tells us what they mean if left to themselves, without the restraining and elevating agencies which build upon them a true and permanent civilization. We accept this hall of science as a noble contribution to those higher agencies, and now before this assembly, made august by the presence of our distinguished guests, true kings of the realm of thought; their presence, and in the presence of the benefactors of this University, enlightened men, and not less sympathetic and generous women. We dedicate the Peter Redpath Museum to the study of the varied and wonderful manifestations of God's creation, and emphatically we dedicate it to the use of the earnest student, who in reverent questioning of the works of living nature, and in their records upon the stony tablets of a dead and buried world, seeks that vital truth which, above all other things, it imports the immortal spirit of man to know.

Dr. Carpenter was then called upon to say a few words. He said when he received the invitation to take part in the meeting he felt that he could not refuse, because he wished to give expression to the very strong and earnest interest he felt in this beautiful city. Nothing had been of greater interest to him since he had been in the city than to be accosted on all sides as the brother of Philip Carpenter. Every citizen of Montreal seemed to have known and honored and loved him. All honor was due to the donor of that building. Reference was made to the remarkable collection of fossils, termed *eozoon canadense*, and to the numerous opportunities afforded to students to acquire knowledge now as compared with the opportunities which existed when he was a young man. He rejoiced at the thought that natural science was now fairly on its legs, and he was confident that it would keep pace with all the great departments of physical science, and concluded with a eulogy upon science as a means of disciplining the mind.

Professor Hall entered into a brief description of the collections. He said they had been placed in order to allow the study of them from the earliest to the most recent geological period. All that was required now was a staff of teachers which would render available all these valuable objects, instead of permitting them to lie idly upon their shelves. The building was in itself a beautiful object of art, adapted for the work in its systematic arrangement.

Dr. Dawson briefly acknowledged on behalf of the Association the great benefits that had resulted to science from this benefaction, and the meeting separated, many to see the exhibition of photographs of American caverns, with explanatory lecture by the Rev. H. C. Hovey, New Haven, Conn., others to still further examine the valuable collections in the Museum.

During the evening choice selections of music were rendered by the band of the 6th Fusiliers.

THE TRIP TO QUEBEC.

Quebec and its neighborhood are so rich in historic associations, so full of interest to the student of science, that the large number of those who took advantage of the opportunity to visit the ancient Capital, is not surprising. The excursionists left by the steamer Canada, which had been placed at their disposal by the Richelieu & Ontario Navigation Company, shortly after half-past seven o'clock on Friday evening. In the morning, people began to throng around the sides of the boat to catch the first glimpse of the "Gibraltar of America." Shortly before eight o'clock the Canada hove to at the Richelieu Company's wharf and the coming of the Committee of Reception was awaited.

Punctually at a quarter to nine His Worship the Mayor the Hon. F. Langelier, together with several members of the City Council and local committee of reception, came on board and were received and introduced by Dr. T. Sterry Hunt, Professor Mendenhall, Dr. George Cooke, Professor Eastman, Dr. Proudfoot, Mr. J. S. Shearer, Major Huguet-Latour, Professor Harrison and Professor Trowbridge. After a short time spent in introductions and conversation the whole party left the boat and wended their way to Dufferin Terrace, where the formal welcome was to take place

From the Terrace the party made their way to the Citadel, the Mayor acting as *cicerone* to the leading group of *savants*. The whole of the fortress was, through the kindness of Lieutenant-Colonel Irwin, thrown open to visitors who showed the greatest interest in everything they saw, wandered from the sally-port to the King's Bastion whence they gazed in admiration on the magnificent view obtainable from that lofty point, and having feasted their eyes on a panorama of country unsurpassed in this country, visited in turn the different points of interest within its walls.

Laval University was the next point to which the visitors were conducted. Here they were most courteously received by the Rector, the Rev. Mr. Hamel. Guided by that gentleman, Dr. T. Sterry Hunt, and still by Mayor Langelier, who is a distinguished graduate of the University, and holds the professorship of Civil and Public Law, the party inspected the class-rooms and museum and picture gallery. Leaving the quiet of this abode of learning, to which the busy hum of the wharves, the next destination of the visitors, presented a strong contrast, the steamer Canada was again reached.

At one o'clock the steamer started for an excursion around the harbor, visiting St. Romauld, the graving dock at St. Joseph de Levis, the Falls of Montmorenci and the new harbor improvements at the mouth of the St. Charles. Lunch was next in order. The bill of fare was somewhat a curiosity in its way, and copies were eagerly sought for as souvenirs. We subjoin it for the benefit of those who failed to obtain it on board. The compiler, we are informed, was a gentleman named Bazerque:

MENU.

PIECES MONTEES.

Les Aiguilles de Cleopatre a la Mariette-Bay. LeCosmos de Leibnitz.

HORS-D'OUVRE.

Sardines d'Archimede, et Thales. Olives en postulatum d'Euclide.
Croque en bouche Apollonius. Beurre de Copernic et Pascal.
Theoremes algebriques de Diophanie. Viete et Dawson.
Geometrie descriptive de Monge. Calculs Trignometriques d'Hipparque.
Sinus d'Euler et Descartes. Pendule d'Ebn Ionis.

POTAGE GEOLOGIQUE.

Eli de Beaumont, Lavoisier, Bernard Palissy, Huygens.
Werner, Logan, Hunt.
Lyell et Brongniard. Scipion de Breslack.

ENTREES.

Filets d'Aristote et de Cuvier.
L'Homme de Platon, emince a la mode d'Aristote.
Jambons du Chimborazo a la Humboldt.
Vibrations de Canard a la Galvani, Bunsen et Volta.
Les Cotelettes d'Agneau a la Tycho-Brahe.
Galantine de Volaille a la Franklin.
Langues a la Cuvier Newton. Gibier a Oersted, Jamin, Dana, Mayer,
Aspics de Cleopatre a la Gullieb, Haller, Halley.
Milne Edwards, de Magendie.

ROTIS.

Le Canards a la Darwin, Littre, Lockyer, Langley et Maury.
Les Roastbeef a l'Hoppocrate et Bichat.
La Tete de Veau braisee a la Lavater.
Logarithmes de Monton a la John Na per.
Bombe Glacee au Magnetisme terrestre de General Sabine.
Evolutions de Faisan a la Galilee.

DESSERT.

Eclairs Edison. Peches de Monge et Agassiz.
Amades Laplace et Lacondamine. Raisins Wurtz et Arago.
Abricots Champollion. Prunes Gallien.
Noix Boussingault, Bertrand, Kœnig.
Claret Punch Jules Verne et Flammarion.

On the return trip the visitors were asked to assemble in the main cabin, and the Mayor, ascending the upper gallery, proposed the first of the toasts, that of "Her Majesty the Queen." The sentiment met with a hearty and generous response, and amid cheers the band played the National Anhem. "The President of the United States" followed, accompanied by the inspiring strains of "Yankee Doodle" and an outburst of cheering. Mr. Wasson, the American Consul, responded in an exceeding happy manner. "The Governor-General and Her Royal Highness the Princess Louise" having been honored loyally, "Our Guests" was given, the band playing "The Star Spangled Banner."

Dr. Sterry Hunt being loudly called for, replied. Dr. Hunt alluded to his long connection with the Association, spoke of its international character and the progress of the work it had in hand; referred to its previous visit to Quebec, and in closing, described some of the interesting features of Quebec, both from a geological and historical standpoint.

Dr. Barker also replied appropriately.

The Hon. D. A. Ross then introduced Mr. J. M. Lemoine, F.R.C.S., who gave a brief but very interesting sketch of Quebec history. Mr. Lemoine had also prepared some memorabilia for the information of the visitors, which were printed and distributed amongst those on board.

The business of speech-making being concluded, the Canada, a few moments afterward reached the wharf again, and the passengers, bidding adieu to their Quebec hosts, landed and made their way to the North Shore Railway station.

At a quarter to seven the homeward bound train, placed at their disposal by the North Shore Company, moved out of the station.

To Mr. J. S. Shearer and Dr. Proudfoot, of the Montreal Committee, credit is due for their untiring efforts to promote the comfort and pleasure of the visitors. Mr. Shearer especially deserves the thanks of one and all for his unfailing courtesy, and his excellent management in the face of considerable difficulty and discouragement. To him the excursionists were certainly largely indebted.

THE EXCURSION TO OTTAWA.

On Saturday, the 26th, a large number of the members visited Ottawa, having with them a goodly gathering of their lady relations. In the programme of the convention the day had been set apart for excursion trips, of which the members had the choice of two, the one to Quebec and the other to Ottawa. The start was made from Hochelaga at 7:30, where a train of parlor cars was in waiting for the excursionists. The varied views along the road were the continual theme of admiration from the party, particularly along the upper portion of the route where the rapids are to be seen crossing the bridge at Buckingham, the pretty views about Montebello, Papineauville, Gatineau and other stations highly appreciated. There was a general sense of surprise, not only at the natural attractions of the route, but at the agricultural state of the country through which the road ran. At Buckingham the lumber yards were a source of astonishment to many who had never been through such huge wood yards before. This brought the party also into the phosphate region and to the gentlemen who took an interest in geology, the many cars of ore along-side the track awaiting shipment afforded subject for keen investigation. A stay of a few moments enabled several of the party to fill their packs with rocks, all glad to have secured specimens of the article from the home of its birth. At East Templeton the quantity of iron ore awaiting shipment there was also the subject of comment, and the view of the material itself opened to many of the gentlemen new ideas of the value of the country through which they were traveling. At several places some members of the botanical section of the party might be seen gathering specimens.

At Montebello the special met the regular down train from Ottawa to Montreal and took on board Mr. W. P. Anderson, Secretary of the Ottawa Reception Committee. That gentleman brought with him copies of the address of welcome to be read to the party on their arrival in the city, cards of invitation to the luncheon to be tendered them and "a souvenir of Ottawa." These were rapidly distributed to all on board by Mr. Anderson, Dr. Baptie and Dr. Thornburn. The souvenir was in great demand among the excursionists and after a glance at it many were the requests made to the Secretary for additional copies to send to friends at a distance, requests which he complied with as far as he could.

The souvenir consisted of a neatly gotten up pamphlet of convenient pocket size of some twenty pages of reading matter, giving the programme laid out for the day, the names of the members of the General Reception Committee, the special committees and other officers, together with a succinct statistical and descriptive account of the expenditure by the city for public improvements since confederation, notes as to the churches, geological museum, the Rideau Canal, the Parliament Buildings, Rideau Hall, the public schools, waterworks, the timber trade and the mineral and other resources of the district. It contained also several well executed lithographic views of the principal points of interest about the city, and several pages of blank paper for the use of those who wished to make notes. The train rushed on at a rapid rate, and shortly before reaching Hull the first view of Ottawa was had. No stoppage was made at Hull, and the train swept on to the long bridge over the Ottawa River. The view from this structure delighted all, and the only expression of regret was and it was a universal one—that there was not longer time to enjoy it. Looking up the stream was the pretty panorama of the many picturesque islands which stud the water, the channels sprinkled with floating cribs and logs, and further up the rapids of the Little Chaudier and the waters of Deschesne Lake. On the other side of the town, below the bridge, could be seen the spray rising from the "Big Kettle," into which the gigantic mass of water seemed to silently disappear, for the loud roar of the "fall" was lost in the rumble of the wheels, and before and behind was spread the vast array of lumber mills and the yards and the factories which have been created about the Chaudiere and which are justly the wonder of all visitors to the Capital of the Dominion.

From the Chaudiere the party proceeded *via* Duke Street to the central part of the city, passing *en route* the waterworks. Here the full force of the pumps had been put on and a grand jet was thrown up from the yard in front of the pump-house. Both the water and waterworks at Ottawa are unsurpassed in this country.

The Parliament buildings were reached after a rapid drive along Wellington Street. The carriages entered the grounds at the western entrance, passing up along the Supreme Court buildings and between the conservatory and the western facade of the west block and thence to the summer-house west of the Parliament buildings. At this point all alighted and viewed the surrounding scenery. The magnificent panorama drew enthusiastic remarks from all as a view of extraordinary beauty.

The Library was next visited, and the opinion expressed by all was that it was the finest structure of the kind on the continent. The busts of the various statesmen about it were curiously scanned; none more attentively than that of Sir William Logan. The House of Commons and the Senate Chamber were also visited, but owing to the repairs now going on in the former and in the main entrance, and the Senate Chamber being covered up, the rooms could not be seen to fair advantage. After inspecting the buildings the carriages were again taken to the Drill Hall, where luncheon was prepared. The hall had been very tastefully decorated for the occasion. The walls were handsomely draped with bunting and military trophies and decorated with shields bearing the coats of arms of the provinces and chief cities of the Dominion.

Midway along the western hall a stand had been provided for the few distinguished gentlemen who were expected to say a few words on the occasion, and for the representatives of the city appointed to receive them. The little party on the platform consisted of Dr. Dawson, President of the Association, Dr. Gray, of

Cambridge, Mass., the oldest ex-President of the Association, Dr. Newberry, of N. Y., Dr. Carpenter, of London, England, Dr. Szabo, of Hungary, Dr. Gilbert, of Rotherham, England, Dr. Rae, the celebrated explorer, of London, England, His Worship the Mayor, Dr. St. Jean, Mr. C. H. Mackintosh, M. P. for Ottawa, and Dr. Sweetland. Besides the excursionists there were present large numbers of citizens too numerous to mention, including the best representatives of the profession and commercial sections of the city. Mr. Mackintosh, member for the city, briefly said he was happy to be present at the assembly and asked His Worship the Mayor to take the chair. Dr. St. Jean at once complied and then read a warm address of welcome.

He then requested the company to proceed to lunch, which all were ready for after the long journey.

The committee deserves the greatest credit for the lavish entertainment. Of everything on the *menu* card there was abundance and to spare. The attendance was also excellent and ample. After luncheon the chairman said that it would afford great pleasure to hear a few of the gentlemen present.

Mr. Dawson, of McGill College, Montreal, in reply, said that he had very much pleasure, on behalf of the association of which he was president, to return the society's hearty thanks for the cordial greeting which had been extended them by the citizens of Ottawa, and much more of appropriate character.

Dr. Carpenter, on behalf of his fellow countrymen and himself, was happy to say that there was never a more delightful meeting of the association, and he would beg to return their most cordial thanks to the citizens of Ottawa for the fine reception which had been accorded them, which he could assure them was thoroughly appreciated by them.

Prof. Asa Gray, Dr. Jno. Rea, Mr. Perley, Prof. Newberry and Dr. Grant followed with similar remarks.

Three cheers for the Queen terminated this part of the programme.

After the speeches the party dispersed in various directions, many going to Rideau Hall, Beechwood and other places. All rendezvoused at the Union Station at six o'clock and discovered that the train would not leave till eight o'clock. In consequence of the unexpected delay many of the party were the welcome transient guests of several who had gone to the station to see them off. Our own personal thanks for courteous attentions are due to Mr. and Mrs. McLeod Stewart.

On Sunday, August 27th, the annual prayer meeting, inaugurated at the Saratoga meeting, was held and was participated in by Principal Dawson, Prof. H. C. Hovey, Prof. Lovewell, Prof. Bassett, Rev. Dr. Mathewson, Rev. James McCaul, Rev. Mr. Hungerford, Prof. C. W. Hall and others.

NOTE.—An account of later proceedings will be given hereafter with full report or copious abstracts of some of the more important papers, especially one on Anthropology by Prof. F. W. Putnam.—[ED.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.24, on the 5th of September. Lowest barometer during month 28.78, on the 17th.

Highest temperature during month 104°, on the 13th. Lowest temperature during month 46°. on the 20th.

Highest velocity of wind during month 33 miles per hour, on the 19th.

The usual summary by decades is given below.

Temperature of the Air.	Aug. 21st to Sept. 1st.	Sept. 1st to 10th.	Sept. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min.	62.2	53.9	62.3	59.4
Max	88.8	81.2	92.6	87.5
Min. and Max	75.3	67.5	77.5	73.4
Range	26.6	27.3	30.3	28.1
Tri-Daily Observations.				
7 a. m.	65.0	60.3	69.4	64.9
2 p. m.	82.0	82.0	89.0	84.3
9 p. m.	78.0	68.0	73.0	70.3
Mean	72.0	69 0	76.2	72.1
Relative Humidity.				
7. a m.	.86	.82	.83	.84
2 p. m.	.51	.45	.50	.48
9 p. m.	.80	.73	.75	.76
Mean	.71	.66	.69	.72
Pressure as Observed.				
7 a. m.	29.06	29.11	28.97	29.04
2 p. m.	29.03	29.07	28.95	29 01
9 p. m.	29.03	29.07	28.98	29.02
Mean	29.04	29.08	28.97	29.03
Miles per Hour of Wind.				
7 a. m.	7.0	4.1	15.1	8.7
2 p. m.	13.4	10.0	26.9	16.8
9 p. m.	7.8	9.7	19.0	12.1
Total miles.	. .	2396	5168	. .
Clouding by Tenths.				
7 a. m.	2.5	3.7	3.3	3.1
2 p. m.	5.4	4.3	1.9	3.8
9 p. m.	3.2	1.1	1.5	1.8
Rain.				
Inches	.00	.00	.12	.12

BOOK NOTICES.

Report of the Commissioner of Education for 1880. Hon. John Eaton, Commissioner; 8vo. pp. 914.

The eleventh annual report of the Commissioner of Education, covering the year 1880, has been received.

We learn from it that the present year has been marked by a great increase in the amount and value of the information received at the office with reference to the conduct of education in our own and in foreign countries, and by a corresponding increase in the public demand for the distribution of information. The means allowed the Office for carrying on the interchange of intelligence are entirely inadequate, whether regard be had to specific inquiries or to information which should be published in the general interest of this department of public affairs.

Seven circulars of information and six bulletins have been published during the year, comprising among others the following subjects: College libraries as aids to instruction; rural school architecture, with illustrations; English rural schools, with illustrations; a report on the teaching of chemistry and physics in the United States; vacation colonies for sickly school children; the Indian School at Carlisle Barracks; industrial education in Europe; medical colleges in the United States.

The number of American correspondents of the Office, including officers of State and local systems and institutions of learning, is 8,231, or more than four times the number at the beginning of the present decade. To the material derived from these sources must be added the foreign matter, reports and periodicals, all of which must be examined and summarized for the report.

In introducing the statistical summary the Commissioner explains the scope and value of a perfect system of tabularization and points out some of the deficiencies in the plans pursued in various States and localities. Great improvement in this respect is noticeable in the returns and reports received at the Office, and every year increases the value of the figures for purposes of study and generalization. So far as practicable the statistics in the present report include a comparative view of education for the decade ending 1879-80.

The total school population in the States for 1880 is 15,351,875; number enrolled in public schools, 9,680,403; average daily attendance, 5,744,188, four States not reporting. The school population of the Territories is 184,405, Idaho and Wyoming not reporting; enrollment in public schools, 101,118; average daily attendance 61,154, two Territories not reporting. The percentages of enrollment and average daily attendance are highest in Massachusetts and lowest in Louisiana.

We select a few points of interest regarding our own immediate region. In Missouri growth meets us for both 1879-80 and for the decade which then closed, the enrollment in the public schools in 1879-80 exceeding by 26,594 that of the year before and by 5,263 the increase of youth entitled to free schooling, while 11,710 more children were in average attendance daily in 546 more schools, under teachers better trained and changed less frequently than in former years. Permanent school funds increased by $1,408,580, though school property was rated $1,646,599 less in value and current school income fell off $62,671.

For the whole decade there was great advance at every point, the additional public school enrollment including at the close 57,265 more youths than had meantime come of school age, making thus a deep inroad into the mass of the previous illiteracy, while an average of 32,108 more of the enrolled were in the schools each day. This, with an increase of 1,699 public schools, of 1,631 teachers for them, of $2,333,287 in receipts for schools, and of $4,261,383 in the permanent funds for the support of them, is a record of which the State may well be proud.

In Kansas,—progress at almost all points marks 1879-80 as compared with the preceding year: 28,416 more persons of school age, 23,000 more in the State schools, and 13,952 more in daily attendance, with provision for this increase in 310 more school-houses. There were 858 more teachers engaged at somewhat higher pay and an addition of $291,944 to the current school revenue. Still further evidence of progress appears in 163 more districts with uniform text books, 673 more with graded courses of study, and a rise of $225,908 in the valuation of school property.

This Report is a work upon which a vast amount of labor has been expended and from which all teachers and others interested in education can obtain information on all appropriate points.

Sparks From a Geologist's Hammer. By Alexander Winchell, LL.D., Second edition, 12mo. pp. 400. S. C. Griggs & Co., Chicago; $2.00.

The first thing that attracts attention upon picking up this book is its extremely tasteful binding and the general excellence of its make up. After that the contents engage the reader's mind and hold it continuously till the last page is reached. As long ago as 1870 the writer purchased a copy of this author's "Sketches of Creation" and found it most fascinating and suggestive reading. Since then he has hastened to obtain copies of each successive work by Professor Winchell, including "The Preadamites," and now the volume under consideration. In all the same accuracy of expression, the same wide range of information and thought and the same scholarly though popular manner prevail, so that it is adapted to all classes of intelligent readers, from professor to pupil.

The present volume is devoted to a variety of topics, descriptions, essays, and discussions of scientific subjects which are classified as Æsthetic, Chronological, Climatic, Historical and Philosophical. Under each of these heads are several appropriate chapters, such as a description of Mont Blanc and the Mer de Glace, The Old Age of Continents, A Grasp at Geologic Time, Geological Seasons, A Remarkable Maori Manuscript, The Genealogy of Ships, Grounds and Consequences of Evolution, etc. All of these are treated in an attractive manner, popular, but at the same time comprehensive and practical. No reader having bought a copy of this book will regret it nor will he fail to read it more than once if he has any real desire to acquire the most advanced ideas and the most reliable information on the subjects treated.

THE COUES CHECK LIST OF NORTH AMERICAN BIRDS. Second edition; 8vo. pp. 144. By Elliott Coues, M. D., U. S. Army. Estes & Lauriat, Boston, 1882. For sale by M. H. Dickinson; $2.00.

The original of this work, which now assumes the character or position of a dictionary of the etymology, orthography and orthoëpy of the scientific names of birds in addition to its former character of a catalogue of such names, was published in 1870 and seemed to cover the necessities of ornithologists at that time. But so rapidly has the science advanced that revision has been rendered necessary and a large number of new names has been added.

The most interesting portion of the work to the ordinary reader will be the chapter entitled "Remarks upon the Use of Names." In this a full account of the derivation of the technical terms used by ornithologists is given, also of the rules for the proper spelling and pronunciation of such words. These rules are not applicable solely to ornithological terms and names, but are of general application and may be beneficially studied by all.

The great bulk of the work is devoted to a revised check list of the birds of this continent and a list of the author's works upon the subject. A very useful feature of the former is the accent marks showing the proper pronunciation of all names. Nothing so thorough has ever been published so far as we know.

FLOATING MATTER OF THE AIR. By John Tyndall, F. R. S.; 12mo pp. 338. D. Appleton & Co., N. Y. For sale by the Kansas City Book & News Co., $2.00.

The object of this work is to demonstrate the existence of germs in the atmosphere which produce and spread dangerous and fatal diseases, with numerous accounts of interesting experiments made by the author and other scientists, both as to their existence in the air and their non-production in the absence of atmospheric air; the triumphs of the antiseptic system of surgery and the vital importance of pure air and pure water as sanitary agents. The most valuable chapters are those upon Dust and Disease, The Optical Deportment of the Atmosphere in Relation to Putrefaction and Infection, Researches on the Deportment and Vitality of Putrefactive Organisms, Fermentation and its Bearings upon Surgery and Medicine, and Spontaneous Generation.

It is a deeply interesting book, with a practical bearing which affects the welfare of mankind, combined with a broad philosophical treatment adapted to the most advanced thinkers and humanitarians of the age.

COLLET'S HISTORICAL RECORD. By Oscar W. Collet; 2 Vols. 8vo., St. Louis, Mo.; $10.00.

Mr. Oscar W. Collet, of St. Louis, is receiving subscriptions for a work to be entitled, "The Historical Record," a compilation of all documents, wherever preserved, containing historical facts relating to St. Louis, the State of Missouri and regions adjoining, including Louisiana and New Mexico, of which copies have been, or can be procured. The publication will comprise unpublished official documents (including many from abroad), and some already in print but not accessible; statements found in depositions on file in different offices of record; manuscripts, embracing journals, narratives and letters; some pamphlets out of print and very scarce; a few old maps and plats; also, genealogies, with a few brief sketches (not biographies) of some of the members of families to which the genealogies relate.

Translations of French, Spanish and Italian documents will be given in parallel columns with the originals.

Although the work does not embrace archæology, as such, it will contain many pages interesting to archæological students; such as artotype representations of some unique, or typical objects, utensils and implements, discovered in Missouri; also, reproductions of unpublished plats, and descriptions, some dating sixty years ago, of important ancient earthworks. The accuracy of such plats, etc. as represent remains still in existence has been verified by explorations specially undertaken for the purpose.

The work will be enriched with numerous notes, not only by the compiler, but by several of the first historical writers of the day.

The price, considering the nature and magnitude of the work and the large expense attending its production, seems to indicate that the compilation and publication of the "Record" have been undertaken rather as a labor of love than for gain.

Mr. Collet's work is the most important of its class ever attempted in this State; and it may well be hoped that the effort to produce an historical monument of such enduring value will meet with general practical encouragement. The announcement of this contemplated publication has called forth many warm approvals from different parts of the country as well as Missouri; and, among others, the following interesting letter from the veteran historian of the West:

ELIZABETH, N. J., 1882.

Mr. Collet is doing a grand work: he is redeeming the United States as fast as he can, from one of its greatest sins. It was its bounden duty on acquiring

Louisiana, Florida, Texas, New Mexico and California, to take and preserve the ancient archives of those provinces, rich in documents and well preserved till then. Where are they now? Our government took no steps to preserve them at all; it left everything to decay and destruction, and in New Mexico, as though theft and carelessness did not work quick enough, one of the wretched beings sent there as governors actually sold great quantities of the ancient archives for waste-paper, destroying documents that can never be replaced.

Mr. Collet's noble volume will after great toil and labor bring together much relating to the early history of Upper Louisiana, and the public will owe him a great debt which I hope it will appreciate, I shall not only be among the sub scribers for the "Historical Record," but shall take occasion to call the attention of scholars to the work to add a few more.

JOHN GILMARY SHEA.

The work will be printed in first-class style and as the edition will be limited to 500 copies, subscriptions should be sent in without delay.

F. F. H.

OTHER PUBLICATIONS RECEIVED.

Report of the Chief Signal Officer, U. S. Army, for 1879; Report of the U. S. Commission on Fish and Fisheries, for 1879; *Humboldt Library*, No. 36, Lectures on Evolution, by Thomas H. Huxley, 15c; The *Consulting Engineer of Canada*, Vol. I, No. 1, monthly, Toronto, $1.00; Washington University, 25th Anniversary, An Address by Chancellor W. G. Eliot; *Knowledge*, Part X, Vol. II, London, edited by Prof. R. A. Proctor, Weekly, 10s. 10d. per annum; Report on the Character of 600 Tornadoes, John P. Finley, Signal Corps, U. S. A.; *The Poultry Review and Stock Journal*, Monthly, Washington, D. C., $1.00 per annum. Annual Report of the Kansas City Public Schools, 1881-2, Prof. J. M. Greenwood.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

NOVEL STEAMSHIP.—In the construction of this improved steamship the hull is made to curve inwardly above the water-line, and an elevated cabin is supported above and is of less width than the hull, whereby the waves are caused to act with less force upon the vessel, and the tendency to tip or roll is diminished.

Intermediate tubular stanchions or columns pass from the emigrant cabin to a point above the elevated cabin, and are adapted to support the elevated cabin and serve as ventilating shafts for the emigrant quarters.

Roofing-Tile or Plate.—In this invention the tiles are provided with plain lap-borders, the remainder of their surface having parallel corrugations or ribs rising in relief above the plane of the plain borders, whereby a uniform bearing surface is provided. The corrugations are arranged in the direction of the slant of the roof.

Steam-Engine Recorder.—A novel improvement provides a rotary paper carrier, with mechanism for moving it, and a marker with means for imparting to such marker in a given period upward movements corresponding in number to that of the strokes of a steam-engine piston during such period, in order that marks indicative of the number of the strokes may be made by the marker on a sheet of paper moved as described. The paper carrier is capable of being used for varying pressure of the steam during a stroke of a steam-engine piston and for registering the speed of the engine or number of strokes of its piston in a given time.

Electric Burglar Alarm.—This novel burglar alarm is so arranged that the opening of a door or window breaks a primary circuit and closes a secondary one. The alarm is kept sounding by the current through the secondary circuit, and cannot be stopped by closing the door or window.

Novel Fire-Escape —An ingenious inventor has provided a flexible chute which, when in use is adapted to be anchored at its lower end out in the street by cords so as to make an inclined covered way for the purpose of escaping from the burning building. Weights on the cords which are attached to the upper end of the chute, pull it open when released. When not in use the chute is inclosed in a case in the window-sill, which is held closed by a latch in the window-sash. When the sash is raised it strikes an alarm.

Device for Hanging Venetian Blinds.—In this invention, to the ends of the heavy top slats are affixed castings with an irregular angular opening in each which governs the position and operation of the blind. The shade, by means of these, may be, with all its attachments, lifted off or placed upon supporting pins in the jambs of the window.

LIME vs. POWDER.

On Monday a series of interesting experiments took place in the workings of the Wharncliffe Silkstone Colliery, near Sheffield, the object being to test the new method of winning coal by the use of compressed lime instead of blasting-powder. These collieries, which are amongst the largest in South Yorkshire, employing over 600 hands, were opened in 1854, and have been remarkably free from explosions, though gas is met with in the workings. The experiments, which were witnessed by the officials of this and other collieries, took place in the Parkgate seam. A hole about three inches in diameter and four feet deep was drilled through the solid coal, and cleaned out. A perforated iron tube was then inserted, and the lime cartridge, three inches long, put in When the lime had been rammed home and the hole made up a force-pump was used to inject water into the bottom of the tube around the cartridge. Simultaneously with the injection of the water the rending process began, and in thirty minutes about ten tons of coal came down almost in an unbroken mass, one piece being nine feet long. Of the whole of the fall not more than 6 per cent of the coal was "small," a much smaller percentage than under the old system. A second trial was made in another part of the pit, and the result was exceedingly satisfactory to the colliery officials. It is anticipated that compressed lime will eventually supersede the use of blasting powder, and thus revolutionize the system of winning coal.—*Oldham Chronicle.*

EDITORIAL NOTES.

THE large amount of space given to the Proceedings of the American Association at Montreal in this number of the REVIEW, will be found well appropriated by every person who takes the pains to read the account given. It is only intended as a popular report and contains much of a personal character that will not appear elsewhere. Our experiences were exceedingly pleasant, from the rushing, rapid trip over the Wabash, the Great Western of Canada and the Rome, Watertown & Ogdensburg R. R. to the quiet but charming sail down the St. Lawrence. We made the three thousand mile trip, including the excursions, without an unpleasant adventure, and returned home with nothing but the most agreeable recollections of the whole affair. The only regret felt is that we could not have spared two whole weeks for it instead of crowding so much into eleven days.

ONE of the most interesting and valuable exhibits at the Montreal meeting was that by Prof. Bassett, of Crawfordsville, Indiana. It consisted of several slabs of limestone covered with crinoids of the most perfect and beautiful forms. These slabs varied in size from two to six square feet and the crinoids, worked out with the utmost care and delicacy by the Professor's own hand, and measuring from a few inches to several feet in length, lay in great profusion and in all degrees of entanglement all over them. Professor Bassett has purchased the quarry containing them, said to be almost the only one known in the country and will give his attention to taking them out for the supplying of museums and private collections. He has made some very interesting discoveries concerning the habits of these curious animals which he proposes to communicate to the public soon, through the columns of the REVIEW.

PROFESSOR YOUNG, of Princeton College, will use the new telescope, for the present, mainly in stellar spectroscopy, a department of research which promises interesting results and requires powerful telescopes. The Princeton telescope ranks second in the United States and fourth in the world.

MR. JOHN ADAMS, of Boston, has taken out a patent for a device intended to be used as a brake on steam vessels for the prevention of collisions. It is modeled after the pectoral fins of a fish and has been tested with complete success on a ocean steamer, stopping her within ten feet several times when sailing twelve miles an hour.

THE transit of Venus in December is now filling the minds of the scientific men of the whole world. Every civilized government is extending aid, and simultaneous observations will be taken from every available portion of the globe. As this phenomenon will not again occur for one hundred and twenty-two years the astronomers of the present day will make the most of it.

PROFESSOR J. D. PARKER, who has frequently assisted us in the preparation of the REVIEW, has received the appointment of Post Chaplain in the U. S. Army, and has left Kansas City to assume its duties at San Ant[illegible], Texas. It is a good selection and Professor Parker has the ability to fill the position admirably.

[illegible]ottest September day on record in [illegible] vicinity was the 12th, when the mercury [illegible]ched 104° at Kansas City, 105° at Lawrence, Kansas, 100° at St. Louis, and about [illegible] same at all neighboring points, and was accompanied by a fierce hot wind that scorched vegetation like a flame and filled the air with clouds of suffocating dust. On the 18th, after nearly two month's drouth, a severe rain storm, amounting to over two inches, as reported to us, occured, doing much damage in this city and vicinity.

DR. D. G. BRINTON, of Philadelphia, is about to commence the publication of a series of works under the general title of Library of Aboriginal Literature. These works will be published in the original tongues with English translations and notes. The first of the series will be "The Maya Chronicles." The price of each volume will be $3.00.

THE Edison incandescent light in New York City seems to be regarded now as a success. New burners can not be put up fast enough to supply the demand, and there is no prospect of a return to gas in the buildings now illuminaed by electricity. This means that the new light is more agreeable than gas, and cheaper.

PROF. A. N. LEONHARD, of St. Louis, has recently published a very full list of the minerals of Missouri, with the localities where found, etc. As Prof. Leonhard was formerly connected with the State Geological Survey and is now in charge of the department of Mining and Metallurgy in the Washington University, this list may be relied upon as very accurate and complete.

Two comets are now engaging the attention of astronomers. One was discovered first by E. E. Barnard, of Nashville, on the morning of Sept, 14, and is consequently called the Comet Barnard. It is only to be seen by the use of the telescope, and according to the Boston *Science Observer*, its orbit does not bear any resemblance to that of any known comet. The other was discovered first by Mr Cruls, at Rio Janeiro, Sept. 11; and on the 18th by C. C. Miller, of Leon, Kansas. It is a very prominent object in the eastern sky, on any clear morning, at about 4:30. The nucleus appears to be heading directly towards the sun, while the tail lies to the westward.

P. BLAKISTON SON & CO. announce a handsome edition of Harley's Diseases of the Liver, to be ready in October. It will be an octavo volume, illustrated with colored plates and wood engravings. It is offered as the only thorough book on the subject now before the profession.

ITEMS FROM PERIODICALS.

THE contents of the *Popular Science Monthly* for October are as follows: Massage: Its Mode of Application and Effects, Douglas Graham, M. D; Literature and Science, by Matthew Arnold; What are Clouds? by C.

Morfit; The Past and Present of the Cuttle-Fishes, by Dr. Andrew Wilson (illustrated); Mozley on Evolution, by Herbert Spencer; Explosions and Explosives, by Allan D. Brown; The Utility of Drunkenness, by W. Mattieu Williams; Delusions of Doubt, by M. B. Bill; The Progress of American Mineralogy, by Professor G. J. Brush; Industrial Education in the Public Schools, by Professor H. H. Straight; Physiognomic Curiosities, by Felix L. Oswald, M. D.; The Formation of Saline Mineral Waters, by M. Dieulafait; A Partnership of Animal and Plant life, by K. Brandt; Sketch of Professor Rudolf Virchow, (with Portrait); Editor's Table: Matthew Arnold on Literature and Science—The Montreal Scientific Meeting; Literary Notes; Popular Miscellany; Notes.

THE *Atlantic Monthly* for October contains the following attractive articles: Two on a Tower, XXVIII—XXXII, Thomas Hardy; Among the Sabine Hills, Harriet W. Preston; Storm on Lake Asquam, John Greenleaf Whittier; An English Interpreter, Horace E. Scudder; Cicada, John McCarty Pleasants; Studies in the South, VIII; And Mrs. Somersham, Agnes Paton; Fallow, Lucy Larcom; University Administration, W. T. Hewett; Pilgrim's Isle, Thomas Williams Passons; The House of a Merchant Prince, XIX., XX, William Henry Bishop; The Nation of the Willows, II, F. H. Cushing; A Shadow Boat, Arlo Bates; The Red Man and the White Man; The Salon of Madame Necker; The Contributors' Club; Books of the Month.

THE *North American Review* for October opens with an article on "The Coming Revolution in England," by H. M. Hyndman, the English radical leader. O. B. Frothingham writes of "The Objectionable in Literature." Dr. Henry Schliemann tells the interesting story of one year's "Discoveries at Troy." Senator John I. Mitchell, of Pennsylvania, treats of the rise and progress of the rule of "Political Bosses." Professor George L. Vose, of the Massachusetts Institute of Technology, contributes an article of exceptional value on "Safety in Railway Travel," and Prof. Charles S. Sargent, of the Harvard College Arboretum, contributes an instructive essay on "The Protection of Forests." The *Review* is sold by booksellers and newsdealers generally.

THE *Observer*, Falls City, Nebraska, says of the REVIEW: "This excellent monthly is continually growing in favor. It is fresh and original and numbers some of the ablest contributors on the continent."

THE Wichita *Eagle* says: "The Kansas City REVIEW should reach the table of every professional, literary and scientifically inclined man in Kansas. It is a splendid publication, full of matter pertaining to the formation and wonders of the trans-Mississippi country and general scientific papers of great worth and absorbing interest. Two dollars and fifty cents per annum is wonderfully cheap for a magazine of such size and worth, and which is published by Hon. Theo. S. Case, not for the money there might be in such a publication, but for his love of the work."

As usual, the REVIEW is full of interesting reading matter. The original articles are on subjects that interest most readers and searchers after knowledge. This work is a credit to the intelligent forces of the West and should be liberally supported. In the East it is looked upon as authority.—*Herald.*

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ASTRONOMY.

THE COMING TRANSIT OF VENUS.

PROF. H. S. S. SMITH, UNIVERSITY OF KANSAS.

The distance between the Earth and Sun is the astronomer's foot rule. With it he measures distances in the solar system and even reaches out and spans the almost endless spaces between the stars. It is, then, of prime importance to him that he know the exact measure of this, his measuring rod.

Ever since the time when Kepler proved and refined the Copernican theory, this problem has been one of the most important and, at the same time, one of the most difficult with which astronomy has had to deal. It has called into exercise the highest powers of mathematical genius, has demanded and obtained, decided improvements in astronomical instruments and methods of observation, and has received more pecuniary aid than any other purely scientific problem.

There are several methods available for the determination of this measure. Among them may be mentioned that by the parallax of Mars and of the minor planets, that by the velocity of light, that by inequalities in the motion of the Moon, and that by the variation of the attraction of the earth on her sister planets. Of these, the first three, in order to be eminently successful, require an accuracy of observation not yet obtained, and the last, while certainly the most reliable of all in its final result, asks for at least five centuries more in which to make a good determination of the distance. In the meantime, the method by observations of the transit of Venus over the face of the Sun is certainly the most celebrated, and, while lacking some elements of accuracy, and requiring a considerable expenditure of time and money, is a method not to be despised.

Such a transit will take place on the 6th day of next December, and it may be interesting to know beforehand what to expect and when. This phenomenon recurs regularly four times every 243 years, at intervals of 8 years, 105½ years, 8 years, and 121½ years. Here are the dates for four centuries:

1761	June 5th.	2004	June 8th.
1769	June 3rd.	2012	June 6th.
1874	December 9th.	2117	December 11th.
1882	December 6th.	2125	December 8th.

From this we see that, if the coming transit is not watched, it will be as impossible for one of us to see the phenomenon again as it is to examine the geological structure of the other side of the moon. The next transit will be reserved for the third generation to come.

It is not a difficult matter to understand the outline of the method that deduces the distance between the Earth and Sun from the observations of a transit. Suppose two observers, one at New York and the other at Cape Horn, and each provided with the necessary instruments. Since Venus is between the Sun and the Earth, it is evident that the path of the planet across the Sun's disc, as seen by the observer in New York, will be nearer the southern edge of the Sun, and therefore shorter, than the similar path as seen by the observer at Cape Horn. Knowing the time that it takes Venus to travel each of these apparent paths, the rate with which the planet moves with reference to the Sun, and the apparent size of the Sun, the lengths of these two apparent paths and their distance apart are readily found. All these measurements are, of course, in seconds of arc. Now the distance between the two paths is, also, 2.61 times the distance between New York and Cape Horn, since Venus is 0.723 of the Earth's distance from the Sun. Knowing, then, the length of a certain line on the Sun both in seconds of arc and in miles, the distance between the Sun and the Earth is the immediate result. Previous to 1874 but three transits had been observed, and the results were far from satisfactory. The uncertainty of the result, as estimated at the time, was only nine-tenths of one per cent, and though this amount of error is comparatively small, it really means about 840,000 miles. Combining the results from the transit of Venus in 1874 with the best results from the other methods the probable error is reduced to one tenth of one per cent, but even this small fraction amounts to more than 90,000 miles. This amount of uncertainty will, for instance, produce an uncertainty of 20,000,000 miles in our estimate of the distance of the nearest fixed star. With this comparatively small but essentially great error still connected with the fundamental unit, it behooves the astronomer to improve his methods and make the determination more exact.

In 1874, neither labor nor expense were spared to make the work as thorough as possible. In that year the transit could be seen only from places in the eastern part of Asia and on the islands of the Southern Pacific, and the expense of fitting out expeditions to go to these distant places was large. Germany alone spent $150,000 on her share of the work. This year the work will be far less expensive because the transit can be seen from all the eastern part of North America and from all of South America, so that it will not be necessary to send out as many parties as in 1874. The observatories already in active operation in this country, South America, Africa and Australia, can be utilized to their full extent. And then the direct outlay will be less because the instruments prepared for the last transit can be utilized for the coming one.

England, France, Germany and the United States have already sent out their expeditions. The English will occupy thirteen stations, viz:—Jamaica, Barbados, Bermuda, Cape Colony (3), Madagascar, Natal, Mauritius, New Zealand, Brisbane, Melbourne and Sydney. France sends out six parties; to Guadelope or Martinique, Cuba, Florida, Coast of Mexico, Rio Negro and Santa Cruz. Germany has chosen four stations; at Hartford, Conn., Aiken, S. C., Bahia Blanca and Punta Arenas.

Parties from the United States will be stationed at the following places: Santa Cruz, Santiago, New Zealand, aud Cape of Good Hope. The principal stations in this country will be Cedar Keys, Fla.; San Antonio, Texas; Fort Thorn, N. M.

The endeavor has been made to choose the places so that the observations to be made may be the most useful in the final solution of the problem. At the same time it has been necessary to take into account the meteorological conditions of the several places and to so arrange the several stations that the probability of unfavorable weather at all the places in any one region may be the least possible. This was done at the International Conference on the approaching transit of Venus held in Paris from the 5th to the 13th of October, 1881. It is of course, necessary that the stations be widely separated from one another in order that the two apparent paths of Venus across the Sun's face may be as far apart as possible and render any small error in the observations as harmless as may be. The work itself is of extreme delicacy. Equal to that, for instance, in the case where a surveyor would be required to find the exact distance of an object six miles away, while not allowed to move his instruments more than three feet in any direction. When such exact work as this is required, it is not strange that particular attention should be paid to the selection of proper stations.

There seems to be considerable difference of opinion among the four nations as regards the best methods of observing the transits. There are three essentially different ways of attacking the problem: 1. By observation of the time of external and internal contacts at ingress and egress; 2. By making direct measures of the distance between the centre of Venus and the edge of the Sun; 3. By photographing Venus and the Sun, and measuring their relative positions afterward.

The English are the advocates of the first method, the Germans of the second, and the Americans of the third. Although the method by contact is apparently very simple and easy, there are some decided drawbacks to its successful prosecution. It is comparatively easy to determine the time of external contact both when Venus enters and when she leaves the disc of the Sun. But to determine the exact time when the body of the planet has just fully entered the disc, and when it is just about to begin its passage across the edge at egress is an entirely different matter. The dense atmosphere of Venus surrounds the planet with a rim of hazy light and this, with the defraction and irradiation necessary under the circumstances, renders the determination of the exact time of geometrical contact impossible. So great is the effect of these causes that two observers, using similar instruments, and watching side by side, may differ as much as a minute in their estimate of the time of the occurrence. The one redeeming feature of the method is that it requires a difference of two seconds of time to make an error of so much as one-tenth of a second of arc in the measurement, so slow is the motion of Venus across the face of the Sun. And it may be that, by properly training the observers and instructing them carefully about the appearances to be seen, the method may be made to yield satisfactory results. It would seem, then, that the English, with their large outlay, are running considerable risk in trusting entirely to this one method.

The second method is essentially German in its history and use. The instrument—the heliometer,—with which alone the measurements can be satisfactorily made, has done its best work in German hands, and it is but right and natural that they should use it to its full capacity. They do not, however, intend to confine themselves to this one method but will also take observations of the times of contacts.

In the photographic method the observations are made almost entirely by mechanical means and thus the personal equation, that fertile source of discrepancies, is almost entirely obliterated. The instruments required, though expensive and delicate, are not cumbrous, the work itself is not essentially difficult, and there is the decided advantage of a permanent record that can be referred to at any time. It is claimed that the collodion films of the photographic plates are liable to slip and render the record worthless; but, as it seems, this statement has yet to be proved. The principal reason why this method is not to be used more generally at the coming transit is said to be that, because the photographic observations made in 1874 have not yet been completely reduced and their worth fully shown, European astronomers do not wish to try an improved method but prefer to use those whose errors they know. Be this as it may, the results already obtained from a partial discussion of the observations show a probable error far less than those obtained by any of the other processes. May it not be that our cousins of England and Germany are just a little chagrined about the fact that their photographic work of eight years ago was decidedly inferior to that done by the Americans? As the case stands at present, the greatest difficulty in the way of a successful result of the labors of the present year is the lack of harmony between the masters of the science as to best methods of observation. Even if advisable, it is a difficult matter to combine the results found by different methods, and it may be that this disagreement will render the final determination far less satisfactory than it would have been if the several parties had acted in concert.

While the astronomers are using all the refinements of science to make their observations as accurate as possible, it may be that some people who are not following this special line of work and who, it may be, are not particularly interested in the advancement of science, will find an interest in watching a transaction that cannot occur again before the expiration of one hundred and twenty years. Unfortunately, these random observations cannot be of use in making the final determination of the distance of the Sun more accurate, but there is, nevertheless, a feeling of interest in knowing that one is looking sunward in common with a large part of the civilized world. Adapting the data given in the American Ephemeris to the latitude and longitude of the University Observatory at Lawrence, the times of the four principal phases of the transit are found to be as follows, expressed in Lawrence mean time:

Transit begins	7h.	43m.	A. M.
Internal contact at ingress	8	3	"
Internal contact at egress	1	28	P. M.
Transit ends	1	48	"

We see that it will take Venus about twenty minutes to pass over the edge of the Sun and that more than six hours will elapse between the beginning and ending of the transit. To change these times so as to accommodate them to other localities in Kansas and Missouri, the only difference to be allowed for is that caused by a difference of longitude. Thus: the map gives a difference in longitude of thirty-five minutes of arc between Lawrence and Kansas City, and this means that the phases of the transit will occur a little more than two minutes later by Kansas City mean time than by Lawrence mean time. For those places using the time furnished by the A., T. & S. F. or K. P. Division R. R.'s, it will be sufficient to add fourteen minutes to the times given above.

And now some one may ask how to see it. A person provided with good eyes and a uniformly smoked piece of glass can see the whole transit. Venus will appear as a very small black dot on the surface of the Sun, and will appear to have an exceedingly slow motion from east to west. If, however, a person has a telescope or opera-glass, the observations can be made much more easily and satisfactorily. To the eye end of the telescope, and about a foot from it, fasten a piece of stiff white cardboard nine or ten inches square to serve as a screen. This can be most easily done with pieces of stiff wire tied to the telescope. Then fasten around the object end of the telescope a shield to protect this screen from the direct rays of the Sun. Place the telescope on some convenient rest, point the telescope toward the Sun, and pull out the eye-piece (or lengthen the tube) a little until the image of the Sun on the screen is distinct. With this arrangement half a dozen persons can see the transit at once with comfort and without any danger of injury to the eye. It may be of service to know that Venus will begin her transit at a point 60° from the south point measured toward the east, and will pass off the Sun at a point 61° from the south point measured toward the west, that is, in the upper half of the southeast and southwest quarters respectively.

UNIVERSITY OF KANSAS, October 10, 1882.

SPECULATIONS ABOUT COMETS.

The present brilliant comet has been the theme of all sorts of speculation, and scientists seem to be at fault equally with the amateur. In fact, as they know nothing definite about comets, those outside the charmed circle may be pardoned if they, too, indulge in speculation.

What seems to us inconsistent in these scientific theories is that, first assuming comets to be composed of the same substance as all other planetary and stellar objects, they disregard the laws of matter. For example, we are told that the comet has passed so near the Sun as to be torn into several fragments that can now be seen with powerful telescopes. On the other hand, the comet of last year, we were advised, was in danger of coming within the attractive sphere of the Sun and convulsing that orb by dropping into it such an addition to its fuel as possibly to burn up our world, or at least be fatal to many forms of life upon it. But this fuel theory has by the same scientists been dissipated by the present comet, which has actually, despite the telescopists, telescoped with the Sun, like two railway trains, and bounded off into space again, minus a few splinters—and even the splinters refusing to fall into the Sun. How are we non-scientific people to gather wisdom from these contradictory hypotheses? Both cannot be true.

As cometary bodies of long periods do not belong to the solar system, it is a question whether they ever really enter it. The Sun's distance from our earth was never known until the parallax was calculated from the transit of Venus in 1761. No cometary parallax is possible and the conjecture that comets enter the solar system at all is not demonstrated. We mean that they never enter the sphere of the attractive force of the solar system. If they did, like asteroids and meteoric matter, they would remain, and from the law of attraction would fall into the Sun did they collide with that orb as the present one is held to have done.

From the very theory of the solar system and the hypothesis that it is but one of a universe of systems of suns and planets, we must conclude that these systems constitute separate spheres of attractive force, and that while they meet, they never commingle—else harmony would be destroyed and chaos reign where order is the first law. Their presence then, as is held, within the attractive force of the solar system is only apparent. The peculiar appearance of comets and the change noted in their aspects can all be explained by the law of optics when we consider the spheres of different densities that intervene in our solar system between the eye and comet beyond the confines of that system.

We have not the space here to elaborate this hypothesis, and can only suggest it by the statement that a body like that of a comet, when approaching the boundary of its own system, and subject to the attractive force of the solar system, would invariably be an elongated body—the length of its tail being in ratio with its size and the forces operating upon it. Comets must obey and be controlled by the central forces of the system to which they belong, and when they approach near or come in contact with our system, they must from the law referred to, have tails.

The effect of the earth sphere and other spheres of the solar system upon the appearance of a comet must differ with the position of the comet itself. Suppose the sphere of the attractive force of the solar system to be convex. The light projected on this convex surface would be to expand it. But when we view it from the earth, with nothing but the earth sphere between, the effect is that of a convex lens, and the comet will appear smaller and present a more natural appearance than under the other conditions. If dense strata or the sphere of another planet lie between the eye and the comet the appearance will greatly differ, as the comet would then project itself upon the convex surface of that intervening sphere.

The intervention of this sphere as related to the eye of the observer is both concave and convex, and of necessity affects the image seen through it. But even this fact is not all, for we know that the planetary spheres are more dense than the sphere of the system, and light from the comet projected upon such sphere is not so freely transmitted, and will be reflected back upon the outer or parent sphere, which from one point of view is convex—thus presenting to the eye a distorted image of the comet.

Taking these well known facts in optics into consideration, and noting the other fact that in the position of the present comet we see it not only through the sphere of the solar system, but through that of other planetary spheres, the observer may readily be misled to the conclusion that the comet and Sun have been in actual contact, the former appearing by its reflected light to have been so near the latter. But it will be noted that no one observed the comet in conjunction, either inferior or superior, which would have been the case had it been within the solar system, for it was first observed so near to the Sun as to preclude the possibility of its escaping the close search of the astronomers when it was on the other limb of that orb, as it must have been to pass around and come in contact with it. And particularly if it has been broken into so many pieces by the collision it must have been much larger when intact, and more readily observable. And as the tail is in proportion to the size of the nucleus it would have been a much more conspicuous object before than after the catastrophe. These facts can only be explainable upon the hypothesis suggested above. And this can be more readily admitted when we know that the direction of the tail often changes, and it is lengthened enormously or lost entirely within a few days, which could not be from any other than an optical cause.

Comets, we are told, have been calculated as to their orbits, but we have the additional fact that no return of a calculated comet has ever been known to appear under the same circumstances, a fact that suggests of itself that they are not within the solar system, either in whole or in part, but that it is the position of the bodies composing the solar system and their spheres to that of the observer on the earth that controls the phenomena attending the appearance of comets. In fact, when we consider that comets are without the solar system and obeying the laws of another system entirely beyond ours, about which we cannot know anything, the presumption is very strong that observers mistake comets that come at or within a few years of calcultated periods for the expected return. There can be no certainty, even if we admit that comets do sometimes enter the solar system and leave it again, for in the infinitude of worlds and systems they must traverse on such theory, we cannot discount the forces with which they come in contact to retard or accelerate their motion or deflect them from the imaginary orbits we prescribe for them. At best the whole comet lore of our astronomers is conjectural—guess work and unreliable—and every one is at liberty, as we are, to have a theory of his own.

There is a theory, admitted by all astronomers, which may account for comets, and coincides with the assumption that they are outside the solar system. It is that our system is but one of thousands of suns and their families, all moving around their central body in the same plane. These systems of suns in their circles of motion must frequently come in contact or close conjunction, and the comets belonging to them become visible or approach so near the attractive force of our system as to be influenced in their movements by it. These sister systems may not all be in the advanced state of planetary evolution that we are, and these comets, numbering thousands, be visible thousands of years, as the systems to which they belong and that to which we belong are performing their evolutions.

That the theory we have here outlined has facts to support it we need only refer to the appearance of Halley's comet in 1835. The comet was visible for nine months from the earth. Its first appearance was without a tail for two months, when a tail began to appear, and rapidly developed until it was twenty degrees in length. It then began to shorten, and in twenty days it entirely disappeared. After its "perihelion" it disappeared for two months. On its reappearance it had no vestige of a tail, and the nucleus appeared surrounded by a coma. As the comet receded from the Sun it increased rapidly in dimensions, until in one week it was forty times its size the previous week. It continued to increase until it actually became invisible from expansion, all except the nucleus, which increased in brightness as the envelope dilated and disappeared. At its very last observation it appeared as when first seen—a small round nebula with a bright point in the center. Can any theory so well account for these rapid changes of appearance as the optical one we have alluded to, and which will be found to be borne out by the position of the planets at the times noted, showing by all analogy that it was the influence of their spheres as related to the position of the earth and the observer upon it that produced the changes in the comet's appearance, and not those of the comet itself.

We might elaborate this beyond the space we have to devote to one article, but enough has been said to show that there is more than one side to this question of comets and to demonstrate that the science of comets, as it is termed, is yet in its infancy, if it can even claim to be that far advanced. Either astronomers are guessing about them or the laws governing our solar system are not so well understood as we have been led to believe. Either the one or the other of these propositions is true, or else comets are but vagrants—emanations amenable to no known law, or optical delusions engendered from the solar system itself—like fogs or wandering clouds in our own atmosphere.

But as we know that nothing else in the universe, that comes within our knowledge, is without purpose and use, and that our system is but a speck in the wondrous structure of the infinite, we must conclude that they have their uses and obey laws as do our planets and their sun, and that our failure to discover their secret is from our own inability to read aright the machinery of the creation, rather than that some mistake has been made in its adjustment, by reason of which these celestial tramps are wandering about responsible to no social law recognized by the heavenly hosts.—*Kansas City Journal, Oct. 22.*

ELECTRICITY AND THE PHENOMENA OF COMETS.

There seems to be a rapidly growing feeling among physicists that both the self light of comets and the phenomena of their tails belong to the order of electrical phenomena. Those who are disposed to believe that the truth lies in this direction differ from each other in the precise modes in which they would apply the known laws of electric action to the phenomena of comets. Broadly the different applications of the principal of electricity which have been suggested group themselves about the common idea that great electric disturbances are set up by the Sun's action in connection with the vaporization of some of the matters of the nucleus, and that the tail is probably matter carried away, possibly in connection with electric discharges, under an electrical influence of repulsion excited by the Sun. This view necessitates the supposition that the Sun is strongly electrified, either negatively or positively, and, further, that in the processes taking place in the comet, either of vaporization or of some other kind, the matter thrown out by the nucleus has become strongly electrified in the same way as the Sun, *i. e.*, negatively if the Sun's electricity is negative, or positively if the Sun's is positive. The enormous disturbances which the spectroscope shows to be always at work in the Sun must be accompanied by electrical changes of equal magnitude, but we know nothing as to how far these are all, or the great majority of them in one direction, so as to cause the Sun to maintain permanently a high electrical state, whether positive or negative. Unless some such a state of things exists, Sir John Herschel's statement, "that this force cannot be of the nature of electric or magnetic forces," must be accepted, for, as he points out, "the center of gravity (of each particle) would not be affected. The attraction on one of its sides would precisely equal the repulsion on the other." Repulsion of the cometary matter could only take place if this matter, after it has been driven off from the nucleus, and the Sun, have both high electric potentials of the same kind. Further, it is suggested that the luminous jets, streams, halos and envelopes belong to the same order of phenomena as the aurora, the electrical brush and the stratified discharges of exhausted tubes. Views resting more or less on this basis have been put forward by several physicists, and in particular by the late Prof. Zollner, who endeavored to show that on certain assumed data, which appeared to him to be highly probable, the known laws of electricity are fully adequate to explain the phenomena of comets.—*The Nineteenth Century.*

GEOLOGY.

REMOTENESS OF THE FINAL CATASTROPHE.

J. D. PARKER, U. S. A.

Geology teaches that transitions have occurred in the Earth's crust from the earliest geological times. The larger part probably were operative over long periods and effected slow changes in the ocean level, but produced more or less exterminations among living species. Thus in passing from layer to layer in the rocks one or more species became extinct with a corresponding introduction of new species. At the opening of an epoch many new species would appear, and at the commencement of a period a whole fauna. Creations and extinctions have thus been going on through the whole course of geological history.

But at longer intervals greater convulsions have occurred in nature. The course of nature seems at times to have completed a cycle terminating in a catastrophe. A catastrophe (a term which may be retained in geology when properly defined) is not really a retrogression, but a new birth, a more violent transition or unfolding by internal forces, an extermination of life, perhaps an extinction of former races, but an introduction of higher and better forms of life. Such transitions have always resulted in an improved condition of things on the earth, higher and more perfect organizations having sprung into being. Geological history has thus been a *periodical* unfolding from the lower, more elementary and imperfect toward the higher forms of being. Now if nature does not retrograde, or if the law of progress shall remain in force, may we not reason by analogy that in fullness of time will come the final catastorophe that will introduce an economy of life far transcending all that has preceded it—in a word, the Golden Age of all the Earth's History? Such seems to be general teaching of Science and Revelation.

It is the purpose of this article to show the remoteness in time of this final catastrophe.

Three violent transitions or catastrophes are revealed as having taken place in geological history. The first transpired at the close of the Azoic Age. From a probable state of fusion the earth cooled down, the vaporous atmosphere was precipitated and gathered into seas, in which depositions took place forming sedimentary rocks over immense continental areas. The beds were spread out horizontal, or nearly so, indicating that it was a period of tranquillity. In all the foldings of the Azoic beds there is always a marked conformability of the various strata. But the close of this period of tranquillity was strongly marked in geological history. There was a general upturning of sedimentary rocks, a profound heaving and displacement, a folding, crystallization and metamorphosing, a development of mountain ranges, and a probable extermination of vegetable life. A complete revolution took place, the features of the globe were changed, and a new order of things was introduced over the whole earth. And now followed the ages of mollusks, fishes and coal plants, during which the seas swarmed with life, and the continents were covered with new and higher forms of vegetation.

At the close of Palæozoic time occurred the second violent transition or catastrophe during which there was a very general extermination of existing life. The Earth puts on a new aspect, and there is a new economy of life over the whole globe. The animals of the Reptilian Age far surpass in the scale of being those of preceding ages. Several great Palæozoic races became extinct; palæozoic formations in many regions were folded and crystallized, and prominent mountain ranges were developed. New and higher forms of vegetation sprang into life, and the whole earth put on an improved appearance.

The third and last violent transition or catastrophe occurred at the close of Mesozoic Time when there was again a very general extermination of life. The beds of the Triassic, Jurassic and Cretaceous, the Reptilian Age, seem to have been deposited during a tranquil period, as they are for the most part conformable. True, there were slight elevations and depressions, and evidences of variations in the ocean level resulting from gentle heaving of the Earth's crust, but the the age was one of comparative quietness. But at the close of the Cretaceous Period, there were profound geological movements, a great displacement of earlier rocks, and an extermination of species probably as complete as that closing the palæozoic era. The globe puts on a new garb, and mammals appear, the forerunners of the age of man and of the age of mind.

In the consummation of all things earthly the globe seems now to be awaiting the final catastrophe to usher in the Golden Age. Does science cast any light upon the time when the Earth shall advance through the last transition to new and higher forms of being?

If we take the time-ratios of the rocks we shall find that they point forward like silent indices to a time for the close of this period that is very distant in the future. Adopting the estimates generally employed by geologists, considering that limestones increase with extreme slowness compared with fragmental deposits, not more than one foot of limestone being deposited while five feet of fragmental rocks accumulate, the duration of the Cenozoic, Mesozoic and Palæozoic will probably stand related as 1, 2 and 4. And when we compare the Cenozoic to the Azoic it is lost as a drop in the ocean. But the Cenozoic, or present age, is the most important one in the Earth's history. It is the age of mammals; it is the age of man; it is the age of mind. All preceding ages find in it their development and fulfillment on the earth. It gives significance in our earthly development to all the immense æons of geological history. It is the age that embraces the human period, the crown and glory of the whole creation. Can any species of analogy reduce this age to a comparative insignificance in the time-ratios, while the preceding ages of preparation are drawn out and occupy such immense periods? Rhetorically speaking, is the order of creation anti-climatic? As creation advances to higher and better forms of being, shall things become ephemeral? When everything begins to assume value and importance in creation, when they begin to have real significance, and arrive at a point where we would naturally reason they should have some solidity and permanence, shall we there find that the natural analogical order of creation breaks down, and shall the creation as we find it on the Earth prove a comparative failure? After immense periods, almost infinitudes of time, when we reach the substance of things, shall it suddenly crumble beneath our touch, and disappear to our view? Or shall we not more rationally conclude that the present Age reaches forward to its fair analogical proportions until the human period shall have its natural development and fulfillment, until mankind in all the races, the seething populations of the globe, shall be carried forward, and developed, in a word, redeemed and prepared for the higher and better order of things, the Golden Age of all the Earth's history?

As voices reëchoing in a mighty cañon indicate its amplitude, so there are many voices sounding through the corridors of time which prophesy its immense duration. If we take the coal-fields for example we find fuel stored up in the earth practically in unlimited quantities. But coal is made to burn, was created for the use of man, and it is fair to conclude that man is destined to use it, not in infinitesimal quantities, but the supply and demand are to be somewhat in proportion. The law of supply and demand is more perfectly observed in nature than in human affairs. Now there is one coal-field, the Western Interior Area, covering part of Iowa, Minnesota, Missouri, Kansas, Arkansas and Northern Texas, which would supply all the accumulating population of the globe for a million years. And what shall we say of other coal-fields, many of which in polar regions have not been developed, and of the unlimited areas of coal beneath the ocean much of which will probably in future ages, by the absorption of fluids by the solid portion of the earth, be rendered accessible? Should a man be ten years in erecting a mansion with all the elaboration of modern architecture, and put enough coal in the basement to last half a century, and then deliberately destroy his house the next day, would he be considered a wise man? Will He who made the house in which we live show less wisdom?

There are certain movements in the solar system which by a species of analogical reasoning have left a deep impression on thoughtful minds. The force of this logic is derived from the analogical relation of one part to another or to the whole. In the light of this method of reasoning there is a deep significance in the slow movements of the solar system. The pole of the equinoctial, for example has a slow movement around the pole of the ecliptic completing its orbit in 25,868 years. If we should find a chronometer constructed of an unknown substance with a wheel that made one revolution in a thousand years we would naturally infer that that instrument was intended to run a long time. The Moon in its orbit beats through different forms of the ellipse, requiring according to Professor Mitchell, five or six million years to complete its circuit. If we found another wheel in the chronometer just spoken of which made a revolution in a million years our conception of the time the instrument was intended to run would be proportionately enlarged, and the whole instrument would be judged by the slower movement of the wheel. It is conceded that the whole solar system has a movement in spaces, a movement of great velocity, but carried forward over such immense space that thousands of years elapsed before the best astronomers detected it. Now whatever relates to the solar system as a whole relates to the individual parts, relates of course to the Earth. The argument tends to prove the permanency of the solar system and of the Earth. And this permanency of the Earth resolves itself naturally into immense periods such as we find in geological history. And as the Earth is carried forward with the solar system in its onward movement, made sensible by the apparent opening and closing of stars in opposite portions of the heavens, as these infinitudes of space break over us through which the Earth circles in its onward flight who dare limit the corresponding times during which it makes its passage? Who can set bounds to the present period which gives significance to all these immense cycles of revolution, and for which all foregoing periods have been merely preparatory?

The argument derived from the physical system might be elaborated, but the whole tendency is in the direction of giving a great duration to the present period. The drift of the moral argument is in the same direction. If we take the human period and give it as great an antiquity as we please, and look at the development of the human race we find it only in its infancy. When we speak of the noontide glory of the nineteenth century, our language, stripped of hyperbole, means simply that some portions of the earth are lighter than others. The great masses of populations of the globe still lie in the grossest degradation and darkness. When will the moral regeneration of the populations of the world be accomplished? The difficulties in the way are almost insuperable when we consider the false philosophies, false religions, the spirit of caste, different languages, hostile governments, polygamy and a multitude of social evils, things whose roots have gone way down into the hearts of the nations so deep that it seems almost impossible to eradicate them. The actual work of regenerating the world as a matter of fact has been wonderfully slow, and missionaries are beginning the work over again in the same places where the gospel was first preached. A railroad can be pushed through a mountain range, but it is difficult to push it over a continent covered with mountain ranges. The mechanical powers seem to be in the infancy of their development. We are just beginning to see the fore-gleams of those things which are to illuminate the world. And yet we have the promise in our sacred books of the Golden Age.

If this argument is met by conflicting interpretations of prophecy we simply answer that prophecy is not read forward but backward. "And now I have told you before it come to pass," says the Great Teacher, "that when it is come to pass ye might believe." It is true that coming events cast their shadows before, for "When the branch of the fig-tree is tender and putteth forth leaves, we know that summer is nigh." To deny that we have fore-gleams of great events would be to deny the very validity of the argument of the present article. But the interpretation of prophecy is the most uncertain portion of hermeneutics. If a day is a year, as many suppose, a thousand years would be three hundred and sixty-five thousand years for the millennium, which probably is nearer the truth. We cannot see how it is possible to reconcile with infinite benevolence the advent of the Son of Man, unless the Logos was incarnated as near the beginning of human history as possible, as soon as all things were ready. We may not be able to measure the distance of a fixed star from the Earth, as the diameter of the Earth's orbit gives no sensible parallax. So the final catastrophe is so remote that the parallax seems to be formed of lines that run out almost parallel through the coming ages. Modern astronomy has revealed to us the immensity of space. Two thousand nebulæ, like our Milky-Way, which contains a hundred million suns with all their mighty trains, probably a thousand million worlds, have been catalogued, and as our telescopes are increased in power new nebulæ keep trooping up out of the misty depths of space. In a similar way geology is revealing to us the immensity of time. As the infinitudes of time break over the student of science, of the present period, he seems to be launched on an almost boundless ocean into which flow the confluent streams of all the past ages. He sees deep currents all around him which bear him onward beneath brighter skies and into fairer climes. In his onward course new constellations arise from the mighty ocean, and a deeper glow tinges the cerulean heavens. He hears inspiring voices by day and voices by night from the sounding sea. All things around him and above him are full of marvels, but that which awes him most is the awful grandeur of the limitless ocean on which he is voyaging, for he hears no waves breaking on the distant shores.

If the argument of this article is well founded this subject has important applications in every-day life:

1. It enlarges our view of the creation, of the importance of man in the divine economy, and exalts our conceptions of the Creator.

2. If the human period is only in fact just begun, if the morning shadows have just fallen on the Earth, we are working on the foundations of human society. In laying foundations we ought to take the greatest care to do our work well.

3. The remoteness of the final catastrophe removes the foundations of belief of a certain religious society who are constantly fixing days for its occurrence. These predictions have failed so often that now they cause more amusement than alarm. Even the ox, which a man in New York has impoverished his family for ten years to fatten, to regale the elect on that occasion, has gone the way of all the Earth. Although the subject is serious we cannot forbear a smile at the homely suggestion of a western stockman who said if that ox must be kept until the final catastrophe, it would be safer to kill him and "jerk the meat."

But however remote the final catastrophe may be, it is always well to remember that the Son of Man cometh to each one of us at an hour we know not, and we should heed his admonition when he says, "Be ye also ready."

ZOOLOGY.

ANIMALS AND THEIR DIET.

Certain facts which have recently come before the public are drawing attention to the question "How did animals first become carnivorous?"—a subject which is the more interesting as it naturally blends with the so-called "Vegetarian" movement. In taking the matter into consideration we must first cast aside two words which enable men to mystify themselves and their fellows. I refer in the first place to the term "carnivorous." This word is sometimes applied to beings which feed on animal matter in general, but it is, perhaps, oftener restricted to such as prey upon the larger animals. Thus some persons would assert that a creature which devours merely worms, snails, insects, etc., is not carnivorous, and in fact zoölogical systematists have given the names Insectivora and Carnivora to two distinct mammalian orders. Others would maintain that an animal which feeds upon the eggs of birds is not on that account carnivorous, since eggs are not flesh. To get rid of all this confusion we must for once "do the thing our soul hates," and propose a new word. Let us call creatures which feed upon animal matter, of whatever kind, zoöphagous. With the vegetable feeders there is a somewhat similar confusion. It is not strictly accurate, *e. g.*, to call a being which lives on fruits or seeds "herbivorous." Hence it is the safest to speak of all animals which feed upon vegetable matter as phytophagous —a term already in use.

This being then understood, we turn to the subject itself. If, as every one must admit, plants came into being upon our globe earlier than animals, then, as

Mr. Allinson contends, the first forms of animal life must have nourished themselves upon vegetable matter. Hence the question when and how animals became zoöphagous is perfectly legitimate.

But at the same time we must recognize that among vertebrate animals, and especially among Mammalia, the earliest forms seem to have been zoöphagous. Among fishes, amphibians, and reptiles, even in the earlier geological epochs, the vegetable feeders are found in a minority. The earliest birds, such as *Archæopteryx*, *Hesperornis*, *Ichthyornis*, and *Apatornis*, which approach nearest to reptiles, and which were probably all armed with teeth—were plainly fitted for a predatory life. Among mammals the lowest and earliest forms are decidedly zoöphagous. This is the case with the monotrematous genera *Echidna* and *Ornithorhynchus*, and also with not a few of the marsupials, both recent and fossil. The oldest of the true placental mammals are the Insectivora, including the hedghog, the shrews, moles, etc. Yet few of these animals partake of vegetable food, save under the pressure of necessity. Nor do they by any means confine their depredations to insects. The hedgehog merits the favoring notice of man as being a destroyer of vipers, but at the same time it excites the wrath of the sporting world by its raids upon the eggs of the pheasant and partridge, and even upon the young birds and upon leverets, and is, for his size, as clearly a beast of prey as is the tiger.

It may even be permissible to ask whether among the mammals the purely phytophagous forms have not been developed from a zoöphagous, or at least from an omnivorous, stock? The only large group which, according to our present knowledge, contains no zoöphagous or omnivorous members, is the old order Ruminantia. Now this sub-order, which is first traced in the Eocene Tertiaries, is characterized by its complicated and highly specialized digestive organs, evidently modified from the normal mammalian type, so as to be adapted to a purely vegetable diet. This same structure, or at least one highly similar, is met with again among the sloths, the only phytophagous section of the Edentata.

The next consideration is that numerous animals which are zoöphagous at one epoch of their life may be phytophagous at another, whether earlier or later. This change is not accidental or compulsory, but ensues naturally and normally in every individual of the species in question. Thus all mammalian animals, whatever may be their future diet, begin life as zoöphagous beings so long as they are nourished on their moth's milk. Indeed it is fully proved that *e. g.*, the human infant is for some time incapable of digesting vegetable matter.

Among birds we meet with the same fact. Setting aside the many groups which are zoöphagous throughout life, we find that, as a rule, the young of the seed- and fruit-eating species require an exclusively animal diet, consisting of insects, worms, etc. In other cases they are fed with half-digested food disgorged from the crop of their parents. There are few, if any, cases where a bird when just hatched is able to feed on crude vegetable matter.

Among insects many similar changes take place. The robber-flies of the genus *Erax*, which in their adult state destroy numbers of hive-bees, feed when larvæ upon vegetable matter. Not a few butterflies will sip the juices of dead animals, though in their caterpillar stage they are purely phytophagous. The larvæ of the hive-bee are fed upon honey and pollen, without any accompaniment of animal matter. But when mature they may be styled omnivorous, as, in addition to honey and juices of fruits, they are found to lick meat in butcher's shops, and even, according to Fritz Müller, to imbibe excrementitious liquids, as do also the butterflies.

Changes arising from a scarcity of food, or from caprice, are also on record. The two Carnivora which have become domesticated often partake of vegetable matter. The cat is even known to steal raisins and dried plums, and, according to Mr. Bates, in Brazil it goes into the woods to eat the fruit of the Tucuma palm. But amongst wild animals a change of diet, when it occurs, is almost invariably in the opposite direction, *i. e.*, from vegetable to animal matter. Under this head must figure the well-known case of the sheep-eating parrot of New Zealand, the outbreak of cannibalism in an aviary of parrots recorded by Dr. Buller, and the zoöphagous tastes recently developed by baboons in South Africa, who, according to Mrs. Carey-Hobson,[1] sometimes kill and devour sheep. These instances show that the habits of animals are not so fixed as was formerly imagined. They have their preferences, and their digestive organs may be better adapted for one kind of food than for another. But with few exceptions they will not starve, and if what may be called their natural food is wanting, or is scarce, they take any substitute which presents itself. Curiously enough, when any species has thus adopted a new diet, it shows a disinclination to return to its former food.

We have next to consider that the majority of warm-blooded animals are omnivorous, in so far that they consume both animal and vegetable food.

Thus, beginning with the Primates, it is a great mistake to assert that the apes and monkeys are purely vegetarian in their diet. They never omit an opportunity of robbing a bird's nest, and they feed with avidity upon a great variety of insects, from fleas upwards. The lemurs are, if anything, a shade more inclined to animal food than the true monkeys. Even amongst the Carnivora we find not a few which vary their diet more or less with vegetable matter. Thus the bears and their allies, with the exception of the so-called Polar bear, seem to prefer fruits, roots, honey, insects, and even grain before it is quite ripe and hardened. The Viverridæ also include some fruit-eating members, such as the civet-cat. There is no satisfactory evidence that any of the cats in a wild state will consume vegetable matter, but at least two groups of the Canidæ—the foxes and the jackals—are not averse to fruit.

Among the Rodents an omnivorous character is becoming more and more fully established. The squirrels, in addition to fruits, nuts, and grain, greedily devour eggs, nestling birds, and insects; the hamster, the so-called Norwegian rat (Waterton's Hanoverian, but which might be better styled the Russian), even the common mouse, and indeed all the true Muridæ, are omnivorous. We have

1 Knowledge, March 17, 1882.

little doubt but when the habits of the remaining Rodent groups are thoroughly known, it will be found that they all, in addition to their vegetable diet, prey upon insects, worms, and mollusks, if not upon more highly organized animals.

Among bats the majority appear to be purely insectivorous, but the so-called fruit-eating bats—the Pteropidæ or flying-foxes—although provided with a complex stomach and voluminous intestines, feed also upon such small birds and mammals as they can capture.

The Proboscideans, of which the elephants of India and Africa are the sole surviving representatives, are purely phytophagous.

Of the three divisions of the great order of the Ungulata, two—the Solidungula and Ruminantia—are as far as we know, strict vegetarians; but among the Pachydermata we find the swine, which may be regarded as the most typically omnivorous mammals, and the hippopotamus. All the species of swine are eager for animal food. When grubbing in the earth they snap up rats, mice, snakes, insects, etc,, and when opportunity offers they have been known not merely to attack but to devour much larger animals. A horse left tied to a tree, in La Plata, has been known to be killed and eaten by a herd of peccaries. The feral swine of North America have contributed much to the extirpation of the rattlesnake, and the common English pig often contrives to catch and eat up domestic poultry which stray into his sty.

Among the birds we find a very similar state of things. The number of purely phytophagous species is relatively smaller, that of the exclusively zoöphagous larger, and that of the forms recognized as omnivorous is increasing as our knowledge of their habits extends. Who, for instance, would, either from the morphology or from the general propensities of vultures, have predicted what has been observed by Mr. Bates, that these unclean birds devour eagerly the fruit of the pupunha or "peach-palm" (*Gulielmia speciosa*), and "come in quarrelsome flocks to the trees when it is ripe"? The common peacock is called a granivorous and fruit-eating bird; so it is, but at the same time a zealous and efficient destroyer of young death-snakes. Hence the way in which it is shot down by certain blundering sportsmen in India is nothing short of a public calamity. The pheasant is such an eager devourer of wireworms, grasshoppers, and the like, that his extirpation, as threatened by blundering "anti-sportsmen,"—if we may coin the term,—would be a very doubtful benefit to the farmer.

The Merulidæ—the thrush, blackbird, feldfare, and their allies—occasionally evince predatory habits, especially in severe weather. The most purely phytophagous birds are the finches (many of which, however, feed their young upon insects) and the doves.

We now see that the zoöphagous and phytophagous forms of animal life are not separated from each other by any sharply-marked characters, but are connected by a multitude of creatures intermediate in their organizations, and consequently adapted for a mixed diet. We see that animal food is regularly. and in considerable proportion, eaten by species not constructed on the typical zoöphagous type as witnessed in the tiger or the polecat. Yet such species, as we may infer from the very fact of their existence, are not thereby injured.

We know that the greatest mass of vegetables, especially the leaves, stalks, and even the roots and the fleshy part of the fruits, are less nutritious than is ordinary animal matter. To this rule the seeds of a number of plants, such as the legumens and the various kinds of grain, form an exception, though even here it would appear that a part of the nitrogenous matter is not present in a state suitable for assimilation. In other words, it exists not entirely in an albuminoid but in an amidic state. Hence we must conclude that an animal which is to exist entirely upon a vegetable diet must have larger digestive organs, so as to operate upon the greatest quantity of matter at once. On the other hand, purely zoöphagous species require, or at least can exist with, a smaller and simpler digestive apparatus. We may go a step further: of all nutriment the poorest—*i. e.*, that which contains the smallest quantity of blood-forming matter—consists of leaves and stalks. Accordingly the Ruminants, which feed upon leaves and stalks, have the largest and most complicated stomachs. In the Solidungula, of which the horse and ass are typical specimens, the diet is the same as that of the Ruminants, but the stomach is simple, and digestion is in consequence far less perfectly performed, as an inspection of the respective excrements of the horse and the ox will readily show. May it not be that we have here the reason why the Solidungula as a sub-order are so far less rich in forms and less widely distributed? We come now to such animals as the swine. Here the divisions of the stomach occurring in the Rumimants are but faintly marked out, to suit a richer diet, composed largely of roots mixed with no inconsiderable proportion of animal matter. A step further we find the apes feeding on fruits and nuts, with the addition of eggs, larvæ, etc. Here the stomach is simple, and the whole digestive apparatus lighter in proportion to the entire body than that of the swine. Lastly, in the true Carnivora, where the diet is most concentrated, we find the digestive canal shortest, and the relative weight of the stomach and its appendages smallest.

Another point of difference between animal and vegetable matters is that the former require less preparation before they can be assimilated. Hence we find that the teeth of the dog or cat, besides their action in seizing and killing the prey, need merely to tear it into lumps of a convenient size for swallowing. When this is once done digestion is not difficult. Vegetable food, on the other hand, requires to be ground to a pulp, so that the saliva and the gastric and pancreatic secretions may act upon its smallest particles. Hence true molar teeth are required, destined not to cut, but to pulverize. We see an approach to this structure even in the bears. But for the poorest kinds of vegetable food this arrangement is not sufficient; the leaves and stalks eaten, consisting as they do largely of cellulose,—which man cannot digest at all,—have to go through that double preparation commonly known as chewing the cud.

We may now venture to assign a reason why it is easier for a phytophagous animal to turn zoöphagous, than for a zoöphagous creature to become phytophagous. A lion, or even an ape or a man, could not take into his stomach so much grass as would afford him sufficient nourishment. Not having the teeth of the ox or the sheep, and not being able to ruminate, he would fail to digest the grass in any degree even approaching to perfection, and he would soon perish from hunger, as not a few men have done who in times of famine have tried to support themselves upon grass and leaves.

But an ape, a rat, or a swine experiences no difficulty in digesting animal food.

Man approaches at least as near—probably nearer—to the pure zoöphagous type as do the rodents and the swine. He has three kinds of teeth completely covered with enamel; his digestive apparatus weighs less in proportion to his entire body than does that of the swine, thus pointing to a more concentrated diet. Hence we should be inclined to consider that man is at least as naturally and originally omnivorous as the Rodents or the Suidæ. It has been contended that his "carnivorous practices have not yet changed his nature." Why should they more than has been the case in other omnivorous forms? If sharp nails, projecting canines, and a rough tongue would have given man any advantage in the struggle for existence, doubtless they would have been evolved. But these points do not in the least tell upon his power to assimilate animal matter. His intestine, though of greater relative weight than that of the pure zoöphagous species, is evidently required for his present mixed diet, and hence it persists.—*London Journal of Science.*

A LESSON IN COMPARATIVE ZOÖLOGY.

HUBBARD W. MITCHELL, M. D.

* * * * * *

Having entered the wide field of Zoölogy, we see before us a multitude of animals of different forms, sizes, colors and habits. At first view there does not seem to be the least similarity between any two of them. All appear totally different and distinct.

Here the naturalist and the comparative anatomist step in, and begin to study this great mass of animal life, and see upon what plan, if any, it is formed.

He begins by comparison. He compares one frm with another, and sees if any two or more animals have any qualities in common. If so, he assigns them to some order and species, and in this way he simplifies their study.

Let us apply this principle of comparison in practice. Suppose we see together for instance the following:

A Pig, Tapir, Peccary, Elephant 1
A Lion, Tiger, Panther, Cat 2
A Dog, Wolf, Fox, Jackal 3
A Goat, Deer, Ox, Sheep, Camel 4
A Horse, Ass, Zebra 5

How shall we compare them, in order to find feature common to any two or more of them ?

Perhaps the feature that strikes us first would be the horns in the ox and the deer. Can we associate these with any of the others?

If we examine the teeth of all the animals in the first, second and third lines, except the elephant, we shall find them sharp and cutting, with long canine or prehensile teeth, admirably adapted for seizing and holding living prey, and for cutting and tearing it. We should, therefore, call these animals carnivorous. If we examined the teeth of the animals in the fourth and fifth lines, we shall see that they have large flat surfaces well adapted to chewing and grinding, and as they live on vegetable substances, we shall call these animals herbivorous.

Comparing still further, we find that in the horse and the ox, both herbivoræ, the horse has incisor teeth in the upper and the lower jaw, while in the ox there are incisors in the lower jaw only, and this arrangement of teeth has a direct relation to the different structures of the stomach in the two animals, the ox having a complicated stomach with four pouches adapted to a mode of digestion by which the food is prepared for a second mode of mastication. This order of animals, those in the fourth line, are called ruminants.

The animals in the fifth line have simple stomachs, and do not ruminate.

If we again compare the ox, this time with the deer, we shall find that while both are herbivorous ruminants, and both have horns, in the ox the horn is hollow and remains firmly attached to the animal's head through life; in the deer it is solid and is shed every year.

Upon looking further we find that the pig, tapir and peccary, carnivorous animals, have a cloven foot like the herbivorous animals in the fourth line, and those last again, are different from the herbivorous animals in the fifth line, which have a solid hoof or foot.

These comparative studies will enable us to classify animals into different orders and species.

Naturalists tell us that certain animals sprang from a common stock, and the differences between them are the results of modifications of structure gradually occurring during long periods of time. Thus the pig has a stout rounded body and a mobile nose. The peccary is a step higher. Then in the tapir, the body is about the same, but the nose is decidedly more developed. The rhinoceros comes in next with the same form of body, and his nose modified and turned upward into one or two horns, and lastly the elephant, with his long mobile nose or trunk, is the highest expression of this common stock.

The order Felidæ, or cats, are almost precisely alike, the differences being chiefly of size, color, and growth of hair. The lion, tiger, panther, leopard, puma, and cat certainly sprang from a common stock, the domestic cat, perhaps, having the highest development, from the fact of its ability to rotate the radius upon the ulna, a motion the larger cats do not have. We see the grace of this motion when our cats play with a mouse or a ball of yarn.

The same fact is seen in the Canidæ, or dogs. They came from a common stock also. The wolf, jackal, dog and fox are of the same species, and have the same structure.

In the Graminivorous Ruminants, the origin from a common stock is apparent. The sheep, with its woolly coat and curved horn, undergoes a slight modification, and we have the goat, also with a curved horn and woolly hair. A further development gives us the deer, and further still the ox. Then comes the camel, and lastly the camelopard, or giraffe.

As an interesting instance of the structure of animals conforming to their modes of life, the giraffe may be mentioned. This animal feeds upon the foliage of trees. Upon his head he has tufted sensitive horns that he may *feel* his food as he passes along. His elongated neck enables him to reach it easily, and in order that he may be on the lookout for his enemies, the crouching lion being his most dreaded enemy, while his head is so high above the ground his eyes are set so that he can see above, below, forwards or behind without moving his head.

The complicated digestive apparatus of ruminants has some relation to their methods of escape from danger. As their food consists principally of vegetable substances, little nutritious and demanded in large quantities, and as they are in turn food for the ferocious carnivorous animals, their only means of safety is in flight, while mastication is a work of time.

They are therefore, obliged to graze rapidly, fill their large stomach reservoir with unchewed food, and then retire to place of safety, where they can remasticate it at leisure.

The horse, ass, zebra and other animals of this order sprang also from a common stock.

We have now seen that by comparing animals with each other we are able to classify them into order and species, each order and species having some distinctive character entitling them to a fixed and permanent place in zoölogical classes.

If now we examine all the forms of animal life on the earth, the fauna, or the animal kingdom, we shall find that they can be comprised under four great heads—namely, Vertebrates, Articulates, Mollusks, Radiates.

It is with the first of these only that this paper will deal.

As we saw that animals were classified under several heads by examining them externally and internally to a limited extent, and this classification gave us Carnivoræ, Herbivoræ, etc., so now if we examine this immense order of Vertebrates by the study of their bony frame-work, or osteology, we shall find that all, from an eel up to man, are constructed upon one single plan.

Beginning with man and descending in the scale, we will briefly examine this bony frame-work, or skeleton, and see what this plan is upon which such a vast part of the animal world has been constructed.

First we find a skull, rounded in shape, hollow, having apertures for the eyes, mouth, etc., jaws set with teeth, and articulated upon the first of a series of bones, or vertebræ. These vertebræ joined together by ligaments so as to form a continuous column, or backbone, mark the distinctive features of the whole order—viz , Vertebrates.

From the upper part of this spinal column are given off twelve pairs of ribs, which, nearly meeting in front, form a bony cage containing the heart and lungs.

The upper extremities are formed by a scapula and a clavicle, a humerus, radius, ulna, carpus, metacarpus and phalanges.

At the lower end of the spinal column is the pelvis, from which is given off the femur, the tibia and fibula, the tarsus, metatarsus and phalanges to form the lower extremities.

This briefly is man.

In the Simidæ, or monkeys, the facial angle is a little greater, the humerus, the radius and ulna a little longer, the tarsus slightly modified, and in some species the vertebræ are extended into a tail. These are monkeys, modified a little from man.

In the Felidæ and the Canidæ, the facial angle is still greater, the teeth sharp and cutting, with well developed canines, the upright position is changed to a horizontal posture, the upper extremities are now fore limbs, bones modified in shape, species mostly digitigrade. The bears all plantigrade.

General plan same as man.

In the remaining members of the Carnivoræ, as the sea lion, seal and walrus, the fore limbs are modified into paddles, while the hind limbs are less developed. In the walrus the lower incisors and canines are absent, while the upper incisors are elongated into tusks.

General plan same as man.

In the Bovidæ, beginning with the camels and running through the llama, giraffe, ox, bison, yak, goat, zebu, gazelle, gemsbok, sheep, antelope and deer, we have an elongated skull, modified bones of the fore and hind limbs, and a modification also of the carpus and metacarpus, the tarsus and metatarsus, whereby the foot is cloven, owing to consolidation of some of these bones. In some of the members of this order we have the horn, either deciduous or permanent, and in all the cauda. In some, also, we have a longer scapular and longer spinous processes. This affords greater attachments to the nuchal ligaments and muscles for those animals with heavy heads and horns. In the giraffe this is especially noticeable. The shoulders are so high that it makes the fore legs seem higher than the hind legs. This is due to the lengthened scapula and spinous processes. The heads of the femur and humerus are on the same leve.

In all other respects, the general plan is the same as man.

In the Cetacea, as the porpoise, dolphin and whale, the skeleton is the same, except the hind limbs are modified into complete or rudimentary fins.

In the extensive orders of Insectivora, Rodentia, Edentata and Marsupiala, the general plan is that of the higher animals and of man, modified to meet the requirements of its mode of life.

In the enormous class of Aves, or birds, beginning with the robin and ending with the penguin, we have the elongated skull ending in a beak or bill, light porous bones, an extensive sternum, clavicles united to support the wings, various modifications of the humerus, radius, ulna, and the carpus, metacarpus and the phalanges, as in the bats, etc.

In all the species of birds, the general plan is the same as man.

The same is true of the class Reptilia and Amphibia. In some of the snakes the legs are rudimentary, in others the ribs serve as legs. In the sharks the fins take the place of the fore and hind limbs.

In the class Pisces, or fishes, through the whole series down to the eel, we have the skull, vertebræ and ribs, and the bones of the fore and hind limbs are more or less perfectly represented by the fins. The pelvis in fishes is rudimentary, or wanting.

This brief sketch of the Vertebrata, from man to the lowly eel, shows that the whole sub-kingdom is formed upon a single plan, and that any variations are but simple modifications designed to meet some special requirement. The study of osteology shows us that in this long line of animals—the Vertebrates—the distinctive feature is the spinal column, and it is astonishing, as well as interesting, to observe how little difference there really is between the backbones of any two members of the whole series. The chief differences are in the structure of the head and limbs.

If we compare the anterior limbs of some of the lower animals with the arms of man, we shall see that bone for bone is present, from the humerus to the phalanges. For instance, take the anterior limb of, say, an ape, a bat, a dog, a mole, a deer, a whale, a seal, a tortoise, a fish, or a bird. In each we can distinctly trace the humerus, the radius and ulna, the small bones of the carpus and the metacarpus, and the phalanges.

The differences of shape in each animal are simply modifications of the same bone to adapt it to its individual mode of life.

The intelligence of animals, no doubt, resides in the brain, and it is believed that the amount of the reasoning power, or faculty, is in some way proportioned the quantity of *gray matter* of the brain.

In connection with the reasoning power of animals, depending on brain action, may be mentioned a provision of nature for the safety, which—although it has nothing to do with reason—acts in connection with it.

This is the *mimicry* of animals, or the adaption of the color of an animal to that of surrounding objects in its native wilds.

Nature excites our wonder by her wisdom of this curious and interesting provision.

Thus the tiger, so beautifully decorated with black stripes upon a ground of reddish-yellow fur, tending to white below, living in the long jungle grass of Southern Asia, with the color of which its stripes so closely assimilate, it is impossible for an unpracticed eye to discern it even at a short distance. This mimicry not only protects the animal's satety, but enables it to steal unseen upon its unsuspecting prey.

The uniform dun color of the puma gives it a mimicry for its safety and attack, while crouching upon the branches of trees.

The dark circular spots upon the skin of the leopard give it a mimicry that utterly deceives, as it conceals itself among the leaves of bushes and trees.

The giraffe has, perhaps, the most astonishing mimicry of any animal. Inhabiting as it does the forests of Africa and feeding upon the boughs of trees, its great size makes it a most conspicuous object. Its most dreaded enemies are the stealthy lion and man. In the regions it most frequents are many dead and blasted trunks of trees, and its mimicry is such that the most practiced eye has failed to distinguish a tree trunk from the giraffe, or a giraffe from a tree trunk. Reliable accounts have reached us where lions have gazed long and earnestly at a motionless giraffe, and being in doubt whether it was a tree or not, have actually turned and skulked away.—*Journal of Comparative Medicine aad Surgery.*

BOTANY.

SOME OF THE WASTES OF NATURE.

REV. L. J. TEMPLIN.

If we take a view of Nature from a utilitarian standpoint, we find that, though exceedingly parsimonious in many things, still in others she is lavishly prodigal and wasteful.

A brief review of some of her wasteful doings may not be without interest to the readers of this Journal. We will draw our first illustration from the vegetable world. The profusion of vegetable organisms seems, from our point of view to be out of all proportion to the uses and needs of the case. Look, for instance, at the wasteful extravagance of plant life on the prairies of North America, the llanos and pampas of South America and the steppes of Northern Asia, where millions of square miles have for inconceivable ages been clothed with a luxuriant growth of grass and other plants, that through all these years have flourished, apparently only to perish and decay. The proportion of these almost limitless productions that serve any apparently useful purpose is so infinitesimally small that it would seem that these profuse productions were only the result of Nature's restless tendency to change.

The same may be said with regard to the vast forests of arboreous productions that have for countless ages covered large portions of the various grand divisions of the earth. But when we take a closer view of Nature's processes in the vegetable kingdom we find this spirit of prodigality carried into her minuter operations in this field. It is a well known fact that in order to the production of mature seed the flower must be fertilized with the fine pollen dust produced for that purpose. There are three different methods by which this fertilization takes place.

Flowers are composed of two sets of organs—stamens and pistils. These answer to the male and female organs in animals. The stamens produce the pollen that must come in contact with the pistils through which the ovules or rudimentary seeds are reached and fertilized. In the first method by which fertilization takes place both sets of organs are arranged in the same flower. These are termed perfect or hermaphrodite flowers. In some cases the stamens of these flowers are placed in direct contact with the stigma of the pistil so that fertilization takes place by contact; in others the pollen falls or is thrown upon it; while in still others the organs are so arranged with reference to each other that the insects that visit the flowers for their nectar carry the pollen from one flower and deposit it on the pistil of another. But in whatever way this result is brought about there is always a large surplus of pollen produced that answers no useful purpose. Of this class of plants the rose family and most garden plants are examples.

In the second or monœcious class the different organs of the plant are arranged in different flowers on the same plant. Here the pollen must be conveyed from the staminate to the pistillate flowers by the agency of gravitation, winds or insects. In this process of course a very large proportion of the pollen is lost. We have examples of this class in the walnut, squash and corn. In the third and last class, called the diœcious, the different organs grow upon entirely different plants. The poplars, mulberry and hemp are illustrations of this mode of fertilization. In this case it often happens that the plants bearing the male organs are at a long distance—even some miles—from those that bear the female flowers. Here the agency of winds and insects must be employed in conveying the fertilizing elements from the one to the other. In all these different cases the amount of pollen that is actually employed in fertilizing the flowers of the various plants is but a very small part of all that is produced. In many cases, probably not one-thousandth, if indeed it is above one-millionth part of that which has been produced. Let any one pass through a field of corn at the time the pollen is mostly fallen from the tassels and if it be a dry time he will find the whole surface of the ground literally covered with the shed pollen. Why this great waste? It may be answered that under the circumstances this great surplus is necessary to insure perfect fertilization. But it may be answered that any system that requires such a waste of materials to accomplish the desired end certainly has the appearance of being a very prodigal and imperfect one.

Still another example of wasteful prodigality in the vegetable kingdom is seen in the superfluous amount of seeds that are constantly produced above that which can by any possibility serve any useful purpose. I do not forget, nor would I overlook the fact, that a large part of the grains and seeds annually produced are used for food by man, beast and bird; but aside from this a large proportion of that which is produced from year to year fails to meet any want in either the animal or vegetable kingdom so far as we are able to discover. To impress this fact on the mind let us use a simple illustration. Let us take the surface of the earth and see how long it will take for the progeny of a single plant to completely cover it with vegetation. The land portion of the earth's surface contains about 47,000,000 square miles. Reduced, this gives us 1,310,284,800,-000,000 square feet. Now let us take a plant that will average 500 seeds a year, which is a very low estimate, as many produce several thousands of seeds annually. Now suppose every seed should be preserved and grown for seven years and the product for the last year would be 7,812,500,000,000,000,000 plants, which would be equal to 5,962 for every square foot of land on the earth's surface. But if we estimate the annual increase at only 100-fold, then in nine years the product would give 763 plants to each square foot of surface, which, even at this low estimate, will be seen to be many times as much as could possibly grow on the given space; and this makes no allowance for deserts or barren mountains, which occupy no inconsiderable portion of the earth's surface. This proves that a very large proportion of the annual production of seeds perish without having served any apparently useful purpose in the economy of nature.

In the employment of the forces of nature there seems to be a vast expenditure of energy the utility of which we are unable to discover. A forcible illustration of this waste of energy is found in the force that is constantly employed in lifting the waters of the earth to the aërial regions where they are formed into clouds and afterward precipitated in rain, hail and snow. The amount of water thus lifted up by evaporation to an average height of three and one-half miles is equal to 2,000,000,000 tons per minute. This would be equal to the continued exercise of the combined strength of more than 2,239,000,000,000 horses. Of the vast energy with which this force operates we have an example in some portions of the Indian Ocean, particularly the Bay of Bengal, where at times the evaporation is as much as from twenty to thirty inches in depth over the whole surface in twenty-four hours. Not only is this vast volume of water elevated to this great height but it is conveyed to great distances, frequently hundreds of miles, where it is poured down in rain or snow. It should be remembered that when this vast amount of vapor has been elevated to this great altitude it contains a latent energy equal to that which has been exerted in lifting it to its present position. And in returning to the level of the ocean, as it all does eventually, it gives out this latent energy. Every drop of water that falls gives up in its descent an amount of energy just equivalent to that which was expended in lifting it up to its highest altitude. Every stream that flows is evolving this energy thus stored up in its waters.

This evolution of energy is constantly going on before our eyes in the various rivers that flow by us on their way to their ocean home.

The amount of power that is continually going to waste in the rivers of the Earth is entirely beyond our calculation. Take a single instance—that of the Falls of Niagara, 100,000,000 tons of water plunge over that precipice every hour. Here we have a loss of not less than 56,000 horse-power every minute; about three and a half times the amount of power developed by burning all the coal dug from all the mines in the world. But this great cataract represents but an infinitesimal part of the energy that is constantly being dissipated by the flowing waters of the rivers of the globe. We may safely admit that a large amount of water is constantly needed to water the earth and cause it to bring forth its various vegetable productions for the use of man and beast, but to assert that the larger part of it is ever so utilized is to claim what is not borne out by the facts before us. We are compelled to admit that a large proportion of the force expended in lifting up the waters that form the clouds and that is given out again in the return of these waters to the ocean, serves no practically useful purpose in the world, but must be set down as a great and useless waste in the economy of nature.

A like waste of energy is in the movements of the waters of the ocean. This vast collection of water is lifted up on its surface, from a few inches in some localities to as much as seventy feet in others, twice in the course of every twenty-four hours. This in mid-ocean is a simple vertical oscillation of the waters through a greater or less space according to the relation of the locality to the position of the Moon. But where it comes in contact with the shores of continents it is greatly modified according to the configuration of the shore line. This variation reaches its maximum in the Bay of Fundy, where the rise and fall often reach from sixty-five to seventy feet.

Where the shore is low the tide flows out over the land till arrested by the higher ground. At the mouths of rivers it enters and flows back until it has reached its level. The rise and fall, the flow and ebb of these tides are attended with an expenditure of force that is beyond all computation. But notwithstanding the immense amount of force involved in the motions of the tides it is almost all uselessly expended so far as appears from a practical standpoint. But the force of waves and currents is not confined to waters of the globe. The great ocean of air that surrounds and envelopes the Earth partakes of like motion and is governed by similar laws. The atmosphere is in almost constant motion. I need not stop here to either prove the fact or to explain the reason. On each side of the Equator for a distance of twenty-five or thirty miles the trade winds blow almost constantly with a velocity of from fifteen to eighteen miles per hour. In other extensive regions there are winds that blow regularly for from six to ten months in the year, while in most other places they are quite variable, but blow from some quarter a considerable part of the time.

Taking it altogether it is probable the winds that blow over the surface of Earth would equal an average of twenty-five miles an hour constantly over one-half of the earth's surface. A wind blowing with this velocity exerts a pressure of about three pounds per square foot. We know only too well the irresistible energy of the cyclone, the tornado and the hurricane. Nearly all this illimitable force is a useless waste so far as appears to the merely practical mind.

The last but not least waste of energy to be noted is that which is constantly emanating from the Sun in the form of light and heat. Careful experiment led Sir John Herschel to the conclusion that the heat of the Sun that falls on the Earth is sufficient to melt 26,000 tons of ice per hour for every square mile.

And it has been estimated by very high authority that if a column of solid ice forty-five miles square and of indefinite length were shot toward the Sun with the velocity of a ray of light, and could all the heat of the Sun be concentrated on the end of that approaching column of ice it would not only melt it but boil it to steam and dissipate it in invisible vapor as fast as it could approach even at the enormous velocity supposed. The amount of heat at the surface of the Sun must be equal to what would be produced by the consumption of not less than 11,600,000,000,000,000 tons of coal every second of time. This is about equal to the consumption of six tons of coal for every square yard of surface per hour. All the coal known to exist in the Earth would suffice to keep up this heat about one-eighth of a second. Now what proportion of this vast energy serves any useful purpose? We know not that any part of it does except that which falls on the Earth. That a large part of this is practically useless is evident from the fact that this is the power that is concerned in the elevation of the vast quantities of water from the Earth's surface noticed above, while much of it falls on deserts and mountains where it is inevitably lost. But suppose all that falls on the surface of the Earth answers some useful purpose, a simple calculation shows that only one part in 2,000,000,000 of the Sun's light and heat falls on this globe. And if we assume that all that is intercepted by all the planets of the solar system is usefully employed it amounts to only 1-227,000,000 part of the whole. All the remainder is waste so far as we are able to see. And it be true that the stars are all suns this waste is to be multiplied by their number and magnitude. From this brief review it appears that in both her materials and forces nature is exceedingly prodigal. True, I have looked at this subject only from a practical, utilitarian standpoint. Had it been viewed from the position of a scientist, a philosopher or a theologian, the conclusion might and probably would have been different. Some of the forces named will doubtless be partially or wholly utilized in the future, but some of them must always remain as apparent examples of dissipation of energy without any compensation.

HUTCHISON, KANSAS.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, September 23, 1882.

Paris is a beautiful capital, but it is not at all salubrious; this drawback is due, not to its site, but to its sewerage, though the latter is most remarkable and in many respects fairly provided for. The houses are very substantially built, of excellent stone and iron—wood being expensive and not sufficiently durable—and on an average are expected to last three centuries. It is only in the edifices constructed within the last quar+er of a century, that any attempts to remedy the abominable system of so-called water-closets, have been made. In some hospitals the *latrines* are horrible: no seats, no water to flush, but a hole sunk in the ground the approaches to these dens constituting for the patients a wading through a *cloaca maxima.* In the dwelling houses, the garrets are occupied by the domestics, and the common water-closet is the same receptacle arrangment peculiar to hospitals, railway stations, and several public establishments. Of course there are private water-closets in these places exempt from the foregoing objections. The plan of running off the fœcal matters directly from houses into a street-sewer, may be regarded as unknown in Paris. The Lyons system of emptying the collectors by means of a pneumatic arrangement has just been tried, and found to be impossible, owing to the expense. The *diviseur* plan is the best that exists; cylindrical *tinettes* receive the fœcal matters; a kind of grating apparatus divides or separates the solid from the liquid dejections—the latter being run off into the sewers. At stated periods dustmen replace the full by empty *tinettes* or even barrels; the contents are conveyed to works outside the city—dépôts, mixed with charcoal and other pulverulent substances; then dried, and ground into *poudrette* for which there is a ready sale. The dominating, and old plan, consists of a reservoir in the courtyard, into which the contents of all the water closets flow down an enormous common pipe, which, open at the top, at the roof of the house, acts as a ventilator for the reservoir; the atmosphere of Paris is thus permanently polluted. For successful house and city drainage, the first requisite is a liberal supply of water for flushing the closets, and acting as an extra guard over the piston valve; next, an unvarying flow in the city sewers, as in Brussels, to carry away to a distant out-fall, the fœcal matters. The danger to guard against is, the entry, up sewer or pipes, of the toxical gases or fermentable substances. The latter, according to the delicate experiments of Tyndall, can remain for an indefiite period undecomposed, wherever the air remains stationary.

The blood being life, it is not surprising the extraordinary attention physiologists are at present devoting to its study. Borden described blood as flowing flesh; rolling incessantly through several thousands of channels in the middle of the cellules of our organs, the fertilizing torrent brings with it nutritive matters. It is the source of life. Cut a member, electrify it; the muscles will not contract; but if blood be injected by the artery, the muscular contractibility will reappear. Hence the curious experiment of Brown-Sequard, of a dead head on a living body; if the ligature be removed which prevents the flow of blood to the brain the animal will revive. The blood not only brings the nutritive principles to the organs, but it carries away the products of combustion which have become useless for life. Its function becomes interrupted when it cannot obtain the materials of nutrition, in a pure atmosphere and suitable food, and also when the organs destined to carry off the detritus, work imperfectly. Thus all alterations of the organs act on the blood, as the latter re-acts on the organs that it nourishes.

Normally speaking, the blood is rarely primitively diseased; it becomes altered, however, as the materials which produce and feed it, become deranged. Blood has no malady peculiar to itself, but it is the mirror which reflects all diseases of the organs.

Blood is the vehicle of irrigation and excretion; when drawn from a vein it rapidly separates into a white, solid part, the clot or fibrine, and a liquid part, consisting of red and white globules, and the serum itself composed of albumen, salts, and a multitude of organic substances and gas soluble in water. But they are the red globules which attract most attention; they are composed of a kind of white envelope, called globuline, a substance resembling fibrine, and a red coloring matter designated hemaglobine. The mission of this latter substance is to unite with the oxygen of the air when it arrives in the sanguinary vessels of the lungs. The red globules are thus the principal agents of the phenomena of combustion—the process that sustains life. Experiments attest, that the more the globules contain of the red material, the more capable is their *role* of nutrition. Formerly these red globules were counted, to determine the richness of the blood; that process is now superseded by the test of the power of the coloring matter to absorb oxygen. Hitherto bleeding was the grand panacea for all diseases. Botelli laid down, the more water we draw from a well the more that which follows will be pure. This figure was the theory perhaps of Sangrado in *Gil Blas*, who maintained, "one has ever enough of blood to live."

Professor Hayem has demonstrated that blood cannot be taken from the body with impunity; repeated bleedings beget chronic anemia, the blood becomes diluted, the number of red globules diminish, require a long time to re-form, and contain less of the important red coloring substance, that is to say, of life. Thus the majority of the organic combustions get weaker; less oxygen is absorbed, less carbonic acid eliminated, fat augments, owing to the work of dis-assimilation being impeded. At the same time the assimilation of nitrogenous substances by the cells ceases; these substances are destroyed in the nourishing fluids, even without filling the office of nutrition, and the residue, such as urea, augments; hence, gout, rheumatism, diabetes, etc. Similar trouble ensues in the assimilation of phosphoric acid, which forms an integral part of all living cells.

It was once held, that the more blood extracted, the more blood would be re-made; similarly as the more an infant suckled its nurse, the more the milk would be abundant. But there is a limit to the re-formation of the blood. As bleedings weaken the system, if the blood happens to contain any poisonous element, as an infection of purulent nature, the less the constitution can struggle against the disease. However, bleeding is excellent in the case of asphyxia or derangements of the nervous system. Indeed, bleeding is not sufficiently resorted to in the treatment of apoplexy and convulsions as the consequence of accouchment; extracting under such circumstances say seven ounces of blood, acts as a fillip on the circulation. Professor Hayem has obtained very important results from the transfusion of blood, but that process must be supplemented by iron preparations. Iron exists in our food, in our body, and most largely in the red coloring substance of the blood. Now this coloring matter or hemaglobine and iron, diminish when the number of globules grow less, or even where their state has become altered, though plentiful in point of numbers. This is the case in chlorosis, where the iron in the blood is reduced by one-half. Preparations of iron are naturally administered for this disease, but the efficacy of the medicament does not lie in exciting the functions of nutrition. The iron has an action special in the formation of the red globules, and that action must be sustained by curing the stomach and stimulating nutrition by baths. The globules are not solely composed of iron, but of nitrogenous and fatty substances also, hence why a meat diet, tempered with fatty matters, such as cod-liver oil, favor the regeneration of red globules.

The French Association for the Advancement of Science, has held its meeting this year at Rochelle. The inaugural address was delivered by M. Janssen, director of the Observatory at Meudon. Among other interesting points he stated that it was not Galileo who discovered the first spots on the Sun, but one Fabricius, in 1610. He showed the spots were upon the Sun itself, and not as was then believed, due to the interposition of small planets. Spectral analysis reveals that not only the suns and stars visible to us, but those so distant that the most powerful telescopes are incapable to assign them a sensible diameter; nay more, those nebulæ which appear to the best instruments as only faint rays of light, have been seized by chemistry, by spectral analysis, and shown to be composed of the same matter as our own planets, of the same as we ourselves are formed. Also, that despite the fabulous distances of the nebulæ, chemistry demonstrates that they are subject to the laws of gravitation. When Newton decomposed a ray of white light and thus laid the basis of the theory of the spectre, he little thought his law of gravitation would there find wings to carry it to regions where all measurement ceases and all calculation is powerless.

By spectral analysis and photography, the Sun's atmosphere has no longer mysteries forus; round the central kernel is a luminous envelope—photosphere, formed of incandescent hydrogen, traversed by eruptions of metallic vapors, sodium, magnesium, calcium, etc. This photospere is itself surrounded by another atmosphere, very profound and very rarified. Hurricanes of the most frightful nature occur in the photosphere, which disturb the repose of matter, forming globules of light. The substance of the Sun, as the blood of animals, owes its force then, to globules.

METEOROLOGY.

METEOROLOGICAL FACTORS AND PHENOMENA.

ISAAC P. NOYES.

The Factors which produce our meteorological phenomena are very few, and may, like all other branches of science, be divided and sub-divided into positive and negative, or active and passive. To enumerate them in exact order may be difficult and unimportant.

It matters not whether for the first of our two grand factors we take the Sun or the Earth, for without them both we could not have our peculiar existence or our present meteorological system.

The Sun as the active agent of heat, the generator and sustainer of life, is the active or positive factor, while the Earth is the passive or negative one, yet both are equally important, and in many respects both positive and negative.

But the mere presence of heat or sunshine upon a planetary body will not produce meteorological phenomena. The body must itself be in condition and have certain combinations of elements in order to produce the effect. The heat of a hundred suns concentrated on a non-aqueous body like the Moon would not produce the necessary combinations. In combination with heat we must have water. Such a body as the Moon may, and undoubtedly does have commotions of atmosphere, such as they are, but then all these commotions would not be like those on a body like our earth where water is abundant.

If satellites like the Moon have storms they must be what we would term *dry storms.* The concentrations of heat on certain parts of the Moon must create some disturbance there, but owing to the absence of water whereby an atmosphere is created, the element surrounding the Moon, (ether, if we may so term it—being so subtle and transparent)—though it cause a disturbance, what it may create is not visible to us 240,000 miles away. If there are any storms on the surface of the Moon they must be the result of the movement of dry ether or very light air. There must necessarily be some concentration of heat; some parts of the moon must be hotter than others, and having no moisture to retain heat they must heat and cool rapidly; and it would seem that the points of concentration of heat must change from place to place, at least that the atmosphere, such as it is, of the cooler reverse side must be moved toward those portions where the heat of the Sun is concentrated and that this must establish currents from the cold to the hot and from the hot to the cold.

This idea assumes that the Moon must have an atmosphere, while science tells us that the Moon has no atmosphere, but it would seem before we decide the point that we must first determine what atmosphere is. It is not necessary that the Moon have an atmosphere like the earth in order to be recognized as having an atmosphere.

But for the presence of water the Earth would have no more atmosphere than the Moon, so atmosphere in the sense as generally understood must be the product of moisture or something resulting therefrom. These remarks about the moon may seem a little of a digression, yet they naturally follow when we come to speak of atmosphere.

In this connection some may wonder why the planets and Moon are not considered as factors in our meteorological economy—for the simple reason that they have not the least bearing in the case and therefore are not factors. Nothing but concentration of heat effects the meteorology of the earth, and only the Sun has power in this direction. There is no heat from the stars, therefore no effect. "How about attraction?" some may ask. The reply to this is, no one who would study the weather-map for a season and see for themselves how storms travel would be apt to put any dependence upon the accidental relative position of the stars or other heavenly bodies than the Sun. The storms come from the development and concentration of the clouds and movement of the atmosphere, and neither the stars, planets, nor even the Moon, have any power over this department. The earth is beholden to the Sun and only to the Sun for its meteorological phenomena; it alone is the major factor—the great positive, active force, while the earth in relation to it is the minor-negative, passive power.

The next great factor, or better, factors, for they are really distinctive and peculiar in their results, is the combinations of motions of the earth in space; its daily motion on its axis—its yearly motion about the Sun, and the gradual oscillating motion of its axis which exposes different parts of the Earth's polar axis more directly to the influence of the Sun.

The daily motion of the Earth on its axis exposing every twenty-four hours the surface of the Earth to the heat of the Sun is the factor of all the daily changes; the yearly motion of the Earth about the Sun is combination with the parallelism of the Earth's axis is the factor of the yearly or season changes. The common notion is that the yearly motion of the Earth about the Sun in the only and sole cause of the changes of the seasons, yet but for what science terms the "parallelism of the Earth's axis" in connection there with these changes would not take place, for the Sun shining perpendicular to the Equator would produce a sameness and no variety—all our months would be alike and the habitable portions of the globe would be much reduced, at least for such organisms as at present flourish upon it.

It is said that we are sometimes nearer to the Sun than at others, but the distance is comparatively so infinitesimal that it amounts to little or nothing, and practically would not be noticed. The third motion, the gradual change in the angle of the inclination of the Earth's axis, the oscillation of the poles, whereby the polar axis describes a circle in the heavens of some 25,000 years, is the factor of decades or cycles, or the changes which are the result of vast periods of time —producing these, at present, gradual climatic changes which cause the surface of the earth near the poles to be more directly exposed to the rays of the Sun.

These last three factors are the general results of the three motions of the Earth in connection with the heat of the Sun. The third motion of the Earth, however, seems to be very little regarded, yet it is as important as the other two which cause the daily and yearly changes of the seasons. The three motions of the earth are best represented by the spinning top, including the state known as "dying out." It has one (first) motion on its axis; one (the second), along the ground; another (the third) back and forth, which in combination with its rotary motion causes the upper part, which would correspond to the polar axis of the Earth, to describe a circle in the space above it. This third motion of the Earth at present is very gradual, yet there may have been a time when the change was very sudden, and nothing it would seem would so well account for these peculiar and rapid climatic changes of past periods of the Earth's history, when the features of the present torrid zone prevailed as far north as Siberia, and were changed so rapidly as to entomb alive the huge mammoth, nothing it would seem would so well account for this phenomenon as a sudden change in the inclination of the Earth's axis.

The next great factor in our meteorological economy is the concentration of the Sun's rays along certain paths of the Earth's surface. These concentrations are always on general lines from the west toward the east and are termed areas of low barometer—*i. e.*, the heat of the Sun concentrating on certain points produces there a rarification of the air, or would-be vacuum which is the agent to establish a current of air toward this point. The water present on the Earth is a latent factor in the case; it not only provides moisture to immediate surroundings but furnishes the material for clouds which are simply suspended moisture and which are ever ready, when formed, for transportation to wherever the prevailing winds may dictate. The concentration of the Sun's rays producing the area of low-barometer, technically termed "low," is the agent or power that creates the winds.

All these factors, winds, clouds, motion, conditions for existence, all come through that great agent of heat, the Sun. The minor factors though great in themselves, all depend upon are subordinate to the Sun; and it is only when we come to understand the importance of these minor factors that we can by comparison begin to comprehend the greatness of the major factor and the infinite wisdom that established all the beautiful mechanism of our terrestial system.

On the surface of the Earth we have the factors high and low thermometer and high and low barometer. The thermometer we know is the register of the heat, and other things being equal, it will be hottest where the Earth receives the most direct influence from the Sun. The belt comprising the torrid zones is warmer than the temperate, and the temperate warmer than the frigid, and it would seem that there would be no exceptions—it would seem at least in the immediate vicinity of the Equator it should be warmer than half way from there to the poles. It is *generally* or more extensively warmer as we approach the Equator; notwithstanding this, even as far north as 45° there are points where at times it is full as hot as on the Equator and even more disagreeably hot. General, broad-spread temperature, though a powerful factor in our meteorological system, causing vegetation to grow and the Earth to be fruitful, is not a power for the distribution of heat and productiveness. If heat had no other peculiarity than that indicated by the thermometer the Earth would not support such beings as we much beyond the tropics of Cancer and Capricorn. But the meterological facts of late years have thrown much light upon this department. It has shown to us that what we term the area of "low-barometer," technically called "Low," and caused by the concentration of the Sun's rays, has the power to and does continually travel around the world, on general lines, from the west toward the east. Many people ask, why this is so? Enquiring minds always desire to know the "cause," and it is well they should, but when they will not take the trouble to enquire into the other important causes, in this department, that lead up to and explain this, it does not become them to simply demand the cause of only this prominent phenomenon of meteorology. In all departments of nature we are repeatedly lead up to a *first cause*, every department has its *first cause*, which is established as a fact—a fact that we know as well as we know that the Earth is suspended and moves in space.

What should cause this condition "Low" to obey its peculiar laws? The concentration of the Sun's rays.

What should cause concentration of the Sun's rays, particularly at so great a distance from the Equator, and why should it move as it does? It is easier to explain why it moves, and in other papers (under the "theory of Low") this perhaps has been as satisfactorily explained as it is possible to be. But why the concentration? Some day, with more facts, there may come an explanation; but until then we must accept it as a "first cause." Now that it is so, like many other laws in nature, we can see the beauty of the law establishing it and the wisdom therein; at present it does not seem that we could go further.

The tracks of "Low" (low-barometer) are very eccentric—at times they take directions toward all points of the compass, but as a whole on general lines from the west toward the east or toward the rising Sun. Occasionally, twice this year (1882,) "Low" has retrograded toward the west; this has been during the night. The returning heat in the east the next day soon re-established the current toward the orient. "Low" is the agent of the storm; no "Low"—no storm. "Low" is the centre toward which the wind is drawn; and on its power of concentration depends the force of the winds. People, intelligent people, even those claiming to be meteorologists and writing upon the subject, repeatedly ignore the important factor "Low." An article of this kind recently appeared in one of the leading journals of the country—an article on storms—with not a word abou "Low." Hurricanes were produced by the coming together of two currents of wind, a warm and a cold current. Now these two currents cannot come toge er in any other place or at any other time than when "Low" is passing, or the very centre of "Low." As the wind is always toward "Low," it follows that the winds from all quarters must be toward it. North winds which are cold as well as south winds that are hot, and the east and the west winds which combine and partake of the two.

The tornado or the hurricane, call it what you will, for it is all one without regard to name, is the result of "Low" and will always be found in and only in the track of "Low"; and every time "Low" has passed, and is passing over the territory of the United States every three to five days—never regular in time, speed, or direction—always peculiar and irregular in its qualities of concentration, power, speed, spread and direction; every time it passes we are liable to have the fierce storm which we term the tornado or hurricane; and for the reason that it always occurs in the track of "Low" as it passes to the eastward, the Sun being the more powerful in this direction as it not only has the direct power of "Low," but, so to speak, the momentum of "Low" in its course to the eastward. But, it may be said, we sometimes have the tornado with a north wind, which would seem to contradict this; then in the United States it may apparently be so, or locally so, but the power that creates it is the while moving to the eastward. Along the Atlantic sea-board, particularly in the vicinity of Washington, the hurricane will at times occur with a northwest wind for the same general reason that water forming the whirlpool does not travel in a straight line toward the center, if it did there would be no whirlpool. The waters coming with force from every direction act and react upon each other; the result is to establish a circular motion of the currents; so with the winds toward "Low"; they approach "Low" from all points of the compass; their action upon each other establishes a circular motion to the currents. The circle is large, so notwithstanding it may be locally a northwest wind it is really toward the centre, "Low," which has passed the locality to the eastward; and the wind blowing in this manner is what gave rise to the idea that the wind blows, between "High" and "Low," so that if you stand with your right hand toward "Low" and left hand toward "High" the wind will be your face. The wind may in some places be in your face, yet it is all the while seeking the centre "Low"; not in a straight line, but in a grand volute curve.

I may be wrong, but I cannot see wherein the coming together of the so-called warm and cold currents causes the tornado. If the warm and cold currents meet (and they do), they are meeting all the time at the very centre of "Low" and not in the track of "Low" where the tornado takes place; and if they meet all the time it would seem that they should all the time produce the same effect and give us the tornado not only every day but every hour of the day; but we see that they do not—that a great many "Lows" pass over the country without producing a tornado. The tornado occurs late in the afternoon when the Earth has become heated to its maximum point—occurs in warm weather, and seldom if ever in cold, and only with a *high* "Low," or perhaps better, with a "Low" that is traveling on a high line or toward a high line.

August 26, 1881, a hurricane occurred at Charleston, S. C. The "Low" that caused this storm, at the time not being on a very high line, may seem to oppose this idea, but then it must be remembered that this "Low" came from the south. On the 24th day of August it was reported at St. Thomas. It was therefore at the time seeking a high line, and from present knowledge only under such conditions would it have produced a hurricane in the latitude it did.

A "Low" travelling across the country on the latitude of Charleston I do not think would produce such a storm—it would produce cold, and such a storm requires a vast amount of accumulative force developed by heat which can only be generated, at least in latitudes embracing the United States, by a high "Low" or a "Low" traveling for some distance in a northerly direction.

For years people have been, and are still studying the *effects* of the tornado in its paths of destruction. Many changes are produced, indeed it would be difficult to have a sameness in details, yet with all the general effect is the same every time. There is no light to be obtained by studying the endless variety of detail—it is studying the *effects* and not the *cause*—the cart and not the horse. What we want to study is the cause—the power that creates and not the mere effect that follows. "Low" is the concentration of heat. The tornado is the concentration of that heat to a narrow limit.

A tornado track is never very wide—extended width would prevent its power. Sometimes it is said to be a mile wide, but generally not more than a quarter of a mile or less. For some reason, unknown to us at present, the concentration of the heat is so peculiar as to only effect a narrow track—nature become unbalanced. The tornado is the effort on the part of nature to restore that balance—it is done in the twinkling of an eye. All sorts of plans have been devised whereby to give warning of its occurrence. One might as well during a thunderstorm undertake to give warning of where the lightning will strike. In years to come with more perfect instruments it may be done, but at present it is simply impossible. This is the view of the tornado I would present. Let time prove it or disprove it, it matters not so long as the truth is at least obtained and understood.

In these articles it has been frequently said that "Low" is the agent or factor of the phenomenon, "the storm." Because of this general statement it must not be understood that the phenomenon rain is only the product of the factor "Low"; for meteorology as well as other departments of science has its exceptions, but the exceptions are too often overlooked. Bear in mind that the clouds are all the while being formed everywhere where there is heat and moisture, and that "Low" is simply the agent that gathers them and carries them from point to point to water the Earth. But there are times when the clouds precipitate in the very centre of "High."

This prove that the clounds are being formed everywhere, in "High" as well as in "Low." There are times it is *generally* "High." Under these conditions "Low" is afar off—the clouds the while get heavier and heavier, and when they get sufficiently heavy they precipitate, not waitlng for "Low" to come and take them to other localities.

This summer (1882) "High" has prevailed over a very extensive portion of the United states. The result is pleasant summer weather, and although hot, not oppressively so where "High" has reigned. In the northeast where they have been more under the influence of a *high* "Low" it has been hot and dry. In the neighborhood of Washington it has been a most delightful summer and the foliage has remained bright and green, with few or no vermin to destroy the foliage. So the factor "High" it would seem was not favorable to vermin. The question is do they exist the same as during the protracted presence of a *high* "Low"—are they latent the while, or is it necessary to have the presence of "Low" to generate them? This branch of the subject I respectfully refer to the entomologists.

I have spoken of a *high* "Low" etc., I would specially call the readers attention to these expressions. They may seem paradoxical or ludicrous, but if they will pay a little attention to the subject they will readily see the force of the expressions. A *high* "Low" will be "Low" or low-barometer on a high line of latitude, and as the wind blows toward "Low" it follows that under these conditions we will have the wind from the south and therefore it will be very warm. A *low* "Low" will be in effect the reverse of this. A *high* "High" will be "High" on a high line of latitude, which will prevent the south winds from reaching far to the north, therefore the while it will be relatively cool. "High" over us keeps our locality cool; the south winds do not reach us. A *low* "High" will act as a barrier to the south winds—a *high* "High" as a barrier to the north winds. These factors "High" and "Low" in their variety of changes produce the phenomena daily presented to us. Study them well—keep their motion, speed, spread and direction in mind as they follow each other across the country and we will always be well posted, and as well posted as possible for the human mind to be in regard to the conditions of the atmosphere about us. The weather-map, the all important agent whereby we may understand and keep track of the meteorological phenomena of our country, is, in its present shape, quite impractical to those who are beyond its daily reach. If in lieu of, or auxiliary to this, we could have skeleton maps in every office and even in public places throughout the country, and if people would take the necessary, yet *little trouble* to read them, our Weather Bureau might soon become a far more important and popular institution than it is at present. By making it still more of a necessity to the people it would become more and more popular; and worked upon such a basis would soon wield a powerful influence for good.

Let these skeleton maps be of various sizes, small enough even to appear in the columns of a newspaper, and large enough to hang in public places and be seen and read a number of yards away. Have the map of the United States divided into sections of any convenient size. These sections to be designated by letters or numbers or both. In place of the daily "indications" as at present let the office telegraph all over the country the location of "High" and "Low" in such and such squares and on such and such lines, etc. By daylight in the morning every city, town and village from the Atlantic to the Pacific and from

Mexico to Canada could be informed of the situation—of the meteorological conditions of the whole country.

The intelligent people of the world at least will readily become familiar with "High" and "Low," and it will afford them an infinite amount of satisfaction and be most profitable to them to watch and study the changes of nature, and in many ways be of great practical value to them in forewarning and giving them timely notice of the changes that are to occur—and as it were taking them up into a high mountain and showing them the meteorological conditions of the whole country. It would seem that a plan that could easily accomplish this was worth putting into execution. Let this be done and the Weather Bureau will no longer remain in the background with few to do it reverence. Let it once be thus placed in bold-relief before the public and it will take a new lease of life—indeed its past will be very tame and quiet beside what its future will be. The public will then begin to appreciate the work of this Bureau, and will more readily "lend it a hand" and advocate its claims.

Bear in mind, the weather-map is the *geography of the atmosphere*. By it we have been instructed in the factors and phenomena of meteorology as never before. By it we have been brought face to face with the great revelations of nature. Present this map every morning to the eyes of the whole country in a form suitable for practical purposes and the whole country will comprehend its practical value and sound forth its praise.

Only in a skeleton form can it be made thus valuable and universal. Sooner or later this idea must prevail, and when it does the factors and phenomena of meteorology will be more completely revealed, and through this revelation the world will the better be enabled to comprehend the mysteries of nature in this department and the better understand how to derive practical benefit from its meteorological knowledge.

WASHINGTON, D. C., August 26, 1882.

WEATHER PROGNOSTICS

S. A. MAXWELL.

From time immemorial the people of all countries, savage or civilized, have quoted proverbs in relation to the weather whose origin belonged in the dim and distant past.

Some of these can be traced back, and some of them it seems had more than one origin, if we may use such a paradoxical expression—the same proverb being found current coin in the languages of distinct and widely separated races. When this is the case there must be of course more or less truth connected with it. It is customary to accept these weather proverbs as facts, never looking carefully within to see whether truth or falsehood is clothed with their sober garb. It is probable that more than one-half of the trite sayings in regard to the weather are utterly without foundation, and if their origin could be traced it would be found the thoughtless utterance of some lunatic or the chance rhyme of a crank who "never had a dozen thoughts in all his life," and who "thinks the visual line that girds him round the world's extreme."

The effort which our Signal Service Bureau is making to collect these proverbs and have them published will clear up this subject to some extent; will doubtless separate the chaff from the wheat, as it were, so that those sayings which have a real value may be made to play a part in perfecting our knowledge of the science of meteorology. It will have little effect, however, on public opinion. Five hundred earnest, educated men may use the most perfect instruments at established stations, and make tri-daily observations of these, record the same, and use many thousand miles of telegraph lines almost constantly, thus mutually assisting one another, and then, the result of their combined labors, under a system the most perfect ever devised, is regarded by millions of our people to be less reliable than the "probabilities" of a medical almanac or the equally valueless prognostication of a weather-prophet, so-called.

But our laborers in the cause of science are producing *some* effect. Public opinion is slowly changing in their favor. The day is distant but is approaching when the people will acknowledge the merits of our Signal Service Bureau and the value of the work accomplished by it.

Some weather proverbs have reference to observed conditions of the atmosphere as, "when there's a fog in the cellar there will be rain;" again,—

"An evening red the next morning gray
Are sure signs of a beautiful day."

These sayings have a scientific basis on which to rest, and are therefore to be relied on, while some sayings, I think a majority, originate from some chance rhyme, and are totally unreliable.

We will now trace the causes of some of the phenomena which give rise to weather prognostics.

A fog in the cellar results sometimes, on a very warm morning, when the air is heavily charged with moisture. It is more likely to be observed in cellars where there are openings on opposite sides, permitting a free passage for the air. During the past summer I have noticed a fog in the cellar on two occasions and were followed within twelve hours by severe rainstorms. Brick pavements have been observed to be moist or even wet at mid-day from the condensation of vapor, at times when the air was in a condition closely approaching saturation. This phenomenon, produced by the same cause as the fog in the cellar, will of course indicate a storm in the same manner, or, I might better say it indicates such a condition of the atmosphere as almost invariably precedes a storm. Even the barometer itself does not indicate, when the mercurial column settles, that a storm is approaching a certain locality, but simply that the atmospheric conditions are favorable to the development of storms. On showery days, the bulk of the precipitation occurs in parallel belts from ten to fifty miles in width, separated by tracts of greater or less extent where but little or no rain falls; yet the atmospheric conditions are very nearly, or quite the same in both,—the rainy belts and the rainless ones. We may see from this how impossible it is, even with the best instruments, to foretell absolutely what weather will follow even favorable indications of rain. It is not difficult, however, to tell with tolerable accuracy, say five times in six, what the weather will be from one to two days in advance if one observes closely the various phenomena of the winds and clouds in connection with a reliable barometer.

" A rainbow in the morning
Is the sailor's warning ;
A rainbow at night
Is the sailor's delight."

There is some solidity in this old saw about the weather, from the fact when a rainbow is seen in the morning it must be in a westerly direction, the one from which storms of the temperate zones most frequently approach. Again, when seen in the east, the bow is formed after the storm has passed, and it is but fair to suppose that pleasant weather will follow. It has also been noticed that the nearer sundown the rainbow is formed, the better the prospect for fair weather. This is because such bows are formed, not after the passage of small, local showers, but of what we term clearing-up storms or those which are of wide extent.

Weather-sayings like those already given, having their basis on certain known physical facts, and being of themselves the simple statement of such facts, can be relied on as true, and when the weather does not accord with them it will generally be found that the failure was due to local or latent causes—such as affect in a greater or less degree the most accurate conclusions of the meteorologist.

In contrast with these is that class of senseless proverbs still passing as current coins of science among the people of even the most enlightened portions of our country,—proverbs originating by accident, and perpetuated in their existence through ignorance, proverbs whose absurdity and unreliability are observed at once by any one who will subject them to the searching light of reason. Among this class of absurdities are the following: "When the Sun sets clear on Friday it will rain before Monday;" "Three frosts and then a rain;" "As the first three days of December be, so will the months of winter be;" "If the woodchuck can see his shadow on Candlemas-day he will go into his burrow and stay six weeks;" "It will be just as many days before a storm as the number of stars within a circle round the moon."

Enough! Ye Gods! What a pity that the authors of these sayings are not known, for if they were, their sacred names might be handed down through the ages, to a remote future, when an appreciative generation would erect to their memory an appropriate monument of donkey-skulls as high as the famous spire at Cologne.

There is not a point in one of this class of weather sayings but may at once be proven absurd by the weakest process of reasoning, so that an attempt to do so would be like trying to prove an axiom.

There is still another class of weather-proverbs having reference to lunar and and planetary influence whose truth is not as yet positively ascertained. The elder Herschell it is claimed believed that the time of the moon's changing had an effect on climate, but the prevailing opinion now among scientific men is to the contrary. Some years ago I believed that the moon influenced the weather on our planet and set about the task of preparing a paper to prove the same; but the result was, that the investigation of my own meteorological records changed my belief, and I think that with the data I have at hand I can prove conclusively that terrestrial climate is unaffected by lunar or planetary influences.

Some people plant and harvest when the moon is in the right quarter, and think success is assured by so doing, but not one of them can give a good reason, unless it be: "As our fathers did before us so do we." If one would become a reformer of these abuses, would try to enlighten the darkness of those about him who put their trust in the proverbs and practices of a past and superstitious age, he would become discouraged when he discovered the number whose minds like that of Hamlet's mother have been so brazed by custom that they are "proof and bulwark against sense."

MORRISON, ILL., September, 1882.

HAIL AND HAILSTONES.

The immense magnitude of some hailstones, and the intensity of cold during the hottest period of summer requisite to freeze these in their descent to the earth, have never been satisfactorily accounted for. An explanation offered is, that they must have been originally formed at an altitude in the atmosphere where the temperature is greatly below 32°, and that, in consequence of their extreme coldness, they acquired magnitude during their descent by condensing on their respective surfaces the vapors contained in the electrified cloud and atmosphere through which they passed. The difficulty, however, is not altogether obviated by this conjectural explanation. In this country hail-storms seldom assume any remarkable appearance, but in some other countries, especially in the southern districts of France between the Alps and the Pyrenees, hail-storms are so violent, and the hailstones so large as frequently to lay waste large districts of country. Of late years some very disastrous hail-storms have occurred in portions of the western United States and Western Ontario. These storms have invariably been accompanied with thunder and a violent squall or whirlwind. Individual hailstones have been known to weigh as much as five ounces, but there are stories in existence of much heavier ones. These large particles of ice are seldom globular, but rather of an irregular and angular shape. Hail-storms generally occur during the hottest period of the year, and seldom during night or winter.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

Temperature of the Air.	Sept. 20th to 30th.	Oct. 1st to 10th.	Oct. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	49.6	55.7	42 9	49.4
Max	73.1	73.1	69.1	71.8
Min. and Max	61.3	64 4	56.0	60.6
Range	23.5	17.4	26.2	22 4
Tri-Daily Observations.				
7 a. m.	56.5	61.1	47.4	55 0
2 p. m.	73.2	71.1	65.3	69.8
9 p. m.	61.0	61.7	52.4	58.7
Mean	62.9	63 7	54.3	60.3
Relative Humidity.				
7. a. m.	.84	.91	.86	.87
2 p. m.	.64	.65	.51	.60
9 p. m.	.79	.90	.80	.83
Mean	.76	.82	.72	.77
Pressure as Observed.				
7 a. m.	29.10	28.99	28.94	29.01
2 p. m.	29.06	28.97	28.90	28 98
9 p. m.	29.03	28.97	28.91	28.97
Mean	29.06	28.98	28.92	28.99
Miles per Hour of Wind.				
7 a. m.	..	..	..	..
2 p. m.	..	..	..	..
9 p. m.	..	..	..	..
Total miles	3560	3074	3571	10205
Clouding by Tenths.				
7 a. m.	..	..	..	..
2 p. m.	..	..	..	..
9 p. m.	..	..	..	..
Rain.				
Inches	.58	1.49	1.52	3.59

CHEMISTRY.

CHEMICAL LITERATURE.

PROF. H. CARRINGTON BOLTON.

[*Extract from an Address Delivered at Montreal, August 23, 1882.*]

* * * * * *

The very earliest information concerning chemical arts comes to us from that ancient nation supposed by some to have given its own name to the science itself; not only do the sculptured tombs and temples of Egypt portray with unimpeachable authenticity and wonderful accuracy the technical skill of that venerable people, but these same monuments are even now relinquishing their hold on long-buried treasures in the form of papyri, whose perplexing script no longer conceals their meaning from the erudition of Egyptologists.

Of these miraculously preserved papyri the most valuable to chemistry is - t discovered by Prof. George Ebers at Thebes in 1872, and named after its ned discoverer. We have described this elsewhere and shall not here enter details. It is the most ancient medical work extant, being assigned to the eenth century B. C., and contains a vast amount of information on the med- l practice and the pharmaceutical preparations at that remote period. The nknown author wrote less obscurely than many of a much later date, and when the whole papyrus shall have been deciphered it will prove an invaluable contribution to chemical history.

The most ancient manuscript treating exclusively of chemical operations is a Greek papyrus of Egyptian origin preserved in the Library of the University of Leyden. Its authorship is unknown, its date is placed by Reuvens in the third or fourth century A. D. This MS. consists of a collection of prescriptions and receipts for conducting various operations in metallic chemistry, such as the testing of gold and silver; the purification of lead, of tin and of silver; the hardening of tin and of silver; the albification of copper, etc. It deals little with alchemy though some of the receipts evidently refer to transmutations, as those entitled "the preparation (artificial?) of silver;" "the preparation of gold;" "the purification of tin by silver," etc.

Reference is made to sandarach (realgar), cadmia zinc ore), chrysocolla, cinnabar, natron (soda), mercury and other chemical substances, but no receipts are given for their preparation. The author quotes from the Materia Medica of Dioscorides who probably preceded him by about two centuries. It is to be regretted that the full text of this ancient manuscript has never been published; the little known of it foreshadows information of great interest.

The great libraries of Paris, Rome, Venice, Milan, Escurial, Cracow, Gotha, Munich and Cologne preserve a large number of Greek alchemical manuscripts of unknown authorship and uncertain date. Hoefer, the French historian of of chemistry, refers them to the third and fourth centuries, but other authorities with greater probability place them not earlier than the tenth and eleventh.

The most celebrated of these essays are attributed to Zosimus, of whose history nothing is certainly known, and bear these titles: "On Furnaces and Chemical Instruments," "On the Virtue and Composition of Waters," "On the Holy Water," "On the Sacred Art of Making Gold and Silver." In a treatise attributed to Synesius, we find a description of a hydroscopium or hydrometer which was rediscovered as long after as the sixteenth century.

In a treatise attributed to Olympiodorus, he cites as authorities Democritus, Anaximander, Zosimus, Pelagius, and Marie, a certain Jewess whom the later Alchemists confounded with Miriam, Moses' sister.

In these manuscripts chemistry is called the "sacred art" and the exceedingly obscure and figurative language in which they are written, makes it well nigh impossible to separate fact from fancy; Hoefer has indeed attempted to discover modern chemical conceptions in the allusions to Egyptian myths and the chaotic collections of spagyric arcana.

Of systematic nomenclature there is absolutely no trace; indeed each author seems to have aimed to write treatises intelligible only to himself, and we grea[illegible] doubt his success in even this respect. "Cadmia," we are informed, "is m[illegible] nesia," and "magnesia is the female antimony of Macedonia;" "nitre is wh[illegible] sulphur which produces brass;" equally clear is the statement that the "a[illegible] spermatism of the dragon is the mercury of cinnabar." That lexicons were ear[illegible] in demand is not surprising; in fact some of the most ancient MSS. are "vocab ularies of the sacred art," but even with their assistance it is difficult to form satisfactory concepts of contemporary chemical science.

Suidas, a Greek lexicographer of the eleventh century, states that Diocletian having conquered the rebellious Egyptians (296 A. D.) destroyed their books on the preparation of silver and gold, lest becoming rich by the practice of that art they might again resist the Romans. Regrets at the wanton acts of this imperial biblioclast are tempered by the reflection that modern scholars are spared the study of such literary absurdities.

The Chinese, that curious people who always claim a hearing when the origin or antiquity of arts and sciences is under consideration, were acquainted at a very remote period with many branches of chemical technology. We do not know of any special chemical literature produced by them, but the researches of Rev. Joseph Edkins and of Dr. W. A. P. Martin make it highly probable that scholars will yet discover contributions of no small importance to the early history of chemistry. Prof. George Gladstone has endeavored to show that the Chinese originated the doctrines and pursuit of alchemy and communicated it to the Arabians by whom it was disseminated throughout Europe.

The high state of civilization and extraordinary intellectual development of the Arabians has left a deep impression on chemical science. Cultivated chiefly by physicians, attention was directed to its pharmaceutical applications, and in spite of the prohibitions of the Koran, to the fascinations of alchemy. Of their extant writings, preserved in European libraries, only a portion have been edited; those best known partake of the poetical imagery and hyperbole characteristic of the Oriental mind. This is shown to some extent in the singular titles prefixed to their treatises, *e. g.*, "The Rise of the Moon under the Auspices of Golden Particles," by the alchemist Dschildegi; "A Poem in the Praise of God, of Mahomet and of Alchemy," by Dul-nun-el-Misri.

The well known treatises of Geber, "Of the Investigation of Perfection," "Of the Sum of Perfection," "Of the Invention of Verity," and "Of Furnaces," notwithstanding a bewildering style of composition, which seems to confirm Dr. Johnson's derivation of gibberish. from Geber, display very great familiarity with a large number of chemical substances and operations.

Geber's works are generally assigned to the eighth century and consist chiefly of compilations from the "Books of the Ancients;" he mentions no author by name. They contain chapters devoted to the seven known metals, to the methods of distillation, calcination, cupellation and other operations, to the preparation of saline substances and to chemical philosophy. Geber adopted Aristotle's views of the constitution of matter from four principles, the hot and cold, the wet and dry, and adds thereto: "Mercury and sulphur are the components of metals," a doctrine which with slight modifications prevailed for more than eight centuries. Geber describes the preparation of nitric acid, of aqua regia, and of mercuric oxide; he mentions the increase in weight of metals when calcined with sulphur, and gives the results of a rude quantitative analysis of crude sulphur. He constantly maintains the doctrine of transmutation of metals and gives a refutation of the ingenious arguments opposed thereto. His remarks on the qualifications of a chemist are most intelligent and are not inopportune in modern times; he urges the necessity of diligence, patience, learning, a temperate disposition, slowness to anger, and a full purse, "for this science agrees not well with a man poor and indigent," together with faith in the God who "withholds or gives to whom he will" the secrets of nature, and who will infallibly punish the foolish meddler with magical mysteries.

To detail fully our obligations to Arabian chemists is no part of our plan. They have left an indelible impression on the very language of the science, in the words alcohol, alembic, alkali, borax, and many others. All honor to the intelligent authors who a thousand years ago defined chemistry as the "Science of Combustion, the Science of Weight, the Science of the Balance!"

In the middle ages intellectual activity was confined largely to the clergy, who controlled the schools of learning, the libraries, and nearly all sources of knowledge. University chairs were occupied exclusively by clerical professors, literature and science were cast in ecclesiastical moulds. Scientific treatises were the production of monks and emanated from cloisters. Many distinguished philosophers mastered widely separated branches of learning: among these were Alain de

Lille (b. 1114), celebrated as a physician, theologian, poet and historian, who filled the episcopal chair at Auxerre; Roger Bacon (b. 1214) an English cordelier; Raymond Lully (b. 1235), a Franciscan friar, and Albertus Magnus (b. 1193), Bishop of Ratisbon. The latter, amid the monotonous routine of a Dominican monastery, found leisure to distinguish himself in astronomy, medicine, alchemy and, according to his enemies, in necromancy. At this remote period, accusations of dealing with magic were not unfrequently made against those whose learning and skill in experimental sciences excited envy and superstitious zeal.

* * * * * *

Valentine's celebrated "Chariot of Antimony," extolling the medical virtues of this metal, is perhaps the least obscure of his works; the "Twelve Keys of Philosophy" with its singular plates, one of the most unintelligible; yet beneath the extravagant jargon characteristic of the period, glimpses are obtained of light and intelligence. The latter work presents clearly the theory that all metals are compounded of three principles: fixedness, metallicity and volatility, represented respectively by salt, mercury and sulphur, an hypothesis which long completely controlled chemistry until it gave place to the seductive theory of Phlogiston. It is uncertain whether the works ascribed to Valentine were first written in Latin or in German; his writings were collected in the seventeenth century and have been through many editions. Several of his treatises have been translated into English and into French.

In the fifteenth century the newly invented printing press was employed in the production of few works which can be regarded as chemical, and these were chiefly confined to isolated treatises of the ancient philosophers; in the sixteenth century the alchemists began to publish the results of their industry and speculations, and in the succeeding century a prodigious number of alchemical works were issued in Germany, France and England, creating literature of an extraordinary type.

Some of these treatises, which are numbered by thousands, record valuable experiments made by enthusiasts seeking the philosopher's stone, but the majority contain "a crude mass of incoherent propositions and wild assertions, a mixture of poesy and insanity, in which all logical ideas are lost amidst the stilted phraseology, but through which breathed a blind yet fervent faith." Great obscurity of style, an enigmatical method of naming chemical substances which found its highest development in the use of arbitrary symbols and the pictorial representations of alchemical processes, the intimate association with astrology, the honest or affected intermingling of pious comment and prayers, the extravagant claims to interpret the mythology of Egypt and Greece on an alchemical basis; the endeavor to associate the mysteries of Hermes with the sacred truths of the Christian religion, all combine to produce literary monstrosities as fascinating to the student of chemical history as they are profitless to the practical worker in modern science.

Among the fabulous writings, highly esteemed by the credulous alchemists, may be mentioned the celebrated inscription of Hermes Trismegistus upon an

Emerald Tablet, the Golden Leaves of Abraham, Jew Prince, Priest, Levite, Astrologer and Philosopher, which in the hands of Nicholas Flamel yielded such a rich harvest, the Practical Chemistry of Miriam the sister of Moses, and a multitude of grotesque writings ascribed to personages of known reputation. Raymond Lully is credited with five hundred works; Hermes Trismegistus, the mythical Father of Sciences, with several thousand.

THE EXTRACTION OF THE PRECIOUS METALS FROM ORES BY ELECTROLYSIS.

Mm. Blas and Miest have discovered that if in electrolysis we replace the metal of the anode by compressed sulphur-ores these may themselves serve as an anode. Further, if we place such anodes in a bath of a suitable electrolytic salt having the same metallic base as the metal of the ore, and if we let the electric current act in such a bath, the effect is that all the sulphur of the ore is precipitated upon the anode and falls to the bottom of the bath. At the same time there is formed at the cathode a precipitate or continous deposit of metal liberated from the salt of which the electrolytic bath consists. The acid of the bath being set free appropriates an equivalent proportion of the metal contained in the ore placed at the anode. In this manner the neutral electrolytic bath is re-constituted without ceasing and serves indefinitely.

Electrolysis of Various Sulphuretted Ores. For simple sulphides, without gangue, containing only sulphur and a single metal, is exceedingly easy and complete. If we have an electrolytic bath containing a soluble salt of the same base, *e. g.*, a bath of lead nitrate, in case of the treatment of pure galena, this ore is placed at the anode, when under the action of the electric current the sulphur is deposited at the anode and the lead at the cathode. If the ore contains in addition to the metal a silicious gangue, the silica is deposited at the anode at the same time with the sulphur. But these two substances though mixed together remain distinct. They fall in part to the bottom of the bath, and it is advisable to remove the rest from the anodes by an automatic brushing.

If there are antimony and arsenic in the ore, which are also precipitated at the anode, but chiefly in the state of insoluble oxides, mixed, but not combined together, nothing is easier than to separate them again by electrolysis.

In case of ores containing exceptionally much arsenic, a part of this during precipitation at the anode combines with sulphur, producing arsenic bisulphide or realgar and the yellow sulphide or orpiment.

These products are extracted and purified at first by sulphuret of carbon and afterwards by separate electrolysis in a bath with a feeble electric current, when they yield pure sulphur at the anode and oxides of arsenic and antimony at the cathode.

If we operate electrolytically on sulphides containing several metals, those of the precious metals contained in the sulphur ores, being the most easily precipitated, are thrown down first in the metallic state at the cathode, under the action of a moderate current, and consequently the electrolytic bath is regenerated without ceasing. There is merely one further operation, that of separating afterwards those of the metals which have been thrown down together at the cathode. But this final separation requires very little electric force, because this mass of metals, already previously reduced to the metallic state and purified, when they are placed together in another electrolytic bath and are dissolved there under the action of the electric current, regenerate the thermic force or thermic work necessary for the ulterior precipitation of each metal separately, saving the slight unimportant and inevitable losses of thermic or electric action.

We extract first the sulphur of carbon disulphide used, with or without pressure. Carbon disulphide dissolves and removes promptly that part of the mixed sulphur which is combined neither with silica nor iron.

On re-distilling the decanted carbon disulphide loaded with dissolved sulphur, the latter is deposited in a state of purity.

If the electrolysed ore is a multiple sulphide, containing especially much iron, we obtain then at the first operation sulphur and iron oxide. If in place of then separating these two bodies by one of the methods descsibed above, we electrolyse them feebly a second time in a bath composed *e. g.*, of dilute sulphuric acid, we obtain then pure sulphur at the anode, and iron as a basic sulphate at the cathode. But sulphate of iron is in regular demand and of great use in industry. We may otherwise electrolyse it again or use it as an electrolytic salt for the extraction of iron.

In separating the mixture of sulphur and iron oxide there is no outlay of work or of thermic power. On the contrary, in this operation there is production of heat, and consequently of work.

Practically, one and a half horse-power is required to produce electrolytically in one hour one kilogramme of copper set free from a sulphuretted copper ore, a wonderful result in point of economy.—*Les Mondes.*

PHYSICS.

TELEGRAPHING WITHOUT WIRES.

At the British Association meetings at Southampton, Mr. W. H. Preece, electrician at the General Post Office, adverted, in a paper on "Telephones," to an experiment he had made of telegraphing from the mainland to the Isle of Wight without employing a cable across the intervening space of water. This he accomplished by utilizing the property of electricity named induction. The efficiency of the telephone is frequently interfered with by currents of electricity being "induced" in the telephone wire by the electricity in telegraph wires, and Mr. Preece conceived the idea that as induction takes place sometimes in wires which are several miles apart, use might be made of this property to dispense with wires in certain cases. The purpose of wires is to carry the electric current, but if the current were ready to travel of its own accord without wires the saving in maintaining telegraphic communications would be very great.

This idea, however, is not a novel one. At the meeting of the British Association, held in Aberdeen, in 1859, the late Mr. J. B. Lindsay, of Dundee, read a paper, in which he described experiments almost as extensive and precisely the same in their method as that explained by Mr. Preece at Southampton the other day. In the days when our achievements with electricity are deemed so considerable, the humbler efforts of Mr. Lindsay are apt to be forgotten. There is no doubt, however, that he foresaw much that has only been accomplished within the last few years. His inventive faculty was keen, and he possessed the energy and perseverance, though unfortunately not always the resources, to work out his inventions. His studious disposition was remarkable, and if his talents had been developed in a sphere more suitable for them than the banks of the Tay, his name might have become famous in the annals of science. His prescience is exhibited in the following paragraph, which is taken from the *Dundee Advertiser* of August 7, 1835. It describes all the virtues of the electric light with as great completeness as though it had been written of a discovery by Edison or Swan:

"Mr. Lindsay, a teacher in town, formerly a lecturer to the Watt Institution, succeeded, on the evening of Saturday, the 25th ult., in obtaining a constant electric light. It is upward of two years since he turned his attention to the subject, but much of that time has been devoted to other vocations. The light, in beauty, surpasses all others, has no smell, emits no smoke, is incapable of explosion, and not requiring air, can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly adapted for flax houses, spinning mills, and other places containing combustible materials. It can be sent to any convenient distance, and the apparatus for producing it may be contained in a common chest."

In 1836, Mr. Lindsay lectured on the electric light, and stated that as early as 1831 he had turned his attention to the subject. In a letter published by him in 1845 he suggested the possibility of laying an electric cable across the Atlantic, a dozen years before the project was seriously entertained. Afterward he developed a scheme for telegraphing across oceans without cables. He lectured at Glasgow, in 1853, on his theory of forming an electric communication between Great Britain and other countries without the employment of submarine wires, and the cost of such communication to America he calculated to be £60,000. A patent for his scheme was taken out in 1854, and several experiments were made by him at different places. The following paragraph appeared in the *Dundee Advertiser* of May 20, 1859:

"ELECTRIC TELEGRAPHING ACROSS THE TAY WITHOUT WIRES.—We have received the following note from Mr. J. B. Lindsay, reporting progress with his experiments. The results, it will be seen, are highly encouraging: 'Yesterday, May 17th, I telegraphed successfully across the Tay, opposite to Glencarse, where it is about half a mile broad. The action on the needle was strong, and the same battery power would cross, I think, at Broughty Ferry.'"

The dock authorities at Liverpool invited him to exhibit his invention on the Mersey, but owing to his apparatus having been deranged, his experiment in England was not successful. This caused skepticism as to the merits of the discovery, and he made renewed tests with it on an extended scale on the Tay. These fully realized his expectations. The *Dundee Advertiser* of July 10, 1860, contained a letter to the editor, in which Mr. Lindsay wrote:

"During last week I was engaged in making a telegraphic experiment across the Tay below the Earn, at a place where the river is more than a mile broad. The experiment was successful, and the needle was strongly moved, but, as I had no person with me capable of sending or reading a message, it was not attempted."

Meanwhile he had exhibited his scheme to the *savants* of the British Association at the meeting in Aberdeen in 1859. Experiments were made with it across the river Dee, and he read a paper describing its theory to the Mathematical Section, in the debate on which Lord Rosse, chairman of the section, and other leading scientists took part. Before quoting the condensed report of this paper, it may be well to quote the passage in Mr. Preece's paper on "Telephones," read at Southampton last week, in which he adverts to an experiment exactly on the lines of Mr. Lindsay's scheme:

"Mr. Preece had recently tried an extremely interesting experiment between this place (Southampton) and the Isle of Wight—namely, to communicate across seas and channels without the aid of wires at all. Large metal plates were immersed in the sea at opposite ends of the Solent—namely, at Portsmouth and Ryde, six miles apart, and at Hurst Castle and Sconce Point, one mile apart. The Portsmouth and Hurst Castle plates were connected by a wire passing through Southampton, and the Ryde and Sconce Point plates by a wire through Newport; the circuit was completed by the sea, and signals were passed easily so as to read by the Morse system, but speech was not practicable with the telephone."

The following is the report of the paper on "Telegraphing without Wires," read by Mr. J. B. Lindsay to the Mathematical Section of the British Association, at its meeting in Aberdeen, in September, 1859, which appeared in the *Dundee Advertiser.* After relating various minor experiments, he proceeded to describe his process, saying:

"Recently he had made additional experiments, and succeeded in crossing the Tay where it was three-quarters of a mile broad. His method had always been to immerse two plates or sheets of metal on the one side, and connect them by a wire passing through a coil to move a needle, and to have on the other side two sheets similarly connected, and nearly opposite the two former. Experiments had shown that only a fractional part of the electricity generated goes across, and that the quantity that thus goes across can be increased in four ways: First—by an increased battery power; Second—by increasing the surface of the immersed sheet; Third—by increasing the coil that moves the receiving needle; and Fourth—by increasing the lateral distance. In cases where lateral distance could be got he recommended increasing it, as by that means a smaller battery was requisite. In telegraphing by this method to Ireland or France, abundance of lateral distance could be got, but for America the lateral distance in Britain was much less than the distance across. In the greater part of his experiments the distance at the side had been double the distance across; but in the experiments in the Tay the lateral distance was the smaller, being only about half a mile, while the distance across was three-quarters of a mile. Of the four elements above mentioned, he thought that if any one were doubled the quantity of electricity that crossed would also be doubled; and if all the elements were doubled the quantity transmitted would be eight times as great. In the experiment across the Tay the battery was of four square feet of zinc, the immersed sheets contained about ninety square feet, the weight of the copper coil was about six pounds; the lateral distance was less than the transverse distance, but if it had been a mile, and the distance across also a mile, the signal would no doubt have been equally distinct. Should the above law (when the lateral distance is equal to the transverse) be found correct, the undermentioned table might then be formed.

"But supposing the lateral distance to be only half the transverse, then the distance crossed might be 16,000 miles, and if it was only a fourth, then there would be 8,000 miles, and thus a greater distance than the breadth of the Atlantic. Further experiments were, however, necessary to determine the law. Since last experiment he had increased the coil, and thought there was power to come two miles. According to this calculation, he thought a battery of 130 square feet, immersed sheets of 3,000 square feet, a coil of 200 pounds weight were sufficient to cross the Atlantic with the lateral distance that could be obtained in Great Britain."

The following is the table above referred to:

ZINC FOR BATTERY.	IMMERSED SHEETS.	COIL.	DISTANCE CROSSED.
4 sq. ft.	90 sq. ft.	6 lb.	1 mile.
8 "	180 "	12 "	8 "
16 "	360 "	24 "	64 "
32 "	720 "	48 "	512 "
64 "	1,440 "	96 "	4,096 "
128 "	2,880 "	192 "	32,768 "

If Mr. Lindsay's hopes are to be realized, some great discovery yet remains to be made, for, by the laying of the Atlantic telegraph cables, we know that the electric current, transmitted across the wide expanse of the Atlantic, must be of extraordinary power to be apparent on the other side, even with a cable to lead it. Without a cable it would be hopeless to expect to find it, although the best apparatus were employed. Telegraphic instruments are greatly improved since Mr. Lindsay worked with them, and as regards batteries and coils he would find available for his purpose all that he could wish. No currents, however, are in use which would induce another current 2,000 or 3,000 miles away. Still it is within possibility that such may be found, and to a Dundonian must be ascribed the honor of having first conceived the scheme of transoceanic telegraph communication without the aid of cables.—*Dundee Advertiser.*

ARCHÆOLOGY.

AZTEC REMAINS IN LA PLATA COUNTY, COLO.

At the Denver Exposition there were exhibited some Aztec remains from Farmington, La Plata County, Colo., of intense interest to the student. They were found in the ruins of a building several stories high, which had been erected in the form of a terraced pyramid, near the mouth of the Animas River.

Nearly all the bones of the human body were discovered in a good state of preservation. Among them were three skulls, two of men and one of a woman. The latter was also young, as the distinctness of the suture joints testify; one of the male skulls was of a middle-aged person, and the other evidently of an old man as the several parts had grown almost solid. All were very thick, showing characteristics of the semi-barbaric races. The teeth remaining were mostly sound, though one showed marks of an ulceration, and there were several empty sockets.

Besides, there were some fine specimens of Aztec pottery of perfect color, parchment, stone implements, etc., from the same vicinity. This section of Colorado has been as yet little explored, but enough has been found to demonstrate that it is a region of great value to archæology. F. E. S.

HUMAN FOOT-PRINTS FOUND IN SOLID ROCK.

The Nevada State's Prison, at Carson, is situated on a sand-stone spur, which runs out from the Pine Nut Mountains into the Carson Plains, like a great promontory. The prison quarry has uncapped the spur to a depth of from thirty to forty feet, and exposed a layer of arenaceous shale. In this shale, and covering a space of about an acre and a half, have been found a large number of tracks, both of animals and birds, and what are supposed, also, to be human footprints. Eight great square impressions, twenty by twenty-two inches in size, showing stride of four and a half feet, come out from the super-incumbent rock. These have been supposed to be the tracks of a mastodon, or mammoth. Tracks of a wading bird are also seen along with it. What is more remarkable, however, is that a number of foot prints, such as a giant man would make, if shod with thick-soled moccasins or sandals, have been found. There are six series of them, the foot-prints numbering from eight to seventeen inches in each. The size of the sandal is as follows: nineteen inches in length, eight inches broad at the ball, six inches at the heel, having a length of stride two feet three inches. The distance between the feet, or straddle, is eighteen inches. Most of them have straight-pointed toes, supposed to distinguish the white man of to-day. In no case is the naked foot distinctly shown. In all the tracks the toes turn outward.

This discovery, with that of the Calaveras skull, will, no doubt, be seized upon as direct proof that man existed in the Tertiary, as early as the Miocene. From these papers it appears that several quite distinct tracks of deer are to be seen, some which resemble those of a wolf, and abundant tracks of wading birds, which do not differ from those of the same class now living. The rock above the tracks is fifteen feet in height, and gives evidence of having been at one time the shore of a local or isolated lake. Its level is above that of Lake La Hontan, which itself is, as is well known, an ancient basin, now empty, but was, in the Pliocene age, the bed of a great lake or fresh-water sea. These tracks antedate the present river-system of the Sierras, and must be very old. It seems to be uncertain whether the rock belonged to the Quarternary or Tertiary, but it is more uncertain whether they are human foot-prints or not. Papers were read before the California Academy of Science by Dr. Harkness and Mr. Gibbs, both of whom seemed to think that the tracks are doubtless human.—*American Antiquarian.*

PHILOSOPHY.

THE ORIGIN OF MATTER AND THE INDESTRUCTIBILITY OF MIND.

WILLIAM STEVENS.

At present there are and have been for innumerable cycles of ages two great forces in the Universe. One Superior, the great moral force self-existent and eternal, and the Inferior, physical force emanating from the great moral force. All the mental and moral powers in the Universe have had their origin in this great moral force, and are governed, directed and controlled by that great force, while the physical forces are rules of action or laws of matter also, an emanation from the great moral force and to which their author set bounds at their origin for the production, government, direction and control of matter throughout the universe; nor does either act except in its appropriate sphere and each as distinct during all these long ages as if the other did not exist. To say the physical forces were not perfect and would need revision or supervision would be to im-peach the power and wisdom of the great moral force. These physical forces are not matter, are not mind, but are laws enacted by the great force to prepare a place for the culture, increase and expansion of mental and moral power to inhabit, the moral Universe, which is destined to take the place of the material Universe. The physical forces having had a beginning will necessarily have an ending and when the laws which originated, governed, directed and controlled matter cease, matter must of necessity cease and become entirely extinct and the great moral Universe, be inaugurated and naught will exist in that Universe but mental and moral power. Then that vast amount of mind which has been in a preparatory and tutelary state in the material Universe will be transplanted into the great moral Universe to enter on a new state of existence running parallel with eternity, increasing and expanding as the cycles of eternity roll on.

In the incomprehensible eternity of the past there must have been a fragmentary part of that eternity when there were no physical forces and consequently no matter—nothing but the great moral force. To argue against this hypothesis is to claim the physical force, the inferior and the creature, the equal of the superior and creator, the great moral and eternal, which is to maintain the eternity of matter, as the physical forces could not have existed without producing matter governing, directing and controlling it.

How long these physical forces have existed, or how long they will exist, is a secret in the bosom of the great moral force, and can be, under the present lights of science, but a matter of conjecture, and as philosophy does not deal in conjecture we will not attempt to discuss a subject which has no data from which to reason.

Is it insisted that these are assumptions without any authority to sustain them? We reply they have a basis as broad as the verdict of the advanced thought upon the improvements, discoveries and advancement in scientific knowledge. We are sustained by the cultured and educated mind, the world over, where science is made a study and particularly by the savants, scientists, matheticians and chemists, that matter is exclusively governed, directed and controlled by fixed laws, the physical forces.

The astronomer, familiar with the heavenly bodies and with the physical forces governing, directing and controlling those bodies, can foretell centuries in advance with absolute mathematical precision the very moment when an eclipse of the Sun or Moon will begin or go off, when a comet that has not been seen for half a century will make its appearance and when it will take its departure, as well as other phenomena which are occasionally taking place in the heavens. The chemist in his laboratory, from his knowledge of affinities and certain of the physical forces, can make compounds with the most implicit confidence as to the result. While in another branch of science the age of our planet has been told probably with some accuracy, but from the fact that the science in which they have made their discoveries and from which they have drawn their data is yet in its infancy conclusions are not satisfactory, but vary from two hundred millions of years up to six hundred millions—sooner or later more diligent and accurate research will enable them to closely approximate its actual age. This then will fix the date and age of the physical forces, as the age of our part of the planetary system is about the age of the other planets, the Sun preceding them as they were doubtles fragments of the Sun thrown off at different times, while the satellites of the different planets are parts of their respective planets and are younger.

But again the mathematicians have weighed the planets and by calculation located undiscovered planets and satellites where the physical forces required they should be to keep the different bodies in their orbits directed astronomers to turn their telescopes into that portion of the heavens and who found them as located. Here is proof positive of government, direction and control of the physical forces. But the age of the globe will fix the age of the physical forces, as they could not have existed in that portion of space occupied by our system for any considerable space of time without producing the matter of which the system is composed, nor could our system have existed at its origin without these laws any more than it could to-day, and without them now there would be an immediate "wreck of matter and a crush of worlds." All the different laws governing matter are as inflexible and as exact as mathematics and chemistry and they will be so regarded by the learned as soon as they shall be as well understood and will remain as unchangeable as their Author throughout until their appointed time comes when they will die and with them matter and time. But it is said matter is indestructible and so says philosophy, that is, however, during the existence of those laws that gave it birth and govern it. For during the existence of the physical forces as fast as matter in one form dissolves the physical forces take up the elements of which it was composed and clothe it in new forms. But when there are no physical forces to take care of those elements they too will dissolve with the form they composed, and death and not mutation will be written upon every form of matter.

There is now, has been and will continue to be in the material world so long as that material world shall remain an inconceivable amount of minor, mental and moral forces, emanations from the great moral force and governed, directed and controlled by this force, and over which the physical forces have no influence, no power, no control, no direction, except incidentally and as the moral and mental symphatise with the material as it may be brought under the influence of and subjected to the physical forces.

But man has assumed that he is the highest order of intelligence in the material Universe and being at the head of the animal kingdom he alone will inherit the future domain of mind, intelligence and moral force. That he is at the head of the animal kingdom and the highest order of intelligence in the material Universe is the merest assumption, with no authority in reason or nature and without any proof to sustain it. While it is not denied that on this very minute portion called the globe he occupies that position, but as to what orders of mind, intelligence and moral forces exist in other portions of the physical worlds may be regarded as too uncertain for even conjecture, yet it must be considered that somewhere in the material Universe there is a very high order of mental and moral force in the shape of beasts, higher than any known to this little mundane sphere. If not, from whence came the "four beasts in the midst of the throne and around about the throne of God who fell down with the four-and-twenty elders and worshipped the lamb."

He further assumes that the inferior order of organisms, governed, directed and moved in all their actions by what he is pleased to call instinct, must forever perish and never exist in any form whatever in the great hereafter. And that too after having lived and done many wonderful things to challenge his admiration, which he with all his inventive power and boasted reason has failed to duplicate or even successfully imitate. But who has analyzed instinct, or what writer or thinker has defined the line of demarkation between instinct, and reason or has said where the one ends and the other begins. A distinguished mental philosopher has told us "the will is the fulcrum, the prop, and the whole moving power of the intellect. Upon this and other as good authority we maintain that all organisms, from the animalcule to man and in common with him, have more or less will power which demonstrates the claim of all animal life to a portion, great or small, of mind. The diminutive insect, before it raises its tiny wings at the approach of danger and flies away, must first will to do this voluntary act. The lowest order of animal life that moves and sustains existence and carries out the objects of their being could do none of these things without exercising some will power.

All animal life has the will power necessary for more or less self-preservation and the perpetuation of their kind, which proves them in possession of some mind and an emanation from the great source and fountain of mind and as eternal as its source. Nor does it matter whether we find mind in the ponderous brains of a Webster or a Cuvier or in the scarcely perceptible nervous centre of the lowest order of organism, it is mind according to all rules of logic, and only differs in quantity or degree. What then becomes of this vast amount of mind when the frail and ephemeral tenements that hold them decay? The indestructibility of mind is an axiomatic truth, therefore it must exist in some form somewhere. Does it return to its author to be implanted in a new and improved form and returned to its former home and rise by gradual progression? Does it take its flight in obedience to some occult law through space to another portion of the physical Universe which the great moral force has prepared, an improvement upon this for the culture, education and expansion of these infinitesimal portions of mind to remain in a state of tutelage, improving and expanding for a higher state of existence when he will again transplant it to a still higher sphere and thus educate it up by regular gradation until it shall have attained the intellectual and moral power of the "four beasts in and around the throne worshiping the lamb." Or, is it started at once in its feeble and imperfect condition on a career in the great eternity of the future?

These are questions that do not belong to the domain of reason or philosophy; nor has revealed revelation thrown any light upon them, and the revelations of advanced science have as yet failed to make them clear.

It is no part of our purpose in this paper or those that may follow to antagonize true Christianity as it came from the great Teacher and his immediate followers, as we regard true and undefiled Christianity as the grandest civilizer of man the world ever saw, and the man who would pull down this form of religion is an enemy of his race.

Man has ever been a worshiping animal, and some form of religion dates away beyond the historic period, until it is lost in the mists of fable. We find some form of religion known and practiced, and it is destined to continuity the close of time in some form. There is not and has not been a form so likely to survive, as the Christian religion, which for nearly twenty one centuries has withstood the rude shock of its professed enemies and the still ruder shock of its pretended friends.

Most of the various religions that have prevailed in the world have been made up of priest-craft, idolatry, heathen mythology, superstition, error and brute force with little or no admixture of truth and have existed upon the ignorance and credulity of the uneducated masses they have oppressed and impoverished.

When Christianity dawned a new era was rapidly approaching and could it have remained in its purity as Christ and his apostles left it, would it not have filled the whole earth. But as early as the days of Constantine, courtly favor, office and thrift, as reward, followed a profession of Christianity, and multiplied thousands flocked to the church, most of whom had never been touched by the spirit of the Master, nor is it much better to-day. Priest craft, the traditions of churches, some heathen mythology, a large amount of superstition and error has crept into the Christian churches and is multiplying infidelity to an extent beyond the grandest efforts of the most deadly professed enemies of the true faith. A large proportion of the best cultured intellect of the world is now combating these departures from the faith in its purity. When this is accomplished, which is an herculean task, the world will be better.

BOOK NOTICES.

The Currents and Temperatures of Bering Sea. Wm. H. Dall, Quarto, pp. 46, Illustrated, Washington, 1882. Government Printing Office.

This is Appendix No. 16 to the Report of the United States Coast and Geodetic Survey for 1880, and is the result of the personal work of Mr. Dall, who has been for several years an energetic worker and observer in various fields of research on the Pacific Coast. After giving tabular and classified records of temperatures, in winter and summer, of the Bering Sea and the course, rate of flow and temperature of the Kuro Siwo or Japanese Stream with voluminous extracts from the log books of numerous whalers and exploring vessels, he arrives at the following conclusions, which will be found at variance with the heretofore accepted views regarding the Kuro Siwo:

"The Kuro Siwo compared with the Gulf Stream is cooler, has a much smaller volume, and is subject to serious fluctuations, which appear to be due to the monsoons.

"The Kuro Siwo sends no recognizable branch northward, between the Aleutians and Kamchatka, nor from any other direction into Bering Sea.

"The chief current of Bering Sea is a motion of cold water southward. This has a superficial stratum above it, which has, in summer when not interrupted by winds, a northerly motion of translation, but it is not sufficient, either in mass, motion, or consistency of direction, to be entitled to take rank as an ocean current.

"The surface currents of Bering Sea are formed by or chiefly dependent on tides, winds, river flows, the southerly motion of cold water, the distribution of floating ice, and the northerly motion of slightly warmer surface water, which are effective about in the order named.

"No warm current from Bering Sea enters Bering Strait, with the exception of water from the neighboring rivers or the adjacent sounds. This water owes its heat directly to the local action of the Sun's rays.

"The Strait is incapable of carrying a current of warm water of sufficient magnitude to have any marked effect on the condition of the Polar basin just north of it.

"The currents through the State are cool and chiefly tidal, but with a preponderating tendency northward, as before fully set forth.

"The currents in the Arctic, north of the Straits, are largely dependent on the winds, but have tendencies in certain recognized directions. Nothing in our knowledge of them offers any hope of an easier passage toward the Pole, or, in general, northward through their agency. Nothing yet revealed in the investigation of the subject in the least tends to support the widely spread but unphilosophical notion that in any part of the Polar Sea we may look for large areas free from ice."

Publications of the Washburn Observatory of the University of Wisconsin. Vol. I, octavo, pp. 180, Madison, Wis., 1882.

This report is made by Professor E. S. Holden, who was selected to fill the vacancy caused by the death of the lamented Prof. J. C. Watson, and covers the period of time from the erection of the Observatory by Hon. C. C. Washburn, to the 30th day of September, 1881.

It comprises a description of the building and instruments, with catalogues of stars, new nebulæ, new double stars, red stars, etc., discovered or observed and reduced under the direction of Professor Watson by Mr. G. C. Comstock and Mr. L. W. Burnham. The latter has as usual devoted himself to the discovery and observation of double stars. A very valuable and interesting chapter is that upon the great comet of 1881, which is illustrated by twelve drawings. The observations were made by Prof. Holden with the fifteen and a half inch equatorial and the zone eyepiece. Reports of observations of meteors, auroras boreales, the transit of Mercury, etc., are also given.

The State of Wisconsin is greatly indebted to Governor Washburn for the magnificent gift of this Observatory with its valuable instruments and equipments, and doubtless the work done in it will perpetuate his name far into the future of scientific progress as well as add increased lustre to the fame of Professor Holden.

KNIGHT'S NEW MECHANICAL DICTIONARY. Section II., Octavo, pp. 240; Edward H. Knight, A M., LL.D., Boston, 1882. Houghton, Mifflin & Co., $2.00.

This is Part II of the work so fully noticed in the August REVIEW. It commences with Cutting Machines and ends with Hydraulic Force-Pumps and Jacks, giving minute descriptions and illustrations of thousands of machines, instruments and processes.

To give an idea of the extent and accuracy of the information furnished we will say that about twenty pages are devoted to electrical subjects, including the electrical diapason, electrical machines, battery, cable, candle, clock, furnace, lights and lamps of every description, writing apparatus, telephone, motor, etc. Explosives are fully treated, also fire-engines, fireless locomotives, fuel, galvanic apparatus; gas and gas machines to the extent of nearly twenty pages; governors of all kinds, grain separators, hand machines, heaters, horse-powers, hot-air engines, hydraulic machinery, etc. In nearly all cases references to articles upon the different subjects are given. This important and valuable work is to be completed in four volumes at $2.00 each.

SLIGHT AILMENTS. By Lionel S. Beale, M D., F.R.S., octavo, pp. 283, cloth, Philadelphia; P. Blakiston, Son & Co., 1882. For sale by M. H. Dickinson, $1.25.

In this work the common diseases known as slight ailments, such as Indigestion, Constipation, Biliousness, Sick-Headache, Neuralgia, Colds, Sore Throat, Diarrhœa, etc., are taken up, their nature explained and proper treatment suggested. Professor Beale's long experience as a practitioner and teacher enables him to handle such subjects in an easy and popular manner, and at the same time to keep within strictly professional bounds. The work is in its second edition already and cannot be excelled in usefulness as a family guide for the management of any of the milder diseases such as are referred to above.

OTHER PUBLICATIONS RECEIVED.

Six Lectures on Light, by Prof. John Tyndall, F.R.S., in *Humboldt Library*, Vol. II, No. 37, 15c.; Sketch of Hon. Lewis H. Morgan, by F. W. Putnam, pp. 7; Semi-Annual Report of the Comptroller of the City of Kansas for the six months ending June 30, 1882, by N. Grant, Comptroller; Advocacy of the Proposed Amendment to the Constitution of Missouri concerning the Judicial Department; The *American Journal of Forestry*, Vol. I, No. 1, monthly, devoted to the interests of Forest Tree-Planting, etc., edited by Franklin B. Hough, Ph.D., Washington, D. C., $3 per annum; The *Collector*, a monthly journal devoted to Natural History, etc., edited by Charles and James Keyes, Des Moines, Iowa, 50c per annum; The *Epitome*, a monthly Medical Journal, edited by C. F. Kirk, M. D., Meridian, Miss., $2.00 per annum; Signal Service Notes, No. III, to Foretell Frost, by Lieut. James Allen, U. S. A., Washington, D. C., 1882; Drunkenness a Vice, Not a Disease, by Rev. John E. Todd, Hartford Conn.; Taylor's Freezing Microtome, by Thomas Taylor, M. D., Microscopist Agricultural Department, Washington, D. C.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

Mechanical Telephone Exchange.—In this novel system of mechanical telephone lines, a series of telephones, which are severally connected with the several conveying line-wires, are employed. Means are provided for connecting therewith an extension-line, and a angle-hanger located centrally with relation to said conveying lines and their attached telephones. Two branch lines are arranged to connect any two of the telephones through the angle-hanger. These branch wires can be attached and detached from any of the telephone line termini, and thereby form a circuit with any two of the lines.

Artificial Fuel.—A late invention consists of artificial fuel made out of cut straw, chaff or hay, and residuum of petroleum, combined with peat, turf, or other like material molded by pressure into suitable blocks.

Preservation of Wood.—A recent German invention consists of a process for preserving wood, which contemplates exposing timber to a current of steam under pressure; then removing the moisture by the production of a vacuum marked on a barometer about equal to a column of mercury of twenty-seven cubic centimeters; then introducing a solution of sulphate of zinc under pressure until the wood is saturated therewith and removing the same by a vacuum; and, lastly, introducing a dilute solution of calcium chloride.

Railroad Signal.—In this improvement the rotating shaft of the signal operates the gong or bell, and is driven through a spring treadle actuated by the flanges of the wheels of the coming train. This spring treadle carries a panel, which acts upon a ratchet-wheel on a shaft, which is geared to other shafts extending to the signal device.

Hydraulic Elevator.—A hydraulic elevator is the subject of a recent invention. It consists of a moveable car or platform and apparatus for raising and lowering the same by means of hydraulic pressure acting in a cylinder upon a piston. A starting and stopping apparatus is combined therewith, controlled by the operator and constructed so as to automatically start the car with a fixed acceleration and to stop the car with a fixed retardation, independently of the speed at which the controlling mechanism is worked by the operator.

THE COMET.

T. BERRY SMITH.

O wanderer, from where dost thou come to my sight,
And whither art going so radiantly robed?
Hast been to the uttermost limits of night,
And far into Nature's deep mysteries probed?
No answer! No speech! O mysterious thing,
That burneth thy torch in the heavenly spans!
Far from me my boasting of wisdom I fling,
And bowing I bury my face in my hands.

EDITORIAL NOTES.

We have received quite a number of pleasant letters and editorial compliments upon the October Review, which was almost entirely given up to our report of the Montreal meeting of the American Association for the Advancement of Science. This is very gratifying, as the writing, condensing and arranging the matter for publication required an expenditure of personal labor and time that, coming upon us in the midst of the most busy month we have ever had in the course of a very busy life, was only to be made by sacrificing many hours badly needed for rest. To this latter fact must be ascribed some errors and omissions that appear in the report.

Prof. J. W. Spencer, M. A., Ph.D., F.R.S., late of King's University College, Windsor, Nova Scotia, has been called to and accepted the chair of Geology and Mineralogy at the University of Missouri. He also has charge of the branches of Palæontology and Zoölogy.

THE railroad companies interested in protecting the north bank of the Missouri River above and opposite this city are taking advantage of the unusually favorable fall weather and low water to riprap it along their lines. The Government engineers, into whose hands the application of the extremely liberal Congressional appropriation for this purpose has been placed, have commenced a preliminary inspection of the task before them and it is hoped that a good use will be made of the money before the high water of next spring shall again undo their work and possibly cut a channel across the isthmus back of Harlem and leave an island in front of Kansas City. Prompt and efficient work, such as is amply provided for in the appropriation, can prevent this, but it is highly probable that nothing else can. It is a serious matter with this city and if anything can be done to expedite action by the Government officials it should be attended to at once.

MR. W. H. CORY, of Philadelphia, has patented a process for the utilization of coal dust and slack by converting it into artificial fuel. This has been attempted many times but has ordinarily failed from the fact that the cost of the process exceeded the value of the manufactured article. Mr. Cory, however, claims, since his process is a cold one, that there is an enormous saving of labor, material and expense as compared with the pitch processes, in which the coal and pitch have to be heated. He also claims an advantage on account of the facility of his product for stowage, its cleanliness, hardness and portability; also as the only process known that will effectually hold together culm, lignite and the non-coking coals during combustion. An efficient and economical process for this purpose is a great desideratum to all class of consumers and a suitable machine would undoubtedly meet with an extensive sale in the west.

IT seems that in our abstract of Prof. H. C. Bolton's paper read at Montreal we misapprehended the scope of his proposed Index of Chemical Literature. He only invites the co-operation of chemists in compiling special indexes of the literature of the various chemical elements on some uniform plan, similar to those on manganese and ozone, already published. At a meeting of the Chemical Section of the A. A. A. S., held August 25th, a Committee was appointed "to devise and inaugurate a plan for the proper indexing of the literature of the chemical elements, to have full power to secure the co-operation of volunteers, and to report at the meeting of the Chemical Section in 1883." The Committee consisted of Dr. H. C. Bolton, Hartford, Chairman, Prof. Ira Remsen, Baltimore, Prof. F. W. Clarke, Cincinnati, Prof. A. R. Leeds, Hoboken, Dr. A. A. Julien, New York.

MR. F. W. VOERDE, formerly of this city, is now here putting Singer's Elevator Safety Stops upon the elevators of some of the best mercantile houses in the city. The device is extremely simple and effective, and, in view of the numerous elevator accidents that have occurred here lately, it would seem advisable for every person interested in this direction to investigate it carefully at once.

WORK is actively going forward at the new National Museum, and a large force of men is very busy in arranging the natural history collections, removed from the lower floor of the Smithsonian Institution and in opening boxes of collections which have been kept in store, some of them for years, simply because there was no space for exhibing them in the old building.

PROF. H. S. PRITCHETT, of Washington University, says in a recent letter, inclosing a remittance, "I feel a great interest in the success of the REVIEW and recognize very fully the service you are doing for science in the western country, and appreciate to some extent, at least, the difficulties of the position."

THE action of Dr. John Fee, City Physician, in attempting to inaugurate a system of interchange of views and co-operation between the medical officers of the various cities of the west for the prevention and management of pestilential and contagious diseases is highly commendable. The National Board of Health should have its powers and duties enlarged, so as to have direction and control of sanitary matters of all kinds instead of being limited to yellow-fever, cholera and small-pox.

PROF. C. D. ABBEY, of Wausau, Wis., in sending his annual subscription to the REVIEW, pleasantly says: "I consider the REVIEW a valuable periodical. In fact few are of more use to me and I am a subscriber for a large number. I must read and must read the best."

THE Surgeons-General of the army and navy have made a report to Secretary Lincoln, recommending a plat of five acres in the southwest corner of Hot Springs Mountain as a site for the proposed army and navy hospital, for the construction of which $800,000 was appropriated at the last session of Congress.

THE Directors of the National Mineral and Industrial Exposition, to be held in Nashville, commencing the first Wednesday in September, 1883, have organized, with a capital of $300,000. The exposition will embrace displays in every branch of industry in the Union, as well as minerals and timbers. It is also designed to include those from Mexico, South America and the West Indies.

ITEMS FROM PERIODICALS.

AMONG the original articles in *Van Nostrand's Engineering Magazine* for November, is one upon "House Drainage and Sanitary Plumbing," by Wm. Paul Gerhard, of Newport, R. I., formerly connected with the City Engineer's Office at St. Louis. Among the selected articles we find a very interesting Report on the Incandescent Lamps exhibited at the International Exposition of Electricity at Paris, in 1881, also an article upon "Sewer-Gas as a Factor in the spread of Epidemic Diseases, and on the Direction and Force of Air Currents in Sewers," and a valuable one upon "The Durability of Building Stones."

AMONG the practical articles in the *North American Review* for November is one by Judge Joseph Neilson upon "Disorder in Court Rooms" that may be read with profit by lawyers and judges all over the country; "A Problem for Sociologists," by Dr. Wm. A. Hammond; "Safety in Theatres," by Steele Mackay, and one on "Suppression of Vice," by Anthony Comstock, Rev. O. B. Frothingham and Dr. J. W. Buckley.

THE *Popular Science Monthly* for November gives an illustrated account of a phenomenon which has never before been observed—that of a snake, having crawled in between the bark and wood of a tree and died there, becoming lignified, or changed into wood, in the same manner as animals become fossilized, *i. e.*, the cells and fibres of the wood have actually taken the place of the organic parts of the reptile and left it perfect in shape, size and all other details, even to the eye-cavities, scales, etc.

MR. J. W. HEISS, telegraph operator at Watrous, N. M., has invented a modification of the telephone which he calls the Vibraphone. From a description of this invention given in the Las Vegas *Daily Optic*, it appears to be more simple and is claimed to be fully as effective as the telephone itself.

NUMBER 7, Vol. IX of the *Art Interchange*, published at New York City by Messrs. Turnure & Whitlock, has been received. It is called "a household journal," but it is nevertheless admirably adapted to the wants of amateur artists as a guide and a former of correct taste. Its editorials are original, sensible and practical, as well as appropriate, in view of its objects. Its illustrations are artistic and well executed and its general make-up is tasteful and elegant. Fortnightly; $2.00 per annum.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. DECEMBER, 1882. NO. 8.

ANTHROPOLOGY.

THE ANCIENT MAN OF CALAVERAS.

W. O. AYRES.

In the minds of almost all, the existence of prehistoric man in California is associated mainly with the famous "Calaveras skull," and inasmuch as doubt has been cast on the authenticity of that relic, the whole subject has been badly neglected, and even by men of science has been unreasonably set aside. We will speak of that skull presently, but it is only one of the many evidences to be considered, and we will at first put it out of view. We shall find that if it had never come to light at all, the proofs that man existed when, or rather before, the auriferous gravel was deposited, are so complete that he who doubts them would as readily doubt that Napoleon Bonaparte died on the Island of St. Helena.

The auriferous gravel of the books is the pay-dirt of the miners, and that we may know what the existence of man at the time of its deposit means, we must endeavor to ascertain how long ago that deposit occurred. If we say to a geologist that the gravel is of Pliocene age, he carries back his thoughts over an interval of which the years reckoned by thousands are never counted, though he knows the thousands must be very many. But for those to whom Pliocene and Post-Pliocene sound like barbarous terms it may be possible to adduce a form of proof which appeals to the eye, and which brings with it therefore, a force which all can appreciate.

It is well to state at the outset that the pay-dirt is manifestly all of one formation and of one geological age, wherever we find it. Some of it is lying opened and exposed; we will let that pass. Some of it is covered by volcanic rock, and of course is itself older than the rock; that is, the lava flowed out and covered the gravel after the gravel was in its present form and position. That is sure, for after the gravel was thus imbedded, it has most certainly never been disturbed until within these last few years the miners have dug into it in search of gold. To the gravel then below the lava, we will turn our attention.

Looking out from Carson Hill, in Calaveras County, you see across the Stanislas in Tuolumne, a long mountain ridge. It extends down into the plain, where it ends very abruptly, while its upper limit is out of sight away among the main heights of the Sierra Nevada. It looks like a huge railroad embankment, and suggests to you that idea, but men do not make railroad dykes forty miles long and 1500 to 3000 feet high. That which gives it its smooth even upper surface is basalt, that is, ancient lava; the lower part is of looser materials. The thickness of the basalt varies at different points, being here and there hundreds of feet thicker than it is at other places a mile or two either above or below. This is Table Mountain, a name which has been famous in the history of California, as we shall see.

The question occurs to us: How came Table Mountain to exist? That basalt, when it was erupted, was fluid like other lava. How could it be piled up so thick and so abrupt (for its sides are often perpendicular) on that high mountain ridge, and remain there? Why did it not spread itself out laterally and cover the plain? But one answer to these questions can be given: *There was no plain.*

When that eruption took place and the crater or fissure opened, far up near the summit of the Sierra Nevada, it naturally flowed into the bed of the first stream which crossed its track. This it filled and followed down until, when the eruption ended, the old river bed, away down to the plain, was blocked up by the solid volcanic rock, and the waters which should have been there, were finding their way by some other track.

As time passed on, the side of the mountain range was yielding to atmospheric influences. The flowing water was carrying off the softer material on each side of the hard basalt, which had filled and obliterated the old river-bed; the Tuolumne River on the south and the Stanislas on the north, with their tributaries, were formed, and scooped out their present valleys, and thus Table Mountain, which had been deposited in the bed of an old mountain torrent, with high ridges confining it, became itself a ridge, standing like a wall above all which adjoined it. But beneath the basalt lay the stones and gravel and sand and clay which made the bed of the ancient torrent, as they do of the modern streams. And like the modern streams, their predecessor in age, but not in locality, was rich in gold, and thanks to this gold, we know something of the Ancient Man of Calaveras and Tuolumne. We know him because he has left his mark among the stones and gravel.

In what are called the "early days" in '49 and '50, the southern mines were especially noted and productive. Don Pedro's bar and Hawkin's bar on the Tuolumne were crowded with miners, and all the region about Sonora, and Columbia, and Shaw's flat, was swarming like a hive. The gold which was obtained had been brought down in company with the gravel from the mountain heights far above, by the rush of water, ages before. Wherever an old channel could be found in which the flow of water had been confined to narrow limits and to whirling eddies, there the gold had been deposited more abundantly, and rich strikes were made. While exploring these surface deposits, an old river-bed was struck at Shaw's flat, in 1854, which showed features quite distinct from the "diggings" adjacent, and in following out this discovery it became manifest that Table Mountain, as already stated, was simply a mass of lava filling an ancient torrent cañon, and that the gravel thus buried was in various places most wonderfully rich. This was the beginning of Table Mountain mining.

The whole matter had very much the character of a lottery, for the expense of running a tunnel under the mountain was very great, and the result entirely uncertain, commonly rich to even a fabulous degree, or on the contrary a total failure. The failures were many and the losses destructive to the fortunes of the men interested, but the wild excitement of golden possibilities lured multitudes along, and for years and years in succession Table Mountain was bored and tunneled most completely. It is not for us now to speak of the triumph or the heart-ache which went with the work; we know well that

"No minstrel ever sung or told
A song so sweet as chink of gold,"

and nowhere, even in that land of enchantment, was the wild and fatal fascination of the search more fully felt than at Table Mountain. But that goes by us. Out of these tunnels came the tokens of the past, and we see shadowy visions of the ancient man looming up.

But we will first try to measure off the intervals since the Table Mountain lava flowed; not that we can specify it in figures, but we may learn enough to reverence its extent. We will consider but one feature. This is the magnitude of the work which has been done by streams of water since the period of volcanic eruption of which mention has been made.

The western slope of the Sierra Nevada is furrowed with enormous gorges reaching from the summit ridges to the plains of the Sacremento and the San Joaquim. Any one of them may be taken as a type of all the others. At their upper part they are, of course, shallow and narrow; a few hundred feet deep and a quarter to half of a mile wide, more or less, but steadily increasing in both dimensions. Before they reach their debouchure they are ten to twenty miles wide and two to four thousand feet deep. Stand far up among the higher ranges and following with the eye the stupendous furrow through its windings, fifteen, thirty, forty miles, till all is lost in the blueness of depth and of distance, one often tries to roll back the tide of time and get some glimpse of the days when that plowshare began its work. But the blueness of the chasm is only a faint index of the dimness which comes across the mental vision. It is idle to suggest to one thus standing and looking down the cañon of the Yuba, or the American, or the Tuolumne, that water can have done that work (and water certainly has done it) within an interval which, reckoning years by thousands, must not have written against it *very, very many.* We will not specify how many, but the number surely is great.

And all this scooping out of cañons, this furrowing the western Sierra slope into its configuration of the present era, has been done since the Table Mountain lava flowed. Of that there can be no question. The evidence is too plain to admit a doubt.

If now we find the remains of man, or works which none but man could have made, among the gravel-beds beneath Table Mountain, or in any other place amid the undisturbed pay-dirt, we cannot fail to know that human hands and human brains had done their work before the immense cañons of the Sierra Nevada commenced their formation in the little furrows near the summit down which the waters trickled.

We can take the proof only in brief, and we will take none but those which are absolutely established and authentic.

Dr. Perez Snell, of Sonora, had in his collection (this collection has unfortunately perished by fire) a human jaw which was brought out in a carload of "pay-dirt" from a shaft stretching far in beneath the Table Mountain, and with it were several stone implements. Dr. Snell did not himself see this bone in the car as it was drawn to the surface, and in the minds of some a doubt might thus be thrown on its authenticity. The specimen was given to him by a miner. If it were an isolated instance this would be possibly worth considering, but is only one of many, and at the same time it is only fair to state that there could not well have been found a miner in all that region who would have thought it worth his while to attempt a deception, nor even one who had any doubt in his own mind as to the point we are considering. They saw the products of man's work come out with the gravel too often to pay commonly any attention to them. The only wonder is that he even took the trouble to pick out the bone at all. There can be no question that for one such that has been preserved, dozens and perhaps hundreds have gone down in the current of water in the sluice washing.

In 1857 Col. Hubbs, who was afterward State Superintendent of Instruction, found in a load of "dirt" as it came out from his claim under Table Mountain, portions of a human skull. He was on the ground himself, and saw the fragments as they were taken out of the sluice. They had come from a distance of 180 feet beneath the lava. One of the pieces is now in the collection of the Boston Society of Natural History; the other in that of the Philadelphia Academy.

Mr. O. W. Stevens certifies that in 1853 he found in a shaft under Table Mountain, "about two hundred feet in," a relic that resembled a large stone bead, of white marble, about an inch and a half long and an inch and a fourth in diameter, with a hole through it a fourth of an inch across.

Dr. Snell had in his collection a stone muller or pestle which he took with his own hands from a car load of "dirt" as it came out from under Table Mountain.

Mr. Llewellyn Price certifies that in 1862 he dug a stone mortar under Table Mountain at a depth of about 200 feet from the surface and about 1800 feet in from the mouth of the tunnel.

But why need we specify any further single instances. The witnesses already given were all credible and worthy men, they could have had no possible collusion, they had no motive for deception, and the circumstances were such that they could not well be deceived as to what they stated. If any candid person will not be convinced by the evidence they give, he would be equally incredulous were a hundred more to testify to the same truths.

And the hundred more could be summoned were it worth the while, for the instances in which the products of human workmanship have been washed out of the "gravel" in searching for gold are altogether too numerous for record. Very many of them are now in the Museum of the University of California, and very many more were disregarded and lost, for so common did they become during the days of surface mining, that at length the miners paid no attention to them, and they simply went in with the refuse of the workings.

They were almost universally implements of stone, such as mortars, pestles, rude vases or platters, that is, articles which could be used for grinding food, etc., but all rough in workmanship and evidently fabricated by people low in the scale of civilization. But such as they are, they show with what appears to be conclusive proof, that they were made before Table Mountain lava was erupted, and perhaps long before, for they were also surely made before the auriferous gravels were deposited.

One item comes naturally to our consideration here in the line of confirmation The auriferous gravels contain abundant remains of plants and animals. Mastodons and elephants appear to have specially abounded; in no other part of the world have their bones and teeth been found in greater numbers. With them were found species of rhinoceros, Elotherium, horse, ox, camel, etc., etc.[1] But all of these were of types long since passed away, and the same can be said of the leaves and fossilized wood. Dr. Newberry's report characterizes them as being entirely unlike anything now growing in California, and as belonging to the Tertiary age, the later Pliocene. Now we know that the fauna and flora of a country cannot be *completely* changed except through the intervention of a very great space in time, or the agency of a sudden cataclysm and reconstruction.

And shall we now compare them in age with the others which are absolutely prehistoric, and which have disturbed the scientific world by their venerable antiquity. Fierce have been the conflicts waged over the Neanderthal skull, the Engis skull, the men of Cro Magnon and the various other relics gathered from

1 We pointed out in the *Naturalist* for January, 1880, that the occurrence of rhinoceros and Elotherium in these beds is impossible, unless transported from a long distance. The Elotherium, especially, could only have been bought there by man from Central Oregon or farther off. For camel should be read lama.—*Note by Ed. Naturalist.*

the gravels and bone-breccias of Europe. But their record is dwarfed to comparative insignificance when laid by the side of that to which we have been looking. The days of Table Mountain had passed off into the dark realm of the forgotten past ages before the drift of the valley of the Somme was deposited or the man of the Neanderthal lived. Those European relics have by none been counted older than the Post-pliocene; these of the Sierra Nevada go back to the Pliocene, and as the "new world" of modern style was the very oldest in showing itself above the waste of waters, so perhaps it was also the first to feel the step of man. It is possible that the discoveries of Ribiero in Portugal and of the English Geological Survey in India may be found to carry us as far back as the times we have been discussing, but they have thus far been strangely ignored.

What manner of man then was this Ancient Man of Calaveras? Let him speak for himself. All notice of the skull described by Professor Whitney has been purposely omitted till this moment, because it is by far the most important "find" yet made, and it is worthy of being considered by itself and in the present connection. The chief point in estimating its value, is its genuineness. It has been the subject of much criticism, and in the minds of very many, its mention barely recalls Bret Harte's ridiculous doggerel,

> "My name it was Brown, and my crust it was busted
> Falling down a shaft in Calaveras County,"

and the request to send the pieces back to old Mazzoura, has relegated the whole matter to the domain of joke. In the belief that Professor Whitney was the victim of a *sell*, the question is often asked whether there is any evidence that the skull was actually taken from the shaft to which its discovery is credited.

Now with all due submission to previous judgment (or misjudgment), I maintain that that question is of only secondary importance. The skull speaks for itself, and notwithstanding that its lower jaw is gone, it talks good English, whatever its vernacular may have been in the days of the flesh.

That it came to Professor Whitney from the hands of Mr. Mattison (or as I always heard him called, Matthewson), of Angels Camp, is certain. Where did Mr. Matthewson get that skull? I do not know, nor is the precise spot of much consequence. He says he took it from his shaft near what was then called the Forks of the Road, above Angels. Suppose he did, or suppose he foolishly tried to humbug the geologist, what does it matter? He got the skull *somewhere*, and wherever it might have been first found, it surely has imbedded in the auriferous gravel, and it had become so imbedded at the time the gravel was originally deposited.

You say, that is a bold assertion; how do you know it? I will tell you; I know it, because *the skull told me so*. I saw it and examined it carefully at the time when it first reached Professor Whitney's hands. It was not only incrusted with sand and gravel, but its cavities were crowded with the same material; and that material was of a peculiar sort, a sort which I had had occasion to know thoroughly. It was the common "cement" or "dirt" of the miners; that known in books as the auriferous gravel. This is an article "*suigeneris*"; it is not easily imitated. No skill possessed by Mr. Matthewson or any one else could have been sufficient to give the skull the characters which it had as I saw it. It is most certainly no fabrication.

But it has been said that it is a modern skull which had become incrusted after a few years of interment. This assertion, however, is never made by any one knowing the region. The gravel has not the slightest tendency toward an action of that sort. The skull would either decay and waste away, or it would remain unchanged; and added to this comes in the fact that the hollows of the skull were crowded with the solidified and cemented sand, in such a way as they could have been only by its being driven into them in a semi-fluid mass, a condition which the gravels have never had since they were first laid down.

No, no! Let the skull tell its own story, and believe what it says, because it brings its own proof. Whatever age belongs to the gravel deposit under Table Mountain belongs to the Calaveras skull, entirely irrespective of the question of honesty or dishonesty in the alleged finder. Wherever he found it, I believe its age to be beyond cavil.

Its degree of fossilization has not been here insisted upon, because that change is more rapid in some localities than in others, but it is an interesting fact that this Calaveras skull is more thoroughly fossilized, a greater proportion of its phosphate of lime has become carbonate, than in either of the European specimens which were reckoned of the greatest age.

We seem then fairly entitled to consider the Ancient Man of Calaveras the oldest representative of our race to which we can as yet refer; and being such, is he of a bestial type? Look for yourself. Figures have been published by Professor Whitney in his work. What is there bestial as shown by them? A single skull cannot, of course, speak for a whole race, but so far as this specimen can testify, what man is now, man was then. It manifests no sign of inferiority to the American race as now existing. Barbarous in habit he doubtless may have been. All the relics of workmanship thus far discovered of those coeval with him, indicate a low grade of civilization, and yet one not necessarily much, if at all, lower than that of most of the Indian tribes which formerly occupied the entire breadth of the continent. And in intellectual power, judging from his cerebral development, he might assuredly have claimed a fair average rank.—*American Naturalist.*

SOME RARE PRE-HISTORIC RELICS.

PROF. H. A. REID, DES MOINES, IOWA.

In the REVIEW of February, 1882, I gave a pretty full account of a tiny copper ax which I had found on the site of an ancient or pre-historic village at Lexington, Missouri. Since that time Mr. Charles Teubner has sent me exact natural size drawings of another such ax, found at the same place, which corresponds so exactly with my specimen that I cannot doubt they were swedged in the same mould. And hereby another mystery is explained. My specimen has a nicely shaped edge, with the corners very neatly and artistically formed; then the body of the ax appears to have been broken off by an irregular fracture just a little below where the crease or groove should have been—but it was noticeable that there was not the slightest show of the copper having been bent by the force supposed to have broken it off. I at first explained this singular fact by supposing that the copper had been tempered and made brittle in some way, so that it would break off short and sharp without bending. But Messrs. Carey and Bailey, of our Academy of Science, "knocked the stuffing out" of this theory by proving by chemical tests that the material was pure, malleable, unalloyed, soft native copper. The apparent break had occurred just where there was the greatest bulk or thickness of the metal, and hence the perfect non-bentness of the whole piece was a phenomenal puzzle unsolved. But when Mr. Teubner's specimen was found, and showed a similar appearance of break in about the same place, (although the seeming line of fracture was not exactly the same,) it went to prove that neither of them had ever been broken at all; that each specimen as it is comprises all the metal there was in the original piece of native ore, and the apparent "broken off place" was the irregular and unshaped terminal end of the whole piece, the swedge having shaped three edges and left the fourth one just as it happened to come out.

In addition to this second copper ax relic, Mr. Teubner also has a copper relic found at the same place, which was a bit of copper about as large around as an ordinary lead-pencil, two and a half inches long, and tapering or pointed at both ends. After considerable scratching and picking and examination with magnifying glasses, it was discovered and demonstrated that this instrument was composed of four small strips of copper cold-welded or swedged together so neatly and perfectly that the relic had been much handled and several times critically examined, before this fact of its quadruplex composition was discovered; but after discovery the four pieces were picked apart at one end and some of the weld-lines traced. Well, what was it for? It may have been polished, and twisted into the hair as an ornament; but quite as likely it had no other use than as a charm, or fetish, to protect the owner from unseen harms. The small strips were probably made by rubbing or rolling a bit of the native and malleable copper ore between two heavy, flat stones until it was rolled into a sort of wire, and then the four pieces perhaps swedged together in a double mould made in hard stone, and afterward rolled between heavy flat stones.

In addition to the above, the following extract from the report of a recent meeting of the DesMoines Academy of Sciences will be of special interest to those whose taste in scientific matters runs to archæology:

"An ancient stone ax was exhibited which was different from anything of the sort ever seen or heard of before by any of the members. It was nine inches long, and two and five-eighths inches wide. The head is wrought into a peak, flat on two sides and rounded on two sides. There is a large groove worked around for a handle, and bosses or protuberances are worked above and below the groove, two forward, two back, and two on each broadside of the implement. The material seems to be an impure grey-stone, rough-finished, and with a good edge that has been worn smooth by use. This unique specimen belongs to Dr. A. L. Worden, of DesMoines, and was plowed up on his father's farm in Michigan, two or three years ago. Other stone axes brought in for comparison were —one by Judge Fulton from Taylor County, Iowa; one by Master Chas. Keyes, from Ohio; one by Dr. H. A. Reid, from Missouri, and one by Dr. A. G. Field, from North Des Moines. All of these except one showed that the edge was made oblique to the shaft or head of the ax—a fact of strange and curious interest."

The question arises—did the makers of these particular oblique or warp-shaped axes have an obliquity of vision or of mental action, so that they could not do true, straight work. I had noticed that same peculiarity in several axes of stone and hematite in Missouri. And it would be worth while for some one who has access to a large collection of these prehistoric axes to examine and see what proportion of them have the edge oblique or warp-wise to the body and head; and if one-half or more have that peculiarity, it would seem to give a clue for some psychological inquiries.

HUMAN REMAINS IN THE LOESS OF THE MISSOURI RIVER.

E. P. WEST.

PEABODY MUSEUM OF AMERICAN ARCHÆOLOGY AND ETHNOLOGY.

HARVARD UNIVERSITY, CAMBRIDGE, MASS., October 3, 1882.

THEO. S. CASE, ESQ., Kansas City, Mo.:

Dear Sir,—I enclose a newspaper slip at Mr. Putnam's request, and he wishes me to ask you if there is any foundation for the article. He says if it is a correct statement that some geologist ought to give the place a thorough examination. Will you kindly inform him if you have heard anything in regard to it.

Respectfully yours, J. SMITH, Ass't.

KANSAS CITY, MO., October 15, 1882.

Respectfully referred to Judge E. P. West for his consideration and action. Any communication he may choose to make upon the subject I shall be glad to receive and forward.

THEO. S. CASE, Ed. REVIEW.

KANSAS CITY, MO., NOV. 16, 1882.

COL. THEO. S. CASE, Ed. Kansas City REVIEW:

Dear Sir,—It is with great pleasure I answer the inquiry of Prof. Putnam addresssd to you through his assistant, Mr. J. Smith, and which you have done me the honor to refer to me for a reply.

The statement of finding the human remains mentioned in the newspaper slip referred to is correct. The facts may be briefly stated: Mr. Underwood is a large manufacturer of bricks in this city and has an extensive yard near its eastern limit. In the latter part of June last some of the men employed by Mr. Underwood, digging clay for the work, found a human skeleton extended in it in a horizontal position eighteen feet beneath the surface. The bones were kindly given by Mr. Underwood to the Kansas City Institute, and they are now in its collection. I saw the cast of the skeleton and a part of the bones in position in the clay, and can vouch for the depth at which they were found.

The important question is: Were they resting in the undisturbed natural formation? I think there can be but one answer to this, and that is that they were. In this opinion Mr. Underwood and other gentlemen who examined the place concur. The bones were found on a loess hill slope and within 250 feet of the summit. An obstruction to cause a fill of eighteen feet where they were found would seem almost an impossibility. Besides, the clay around and immediately above them did not differ in any way from the clay in the very extensive excavations made by Mr. Underwood for hundreds of feet around in the same hill-side and which unquestionably remained as deposited before the excavations were made. It can hardly be supposed that any people in past or present time would inter their dead so deep. All the facts seem to point to the conclusion that the individual whose remains were so mysteriously enwrapped in their mantle of clay, was engulfed in the old lake of the Champlain epoch in which the loess formation took place prior to its completion and was slowly covered in by the continued super-accumulation of that deposit. At the end of the deposit and before the work of attrition began the bones were covered probably to a depth of more than fifty feet. If it be objected that human bones would not not endure so long, it may be answered that several varieties of *Helix*, in a perfect state of preservation, and the teeth and bones of extinct mammals are found under like conditions in the same formation at depths varying from five to more than a hundred feet and which, evidently, were buried in by its precipitation.

During my geological and archæological explorations along the Missouri River in July and August last, I gathered other facts sustaining the opinion I have here expressed. At White Cloud, Kansas, I was informed by gentlemen of intelligence and unquestioned veracity, that a vase of antique pottery was found in a mound standing on the summit of the bluff immediately overlooking that city, and that another vase precisely similar, was found in a loess hill about a half mile distant from the mound, at a depth of fifteen feet below the natural surface. This, too, was found in a brick yard, and in digging clay for brick-making. I saw and conversed with the gentleman who found and removed the vessel from the clay, and was shown the position where it was found, and I entirely concur in the opinion of the gentlemen of that place, who are conversant with the facts, that the vase must have been covered in by the lake deposits of the Champlain epoch.

Dr. Parr, of Weston, Missouri, opened a mound on the summit of the bluffs near that place, in which he found an antique vase of the basket type of pottery and containing within it fish-bones and shell beads. The Doctor was so good as to present to the Institute some of the beads and fish vertebræ, which are now in its collection in this city.

The chief importance to be attached to Dr. Parr's find is in the contents of the vase. It has been the custom of barbarous and semi-barbarous people to make provision for the subsistence of their departed friends on their supposed long journey to the spirit land. The food provided is that which the people habitually use, and such a people invariably use the food which is most accessible to them. Hence, our modern tribes, who inhabited fertile districts, such as Missouri and Kansas, subsisted almost entirely upon terrestrial animals, because such food was more accessible to them than any other; and they would never have thought of sustaining a departed friend on fish to the land of spirits. But at the close of the Loess deposit, prior thereto, and for a considerable time after its completion, conditions were different and fish must have been more abundant and more accessible than terrestrial animals, hence the subsistence provided for the tenant of the Weston mound for his sustenance to the mystic land. If it is true that these bones were deposited pending the Loess formation, and it seems difficult to escape this conclusion, a hundred centuries would be a low estimate for their profound and mysterious slumber.

The Loess deposit of Missouri and Kansas rests immediately on the glacial drift, nothing whatever intervening between them, so the Loess must have followed the drift in immediate succession.

The same glacial forces which caused the filling up of the old channel of the Niagara River, producing obstructions which diverted its course and forced it to cut a new one, and in this work to carve out that world's wonder the "Niagara Falls," operated here to produce, and leave as a monument of its power, our drift, and to fill the channel of the Missouri River some hundreds of feet, and, perhaps, actually to divert, or partially divert, it in some places.

Since its diversion, the Niagara River has cut its new channel back for a disance of seven miles. This work has required more than 36,000 years, according to the estimates of Professor Hall and the late Professor Lyell, which Professor Dana thinks very low.

As the Loess deposit rests upon and immediately succeeds the glacial drift here, 26,000 years would be a very large estimate of the time intervening between the close of the glacial epoch and the filling of the old Champlain lake to the level of where the human remains were found in the Underwood brick-yard. Besides, the finding of the bones of the large extinct mammals in positions as high as where the human remains were found would indicate an antiquity which a hundred centuries would hardly cover.

In my limited archæological researches, in Missouri and Kansas, I have observed and gathered from others hundreds of facts bearing on this subject and all pointing to the occupancy of the bluffs bordering the Missouri River valley prior to the close of the Champlain era. But it must not be inferred that this was man's first appearance on this vast domain, for it is probable that he and the large extinct mammals existed prior to and retired before the advancing glaciers of the glacial epoch, to beyond the 40° N. latitude, and, that during the Champlain period the large animals became extinct, but that man survived, and advanced northward again upon the retiring glaciers.

I would like to pursue this subject more in detail, but cannot do so without trespassing too far on the patience of Professor Putnam. As I have remained, for some time past, under a kind of promise to the public to renew the consideration of this subject, if you will allow me space in the REVIEW, and will be so kind as to send a number to Professor Putnam, it seems to me proper to answer his inquiry through that channel, more especially so as it would add to the public interest to know that so distinguished an antiquarian and profound a thinker as Professor Putnam deems the matter of scientific importance.

With the best wishes for the success of the REVIEW and your noble effort to add to the sum of human knowledge, I remain

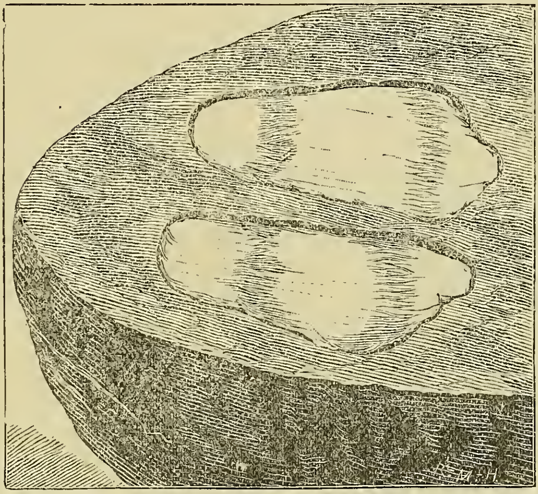
Yours most truly, E. P. WEST.

HUMAN FOOT-PRINTS IN SOLID ROCK.

THEO. S. CASE.

The discovery of supposed human foot-prints in solid rock near Carson, Nevada, leads me to call attention to those discovered by myself in October, 1880, in the Valley of the Pecos River, near the Atchison, Topeka & Santa Fe R. R., in New Mexico, and referred to in the November number of this REVIEW in an article entitled "An Excursion to the Birth-Place of Montezuma."

Our party was crossing the open prairie between Baughl's Station and the old Pecos Church, when we came to a large boulder, or fragment of sand rock, of which there were hundreds scattered around. It being a warm afternoon and this rock lying under a clump of cedar trees, we naturally stopped to rest in the shade. While there our attention was attracted by some very singular markings upon the surface of the rock, which was about six by nine feet and about three feet high. These markings resembled human foot-prints, each being about thirteen inches long by four and one-half inches wide and about six inches apart. The cut below gives a very good idea of their appearance except that the drawing is rather too smooth and symmetrical. These tracks gave us the suggestion of their having been made by a large man in moccasins stepping upon a soft surface and slipping forward an inch or so. The impressions are nearly or quite one inch deep.



There is another rock in the vicinity said to be similarly marked with human foot-prints, both of adults and children, also with those of a bear; these, however, are believed to have been carved with some tool. Those referred to above show no evidence of having been cut or carved, but rather, if not real impressions of human feet, appear to be the result of accidental scaling off and weathering into this peculiar shape.

ASTRONOMY.

OBSERVATIONS OF COMET B, 1882.

PROF. H. S. S. SMITH.

The equipment of this Observatory does not suffice for measures of position, or for spectroscopic or photographic investigations. Attention has, therefore, been entirely directed to observation of the appearance and changes in the structure of the comet. The telescope used is a comet-seeker having an object-glass five and five-eighths inches in diameter and a focal length of forty-two inches. The tube is bent so that the eye-piece is always horizontal, the reflector being a right angled prism. It was found that the power of fourteen was best suited to show the faint portions, as the prism absorbed so much light that the seeing with higher powers was not satisfactory. No attempt was made to study the nucleus or coma critically, as it was evident that the telescopic power was far from sufficient for the purpose. Chief attention was given to the appearance of the fainter portions, and the results seem to repay the labor expended.

The comet was first seen on the morning of September 26th, when it was low down in the horizon but quite brilliant. The nucleus was estimated to be of the same brightness as Procyon, and was seen until fifteen minutes before sunrise. The tail was about five and a half degrees long, and ceased to be visible twenty minutes before sunrise.

On October 9th the comet presented a truly beautiful appearance. As seen with the low power the nucleus appeared slightly granular and elongated in the direction of the tail. There was no dark streak in the tail near the nucleus. It was on this morning that I first saw a peculiar appearance extending from the nucleus toward the Sun. It consisted of two streaks of faint light, one on the north and one on the south side of the coma. The one on the north side was between twenty and twenty-five minutes from the nucleus, ran parallel, or nearly so, to the centre line of the tail, was quite distinctly bounded on the side away from the nucleus, but faded gradually away toward the comet proper. This streak extended fully half a degree from the nucleus toward the Sun, and was no brighter than the fainter portions of the tail that could be seen through the telescope. The streak on the south side was quite similar in general appearance, but it was only about fifteen minutes from the nucleus and extended only fifteen minutes toward the Sun. Both of these streaks extended westward from the Sun until they met the tail where it was broad enough to equal the distance between them. The first appearance of dawn was quite sufficient to render these streaks invisible.

On October 13th, this forward haze was somewhat longer, and of about the same breadth. The streaks were united by a faint haze that extended across in front of the nucleus and coma. The brighter portion of the tail seemed to be enveloped in a thin haze, and the forward haze was but a continuation of this. From this time the haze grew larger and brighter until, on October 15th, it was fully three degrees long, slightly parabolic in its outlines, (but the end was ill-defined), and of nearly uniform brightness throughout. It was bright enough to be seen with the naked eye on October 14th but it was an unusually clear morning. After the 15th the haze began to grow smaller and less brilliant, the decrease in size being very gradual at first. The lessening was first seen in the central parts of the haze becoming much fainter than the edges; then the end of the haze began to disappear, until, on October 25th, the haze was somewhat similar to its appearance when first seen on the 9th, but the boundaries were not so distinct.

What these appearances mean I do not know. The only case that is at all similar that I have met with is that of a comet of 1824 which had a tail seven degrees, long extending toward the Sun, and a fainter tail three and a half degrees in length turned away from the Sun.

University of Kansas, Nov. 6, 1882.

ON SOME VOLCANIC FORMATIONS IN THE MOON[1].

HERMAN J. KLEIN.

The numerous circular formations of the Moon enclosing a hollow, in the middle of which a group of hills generally rises, are, as is known, designated Craters or Ring-mountains. By this, however, it is by no means intended that these formations are to be viewed as analogues of our terrestrial volcanoes; on the contrafy, there are not only distinctions in magnitude, but fundamental differences in the entire structural type, which forbid comparison with the volcanoes of our world. The true volcanic formations of the Moon, those forms which possess the greatest similarity to our terrestrial volcanoes, were not, generally speaking, known at all to the earlier selenographers, Schröter, Lohrmann, and Mädler.

Neison, in his new work 'The Moon,' remarks that the real representatives on the Moon of our terrestrial volcanoes are what he terms "crater-cones." They are those steep or conical hills which vary in size from one-half to two or three English miles in diameter, with a precipitous funnel-shaped central hollow scarcely half the breadth of the hills themselves. When the Sun stands at a great height above them, they are visible through powerful telescopes as very minute white spots; and under a moderate elevation of the Sun, the central chasm that forms the crater can sometimes be perceived in their middle. But for this, a calm clear atmosphere is necessary and a very powerful telescope. Sometimes they appear on the summit of a mountain, not rarely also on the plain enclosed by a ring-mountain or on a walled plain, as in Plato and Fracastorius. To this kind of forms belongs also the small hill containing a crater which at present rises within the at one time large crater Linne, and which can only be seen for a short on the terminator. In the time of Lohrmann and Mädler, Linne was six or seven English miles in diameter, and was at least 1000 feet deep. The filling up of this large old crater was remarked by Schmidt in October, 1866; and on the 26th day of December of that year he saw for the first time that a low "crater-cone" had risen on the new plain, having a central chasm of perhaps 300 metres in diameter. I regard this crater, which I have also seen, as a real representative on the Moon of our terrestrial volcanoes. Similar forms can be made out in great number in the interior of the flat ring-mountain Stadius.

Mädler previously noticed here several tiny little crater-cavities; and Neison mentions thirteen crater-pits on the enclosed plain of Stadius, while Schmidt counts fifty of them. None of these observers, however, mention that these tiny

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1 From Peterman's 'Mittheilungen,' 1882, Heft. vi. (Translation).

craters lie on the summits of pretty steep cones. When Stadius emerges from the lunar night, these "crater-cones" are revealed in immense numbers, like thorns stuck in the ground; but as they are all small and low, the shadows quickly disappear under the ascending Sun, and then the darkness only of the crater itself can be seen.

These formations appear to have a close relationship to our volcanoes; but I would, by the way, turn the attention of selenographers, and of geologists also, to another class of forms on the Moon's surface, which appear to me to correspond in a still greater degree to our volcanic formations, and which up to the present time are little known or not at all. The only selenographer who has paid attention to these forms is Julius Schmidt in Athens. He first saw some of these formations in January and February of 1851. "In a southwesterly direction from Theophilus," he says, in his explanatory volume to his large map of the Moon, "there lie in the Mare two small dark patches, like imperfect half-shaded craters; they remain visible as dark patches under a high altitude of the Sun. The western one is the larger." This remark dates from January, 1851: on the 25th day of February of the same year Schmidt perceived close to Copernicus, and in a southwesterly direction towards Gambart, "a bright point surrounded by a dark grey nimbus, which lies in the grey plain." In the year 1873, Schmidt returned to these formations and found that there is present in them a white cavity, which at times appears like a crater. Among the numerous lunar forms which can be descried with the strong telescopes of the present time, and which I estimate at 200,000, those described above are so rare that I could only reckon five which show the type with certainty and two in which it is also very probably present.

Without being aware of Schmidt's observations, I had come upon the above mentioned very rare formations in the course of my researches on the Moon's surface. I perceived that the two objects in the neighborhood of Theophilus are craters with clear white cavities, which, at a certain distance on the outside, were surrounded by a ring of smoky grey material. In the course of my observations it gradually became manifest that the larger of the two craters fell away externally like an unusually flat cone, so that the base of this cone, which had a very moderate vertical height, yet spread itself several miles wide. Upon the highest point of this very flat base stands the precipitous cone of eruption. Radiating from the crater numerous hills or folds run out upon the gentle declivity, and between them appear tiny little craters which parasitically cover the slopes of the base in great numbers. The dark grey material is deposited only in the neighborhood of the white-colored principal crater, round about its precipitous cone, and indeed within a narrow, pretty sharply limited, circular zone. The smaller crater to the northwest exhibits similar conditions, yet I have not been able to perceive in it the radiating hills and the little parasitic craters.

Since last autumn these two craters have not generally been so plainly visible as in former years; indeed I cannot at present perceive the crater proper, but see only a grey patch within the dark ring. In the crater mentioned by Schmidt which lies off in the direction of Gambart, and in a larger one to the north of Copernicus, the circular zone around the central cavity is broader, clearer, and, towards the outside, paler. Half a century ago, Gruithuisen discovered and repeatedly observed a similar object southward from the crater Hyginus. In this, also, there was to be seen a tiny clear white crater in the middle of a roundish, broad, grey patch. This tiny crater is in existence at the present day, and, indeed, is placed on the flat top of a very low ruined circular wall; but, in the twenty years over which my observations have extended, I have never been able to see it as a white speck. Neither do I find in Schmidt any mention of this circumstance. Now since Gruithuisen's observations are indisputable, it must be concluded that that small crater has grown darker in the course of years. From the agreement in the cases cited, but specially also from my rigorous examination of the larger crater on the southwest of Theophilus, we must conclude that the dark material which surrounds the bright shining crater was ejected from it. We may look upon it as a species of lava, which becomes bleached in time, and then assumes that appearance which we perceive in many so-called "light-surrounded" craters. That the formation of the ring of dark material or, if you will, the eruption, together with the aforesaid crater southwest of Theophilus, belong to recent times is proved by the circumstance that this dark patch, which is so obvious, and even appears in one of Rutherfurd's lunar photographs, was seen neither by Lohrmann or Mädler in the first third of our century. The conclusion that it did not then exist receives complete confirmation from the observations of Gruithuisen. I have thoroughly examined the comprehensive journals of this accurate and sharp-eyed selenographer, and have found that, on several occasions, he specially explored the locality in which to-day that dark patch is so plainly to be seen, without, however, having perceived it, although it was exactly such patches that Gruithuisen eagerly sought after.

The intimate connection between the dark material and the bright crater in its middle, as well as the inference that this mass was cast out lava-like from the crater at a time long subsequent to its formation, I have proved from several years' study of a similar crater which has been mentioned by no previous observer. In this case, thanks to the configuration of the ground, the proof is so convincing, that it could hardly be greater had it been afforded by a terrestrial volcano directly accessible to our ascent.

The object, concerning which I have now to report, lies in the inside of the great walled plain Alphonsus. Mädler has there described, out of several others in the neighborhood of the slope of the east wall, a dark triangular spot, which at at full Moon, when only little of the walls of Alphonsus is to be seen, stands out with uncommon distinctness on account of its dark color and its regular form. According to Mädler, this spot was only to be seen when the Moon stood high over the lunal landscape referred to, and was neither sunk nor raised. The circumstance that, during my observations in the interior of this dark spot, I once spied a bright point exactly similar to the central craters in the above described formations, induced me to devote an accurate search to the object, which gradually led to the result that this also is in reality a "crater-cone" from which the dark material has flowed out. Mädler believed from his examination of the district in question that it was neither raised nor sunken. This mistake, originating probably from the weakness of his telescope, had previously been partially recognized by Schmidt, in whose map of the place in question several hills, small craters, and fissures in the ground (rills) are marked.

According to my opinion, the conditions described in the foregoing account prove the existence of phenomena on the Moon's surface which exhibit the greatest likeness to the lava-streams of our earthly volcanoes, so that there is no longer any doubt of the occurrence of genuine volcanic phenomena on the Moon. These phenomena, as far as regards the crater, belong to an epoch when the chains of hills in the surrounding district were already formed, so that the effluent matter was obliged to follow the slopes of the ground.

If, in the instances described, all the phenomena point to lava-like currents, it may be concluded in another case, although with less certainty, that the ground has been covered with masses of stones or ashes. The district referred to lies on the Moon in 1° N. Lat. and 47° W. Long. There the grey floor of the level Mare, occupied only by very low hills, is marked over with bright streaks of light. But when the Sun is low, it is perceived that an oval patch, like dark gauze, covers the ground over a surface of several square miles, and that beneath it the brighter or darker portions of the ground gleam through. This patch gives to the observer the impression that it is transparent, or as if a thin mist covered the ground. This last impression is not to be accepted, because the patch is a thoroughly permanent appearance, a modification of the color of the lunar ground.

Such an appearance must, however, result if the ground, where it is bright grey as well as where it is marked across with white stripes, has been covered by a very thin layer of stones or ashes. Similar indications are to be found in other parts of the Moon's surface, but they have till now escaped selenographers, because these have generally had in their eyes only the more universal and larger features of the lunar surface, and the search after detail is, properly speaking, only now beginning.

This detailed survey has already proved that there is a far greater similarity between the surface of the Moon and that of our Earth than was formerly believed; but the research is only at its commencement and confronts a literally endless amount of detail: besides, it is far more difficult and entails a greater strain than many other kinds of observation.

It is greatly to be desired, on the part of geologists, that the lunar formations should be submitted to a thorough study founded on eye-scrutiny; the result would be remarkable for the better knowledge we should gain of lunar and also of terrestrial formations.—*The Observatory.*

ANATOMY AND PHYSIOLOGY.

TEETH AND BRAIN.

R. WOOD BROWN, M. D., D.D.S.

" 'Tis the sublime of man,
Our noontide majesty, to know ourselves
Part and portion of a wondrous whole."
COLERIDGE.

Nature does not waste time or material. Nowhere in her wide domains can we find anything in the formation of which she has produced an insufficient quantity for a purpose, or a surplus of material to effect a certain end. Everything is so nicely adapted to the wants of the creature that not anything can be added or taken away without detriment to life. Nature has a method of doing things, of adapting certain things to produce a certain object in a certain manner, and there are no deviations. To illustrate what is meant by this so called adaptive modification, let me refer to the dentition of the poisonous and non-poisonous snakes. The python (non-poisonous) has two rows of well-developed teeth in the upper jaw, and no poisonous fang; the next, the cobra, (colubrine, poisonous) has the inner row of superior teeth small and almost useless, and an immovable fang; then comes the rattlesnake (viperine, poisonous) has only one row of teeth in the upper jaw, but has a large movable fang; the inner row of superior teeth have disappeared because not necessary, the movable fang taking its place. To illustrate further those birds that nature intended for flight have some part of their anatomy especially adapted for it. Take, for instance, the pigeon; it has some of its bones hollow, with a connection between them and its lungs in such a manner that when the bird is about to take its flight, warm air is forced from the lung into the hollow bones, thereby enabling the bird to ascend and fly more easily. This arrangement applies to all flying birds except the woodcock. Only such birds as fly have warm air injected into their bones, and then only in accordance with their needs. To take a third illustra-illustration, those animals that prowl around, seeking food at all times and in all places, have the walls of their crania very thick, while man, who is the only creature that walks erect, has a very thin skull, comparatively speaking. Here again is shown the adaptive modification. Nature at all times, in all places, and under all circumstances shows herself to be an astute artisan, never wasting her material or energy. This evening I shall prove to you that nature does not waste her forces, that she does not put a human tooth into a head with an animal brain, nor an animal tooth in a head with a human brain; that as teeth decide the order to which an animal belongs, they do also indicate the intelligence of the possessor of them. Therefore, the point I shall make is this, that the nearer an animal's tooth approaches the typical human molar tooth, the nearer that animal's brain approaches the human brain, both as to comparative weight and size, also as to position, convolutions and depth of sulci. The brain or encephalon is divided into four parts; the cerebrum, the cerebellum, the pons varolii, and the medulla oblongata. For our purpose we shall use only the first two parts. The brain structurally is divided into white and gray matter, the white making up the greater part of the whole, the gray being upon the surface and the sulci, and upon its amount depends the power either intellectual or animal; the amount of gray being augmented by the number of convolutions and the depth of sulci. The cerebrum controls the intellectual or intelligent, and the cerebellum the animal functions of the creature. In the human brain the cerebrum in amount is to the cerebellum as nine to one. In the human brain the cerebrum completely covers the cerebellum when looking from the top of the head. The greater the size of the cerebrum and cerebellum, the greater the number of convolutions and depth of sulci, the greater is the power of intelligence and animal functions respectively. Man, from the nature of his construction, needs an intellectual brain, and that intellectual brain needs a mixed diet upon which its integrity depends, and which it cannot get with teeth like the shark, alligator, ox, or dog. Therefore, man has teeth for a mixed diet because he needs them, and where there is no such diet needed nature does not produce teeth like unto man's. Reasoning from this basis, it is fair to presume that if there is a gradation of intellectual brain-power from man down, there must also be gradations of teeth from man down. If we look at the head of a wolf-fish we find the lowest order of brain-power, and a very large number of pointed teeth, each tooth the same in shape but varying in size, the same as regards the common pike. The character of its teeth would indicate that its aim in life was to satisfy its hunger, which it does by tearing off shell-fish from adjacent rocks with its front teeth and crushing them with its back ones. The teeth are slightly anchylosed to the jaw as is the case with most fishes. In the lizard (varanus Gouldii) we find that the teeth are produced like the alligators, but different in shape, being like flattened cones. They are all similar in shape but different as regards size. The lizard has a very small brain, is very stupid, slow of motion, and like all reptiles, is cold blooded, caused by having but three cavities in the heart, one auricle and two ventricles, which causes the venous and arterial blood to mix. When we come to examine the ophidian reptiles (snakes) we find cold-blooded reptiles, with a complicated dental apparatus. The teeth are different in size, same in shape. The venomous snakes have a poisonous fang, but only one row of teeth in the upper and one row of teeth in the lower jaw. The non-venomous snakes have two rows of teeth in the upper jaw and one row in the lower, but no poisonous fang. They, like all reptiles, have a quadrate bone. The teeth are organs of prehension, as snakes invariably swallow their prey whole. When the viperine snake is about to strike the mouth is opened, a muscle contracts and moves the quadrate bone forward; this movement causes the partial rotation of the inferior maxilla or lower jaw, and this rotation throws the fang into an erect position. The act of striking causes a muscle to contract over the poison sac and the fluid is forced into the wound through the grooved fang. When the fang is withdrawn the mouth shuts and the parts return to their first position, and the fang lies upon the roof of the mouth in a fold of mucous membrane. We certainly cannot award to this class (ophidian reptiles) a very high order of intelligence.

The alligator or American crocodile is a familiar reptile. It is a native of the Lower Mississippi, and its characteristics are well known. The teeth are all the same shape and the same number from birth to death, each tooth being replaced by its successor growing inside the old one and causing its absoption, and eventually taking its place without making a new socket. The teeth are all pointed, far apart, and firmly planted in the socket. The alligator's brain is non-convoluted, perfectly smooth and one ganglion behind the other. In a head three feet long the brain is the size of the thumb. Notice three points here. The small size of brain, the smoothness of lobes, and the teeth being the same shape and nearly so in size. As regards birds, there is only one authentic specimen found with teeth. That was found by the late Professor Mudge, of Kansas, in the cretaceous deposits of Colorado, Niobrara group. Its beak is about seven and one half inches long by one and a quarter broad. The teeth are arranged in a straight line, and about twenty one in each ramus of the lower jaw, and there appears to be the same number in the upper jaw. This was supposed to be an aquatic bird and used its recurved teeth for securing fish. This fossil is in the possession of Professor Marsh. This bird does not bear upon our subject only so far as birds are the connecting link between the reptilian and mammalian classes.

In the elephant we find a very small brain compared to its size, it being one of the largest existing mammals. The average weight of the brain is from eight to ten pounds. This animal gets its intelligent look from its large frontal sinuses, while in reality the animal is not as intelligent as its looks would indicate. The teeth are formed for a herbivorous diet. The molars, six in number, grow from above downward and outward in continuous plates of enamel, separated by dentine, and surrounded by cementum. The first, or baby molar, being the smallest, and the last one fifteen inches long. Only one part of the molar is used at a time. The tusks correspond to the incisor teeth. Neither is the size of the brain in proportion to the size of the body, nor its position, nor do the teeth of the elephant indicate a high order of intelligence. We will pass by the rodentia or gnawing tribe, comprising the mouse, beaver, squirrel, rabbit, etc., and come directly to the carnivora, of which the tiger is a typical member. We first notice the immense size of the canines, also the spaces between the front teeth for the reception of the lower teeth when the jaws are closed. The molars are made for crushing, yet we can see a gradual approximation to the human molar; the surface is not flat like the elephant's nor surmounted with cusps like the human's molar. The facial angle is greater in the tiger than in the preceding animal. The brain is small, sets far back in the head, and the cerebellum is partially covered by the cerebrum. We must now notice, as we ascend the scale, the relation of the cerebrum and cerebellum have to the facial angle, for where the angle is increased, we have an increase of lapping of the cerebrum over the cerebellum. This increase of lapping and an approach to right angles is accompanied by an increase of resemblance in the teeth to the human molar tooth. In the same class with the tiger, are the lion, cat, etc. We notice that the teeth of the carnivora are different in shape and size from the fish and reptile, at the same time we find that, while the brains of the two latter are smooth and free from convolutions, the brains of carnivora have some convolutions and a certain depth to the sulci. Here it is seen that the brain develops toward man, as also do the teeth. The average weight of the cat's brain is one ounce and a drachm.

The dentition of the dog is similar to that of wolves and foxes, but the dog has a larger range of diet owing to the molars being tuberculated in addition to the full armament of sharply-pointed teeth. With the tuberculated molars of the dog, we have a greater facial angle, consequently more lapping of cerebrum, more convolutions and greater depth of sulci, in all of which the dog is superior to the preceding animals. In the ox we have a strictly herbivorous animal, belonging to the class termed Ruminantia, comprising the deer, antelope, camel, sheep, giraffe, etc. In the typical Ruminantia, sheep, oxen, etc., there are no incisors in the upper jaw and no canines in either. The ox has six molars made up of circles of enamel, dentine and cementum. The molar teeth are an improvement upon the dog's, and the brain weigh sixteen ounces and fifteen drachms.

In the horse we find that there are incisors and molars in both upper and lower jaws; the horse has canines, but the mare has not. The molars are moulded upon the same plan as the ox, but the brain case is larger and weighs more in proportion, twenty-two ounces and fifteen drachms. The facial angle of the horse is greater, there are more convolutions and greater depth of sulci. The intelligence of a horse above most other animals is a well established fact.

The Chimpanzee in form and structure exhibits the greatest resemblance to man. The Chimpanzee is the highest form of brute, just as the Australian is one of the lowest forms of man. The Chimpanzees are gregarious animals; they walk erect with their hands upon their thighs, they are said to build huts and live in settlements. The face also resembles man, but the outline is rather concave. The facial angle is a low as 35° but increases when measured over the superciliary ridge. The proportion of brain to face is very nearly equal, the latter preponderating. In no animal do we find so much brain-matter, in proportion to the face, as in the Chimpanzee. The dental arrangement of this animal is different from the human species although having the same number of teeth, and the molars and bicuspids very similar in shape, yet the canines and incisors are very large, with spaces between them for the antagonizing teeth to rest between. The cerebrum in the Chimpanzee very nearly covers the cerebellum; more convolutions and a greater number of sulci are found. The walls of the brain case are thinner than the lower brutes, the rule being, the more contracted the brain, the thicker the walls of the skull.

The Chimpanzees belong to the group known as the Anthropoidal or man like apes, which includes the Gorilla, Orang and Gibbon. This group have the same number of teeth as man, the same number of incisors, canines, bicuspids and molars, thirty-two teeth in all, while their deciduous or milk-teeth are the same as in man, twenty in number. The brain of the man differs far less from the brain of this group, than does the brain of some of the lowest animals. The Gorilla is much heavier than man yet its brain weighs about twenty ounces while the smallest, healthy human brain would not be less than thirty-two ounces. The size of the Gorilla's brain is larger than the preceding animals when compared in size with the weight of the animal.

There is a vast difference between civilized man and the lowest savage; difference in cerebral area, in physiognomy, in regularity of teeth; but however vast that might be, it is immaterial as compared to the contrast in these respects presented by the lowest form of man and the highest form of brute species. The connecting link between the lowest races of man and the highest brutes is yet to be found.

In the Australian we find the lowest order of intellectual ability, especially amongst the Papuans. They reckon time by dry or rainy seasons, and number only up to ten, they have no religion, their marriage ceremony consists of each eating half a roasted banana. There is a great prominence of the superior maxillæ, with recession of the frontal eminence. The cerebral area is much less than in the European, and vastly more than in the Chimpanzee, the facial angle is between 80° and 85°, and there is some prominence of the superior canines. What has been said of the Australian is true of the African to a great extent, but the Negro is superior to the Australian, in cerebral development.

Man has the straightest form, the only being that walks erect, that has a perfect dental arch, no one tooth above its fellow, that has a gradual change from the cutting tooth (incisors) to the grinding tooth (molar), and that has the cerebrum completely covering the cerebellum, also having the largest brain known, except the whale and the elephant. Man's brain averages in weight forty-eight and one-half ounces, or a trifle more than three pounds, also a facial angle of 95°; the Greeks adopted for their beau ideal of the beautiful and intellectual, a facial angle of 100°.

The preponderance of the brain over the face is very noticeable in the European head. In the dog it was about one-third, in the Chimpanzee less than one-half, while in the European, the brain occupies by far the largest part of the head. In man's brain the convolutions are numerous and the sulci deep, in accordance with the intellectual development; again, see what a subordinate position the animal cerebellum has under the intellectual cerebrum. In animals with carnivorous and herbivorous teeth the cerebellum is the dominating power; in man, with teeth for a mixed diet, the cerebrum holds the sceptre and everything is subservient to it.

We have described the skull, brain, and teeth of the human species, also the same parts of several animals of different orders. We have pen-sketched the progressive ascent in the scale from the fish to man. We have compared the separate parts of each, showing that the skull, brain and teeth have kept pace each with the other in their respective places, no one ahead of the other, but gradually ascending in the scale. We have seen how nature improved on her previous efforts. We have shown that where an improvement was needed it was made; and we can readily see why a fish's tooth was not placed in man's head or *vice versa.* We have also demonstrated that the near approach of an animal's tooth to man's indicated a near approach of that animal's brain to man's. We have described the vast differences that exist between different animals, and comparatively with man, and this all shows that the nearer an animal's tooth approaches to man's in shape, size, and anatomical construction, the nearer that animal's brain approaches to the brain of man. In closing we cannot do better than to quote from the immortal Agassiz: He says, "It is evident that there is a manifest progress in the succession of beings on the surface of the globe. This progress consists in an increasing similarity to the living races, and among the vertebrates, especially, in their increasing similarity to man. But this connection is not the consequence of a direct lineage between the races of different ages." Again we quote, "The link by which they are connected is of a higher and immaterial nature; and their connection is to be sought in the view of the Creator himself, whose aim in forming the Earth, in allowing it to undergo the successive changes which geology has pointed out, and creating successively all the different types of animals which have passed away, was to introduce man upon the surface of the globe. Man is the end toward which all animal creation has tended, from the first appearance of the first Palæozic fishes."

ECCENTRICITY AND IDIOSYNCRASY.[1]

WILLIAM A. HAMMOND, M. D.

ECCENTRICITY.—Persons whose minds deviate in some one or more notable respects from the ordinary standard, but yet whose mental processes are not directly at variance with that standard, are said to be eccentric. Eccentricity is generally inherent in the individual, or is gradually developed in him from the operation of unrecognized causes as he advances in years. If an original condition, it may be shown from a very early period of life, his plays, even, being different from those of other children of his age. Doubtless it then depends upon some peculiarity of brain structure, which, within the limits of the normal range, produces individuality of mental action.

But eccentricity is not always an original condition, for, under certain circumstances, it may be acquired. A person, for instance, meets with some circumstance in his life which tends to weaken his confidence in human nature. He accordingly shuns mankind, by shutting himself up in his own house and refusing

1 An extract from a Treatise on Insanity shortly to be published by D. Appleton & Co.

to have any intercourse with the inhabitants of the place in which he resides. In carrying out his purpose he proceeds to the most absurd extremes. He speaks to no one he meets, returns no salutations, and his relations with the tradesmen who supply his daily wants are conducted through gratings in the door of his dwelling. He dies, and the will which he leaves behind him is found to devote his entire property for the founding of a hospital for sick and ownerless dogs, "the most faithful creatures I have ever met, and the only ones in which I have any confidence."

Such a man is not insane. There is a rational motive for his conduct—one which many of us have experienced, and which has, perhaps, prompted us to act in a similar manner, if not to the same extent.

Another is engaged in vast mercantile transactions, requiring the most thorough exercise of the best faculties of the mind. He studies the markets of the world, and buys and sells with uniform shrewdness and success. In all the relations of life he conducts himself with the utmost propriety and consideration for the rights and feelings of others. The most complete study of his character and acts fails to show the existence of the slightest defect in his mental processes. He goes to church regularly every Sunday, but has never been regarded as a particularly religious man. Nevertheless, he has one peculiarity. He is a collector of Bibles, and has several thousand of all sizes and styles, and in many languages. If he hears of a Bible, in any part of the world, different in any respect from those he owns, he at once endeavors to obtain it, no matter how difficult the undertaking, or how much it may cost. Except in the matter of Bibles he is disposed to be somewhat penurious—although his estate is large—and has been known to refuse to have a salad for his dinner on account of the high price of good olive-oil. He makes his will, and dies, and then it is found that his whole property is left in trust to be employed in the maintenance of his library of Bibles, in purchasing others which may become known to the trustees, and in printing one copy, for his library, of the book in any language in which it does not already exist. A letter which is addressed to his trustees informs them that, when he was a boy, a Bible which he had in the breast-pocket of his coat preserved his life by stopping a bullet which another boy had accidentally discharged from a pistol, and that he then he had resolved to make the honoring of the Bible the duty of his whole life.

Neither of these persons can be regarded as insane. Both were the subjects of acquired eccentricity, which, in all likelihood, would have ensued in some other form, from some other circumstance acting upon brains naturally predisposed to be thus affected. The brain is the soil upon which impressions act differently, according to its character, just as, with the sower casting his seed wheat upon different fields, some springs up into a luxuriant crop, some grows sparsely, and some, again, takes no root, but rots where it falls. Possibly, if these individuals had lived a little longer, they might have passed the border-line which separates mental soundness from mental unsoundness; but certainly, up to the period of their deaths, both would have been pronounced sane by all competent laymen and alienists with whom they might have been brought into contact; and the contest of their wills, by any heirs-at-law, would assuredly have been a fruitless undertaking.

They chose to have certain ends in view, and to provide the means for the accomplishment of those ends. There were no delusions, no emotional disturbance, no hallucinations or illusions, and the will was normally exercised to the extent necessary to secure the objects of their lives. At any time they had it in their power to alter their purposes, and in that fact we have an essential point of difference between eccentricity and insanity. We may regard their conduct as singular, because they made an unusual disposition of their property; but it was no more irrational than if the one had left his estate to the "Society for the Prevention of Cruelty to Animals," and the other had devoted his to sending missionaries to Central Africa.

Two distinct forms of eccentricity are recognizable. In the one, the individual sets himself up above the level of the rest of the world, and marking out for himself a line of conduct, adheres to it with an astonishing degree of tenacity. For him the opinions of mankind in general are of no consequence. He is a law unto himself; what he says and does is said and done, not for the purpose of attracting attention or for obtaining notoriety, but because it is pleasing to himself. He does not mean to be singular or original, but he is nevertheless, both. For every man is singular and original whose conduct, within the limits of reason and intelligence, differs from that of his fellow-men. He endeavors to carry out certain ideas which seem to him to have been overlooked by society to its great disadvantage. Society usually thinks different; but if the promulgator is endowed with sufficient force of character, it generally happens that, eventually, either wholly or in part, his views prevail. All great reformers are eccentrics of this kind. They are contending for their doctrines, not for themselves. And they are not apt to become insane, though sometimes they do.

The subjects of the other form occupy a lower level. They affect singularity for the purpose of attracting attention to themselves, and thus obtaining the notoriety which they crave with every breath they inhale. They dress differently from other people, wearing enormous shirt-collars, or peculiar hats, or oddly cut coats of unusual colors, or indulging in some other similar whimsicality of an unimportant character, in the expectation that they will thereby attract the attention or excite the comments of those they meet.

Or they build houses upon an idea perhaps correct enough in itself, as, for instance, the securing of proper ventilation; but in carrying it out they show such defective judgment that the complete integrity of the intellect may, perhaps, be a matter of question. Thus, one gentleman of my acquaintance, believing that fireplaces were the best ventilators, put four of these openings into every room of his house. This, however, was one of the smallest of his eccentricities. He wore a ventilated hat, his clothing was pierced with holes, as were even his shoes; and no one could be in his company five minutes without having his attention directed to these provisions for securing health.

In addition to these advanced notions on the subject of ventilation, he had others equally singular in regard to the arrangement of the furniture in his dwelling and the care that was to be taken of it. Thus, there was one room called the "apostles' room." It contained a table that represented Christ, and twelve chairs, which were placed around it and typified the twelve apostles; one chair, that stood for Judas Iscariot, was covered with black crape. The floor of this room was very highly polished, and no one was allowed to enter it without slipping his shod feet into cloth slippers that were placed at the door ready for use. He had a library, tolerably large but of little value, and every book in it which contained Judas's name was bound in black, and black lines were drawn around the name wherever it occurred. Such eccentricity as this is not far removed from insanity, and is liable at any time, from some cause a little out of the common way, to pass over the line.

Thus, a lady had since her childhood shown a singularity of conduct as regarded her table furniture, which she would have of no other material than copper. She carried this fancy to such an extent that even the knives and forks were of copper. People laughed at her, and tried to reason her out of her whim, but in vain. She was in her element as soon as attention was directed to her fancy and arguments against it were addressed to her. She liked nothing better than to be afforded a full opportunity to discuss with any one the manifold advantages which copper possessed as a material to be used in the manufacture of every article of table ware. In no other respect was there any evidence of mental aberration. She was intelligent, by no means excitable, and in the enjoyment of excellent health. She had, moreover, a decided talent for music, and had written several passably good stories for a young ladies' magazine. An uncle had, however, died insane.

A circumstance, trifling in itself, but one, as it afterward resulted, of great importance to her, started in her a new train of thought, and excited emotions which she could not control. She read in a morning paper that a Mr. Koppermann had arrived at one of the hotels, and she announced her determination to call upon him, in order, as she said, to ascertain the origin of his name. Her friends endeavored to dissuade her, but without avail. She went to the hotel, and was told that he had just left for Chicago. Without returning to her home, she bought a railway ticket for Chicago, and actually started on the next train for that city. The telegraph, however, overtook her, and she was brought back from Rochester raving of her love for a man she had never seen, and whose name alone had been associated in her mind with her fancy for copper table furniture. She died of acute mania within a month. In this case erotic tendencies, which had never been observed in her before, seemed to have been excited by some very indirect and complicated mental process, and these in their turn developed into general derangement of the mind.

In another case, a young man, a clerk in a city bank, had for several years exhibited peculiarities in the keeping of his books. He was exceedingly exact in his accounts, but after the bank was closed always remained several hours, during ich he ornamented each page of his day's work with arabesques in different colored inks. He was very vain of this accomplishment, and was constantly in the habit of calling attention to the manner in which, as he supposed, he had beautified what would otherwise have been positively ugly. His fellow-clerks amused themselves at his expense, but his superior officers, knowing his value, never interfered with him in his amusement. Gradually, however, he conceived the idea that they were displeased with him, and at last the notion became so firmly rooted in his mind that he resigned his position, notwithstanding the protestations of the directors that his idea was erroneous. Delusions of various other kinds supervened, and he passed into a condition of chronic insanity, in which he still remains. In most of the cases occurring under this head the intellectual powers are not of a high order, though there may sometimes be a notable development of some talent, or even a great power for acquiring learning. Painters, sculptors, musicians, mathematicians, poets, and men of letters generally, not infrequently exhibit eccentricities of dress, conduct, manner, or ideas, which not only merely add to their notoriety, but often make them either the laughing-stocks of their fellow men or objects of fear or disgust to all who are brought into contact with them.

Idiosyncrasy.—By idiosyncrasy we understand a peculiarity of constitution by which an individual is affected by external agents in a manner different from mankind in general. Thus, some persons cannot eat strawberries without a kind of urticaria appearing over the body; others are similarly affected by eating the striped bass; others again, faint at the odor of certain flowers, or at the sight of blood; and some are attacked with cholera-morbus after eating shell-fish—as crabs, lobsters, clams, or mussels. Many other instances might be advanced, some of them a very curious character. These several conditions are called idiosyncrasies.

Begin,[2] who defines idiosyncrasy as the predominance of an organ, a viscus, or a system of organs, has hardly, I think fairly grasped the subject, though his definition has influenced many French writers on the question. It is something more than this—something inherent in the organization of the individual, of which we only see the manifestation when the proper cause is set in action. We cannot attempt to explain why one person should be severely mercurialized by one grain of blue mass, and another take daily ten times that quantity for a week without the least sign of the peculiar action of mercury being produced. We only know that such is the fact; and were we to search for the reason, with all the appliances which modern science could bring to our aid, we should be entirely unsuccessful. According to Begin's idea, we should expect to see some remarkable development of the absorbent system in the one case, with slight development in the other; but, even were such the case, it would not explain the phenomena, for, when ten grains of the preparation in question are taken daily, scarcely a day elapses before mercury can be detected in the secretions, and yet

2 "Physiologie Pathologique," Paris, 1828, t. i., p. 44.

hydrargyriasis is not produced; while when one grain is taken, and this condition follows, the most delicate chemical examination fails to discover mercury in any of the fluids or tissues of the body.

Begin's definition scarcely separates idiosyncrasy from temperament, whereas, according to what would appear to be sound reasoning, based upon an enlarged idea of the physiology of the subject, a very material difference exists.

Idiosyncracies are often hereditary and often acquired. Two or more may exist in one person. Thus, there may be an idiosyncrasy connected with the digestive system, another with the circulatory system, another with the nervous system, and so on.

An idiosyncrasy may be of such a character as altogether to prevent an individual following a particular occupation. Thus, a person who faints at the sight of blood cannot be a surgeon; another, who is seized with nausea and vomiting when in the presence of insane persons, cannot be a superintendent of a lunatic asylum—not, at least, if he ever expects to see his patients. Idiosyncrasies may, however, be overcome, especially those of a mental character.

Millingen[3] cites the case of a man who fell into convulsions whenever he saw a spider. A waxen one was made, which equally terrified him. When he recovered, his error was pointed out to him. The wax figure was put into his hand without causing dread, and shortly the living insect no longer disturbed him.

I knew a gentleman who could not eat soft crabs without experiencing an attack of diarrhea. As he was exceedingly fond of them, he persevered in eating them, and finally, after a long struggle, succeeded in conquering the trouble.

Individuals with idiosyncrasies soon find out their peculiarities, and are enabled to guard against any injurious result to which they would be subjected but for the teachings of experience.

Idiosyncrasies may be temporary only—that is, due to an existing condition of the organism, which, whether natural or morbid, is of a transitory character. Such, for instance, are those due to dentition, the commencement or the cessation of the menstrual function, pregnancy, etc. These are frequently of a serious character, and require careful watching, especially as they may lead to derangement of the mind. Thus, a lady, Mrs. X, was at one time under my professional care, who, at the beginning of first pregnancy, acquired an overpowering aversion to a half breed Indian woman who was employed in the house as a servant. Whenever this woman came near her she was at once seized with violent trembling, which ended in a few minutes with vomiting and great mental and physical prostration, lasting several hours. Her husband would have sent the woman away, but Mrs. X insisted on her remaining, as she was a good servant, in order that she might overcome what she regarded as an unreasonable prejudice. The effort was, however, too much for her, for upon one occasion, when the woman entered Mrs. X's apartment rather unexpectedly, the latter became greatly excited, and jumping from an open window in her fright, broke her

3 "Curiosities of Medical Experience," London, 1837, vol. ii, p. 246.

arm, and otherwise injured herself so severely that she was for several weeks confined to her bed. During this period, and for some time afterward, she was almost constantly subject to hallucinations, in which the Indian woman played a prominent part. Even after her recovery the mere thought of the woman would sometimes bring on a paroxysm of trembling, and it was not till after her confinement that the antipathy disappeared.

Millingen[4] remarks that certain antipathies, which in reality are idiosyncrasies, appear to depend upon peculiarities of the senses. Rather, however, they are due to peculiarities of the ideational and emotional centres. The organ of sense, in any one case, shows no evidence of disorder; neither does the perceptive ganglion, which simply takes cognizance of the image brought to it. It is higher up that the idiosyncrasy has its seat. In this way we are to explain the following cases collected by Millingen:

"Amatus Lusitanus relates the case of a monk who fainted when he beheld a rose, and never quited his cell when that flower was blooming. Scaliger mentions one of his relatives who experienced a similar horror when seeing a lily. Zimmermann tells us of a lady who could not endure the feeling of silk and satin, and shuddered when touching the velvety skin of a peach. Boyle records the case of a man who felt a natural abhorrence to honey; without his knowledge some honey was introduced in a plaster applied to his foot, and the accidents that resulted compelled his attendants to withdraw it. A young man was known to faint whenever he heard the servant sweeping. Hippocrates mentions one Nicanor, who swooned whenever he heard a flute; even Shakespeare has alluded to the effects of the bagpipes. Julia, daughter of Frederick, King of Naples, could not taste meat without serious accidents. Boyle fainted when he heard the splashing of water; Scaliger turned pale at the sight of water-cresses; Erasmus experienced febrile symptoms when smelling fish; the Duke d'Epernon swooned on beholding a leveret, although a hare did not produce the same effect; Tycho Brahe fainted at the sight of a fox; Henry III, of France, at that of a cat; and Marshal d'Albret at a pig. The horror that whole families entertain of cheese is generally known."

He also cites the case of a clergyman who fainted whenever a certain verse in Jeremiah was read, and of another who experienced an alarming vertigo and dizziness whenever a great height or dizzy precipice was described. In such instances the power of association of ideas is probably the most influential agent in bringing about the climax. There is an obvious relation between the warnings given by the prophet in one case, and the well-known sensation produced by looking down from a great height in the other, and the effects which followed.

Our dislikes to certain individuals are often of the nature of idiosyncrasies, which we cannot explain. Martial says:

4 "Curiosities of Medical Experience," London, 1837, vol. ii, p. 246.

"Non amo te, Sabidi, nec possum dicere quare;
Hoc tantum possum dicere, non amo te;"

or, in our English version:

"I do not like you, Doctor Fell,
The reason why I can not tell;
But this I know and that full well—
I do not like you, Doctor Fell."

Some conditions often called idiosyncrasies appear to be, and doubtless are, due to disordered intellect. But they should not be confounded with those which are inherent in the individual and real in character. Thus, they are frequently merely imaginary, there being no foundation for them except in the perverted mind of the subject; at other times they are induced by a morbid attention being directed continually to some one or more organs or functions. The protean forms under which hypochondria appears, and the still more varied manifestations of hysteria, are rather due to the reaction ensuing between mental disorder on the one part and functional disorder on the other, than to that quasi normal peculiarity of organization recognized as idiosyncrasy.

Thus, upon one occasion I was consulted in the case of a lady who it was said had an idiosyncrasy that prevented her drinking water. Every time she took the smallest quantity of this liquid into her stomach it was at once rejected, with many evident signs of nausea and pain. The patient was strongly hysterical, and I soon made up my mind that either the case was one of simple hysterical vomiting, or that the alleged inability was assumed. The latter turned out to be the truth. I found that she drank in private all the water she wanted, and that what she drank publicly she threw up by tickling the fauces with her finger-nail when no one was looking.

The idiosyncrasies of individuals are not matters for ridicule, however absurd they may appear to be. On the contrary, they deserve, and should receive, the careful consideration of the physician, for much is to be learned from them, both in preventing and in treating diseases. In psychiatrical medicine they are especially to be inquired for. It is not safe to disregard them, as they may influence materially the character of mental derangement, and may be brought in as efficient agents in the treatment.—*N. Y. Medical Journal.*

MINING AND METALLURGY.

GENERAL MINING NEWS OF COLORADO.

The South Pueblo *Evening News* makes the following comparison between Pueblo and Denver as mineral shipping centers: In 1881, there was shipped from Denver gold and silver bullion, which was supplied from the various mineral bearing districts, as follows: Argo smelting works, $2,500,000; Gilpin and Clear Creek Counties, $2,000,000; Boulder County, $1,000,000; Park County, $1,500,000; total, $7,000,000. The above does not include lead and copper bullion. In 1881, there was shipped east from the Pueblos, via the Atchison, Topeka & Santa Fe Railroad, gold and silver bullion, supplied from the districts as follows: Lake County, $12,000,000; Gunnison, $1,000,000; San Juan, $3,-000,000; total $16,000,000. This does not include the gold production of Summit County, which at the present time has reached $1,000,000 a month, or $12,-000,000 a year, every ounce of which goes east via the Pueblos, and, should we add this to the figures of last year's shipment, we have a grand total of $28,000,000 of bullion (gold and silver) going east via the Pueblos yearly, while Denver can boast of but one-quarter of that amount. To these figures may be added also at least three millions, which come to the Pueblo smelters from Southern Colorado, New Mexico, and Arizona, and are there converted into bullion and shipped east.

Grant Smelter.—The completion of the Grant Lead Smelting Works at Denver is near at hand. The main building, 240x100 feet, is all completed. In it are eight furnaces, entirely finished, and which are calculated to average a total capacity of 300 tons a day. Adjoining the building on the west is the engine-house, 50 x 100 feet, also nearly finished, and containing a 200 horse-power engine, a large boiler, and three mammoth blowers, besides a full equipment of pumps, machinery for generating electricity for lighting the establishment, etc. The stack connecting with the dust-chambers will have a height of 165 feet. The receipt of ore has already begun, and two thousand tons will be on hand by the 1st December, when it is expected the works will begin operations.

LAKE COUNTY.

The *Democrat* gives Leadville's bullion product for the month of August as follows: Three thousand six hundred and seventy tons of lead are reported to have been produced and shipped by the Leadville smelters during the month of August. This shipment contained 522,266 ounces of silver and 1,600 ounces of gold. The total value of this shipment was within a few thousand dollars of reaching a round million. This, of course, does not include the production of the stamp mills and the ores shipped by ore-buyers and the Iron Silver and Robert E. Lee mines to Pueblo, Golden and other points.

Garden City Lode.—Among the new discoveries of ore in paying quantities, made during the past week, is that of this lode. This property is situated in California Gulch, at the foot of Iron Hill. A year or two ago, a shaft was sunk on this property, to a depth of about 150 feet, without disclosing ore in any quantity. Recently the property was leased and active operations were commenced. At a depth of seventy feet, a drift was run to the southward, and a fair body of ore was encountered. Drifts were then run in different directions, all disclosing evidently the same ore-deposit. A level now driven to the eastward shows the ore for a distance of twenty feet, having a thickness of about thirty inches. Assays of the samples give twenty-nine ounces in silver and sixty-two per cent in lead, and nineteen ounces silver and twenty-nine per cent in lead. The former is a fine gray lead carbonate, while the latter is a hard carbonate ore.

Chrysolite.—The manager, Mr. N. R. Clark, has shipped several car-loads of low-grade ore to Denver, in order to give the concentrating machines now on exhibition there a practical test on this class of mineral. The ore which it is desired to concentrate is the low-grade oxidized iron of Fryer Hill, as well as mineral carrying small percentages of lead carbonates in addition to a minimum quantity of silver. The latter mineral is about equally divided between sulphurets and chlorides of silver, making it a very difficult production to save and concentrate by any machine operated on the specific gravity principle, especially as the chlorides almost invariably exist in the low-grade ores in small, thin flakes. The manager stated that if machines were found that would do the work required, the Chrysolite Company would expend a limited amount of its surplus funds in putting in concentrating works. Suitable arrangements can be made with Messrs. Cummings & Finn for the old structure formerly inclosing the Raymond & McKay smelter, and the Chrysolite Company already possesses sufficient motive power to run such works.

Matchless.—The new strike recently made was a short distance north of the No. 3 shaft, where there is quite an extensive tract of territory yet to be explored. The mineral is a silicious dark sand and iron, filled and coated with chloride and horn-silver. Up to the latest reports, the ore-body had opened up to thirty inches in thickness, and promises to show to much better advantage still, with a few days' additional work. No assays have yet been made.

Robert E. Lee.—Twenty tons of ore are daily shipped to the Argo smelting works, averaging about 300 ounces to the ton. There are now on the dumps of the mine from 3000 to 4000 tons of 30 to 40 ounce dry ore, which eventually will be shipped to the Leadville stamp-mills, as it is unsuited for smelting on account of the entire absence of lead and the great quantities of silica which it contains.

Shields Mine and Mill.—Work has been begun under the direction of Col. A. V. Bohn, the former superintendent. Some ore is taken from the upper workings, but in the lower levels nothing has as yet been accomplished, and the the water still covers the two drifts, extending on the vein, from the incline shaft, and some distance below the main tunnel or adit. The mill has been running again for a week and has ample work before it to insure its steady employment continually. It is now reducing the ores from the Shields, Welsh, Soper, and other mines in that section, all of which are showing increased value.

PITKIN COUNTY.

The mills and mines in operation in the Gold Belt show that there is great activity in this district. Two ten-stamp mills and one twenty-stamp mill are running day and night.

The Cummings lode, says the Aspen *Sun*, has just had a mill-run, at Argo, of 48 pounds of ore, which returned 220 ounces of silver and 12 ounces of gold to the ton, netting $49.51 for the 48 pounds of ore.

A mill for the treatment of low-grade refractory silver ores is about completed at Pitkin by the Michigan & Colorado Mining Company, of that place, and will be ready to start shortly.

Brittle Silver.—Active work has again begun at the mine.

Streb Consolidated.—The Carbonate *Chronicle* says that this Company has completed the assessment work on all its properties on French Mountain, and developed some of the claims quite extensively. The J. J. Streb, Colorow, and Silver Spur are all said to show strong ore-bodies ranging in value from 44 to 432 ounces of silver per ton. The vein was struck near the surface, and in doing assessment work widened from one inch to a foot. Parties are figuring for a lease of some of this Company's mines, and propose to work them with a large force through the winter.

SAN JUAN COUNTY.

The Comstock Sampling-Works have been crowded ever since they began running, and we learn enough ore has been contracted for to keep them—in connection with the North Star ore—busy running pretty nearly all winter. A building for a concentrator which will be in running order early next spring is now going up.

Red Mountain.—The excitement over the discoveries of rich mineral on Red Mountain, says the San Juan *Herald*, increases. Notwithstanding the recent unusually inclement weather, the country in that vicinity is literally covered with prospectors.—*Engineering and Mining Journal.*

THE EXTRACTION OF THE PRECIOUS METALS FROM ORES BY ELECTROLYSIS.—Concluded.

Electrolysis of Complex Ores.—The same process is equally applicable to the extraction of the metals contained in the multiple sulphurets. Such sulphurets are in reality merely combinations of single sulphides combined or mixed together; consequently the decomposition of such a multiple ore in the electrolytic bath, instead of yielding merely a single metal to the acid which is set free, precipitates the precious metals which the ore contains.

Thus, if we place at the anode in an electrolytic trough an ore composed of a multiple sulphuret and make use of a solution of lead nitrate as the electrolytic liquid and let the current act moderately, it will happen that whilst the lead of the electrolytic salt is precipitated at the cathode the metals of the ore placed at the anode will enter into solution simultaneously just in proportion as the acid of the bath is set free, and will ultimately, if easily precipitable, like lead, silver, copper, etc., be thrown down together at the cathode.

Meanwhile the sulphur, the silica, and other insoluble matter in the gangue will be deposited at the anode.

Suppose that we operate upon a multiple argentiferous sulphide of lead, the ore of which contains also iron, copper, and zinc. It may happen that under the action of an electric current sufficiently energetic the iron and zinc dissolve as rapidly as the other metals, but are not as easily precipitated. In this case the electrolytic solution will become gradually saturated with zinc and iron. It is then advisable to regulate the galvanic current so that the lead, silver, gold, and copper may be precipitated alone upon the cathode, keeping the zinc dissolved in the state of zinc nitrate.

As the bath becomes saturated with zinc nitrate, the iron nitrate yields the precedence, and its base falls to the bottom of the bath in the state of ferric oxide.

Finally, when the bath is almost entirely saturated with zinc nitrate, which is kept in a state non-precipitable by regulating the current accordingly, this solution of zinc is syphoned off for separate treatment.

The opportunity is taken to remove the metals, copper, lead, silver, and gold, which have been thrown down upon the cathode in the metallic state. The ferric oxide at the bottom of the bath is withdrawn separately, and also the sulphur and the silica found at the anode.

The method of ulterior purification of the sulphur is given above.

The metallic zinc contained in the liquid syphoned off may then be precipitated by a more powerful current. If it is desired to collect the zinc in the state of oxide it must be precipitated not electrolytically but by means of chemical reactions.

This separate zinc-bath is treated first with a little zinc oxide, which throws down any iron present in the state of insoluble oxide. Then, if needful, the liquid is placed in a precipitation bath with a zinc plate for anode. A feeble electric current will throw down upon this cathode all the lead, copper, or silver which the bath may retain, leaving merely pure zinc nitrate.—*Les Mondes.*

METEOROLOGY.

HAIL AND HAILSTONES.

FRANCIS E. NIPHER.

In his work on Tornadoes and Water-spouts Mr. Ferrel, of the U. S. Coast Survey, has explained the formation of hailstones in an exceedingly satisfactory manner. According to Mr. Ferrel, the birth-place of hailstones is in the vortex of the tornado. The tornado is the result of an unstable condition of the air due to differences of temperature. If over a region of country the air be abnormally hot, this region then being surrounded by cooler air, the hot air will begin to rise. The condition of equilibrium may be reached without the formation of a whirl, but if the heated region is large, a whirl will be very likely to form at some point, and the hot air will pour up through the vortex formed. The whirl may be the result of the meeting of currents of air, and when thus produced may rotate either with or opposed to the motion of the hands of a watch. In the former case, in the northern hemisphere, the whirl will gradually cease without becoming destructive, as the deflection of all moving bodies to the right in the northern hemisphere (by a force due to the earth's rotation) causes the wind to rush in more and more nearly radially.

The writer has seen one well-marked case of this kind. If the whirl is started in the reverse direction, and the unstable conditions are sufficiently wide-spread, the tornado will result. In the latter case the deflection of moving bodies to the right in the northern hemisphere will develop the whirl. As the air rises in the vortex, it expands, and cools. Its moisture is condensed to rain and snow. This snow is carried upward and outward, and finally falls down into the lower winds which feed into the vortex, where it is again carried up, passing first into a region where water is condensed upon it, which again freezes at higher altitudes. This may be repeated many times for some of the hailstones, and they thus acquire very large dimensions. Occasionally stones will jostle against each other and freeze together, forming large masses. The action of the whirl throws the stones into rotation either around the shorter axis of the hailstone, or around the centre of the whirl. In general both rotations will exist at the same time, so that Ferrel's explanation fully accounts for the discoidal or lens-like forms so common in hailstones, and it also accounts for the fact that hail-storms run in narrow belts.

In the throat of the vortex there may be a large accumulation of water, held up by the ascending currents. The amount of water thus held will depend upon the humidity of the air. It may be very large indeed, and the dispersion of the vortex gives rise to the well-known "cloud-bursts," where the water has been known to pour down in streams, washing holes several feet in depth into the soil. Mr. Ferrel's paper is largely expressed in mathematical language and seems to be somewhat unfamiliar to the general public, but it is certain that it explains fully all the phenomena of the tornado and the formation of hail, and is not open to any objection. He proves beyond all question that the effect of unequal temperatures is sufficient to account for the results, and this cannot be said of any explanation before offered.

WASHINGTON UNIVERSITY, November 23, 1882.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month, 29.80 on the 2nd. Lowest barometer during month, 28.41 on the 30th.

Highest temperature during month, 78° on the 30th. Lowest temperature during month, 14° on the 15th.

Highest velocity of wind, 45 miles per hour. Total travel during month 9206 miles.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Oct. 20th to 31st.	Nov. 1st to 10th.	Nov. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	38.8	39.6	24.0	34.1
Max	68.2	64.6	53.4	62.1
Min. and Max	53.5	52.1	38.7	48.1
Range	29.4	25.0	29.4	28.0
TRI-DAILY OBSERVATIONS.				
7 a. m.	41.8	47.7	32.9	40.8
2 p. m.	66.3	60.8	40.5	55.9
9 p. m.	53.5	53.1	35.4	47.3
Mean	53.8	53.6	36.1	47.8
RELATIVE HUMIDITY.				
7. a. m.	.90	.81	.61	.77
2 p. m.	.47	.58	.64	.56
9 p. m.	.60	.76	.78	.71
Mean	.66	.72	.68	.69
PRESSURE AS OBSERVED.				
7 a. m.	28.90	29.02	29.09	29.00
2 p. m.	28.85	28.98	29.08	28.97
9 p. m.	28.89	28.99	29.13	29.00
Mean	28.80	29.00	29.10	28.99
MILES PER HOUR OF WIND.				
7 a. m.	7.5	9.8	8.5	8.6
2 p. m.	14.6	8.5	17.0	13.4
9 p. m.	11.0	9.1	10.0	10.0
Total miles	2533	3676	2997	9206
CLOUDING BY TENTHS.				
7 a. m.	.23	.44	.37	.35
2 p. m.	.33	.74	.57	.45
9 p. m.	.36	.54	.35	.41
RAIN.				
Inches	.00	.00	1.25	1.25

ANNUAL GROWTH OF TREES.

A. L. CHILD, M. D.

Are the concentric rings of a tree a reliable record of its age in years? Such has been the conception—in fact, the undisputed knowledge—of the world, for all time past. I have no recollection of ever having seen or heard the authority of this record disputed till Desire Charnay, in his "Ruins of Central America," said, when speaking of the age of the ruins as proved by such a record: "Unfortunately for the argument, it is altogether fallacious and proves nothing. I have put the evidence to a test. On examining a slice of wood of a shrub that I knew as a fact was only eighteen months old, I found that it had eighteen concentric rings. I thought it was an anomaly, but, in order to convince myself I experimented upon trees of all kinds and sizes, and invariably found the like result produced in very nearly like proportions."[1]

M. Charnay's statement was, in my estimation, rather loose, and lacking in the proof of his absolute knowledge of the age of the trees examined; and again, so far as applicable to the case, was only so in a tropical climate, where the conditions were entirely different from those surrounding us in a higher latitude, and altogether raised but little doubt on the subject.

In April of 1871 I planted a quantity of the seed of the common red maple (*Acer rubrum*). In transplanting, in 1873, they were placed too near each other, and it has become necessary to cut a part of them out. While cutting, I noticed that the concentric rings were very distinct, and it reminded me of M. Charnay's statement. I took sections from the butt-end of each tree (four of them) and dressed the ends off at an angle of some 35° with the line of the body, thus largely increasing the exposure of each ring, and then counted them.

The situation, exposure, and condition of these four trees were, so far as I could see, identical. I had personal and positive knowledge that they had each twelve years' growth upon them, and I could count on each of the different sections from thirty-five to forty concentric rings. True, I could select twelve more distinct ones between which fainter and narrower, or sub-rings, appeared. Nine of these apparently annual rings on one section were peculiarly distinct, much more so than any of the sub-rings; yet, of the remaining, it was difficult to decide which were annual and which were not.

The thickness of these annual rings varied from two and one-half millimetres to twenty-eight. This measure, of course, gave more than double the real thickness; but was preferable to a right-angled measure, as it gave better facilities for exactness, and yet preserved the proportion between the several rings unchanged.

Now, to ascertain what relation or connection there might be between the meteorology of the several seasons and the growth made during the same, I se-

1 "North American Review," September, 1881, p. 401.

YEAR.	MARCH.				APRIL.				MAY.			
	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.
	Deg	Deg	Deg.	In.	Deg	Deg	Deg.	In.	Deg	Deg	Deg.	In.
1871	......	......	42·80	·40	.....	......	59·60	1·80	......	......	66·80	2·40
1872	......	......	32·70	1·40	......	......	47·70	2·40	......	......	57·10	4·40
1873	74	—4	36 37	·70	78	26	45·22	15·90	89	41	59·11	19 00
1874	60	7	32·15	2·51	88	12	44·65	4·09	92	38	67·48	3·15
1875	72	—3	29·11	3·38	84	20	44·81	4·62	96	25	71·00	3·98
1876	60	—4	27·92	2 09	83	30	51·12	5·16	88	35	63·73	3·10
1877	75	0	32·46	1·01	79	22	49·27	5·88	84	35	59·06	7·57
1878	81	19	46·74	3·09	83	31	53 95	4·01	81	32	57·49	5·54
1879	85	1	40·78	2·15	80	12	52·32	2·17	91	34	65·84	5·94
1880	82	—16	36·42	·56	93	28	52·26	·74	94	42	69·41	5·58
1881	58	1	26 63	1·31	81	4	43·70	4·09	85	39	67·03	6·57
1882	80	2	39·16	1·11	86	29	50·76	3·92	82	34	54·85	4·49

YEAR.	JUNE.				JULY.				AUGUST.			
	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.	Maximum temperature	Minimum temperature	Mean temperature	Rain-fall.
	Deg	Deg	Deg.	In.	Deg	Deg	Deg.	In.	Deg	Deg	Deg.	In.
1871	......	......	76·60	2·30	......	......	76·40	14·10	.....	......	74·60	3·30
1872	......	......	73·06	4·70	......	......	75·17	7·40	......	......	74·53	·90
1873	94	60	75·08	4·80	96	59	75·54	6·40	105	49	77·98	1·00
1874	94	44	74·31	18·02	113	55	82·35	1·10	111	53	78·71	1·40
1875	95	43	71·20	13·58	97	57	74·13	6·72	86	51	69·68	8·40
1876	94	44	68·63	4·58	95	54	75·71	7·44	92	51	74·18	8·39
1877	90	40	67·45	6·41	94	48	73·34	2·20	94	52	71·75	4·56
1878	86	44	66·39	9·64	94	55	76·91	11·61	95	52	75·27	1·23
1879	90	41	70·51	5·05	94	56	75·84	3·10	94	50	73·71	2·16
1880	92	45	71·80	1·57	93	51	75·19	4·73	95	41	74·00	5·42
1881	96	50	73·32	3·99	98	54	76 45	3·68	102	58	78·90	1·42
1882	92	43	69·23	5·77	89	48	68·48	4·26	88*	48	70·77	1·26

* Only twenty days of August included.

YEAR.	Mean temperature of six months.	Total rain of six months.	Growth of wood in millimetres.
	Deg.	Inches.	
1871...........	65 81	24·30	10
1872...........	55·57	20·70	10
1873...........	61·00	46·99	12
1874...........	63·32	30·37	7
1875...........	63·71	40·68	28
1876......	60·33	30 76	8
1877...........	59·c8	27 72	7
1878...........	66·33	35·12	4
1879...........	63·18	20·57	3½
1880...........	61·47	18·70	8
1881...........	61·03	21·04	3
1882...........	56 18	20·81	2½

lected from my meteorological records the maximum, minimum, and mean temperature, and the rain-fall, of the six growing months of spring and summer of each of the twelve years of growth. These extracts I have tabulated, and have also appended to each season the thickness of the ring formed, as measured on the oblique cut previously described.

An examination of this table shows a general relation of cause and effect between high temperature and large rain-fall, and greater growth. But it falls very short of proving a general law of "so much heat and so much water during the growing season, to produce so much wood." For example, compare the years 1875 and 1878. The temperature of 1878 for the season is better than 4° in excess of the season of 1875, and the rain-fall only a little over four inches less; and yet the growth of 1875 is *seven times* what it was in 1878. This almost unparalleled growth of 1875—that is, as compared with the other years—cannot be explained by the above general law. But I think the May and June record of that year throws light upon it. We see there a maximum heat in May of 96° (higher than I have ever known it in an observation and record of twenty-five years), and a mean temperature of the whole month, also unequalled, of 71°; and this great heat continued through the month of June, and no cold spells after the heat set in sufficient to check the growth. Then, in connection with this heat the ground is well saturated with water when this heated term began (May 6th) by 1·62 inch of rain on the 4th. From this on, to the 26th day June, 15 inches more of rain fell, so apportioned over the time as to keep the ground saturated. This synchronous excess of heat and water evidently produced the abnormal growth. And probably, as this matter is further studied, it will be found that these agents, rightly proportioned, operating synchronously, produce these thicker rings; while as one or the other is in excess, or absent, the growth is checked, and thus has time to condense and harden, and form these sub-rings; and the more frequent these alternations, the greater the number of them.—*Popular Science Monthly, Dec. 1882.*

GEOLOGY.

SUPPOSED JURA-TRIAS OF THE FRONT RANGE OF COLORADO.

JOHN K. HALLOWELL, DENVER, COLO.

I feel that the actual existence of the Jura-Trias in Colorado is so questionable, that after giving what authorities I have at hand, I desire to call attention to a fact or two; and also record a recent discovery in the sandstones of the St. Vrain, Colo., hoping it may lead to the further investigation, by those more able to deal with the uncertainty than I, and perhaps be the starting point of arriving at a definite enough knowledge to settle the matter.

In "Hayden's Geological Report of Colorado, 1876, p. 107," in reviewing his labors of previous years, he says: "All along the Front Range the Triassic "beds occupy prominent similar positions, until toward the south, they no "longer appear; west of the Front Range they also occur, but not so continu- "ous as at the locality first mentioned. It appears that at but very few places "the Triassic waters could extend westward of the main axis of the Front Range, "but they found ingress at other points. In their lithological character the strata "of the Triassic formations are very constant; so thoroughly complete is this "constancy that it is no exaggeration to say that the formation can readily be rec- "ognized at a glance."

In "Dana's Geology, p. 406," occurs the following: "There is still some "doubt as to the age of the beds of the Rocky Mountains referred to the Triassic "period. Although very widely distributed over the eastern slope south of the "parallel of 38°, they seldom contain fossils; and the few found—occasional "pieces of fossil woods—are not sufficient to settle the question."

In a foot-note, page 447, "Leconte's Elements of Geology," is stated, "In "Colorado, in strata referred by Marsh to the Wealden or uppermost Jurassic, "but by Cope to the lower Cretaceous, a number of immense Dinosaurs have "recently been found; also, by Marsh a small marsupial mammal allied to the "opossum, and about the size of a weasel, which he calls *Dyatestes piscus.*"

Now we will go a little farther east and take the Dakota Red Sandstone, (No. 1 of the Cretaceous Group), horizon from the Platte River in Nebraska, south through Kansas to the Arkansas River. Throughout this section in a nearly north and south line, it is resting the whole length on the last sedimentary rocks from the east, viz. the Permian. It must here be noted that the Permo-carboniferous sediments were derived, in a measure, from the wearing away of exposed strata to the east; while the Dakota sandstone sediments came from the west; and here two geological sections meet; each having its own types and peculiarities.

Nowhere can I find it recorded that any Jurassic, or Triassic strata appear between these two rivers, to the east of the Colorado State-line, but throughout the Jura-Trias is entirely wanting, and the sandstone of the Cretaceous rests on the Permian rocks, and I believe conformably to them also; and these are the last of the series of the old Carboniferous group of the east.

Now if there was no cause in existence to produce a deposition of Jura-Trias along this horizon, there certainly was no cause to produce it between the same latitudes farther west and have it show, as claimed it does, uptilted along the Front Range of Colorado.

True, it is mentioned in many places in the U. S. Geological Survey of the State, that the supposed Jurassic and Triassic strata rest upon Carboniferous rocks, and show conformability therewith; so they do, but the coals below them are the coal-beds of the Cretaceous, and not the known coals of the Carboniferous series of the east: a very large point was strained here to make rock series fit I think.

Again, through this Front Range section that I speak of, it was thought that one of the sandstones showing was the Dakota sandstone; this must be an error as it is not there.

These matters have troubled me greatly, and it is only by leaving Jurassic and Triassic formations entirely out that I could get at any satisfactory solution of this rock-structure in the named locality.

In "Hayden's Report, 1873, p. 136," is stated, "The close proximity of "the vertical coal-beds to the horizontal beds of Table Mountain, (a basaltic "mountain) has been taken as representing unconformability between the two, "though in reality it no more follows from this fact, than would unconformabil-"ity in the Triassic from the similar phenomena presented on Coal Creek."

On the same page in the paragraph just above the one quoted is stated, "A "few miles north of Golden City a very remarkable contraction of the series "commences, all of the outer ridges bending rapidly westward to form a sort of "loop or bay in the rear of Table Mountain near the narrowest point of which "Golden City is situated. There have been some differing opinions expressed "about the structure of this region, and a section here is one of the most impor-"tant of the series."

Now let the geologist who wants to find the Jura-Trias go to Golden and Table Mountain; he will find the Basalt mountain resting on the Cretaceous shales, with undisturbed strata underneath and east; while west are the uptilted sedimentary rocks (the supposed Jura-Trias) resting conformably on the coals of the Cretaceous, and in some instances almost coming in contact with the foot-hill metamorphic rocks.

Let him examine Table Mountain and it shows a pre-existence to the Rocky Mountain elevation, in fact it existed in the earliest Eocene times. Then examine the heaviest sandstone beds, and they are fine-grained, banded, red and white streaks, or laminæ, alternating nearly equally, very homogeneous in material, no fossil remains, or evidences of sea-life, and every appearance of being produced from one cause, and that cause near by.

The material is volcanic ash, and the cause was just in proximity. The different bands of sandstone, really give the number of eruptions of this volcano; it was a large one then, and sent out intermittingly for a long time its fine ashes, which were blown by the winds over large areas of the surrounding sea, and sufficient of this material was erupted to make beds many feet thick in localities. The variation of thickness was due in a great measure to the unevenness of the sea bottom. This material being depositedi ntermittingly, prevented any sea-life existing at this place, consequently there are no fossils.

But this volcano had a period of rest, for the geologist will find on top of the first sandstones, a bed of conglomerate; on examination it appears to be fifteen feet thick, and instead of being quartz pebbles as one would naturally expect, it is almost entirely Zeolites; and this shows the long period of rest of this volcano, as the Zeolites to this thickness could only come from the long wearing away of the Mountain of Basalt. Our volcano, however, was not dead yet, as following the conglomerate is a thin bed of sandstone, volcanic ash, most beautifully lined in alternate bands, very fine and thin, and telling us that it was the last dying throes of one of Nature's giants.

Along the line of this strata it would be quite natural, after what had been done by this volcano, to expect a line of weakness, which broke as the Rocky Mountain system arose and made a fault between Table Mountain and the Front Range. Here the sedimentary strata tilted up and the volcanic eruptive record was preserved; but east of Table Mountain the rocks are all eroded out of what is now the Platte River basin. I could only get this representative section straightened out when I gave up the idea of the Jura-Trias existing here at all.

Again. Professor Rogers, in his admirable Surveys of Pennsylvania, accounts for the depositing of the Triassic of the Atlantic slope, as a deposition of river silt, the waters of which were possibly more or less affected by tides; that this river extended from the New England States in the north down what is now the Atlantic slope to Georgia, the deposit culminating in its greatest thickness in Virginia. I cannot find evidence for an analogy to this in the Colorado Front Range.

The characteristic fossil representations of the Trias of the Atlantic slope are the foot-prints occurring in the sandstone bordering the Connecticut River of which over 12,000 tracks have been found, averaging 100 tracks for each individual animal known. Comparative anatomists are agreed, that these are the foot-prints principally of reptiles or *cold-blooded* animals. This fact is used by geologists to illustrate the theory of evolution as evidenced by the geological formations of the different periods of the earth. In a lecture in Denver some months ago this subject was clearly and beautifully treated by Professor W. D. Gunning, of Boston, (such theories appear to be his strong forte). To the attention of this gentlemen I presented a discovery of my own, made a short time before his arrival, in some sandstone flagging put down on 16th Street in Denver. The discovery was made in April, 1882, and consists of three distinct sets of foot-prints, made evidently by three different animals.

Professor Gunning verified them as foot-prints on the spot, and this I believe to be the first recorded discovery of the kind. They are in the sandstones of the St. Vrain quarries of the Front Range of Colorado.

The largest foot-prints were evidently of an animal going at a leisurely gait across the wet sands, leaving a record as distinct and perfect as a fox would under similar circumstances in a snow-field. One of the smaller sets have the whole four feet drawn together, as if the animal had just alighted after a spring, and paused a moment to listen and see if the cause of his alarm still continued. Afterward, in the stone-yard, I found one large slab with just two tracks upon it, similar to the ones first mentioned, but impressed by an entirely different action. Instead of a leisurely trot, he had been in a hurry, and had in his jumps come down upon the wet sand heavily; as he sprang forward his nails scratched deeply into the sand and left a record to prove that his age of life was not Triassic, but was long after the close of the Cretaceous age. For those are not the tracks of cold, but of warm-blooded animals; and my friend was evidently an active member of the great family called *Canis.*

I desire to put this discovery, crude as it is, on record, that the attention of men of more time and means than myself and be directed to it, and so help settle a long-standing doubt, which appears to exist, even in the minds of those who found the Triassic formation so constant here in these typical sections "that it is no exaggeration to say it can readily be recognized at a glance."

From the extracts given, and the facts herein noted by myself, I feel that all of my readers will recognize the difficulty I had in finding the Jura-Trias when I examined the very sections pointed out in the U. S. Reports, and why I had to come to the conclusion that they do not exist at all.

GEOGRAPHY.

BOLIVIA A NEW SOURCE FOR RUBBER.

The principal facts given below were first published in the Review with a map of the Beni River region explored by Dr. Heath, in the September Number of 1881, in an article entitled "Explorations in South America." Both Dr. E. R. Heath and his brother Dr. Ivon D. Heath have contributed to the Review articles of great value, during the past three years, upon the geography, climate and archæology of South America, and we are glad to see that their work is beginning to be equally appreciated elsewhere.—Ed. Review.

Dr. Edwin R. Heath has given a reporter of *The World* an account of his recent explorations of the Beni River, in Bolivia and the adjacent country. To Dr. Heath belongs the credit of being the first to make a complete exploration of the River from its source at La Paz to its junction with the River Mamore. He has made many discoveries of geographical interest, such as locating the mouths of the Madre de Dios and the Orton Rivers. He has collected also much material of value to the zoölogist, botanist, and geologist, and a full account of his researches will shortly be published by the American Geographical Society and the Royal Geographical Society of England. The commercial value of his discoveries is that he has established the fact that the Beni River is navigable by large steamers from its mouth to near Reyes, a distance of 525 miles, and for 300 miles further by craft of less than three feet draft. At its mouth the Beni River is a little over half a mile wide and 50 feet deep at lowest water. At Reyes it is 800 feet wide and 30 feet deep.

The country adjacent to the lower Beni produces cacao beans, vanilla beans, Brazil nuts and many other useful articles of commerce. The waters of the upper Beni run through a country that produces Peruvian bark, cacao, coffee, gold, silver and copper.

The commercial product of the country adjacent to the lower Beni, which promises the richest development in the future is rubber. "The supply of rubber to be obtained in this region," said Dr. Heath, "is practically inexhaustible. On the north side of the Beni River the forest extends from the water's edge over 15° of latitude. I penetrated this dense forest at one place as far as twenty-one miles from the river, and the further I went inland I found the rubber trees increase in size and number. Each square league contains from 300 to 5,000 trees. On the south side of the river the forest is only from three to ten miles wide, but it abounds in rubber trees."

Dr. Heath left Reyes for the mouth of the Beni, August 4, 1880, and arrived at its junction with the Mamore October 11th. The first part of the voyage war made in a canoe propelled by eight Indians, the latter part in a canoe with two Indians. The actual time occupied in paddling down the stream was a little over five days, the rest of the time being devoted to an examination of the adjacent country and to collecting and noting objects of interest. On August 7th, Dr. Heath was compelled to lie to near a sand-bar on account of what the natives call a south wind, which is similar to the "norther" of Texas. The journey was resumed on the 8th. On either side of the river was found a mass of dense foliage extending to the water's edge, like the forest on the Amazon. At low water there are many sand-bars in the river, where turtles deposit their eggs in great numbers. They were much relished by the Indians, but Dr. Heath found them strong and oily. On the 8th River Tarene was passed and many tigers were seen. The favorite food of the voyagers was roast monkey. Dr. Heath pronounced the flesh excellent, superior to that of any other animal food. The monkeys were found in abundance throughout the voyage. What is called the black spider monker is regarded by connoisseurs in monkey flesh as most tempt ing to the appetite. The monkey that is to be prepared for the meal is placed for a moment over a brush fire. This blisters the skin and the hair is readily scraped off.

On August 14th Cavinas, a small mission station, was reached. Here they encountered some Arauna Indians who are reputed cannibals. They are of a low order of intelligence, small of stature, with skin dry and wrinkled. Dr. Heath was told that one of these Indians in the neighborhood went out hunting, and returning empty-handed deliberately killed and cooked his infant child, and he and his wife sat down to the repast without any compunctions of conscience. These Indians live upon the banks of the Madre de Dios and occasionally make excursions to Cavinas, murdering Indians of the Cavinas tribe, presumably eating eating them afterward. Some hundred miles below Cavinas are found the Pacavara Indians. These Indians are peculiarly well formed, their features being regular, and some of the women are deserving of being called beautiful, their complexion being a light copper-color. In intelligence they are also superior to other tribes of Indians found in that region. Alligators of various sizes are found to abound on the Ceni River, and they caused much annoyance by frequently stealing provisions from the boat at night while the exploring party was encamped on the bank. Insect pests were numerous. A species of sand-fly called the marnim preyed upon them during the day and the mosquitoes stung them at night. They were also subject to the attacks of the tabino fly, a species of horse-fly of which there are two varieties, one black and the other yellow. They are at about latitude 10.50 south. From thence to the Amazon the marnim fly abounds.

After reaching the Mamore River, October 11th, Dr. Heath ascended that stream 325 miles to Exaltacion, and from that point crossed the plains to Reyes. From thence by rafts he ascended the Beni River to within ninety miles of its source at La Paz, and covered the remaining distance on mules. Previous to the discovery by Dr. Heath that the river was navigable the products of the region were transported to Arica and thence by sea around Cape Horn to Europe, or otherwise across the pampas to the Mamore River, thence down the Madeira to San Antonio, to which point steamers at present ascend. The Beni has an advantage over the Mamore as a highway of commerce in having only one fall, while the Mamore has five such obstructions. "Soon after the results of my explorations became known," said Dr. Heath, "the tide of commerce began to seek the Beni route." All the commerce of Bolivia must ultimately pass to Europe by way of the Amazon and Beni Rivers.

Dr. Heath said that within four years a railroad would be constructed from San Antonio to the Beni River a short distance above its junction with the Mamore River. By this means the falls of the Madeira are avoided. The route for commerce will then be from Reyes by steamer to where the railway taps the river, then by rail to San Antonio and from that place by steamer down the Madeira to the Amazon and onward to the sea.

As an instance of the impulse which the opening of the Beni River has given to commerce, Dr. Heath mentioned that previous to the discovery that the river was navigable 185 men were employed in collecting rubber gum. Soon after the discovery was made 644 men speedily found employment at it. The price of the gum before the exploration was $16 per 100 pounds delivered at Reyes; after the exploration it was worth $25.60 at the point of collection. The 185 men collected on an average 104,000 pounds of rubber annually.

"The supply of rubber," said Dr. Heath, "is sufficient to give employment to 100,000 men, and as soon as the chain of communication by steamer and railway is completed that number of men will be engaged in that field of labor. The rubber, though at present commanding only the same market price, is of a slightly finer quality than that obtained at the old established districts between the falls and the mouth of the Madeira River and on the River Tapajoz and other tributaries of the Amazon near Para. It possesses other more important advantages over the older districts. The climate is healthy. There is an abundant supply of cheap labor at hand, the Indians obtained from the department of the Beni, who are practically slaves, working at from $3 to $4 a month, equivalent to from $2.40 to $3.20 in American money.

The abundant supply of palm-nuts which are used in smoking the rubber—a necessary process previous to evaporation—enables the collectors to work ten months out of the twelve, instead of six as in other districts.

HOW DE LONG AND HIS MEN WERE BURIED.

On the cross is engraved the following inscription, cut in by the search party at their house at nights:

IN
MEMORY
OF 12 OF
THE
OFFICERS
AND
MEN
OF

THE ARCTIC STEAMER "JEANNETTE,"
WHO DIED OF STARVATION
IN LENA DELTA, OCTOBER, 1881.

Lieutenant
G. W. DeLong.

Doctor
J. M. Ambler.

J. J. Collins.

W. Lee.

A. Gortz.

A. Dressler.

H. Erichsen.

G. W. Boyd.

N. Iverson.

H. Knack.

Alexia.

Ah Sam.

It was Chief Melville's intention to bury the remains upon the bank where they were found, but the natives assured him that in all probability any tomb would be washed away, as when the river broke up in the spring there would be about four feet of water over the entire delta. He, therefore, had them all removed to the top of a hill of solid rock about three hundred feet high, about forty versts to the southwest, and there constructed a mausoleum of wood from the wreck of the scow near where they were found. First a gigantic cross was hewn out of a solid piece of driftwood and erected on the crest of the hill, and around it was built a box six feet wide, two feet deep and twenty-two feet long, placed exactly in the magnetic meridian. After the bodies had been placed therein the box was covered with timbers laid side by side and a ridge pole sixteen feet long framed into the cross five feet above the lid of the coffin, the ends supported by timbers having the same inward slant. Against this ridge pole were placed timbers side by side until the whole formed a true pyramid, and then stones were heaped upon the entire structure, so that it looks like a pyramidal mound of stones surmounted by a cross. The cross itself is twenty-two feet high from the surface of the rock, is one foot square, and the crossbeam is twelve feet long by one foot square.

Chief Melville has made arrangements to have the pyramid sodded this spring, under the direction of the commander at Bulun, in case he has finished his search in time to escape before the breaking up of the rivers. The structure is a very creditable affair and conspicuous from the river at a distance of twenty versts.—*Cor. N. Y. Herald.*

PROCEEDINGS OF SOCIETIES.

FIFTEENTH ANNUAL MEETING OF THE KANSAS ACADEMY OF SCIENCES.

The Kansas Academy of Science met at Topeka on Thursday, November 16th, and remained in session until the evening of Saturday, November 19th. The preliminary meeting was held as usual at the office of Dr. A. H. Thompson, Thursday afternoon, where only the ordinary routine business was taken up and disposed of.

The committee on the Mudge monument fund reported the monument completed, the grounds in good shape and a surplus left in their hands. It was decided on motion to use this money to take care of the monument and grounds.

The committee on a State geological survey made a preliminary report and further discussion and action upon the subject was postponed until Friday.

A committee was appointed upon the nomination of officers to report Friday.

In the evening the members were handsomely entertained at the residence of Mr. Geo. S. Chase. The beautiful collection of minerals which Mr. Chase has gathered attracted no small attention, and the hospitality of the hostess and her lady friends were highly appreciated.

SECOND DAY'S PROCEEDINGS.

Pursuant to adjournment, the Academy met in the Senate Chamber at nine o'clock A. M. Friday. The President, J. T. Lovewell in the chair.

An election of officers for the coming year was entered into with the following result: President, A. H. Thompson; Vice-Presidents, J. R. Mead and G. E. Patrick; Secretary, E. A. Popenoe; Treasurer, R. J. Brown.

The following committees were appointed: Geology, O. H. St. John, Jos. Savage and Rob't Hay; Mineralogy, Geo. S. Chase, G. E. Patrick, G. H. Failyer, J. C. Cooper and E. Haworth; Chemistry, G. H. Failyer, G. E. Patrick, J. T. Lovewell, R. J. Brown and H. E. Sadler; Physics, J. T. Lovewell, H. S. S. Smith and S. D. Graham; Anthropology, A. H. Thompson, F. G. Adams, E. P. West, J. D. Parker, W. J. Griffin and H. Inman; Philology, D. H. Robinson, Geo. M. Stearns and Geo. T. Fairchild; Board of Curators, E. A. Popenoe, O. H. St. John, J. T. Lovewell and F. H. Snow; Publication Committee, J. T. Lovewell, Wm. Sims and E. A. Popenoe.

Following the election of officers, the Academy took under consideration the appointing of a committee to memorialize the Legislature on the subject of a geological survey of the State. This committee will have in charge a subject of the highest importance, and quite a full discussion ensued, which was participated in by Profs. Patrick, Carruth, Lovewell, Goss, and Drs. Brown, Thompson and Geo. S. Chase. It was decided to enlarge the committee to five with a further advisory committee of ten members, who shall have the matter in charge in various parts of the State. The names of this committee will be announced hereafter.

A valuable paper upon the "Coal Fields of Cherokee County, Kansas," was read by Erasmus Haworth, of Empire City, which, showing the careful investigations of the subject made by the author, was listened to with close attention by the Academy. In this paper Mr. Haworth spoke of the undeveloped mineral wealth existing in various localities, and emphasized the importance of a geological survey of the State. At the conclusion of the reading of this paper, remarks being called for by the chair, an interesting discussion ensued, participated in by Prof. Patrick and others.

Some interesting remarks were made by Prof. J. T. Lovewell on the "Differences of Temperature due to Local Causes," that gentleman expressing the regret that he had not been able to collect the data necessary for the preparation of the paper upon the subject which he had promised the Academy.

In the absence of Prof. Robt. Hay, of Junction City, an interesting paper contributed by that gentleman on "Fossil Wood," was read by the Secretary. In this paper the writer spoke of some interesting specimens collected by him on the Saline, in Russell County, and in various parts of the State. The conclusion drawn by Mr. Hay was that all his researches "pointed one way, namely, to the cretaceous origin of most of the specimens of fossil wood found on our prairies."

Prof. Patrick exhibited two rare minerals found by him last summer while in New Mexico, giving an interesting oral description of the discovery of the same, together with the classification of the rare specimens in his collection. The two minerals in question are vanadates of lead, containing the rare mineral vanadium. One is supposed to be Dechenite. a mineral discovered in Bohemia, and thus far hardly ever found elsewhere. The species of the other mineral has not yet been determined, as it differs in appearance from all the known vanadates.

Afternoon Session.—Academy convened at two o'clock P. M. President Thompson in the chair. An increased attendance, including a number of ladies.

Prof. Carruth gave an interesting account of a recent visit to the southwestern part of the State in quest of additional botanical specimens. The species of flora known to Kansas botanists Mr. Carruth stated to be 1,400, of which 200 are not found in Wood & Gray's botany.

A thoughtful paper upon "Kansas Ethnography," designed as an introductory paper, was read by Dr. A. H. Thompson, which was listened to with close attention, giving rise to an extended discussion, participated in by Messrs. Inman, Snow, and others.

Professor Snow made some highly interesting remarks upon the "New Kansas Coleoptera," and presented a list, which called forth an animated discussion.

A carefully prepared paper upon "Are there Igneous Rocks in Kansas?" in opposition to the theory, was read by Mr. Erasmus Haworth, which called forth an animated discussion, participated in by Messrs. Patrick, Inman, Snow and others.

Mr. Haworth showed some beautiful specimens of the copper ore, "Chalcopyrite," found in Cherokee County, which has not before been found in Kansas.

Professor Snow exhibited a specimen of the Gila monster, *Heloderma suspectum*, captured by him last summer while in New Mexico, an animal held in great dread by the natives and regarded by them as being highly poisonous, which the Professor declared was erronous; giving a humorous account of sundry experiments which he had made with the animal to test this fact.

Evening Session.—A fine audience greeted the Academy in the evening, to listen to Professor H. S. S. Smith's paper on comets. This gentleman's subject was ably and carefully handled. He advanced no new theories, but presented seriatim the popular views in relation to comets in the olden time, when astronomy was crudely understood, and the most advanced idea of to-day relating to these strange celestial visitors. He seemed to argue most favorably for the electrical theory, though he admitted that all was conjecture and that nothing was known positively of their origin or purpose. The lecture was listened to attentively, and at its close provoked some pleasant and instructive discussion by several of the members present. [A portion of this paper is presented to the readers of the Review on pages 465 to 467 of this number.—Ed. Review.

THIRD DAY'S PROCEEDINGS.—Having failed to receive the report for Saturday, we are compelled to go to press without it. The papers read were as follows:

Notes on the Golden Turkey, (*Meleagris ocellata* Cuv), Prof. Geo. F. Gaumer, Santa Fe, N. M. Preliminary List of the Invertebrate Fossils of Kansas, Geo. S. Chase, Topeka. Cremation, Dr. W. S. Newlon, Oswego. New Kansas Coleoptera—chiefly from Douglas County, Prof. F. H. Snow, Lawrence. Foot-Prints in the Pleistocene, Henry Inman, Topeka. Las Vegas Mineral Waters, Prof. J. T. Lovewell. List of Coleoptera Collected in Gallinas Cañon, N. M., in July and August, 1882, Prof. F. H. Snow. List of Lepidoptera Taken in Gallinas Cañon, July and August, 1882, Prof. F. H. Snow. A Plea for Our Little Birds, N. S. Goss, Topeka. Protozoan Remains in Kansas Chalk, Prof. G. E. Patrick. Standard Time, Prof. H. S. S. Smith. On Some American Species of Cyclops, Prof. F. W. Cragin, Topeka. Notes on the Gila Monster, (*Heloderma suspectum*, COPE), Prof. F. H. Snow. Aborigines in Kansas, F. G. Adams, Topeka. The Pictured Rocks of Pipe Creek, Silas Mason, Delphos. Observations on the Nesting Habits of the Guillemots, etc., at Bird Rock, N. S. Goss, Topeka. New Species Added to the List of Kansas Plants, Prof. J. H. Carruth.

It was voted that in future one of the evening addresses before the Academy at its annual meeting be given by the retiring President, also that the chairman of each of the Commissions be asked to report to the Academy the progress made in his specialty during the year.

BOOK NOTICES.

MANUAL OF BLOW-PIPE ANALYSIS. By H. B. Cornwall. Illustrated; 8vo. pp. 308. D. Van Nostrand & Co., New York, 1882.

Professor Cornwall has charge of the departments of Analytical Chemistry and Mineralogy in the John C. Green School of Science, College of New Jersey, where he has had large experience in teaching the use of the blow-pipe as well as all other appliances of modern analytical methods. This work contains the practical results of his experience and study and will be found eminently useful both to students and instructors. It will also be found of great value to actual workers in the mining regions of the West where the examination of complex ores and new minerals are so frequently necessary and the delay consequent upon sending specimens to distant chemists and assayers is a serious objection.

Beginning with directions for self instruction, lists of substances for practice and of apparatus for qualitative blow-pipe analysis, the author proceeds to describe minutely, with numerous illustrations, the apparatus, reagents and operations in ordinary chemical work. After this preliminary chapter he takes up *seriatim* the special operations and examinations by means of the blow-pipe, such as the management of the flame, the blast, the oxidizing flame, the reducing flame; examinations in closed and open tubes and on charcoal alone; examinations for fusibility, alkilinity, flame coloration, with glass fluxes, with soda, with cobalt solution, etc.; tables showing the behavior of the alkalies, the earths and the metallic oxides. Chapter III is devoted to special tests for the elements or their compounds necessary in some combinations, and comprises fifty-five pages. Then follow the instructions for systematic blow-pipe examination of substances, including the excellent scheme of Prof. Egleston, with explanatory notes and with some alterations by the author; also of metallurgical products and paints. Chapters are also devoted to analysis with the aid of the wet way and spectrum analysis. One of the most important chapters in the whole book is that upon Quantitative Blow-Pipe Analysis, or Assaying, in which the subject is fully treated, there being directions for the assaying of gold, silver, copper, lead, bismuth, tin, cobalt, nickel, and mercury. Chapter VIII comprises descriptions of the more important ores and coals, while the remainder of the work is taken up with a treatise upon determinative mineralogy with explanatory remarks upon minerals, formulas, systems of crystallization, cleavage, hardness and tenacity, lustre and color, streak, magnetism and pyro-electricity, action of acids, specific gravity, fusibility, method of using the determinative tables, etc. His remarks upon classifying examination are divided into minerals with metallic or sub-metallic lustre and minerals without this lustre, with proper and lucidly explained divisions. All the detailed processes are simple, easily understood and readily performed by students or others having an elementary knowledge of inorganic chemistry and a reasonable degree of expertness in handling apparatus. The indexes are full and satisfactory, which is no small desideratum in such a work. We can unhesitatingly recommend it as a reliable guide for all persons who desire practical information and instruction upon the important branches of metallurgical knowledge to which it applies.

Ants, Bees and Wasps. By Sir John Lubbock, F.R.S., LL.D., etc. 12mo. pp. 448, Illustrated. D. Appleton & Co., N. Y., 1882. For sale by the Kansas City Book and News Company. $2.00.

This is the forty-second volume of the International Scientific Series, which now comprises some of the very best works in all departments of science ever brought together in one continuous set. Several of these have been noticed in these pages from time to time and the series has met with a ready sale in this community.

Sir John Lubbock has for a number of years given the study of ants, in particular, a great deal of attention and his articles have been published and copied all over the world. In the present work only two chapters are given to bees and wasps, since, as he says, he found that ants were more convenient for most expermental purposes, as well as having in his judgment more power and flexibility of mind and a far calmer and less excitable disposition.

In this work he has reproduced the substance of two Royal Institution lectures, which include apparently pretty much the whole subject, and much of which is founded on actual observations made upon individual members of ants' nests, or communities, followed up in his own room, where these nests were kept in some instances for more than seven years. It will be a kind of revelation to some readers to know that he has at this time ants in his possession that are more than eight years old, a much greater age than is usually accredited to any insects.

The author's high estimation of the intelligence of these insects is still further shown by the first sentence of his introduction: "The Anthropoid Apes no doubt approach nearer to man in bodily structure than do any other animals; but when we consider the habits of ants, their social organization, their large communities and elaborate habitations; their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence." This seems a bold claim, but perhaps no man has a better right to make it, in view of the time and labor spent by him upon the investigation of the subject. Every branch of it from their classification and structure, their food and dwellings, their habits and characters, to the formation and maintenance of their nests, their relation to plants and to other animals; their behavior to relations, their recognition of friends, their power of communicating; their senses, general intelligence, with his methods of observation, his experiments on all of the above points and the results thereof, is detailed in the most careful, complete and precise manner.

Nothing can be more interesting to any person having the slightest taste for natural history than this account, and we can recommend the book to all such as exceedingly instructive as well as entertaining.

The Diseases of the Liver. By George Harley, M. D., F.R.S. Octavo, pp. 751, Illustrated. P. Blakiston, Son & Co., Philadelphia, 1882. $5.00.

In this work, which has been looked for by the medical profession with much interest ever since its announcement, the diseases of the liver, with and without jaundice, are considered, with the special application of physiological chemistry to their diagnosis and treatment. It is generally believed, though with how much basis of fact is doubtful, that diseases of the liver are more prevalent in the West than in the older portions of the American Continent. Whether this is so or not such diseases are sufficiently abundant and little enough understood everywhere to render such a work invaluable to the general practitioner of medicine, especially as it contains a large amount of clinical and scientific data that has never before been collected together by any author into one volume, and in many instances gives a new rendering to old clinical facts by presenting them to the reader in the light of modern pathological science.

The author calls special attention to that portion of the work devoted to the physiological chemistry of the excretions, on the ground that "we are entering upon the threshold of an important line of medical inquiry which sooner or later will be followed by valuable practical results." Of this there can be no doubt, and the researches of some of our American physicians show that they are not blind to the advantages of this means of investigation.

One conclusion of Prof. Harley's will doubtless be read with surprise, if not doubt, *i. e.*, that mostly all liver diseases are hereditary, even many of those apparently accidentally acquired, such as gall-stones, being no exception to the rule.

As this work is intended only for professional men we will not extend this notice, but merely give a synopsis of its contents to show the scope of the work :

Chemistry, Physics and Physiology of the Liver and its secretions. Etiology of Jaundice—different kinds—causes producing them—treatment. Signs and Symptoms of Liver Diseases. General remarks on all kinds of Hepatic Remedies. Special Hepatic Medicines; their modes of action and uses. Mineral Waters, Wines and Foods; treatment of Pyrexia, Cerebral complications, etc. Congenital and Hereditary Liver Diseases, Biliousness; Its varieties and treatment. Jaundice from Enervation, all its forms explained and their different treatments. Different forms of Inflammation of the Liver and their treatments. Jaundice caused by Diseased Germs, Yellow Fevers, Contagious and Epidemic Jaundice, different kinds and their treatments. Jaundice of Pregnancy. Different forms of Hepatic Atrophy and Ascites. Biliary Concretious, Inspissated Bile, Gall Stones of every kind and form, direct and indirect effects of; their symptoms and treatment. Different kinds of Colics, etc. Catarrhal Jaundice. Jaundice from Poisons. Different kinds of Jaundice from Permanent Obstructions. Physiological Chemistry of the Excretions, Urine and Stools, as a guide to diagnosis and treatment. All kinds of Abscess, Tropical, Pyæmic, Metastatic, etc. Different kinds of Cancers of the Liver and its Appendages. Hydatid and Cystic Diseases of the Liver; Syphilitic and Fibroid Diseases of the Liver. Embolisms, Fatty, Amyloid and other Degenerations of the Liver. Traumatic Diseases of the Liver. Diseases of the Gall Bladder. A concluding chapter, entitled Hints on Differential Diagnosis. Index.

THE THEORIES OF DARWIN. By Professor Rudolph Schmid; 12mo. pp. 410. Jansen, McClurg & Co., Chicago, 1883. For sale by M. H. Dickinson, $2.

In this work the theories of Darwin and their relation to philosophy, religion and morality are so carefully, systematically and learnedly considered, so thoroughly analyzed and so lucidly set forth, that we regard it as the most satisfactory exegesis of the whole subject of evolution and its kindred hypotheses that has ever been presented to the American public. Professor Schmid is President of the Theological Seminary at Schönthal, Würtemburg, where he wrote the work some six years since. It has, however, been recently revised and is now presented for the first time in the English language, having been translated by authority of the original publisher, by Rev. G. A. Zimmerman, Ph.D., of Chicago, and put forth in elegant shape by Jansen, McClurg & Co.

The work is divided into two parts, the first of which is devoted to the Darwinian Theories, including the purely scientific theories, their rise, history and present state and their philosophic completions and consequences, their naturo-philosophic supplement and the metaphysical conclusions drawn from them.

Part second is devoted to the position of the Darwinian Theories in reference to religion and morality, and comprises an historical and critical account of them, and an exhaustive analysis of them. In this part the Darwinian Theories are taken first in connection with religion, then in connection with morality and considered as to the bearings of the descent, evolution and natural selection theories upon theism or the theistic view of the world, also upon the creation of the world and of man, the primitive condition of man, the hearing of prayer, miracles, etc., the effect of Darwinistic naturalism and scientific Darwinism upon moral principles and moral life. The whole is summed up in a profound, comprehensive and original manner whose fairness and toleration cannot fail to impress all readers, and, as the translator remarks, "must serve an important purpose to the cause of religions, nor less than of scientific truth."

The Duke of Argyll, in concluding his introduction to the work, says: "Knowing the author personally, as I have done for many years, I recognize with pleasure in his work all the carefulness of inquiry and all the conscientiousness of reasoning which belong to a singularly candid and patient mind."

Beautiful Houses. By Mrs Haweis; 12mo. pp. 115. Scribner & Welford, New York, 1882. For sale by M. H. Dickinson, $1.50.

"Fine feathers make fine birds," and fine bindings, fine paper and elegant printing go far toward making fine books. At least, one cannot help feeling so upon looking over the "Parchment Series" and finding such of his old friends and favorites as Shakespeare, Tennyson, Coleridge, Poe, the Eighteenth Century Essays, English Odes, Imitation of Christ, etc., presented in all the attractions of parchment covers, superb hand-made paper and the most perfect typography; visions of elegance and models in style; tributes to refined intelligence within and to cultivated taste without.

Taking the volume above named as an illustration, we find it a fitting exemplar of the progress now being made in art in all its branches, while its charming author has rendered equally conspicuous the advance of esthetics by her tact in selecting subjects and her skill in describing them.

The houses described in this book are those of Sir Frederic Leighton, President of the Royal Academy of Art Mr. William Burgess; Mr. Alma Tadema, the artist; the British Embassy at Rome; Mr. Boughton, in London; Mr. Alfred Moraison; the Villa Campagna at Rome, owned by the well known sculptor, Mr. Warrington Wood, and occupied by him as a studio; Mr. Reuben Sassoon; Ashley Park, an old Tudor mansion, now owned by Mr. Sassoon; Mr. William Haz letine's apartments in the Palazzo Altieri in Rome; Mr. Stevenson's house, known as the "Red House," and Miss Hozier's Bijou house in London. All of these are minutely and graphically portrayed by Mrs. Haweis in her most artistic and poetic style, so that after reading one feels that he has actually had an experience.

It is impossible to convey this experience to these pages and we must refer the reader to the book itself, assuring him of a rare literary treat as well as a probable expansion and enrichment of his ideas upon modern taste and style in building, furnishing and decorating houses in cases where, as the author says, "exquisite feeling, devotion and knowledge, with all the skill that money and thought command," are brought into requisition.

Braceridge Hall: Old Christmas. From Washington Irving's Sketch-Book. Quarto, 48 and 36 pp. MacMillan & Co., London, 1882. 6d each.

The above are excellent reprints of two of the genial Irving's best stories or sketches, and have been brought out in good style by MacMillan & Co. who have spared no pains to make them popular. In addition to firstrate typography, the publishers have had each volume illustrated with more than one hundred wood cuts, which add very materially to their appearance and value.

It is altogether unnecessary to speak of the literary merits of these works. Every American knows and appreciates Irving, who is also a favorite in England, where he spent a considerable portion of his life.

The Doctrine of the Unknowable; with a Synthesis. By David Eccles, Kansas City, Mo. 1882; octavo, pp. 22. Price 10c.

Mr. David Eccles, of this city, has recently published in pamphlet form his lecture delivered last summer before the Kansas Liberal Union at Bismarck Grove. It is a bold and somewhat abrupt departure from the beaten track in metaphysics, relegating the doctrine of the Unknowable to a much less prominent position than it has occupied since Spencer enunciated it and substituting for it the assumption that matter and its states are an illusion, having no existence outside of mind; that there is no real of existence besides mind, and that he who knows himself and his sensations knows all; all else being a creation of the senses and having no actuality whatever. From this starting point he constructs a synthesis whose scope includes every mode of matter and motion, giving them corresponding sentiency and culminating in perfect adaptation, which can only abide in "the Great Central Soul." While to us this seems like stepping from the Unknowable to the Inconceivable, (though we suppose all thought must stop at some final mystery and why not as well with Mr. Eccles' incomprehensible mind as with Spencer's fictitious Unknowable, ?) it is the result of a strict metaphysical reasoning and doubtless will satisfy many who have not hitherto been willing to accept the apparent evasions of Spencer in resorting to the Unknowable. It will certainly give Mr. Eccles an advanced position among philosophical thinkers.

OTHER PUBLICATIONS RECEIVED.

Frontier Army Sketches, by Capt. James W. Steele, Jansen, McClurg & Co., Chicago, $1.50; Jewish Nature Worship, by J. P. MacLean, Robert Clarke & Co., Cincinnati, Ohio, 25c; Geological Sketches, Archibald Geike, LL.D., F. R. S.; *Humloldt Library*, No. 38, 15c; Paper-Money Inflation in France, by Andrew D. White, 10c; The Gulf Stream, by Commander J. R. Bartlett, U. S. N.; The Change of Life in Health and Disease, by Edward John Tilt, M. D., P. Blakiston, Son & Co., 75c; Results of Meteorological Observations made in Henry County, Indiana, from 1854 to 1882, by Wm. Dawson.

SCIENTIFIC MISCELLANY.

TRANSIT OF VENUS, DECEMBER 6, 1882.

W. W. ALEXANDER, KANSAS CITY.

The Kansas City mean time of *Internal Contact* at ingress, December 6th, 8h. 04m. A. M. *Internal Contact* at egress, December 6th, 1h. 30m. P. M. Apparent diameter of Venus 64.6″, of the Sun 1952.4″.

Determination of the Sun's Distance.—We all know when Venus crosses the Sun's disc during its transit it appears as a round black spot, (about one-thirtieth of the Sun's diameter). Let us suppose two observers placed at two different stations on the Earth, properly chosen for observation of the phenomenon; one at a station in the northern hemisphere, another at a station in the southern hemisphere. When Venus is exactly between the Sun and the Earth, the observer at the northern station will see her projected on the Sun; the southern observer from his lower station will see her projected higher on the disc of the Sun. Now, what we require to know, in order to determine the Sun's distance, is the distance between the lines?

If the distance between the two stations is sufficiently great, the planet will not appear to enter on the Sun's disc at the same absolute moment of time at the two stations, and therefore the paths traversed, or the "chords," will not be the same. Speaking generally, the chords will be of unequal length, so that the time of transit at one station will be different from the time at the other. This difference will enable us to determine the difference in length of the chords described by the planet, and consequently their respective positions on the solar disc, and the amount of their separation. Now, this separation is what we want to know.

We already know the relative distances of Venus from the Earth and Sun; they are as 28 to 72 nearly; and whatever the absolute distances may be, the value of the separation of the two chords, in miles, will be the same. It is evident, for instance, that if the Sun were exactly as far from Venus on one side as we are on the other, and the observers occupied the two poles of the Earth, the separation would be equal to the Earth's diameter; but as the Sun is farther from Venus than we are, in the proportion of 72 to 28, if the transit were observed from two stations, each chosen not too far from the Earth's poles, the separation of the two chords on the Sun would amount to 18,000 miles; and this proportion holds good whatever the distance.

If it were possible to photograph the Sun at the same moment at the two stations, the thing would be done; we could at once measure the amount of separation, determine its proportion to the whole diameter of the Sun, and determine the size of the Sun, whence its distance would at once follow, as we could at once determine how great an angle the Earth's semi-diameter would subtend at that same distance, which, in fact, would be the Sun's parallax.

Simultaneous observations, however, are out of the question; so the observations will take this form; the moments of ingress and egress are carefully noted at both stations, and the differences between the two chords will show us on what part of the Sun they lie; this known, it is easy to determine the separation.

As the difference between the observed times of transit at the two stations is the quantity which determines the amount of separation, it is important to make this difference as great as possible, as then any error bears a smaller proportion to the observed amount.

This is accomplished by carefully choosing the stations, bearing the Earth's rotations well in mind. Let us introduce this consideration, and see not only how it modifies the result, but also with what anxious foresight astronomers prepare for such phenomena, and why it was requisite in 1874, and will be again necessary this year to go far from home to observe them. We already know the instant and place (true, perhaps, to a second of time and arc) at which the planet will enter and leave the solar disc, in other words we know exactly how the Earth will be hanging in space as seen from the Sun—how much the south pole will be tipped up—how the axis will lie—how the Earth will be situated at the moments of ingress and egress.

Now if we suppose two planes cutting the centre of the Earth and those points of the Sun's limb at which the planet will enter and leave the solar disc, we shall see in a moment that some parts of the Earth will see the planet enter on the disc sooner than others. Some parts, on the other hand, will see it leave the disc later; in other words, according to the position of a place with reference to the place of which we have spoken, both ingress of the planet and its egress will appear earlier or later, as the case may be.

SOLAR UPHEAVAL AND MAGNETIC STORM.

EDGAR L. LARKIN, NEW WINDSOR OBSERVATORY.

The doubts that lingered in the minds of astronomers relating to the sympathy supposed to exist between solar and terrestrial phenomena wherein magnetic and electrical forces are concerned are in a fair way to be removed. The present year has been one of solar upheaval and terrestrial disturbance. On April 16th there was an electric storm and an Aurora on the earth, and an appalling cyclone on the Sun. The great abyss in the solar surface was watched at this observatory for a period of ten hours on that eventful day, and all remember the auroral display of the evening. And now there is a repetition of the same phenomena, with greater activity.

The daily press of November 17 was burdened with accounts of widespread magnetic disturbance, in some places suspending telegraphic manipulation.

The area of electric turbulence extended, so far as is reported, from New York to Yankton, and from Nashville to Winnepeg. And the Atlantic cable was a in state of unrest, so that doubtless the disturbing magnetic waves reached Europe. At Milwaukee carbons in an Edison vacuum lamp were rendered incandescent by electric currents flowing in from the atmosphere. At other points switchboards were set on fire and keys melted in telegraph offices, while in Nebraska electric balls were seen on the wires. Auroral displays of great intensity were observed at many places separated by wide distances, and by reports from the northern portion of the United States one cannot fail being impressed the with magnitude and duration of the electric undulations.

On Wednesday, November 15th, after an interval of cloudy weather, we secured a view of the Sun at noon. An enormous spot was at once seen already advanced on the eastern solar limb twenty-four degrees. It was evidently in a state of excessive turbulence, since none of the tongues of fire were straight, all were twisted, crossed, and contorted in every conceivable shape. The edges of the chasm were notched and indented in all possible forms. The "willow leaves"—jets of fire assuming leaf-like appearances—seemed to be sliding downward from the level surface of the sun along inclined planes leading to the black edges of the central nuclei, and in many cases projected over them, presenting a scene like fiery streams bending into a cavern of impenetrable darkness. The spot was broken by "bridges" of flame into three divisions, the central one being evidentaly in rotation about an axis—a radius of the Sun prolonged. This belief is sustained because all striæ, rifts, and granulations on the penumbra—the incline alluded to—were bent about in such direction and in such manner as would be caused by centrifugal force. Soon clouds obscured the Sun, terminating the observation before we had time to measure the length and breadth of the troubled region.

Seeing at once that the upheaval was on a somewhat larger scale than that in April last, we daily expected to hear of peculiar disturbance on the earth. We had not long to wait. The whole heavens were hung with a drapery of clouds until Sunday, November 19th, when the sky became clear, remaining so four hours, during which the spot was closely observed with high magnifying eye-pieces. The disruption was complete; the jet-black portions of the spot had broken into five huge masses, and another had developed at some distance, though partially submerged by fire.

At 8:30 A. M. two tongues of flame projected two-thirds the distance across the largest black division, apparently seeking to go across.

A 9:30 A. M. a jet started out from the opposite side, and extended toward the approaching end of the first. It was quite faint for half an hour, then increased in brilliancy, and extended further toward the first jet, which was also drawing nearer.

At 10:00 A. M. the ends of both flames became very bright and grew larger, with only a narrow line of black space between, when an approach and union seemed ready to take place at any moment. We watched with intense interest to see them unite, when clouds covered the whole celestial vault and remained all day, putting an end to astronomical observations. For fear of giving wrong impressions as to the rapidity of these movements, we will say that the tongues or jets of fire moved about as fast in the focus of the telescope as the hour-hand of a clock; we cannot see the motion, but after an interval of five minutes one can discern displacement.

But instances are on record in works on solar physics where the most rapid movements have been seen, such as explosions and sudden outbursts of flames. On October 7, 1880, Professor C. A. Young saw an outburst which hurled solar matter vertically to a height of 350,000 miles. At 10:30 A. M. the jet was 40,000 miles high; at 11:00 A. M. 80,000, and at noon the enormous altitude of more than 250,000 miles was attained, while at 12:30 P. M. the column of fire had subsided back again into the flames of the Sun. The velocity of ascent in this case was sixty-six miles per second, although in other cases a velocity of 200 miles per second has been observed.

Besides the five divisions in the great spot of November 15–19, 1882, we counted 108 in close proximity. Whenever we observe a large spot we are nearly always sure of finding many others around the edges. This great cluster then contained 113 distinct black spots, while on other portions of the Sun twenty-three more were to be seen. It is one of nature's mysteries why a solar upheaval should be followed by unrest upon the earth. Yet since the invention of magnetographs and spectroscopes proof seems conclusive. The magnetic or electric impulse requires but little time to traverse the mighty void between the Sun and Earth, as almost instantly after an outburst is observed on the Sun with a tele-spectroscope the instruments in magnetic observatories automatically record violent displacement.

On August 5, 1872, Professor Young beheld a powerful disruption on the

Sun that cast up matter with a rate of 120 miles per second. On writing to England he received reply that at the same time the British magnets were in agitation. Many theories have been advanced in explanation. One quite ingenious was announced by Barlow, who regarded the earth as a helix. He took a wooden globe and placed it on an axis inclined 23½° from a perpendicular, like the axis of the Earth. He passed insulated wires around it in positions in relation to latitude that isogonic and isoclinic lines are known to occupy on the real Earth. Above the globe at different places he suspended horizontal and dipping needles and then passed a strong electric current through the encircling wire. The needles behaved with remarkable similarity to those on the Earth, dipping and changing declination very much as do actual magnetic needles. He thought, therefore, that currents of electricity around the Earth induced terrestrial magnetism. But how magnetic unrest on the Sun affects this earthly current is still unknown. Some think the Earth a vast thermopile, which, when one side is heated by the Sun, produces changes in intensities of earth currents affecting the strength of the magnetic induction in such a way that the needles are enabled to detect it. But no known fact in thermo-electricity substantiates this idea. Again, the spectroscope, armed with a bolometer, reveals that sun-spots emit less heat than the solar surface, rendering the theory untenable. The bond of union between auroras and oscillations of the Earth's magnetism is also unexplained.

The whole series of experiments conducted during the last hundred years may be summed up into three facts: 1. The sun-spots have a periodic time of about eleven years. If we have, say, this year a maximum number of sun-spots, in eleven years another maximum will occur, requiring two years to reach the greatest number and two years to decline, the remaining seven years of the eleven presenting few periods of agitation on the Sun. 2. The number of auroras is the greatest during the year of sun-spot maximum. 3. At the time of the greatest turbulence on the Sun the most rapid changes in electric force takes place on Earth.

The sun-spot of November 17th, the aurora, and the magnetic storm were among the most remarkable known.

The present spot is so large that anybody can see it by simply viewing the Sun with a smoked glass.

The history of astronomy presents several such instances. In A. D. 807 a large solar spot was seen by the inhabitants of Europe; Kepler saw one in 1609; and that of April 16, 1882, could also be seen without other optical aid than a darkened glass.

We timed the transit of the spot on November 19th, the time across central wires being 13 seconds. With a solar parallax on 8.8″, the linear value of 1 second of arc at the Sun's distance from the Earth is 450.309 miles. Since 1 second of time of the Earth's rotary motion is equal to 15 seconds of arc, 13 seconds is equal to 195 seconds arc in space, which, multiplied by 450.309

gives 87.810 miles as the length of the spot; a length 20,000 miles greater than that of the spot of April 16th.

This measurement is that of the extreme length of the cluster including outlying spots and penumbra, and is not nearly as accurate as if made with a micrometer, but is correct, however, within 3,000 miles.

Study of solar phenomena is one of the most exciting lines of research, and it is to be hoped that with the powerful tele-spectroscopes, now capable of being made, together with sensitive instruments for the detection of magnetic pulsations, a hitherto unknown law of nature will soon be discovered able to solve the mystery.

November 20, 1882.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

Electric Lamp.—A recent English invention in electric lamps has four movable circular carbons which are combined with the usual carbon-holder, gear and regulating pinions, frame, armature, and magnet.

Mining Submerged Rock.—A late inventor has constructed a dredging vessel formed of a rod with two parallel rows of teeth projecting upward and outward therefrom and provided with closing end-pieces. It is dragged by a bail pivoted at the ends to the ends of the rod, and limited in motion by guide-slots at the top of the end-pieces. These rows of teeth, or prongs, are symmetrically arranged on opposite sides of the rod so that each set in turn operates to gather or retain the deposits as the dredge is drawn back and forth upon its one side, or the other, over the surface to be dredged.

Combined Coal-Hod and Sieve.—This novel coal-hod is provided with a removable bottom beneath which is located in horizontal ways a reciprocating sieve. When it is desired to sift the ashes gathered in the hod, the bottom is swung out of the way so that the ashes fall upon the sieve.

Electric Incandescent Lamp.—One of Edison's latest inventions comprises a method of manufacturing incandescent electric lamps, consisting in forming the enclosing bulb or globe directly from the molten or pot-glass, forming separately the supporting tube or neck for the incandescent conductor, sealing therein the leading-in wires, attaching the carbon thereto and then hermetically uniting the parts by a welding together prior to the exhaustion of the lamp.

Safety-Stop for Elevators.—This elevator has in combination with the suspension rope a counter-balance weight at its end and stop mechanism attached to the car. A safety-rope is employed having one end connected to the safety-stop mechanism and its free end passes through the counter-balance weight of the suspension rope, whereby the safety-rope is adapted to sustain the counter-balance weight when the suspension rope breaks and thereby apply the stop mechanism to arrest the motion of the car.

Staining Glass-Windows.—M. Oudinot, of Paris, has invented a process of coating stained glass with metal, which consists in first applying over the whole surface of the stained glass a coating of metallic powder, flux, and adhesive substance. The design is then perfected by removing more or less of the coating from some portions and increasing the coating on other portions, and in finally firing the glass thus coated. M. Oudinot has also devised a process of ornamenting glass for architectural purposes. This he does by first delineating the outlines of the design upon the glass, then coating such parts of the glass as are not included in the design with a mixture of gold powder and a liquid composition of ground glass or silex. The design is then covered with enamel of the desired colors and finally subjected to the fire.

EDITORIAL NOTES.

On the 15th day of November earthquake shocks were felt all through the central western States; on the 16th a most remarkable sun-spot was visible, even to the naked eye protected by a smoked glass; on the 17th a most notable electric storm that pervaded the whole extent of the United States, and on the night of the 17th a very brilliant auroral display. About the same time a severe snowstorm swept over the eastern and New England States.

On the 19th of November the first snowfall of the season occurred here, lasting an hour or more and amounting to less than half an inch in depth. Last year our first snowfall occurred November 17th and amounted to three-quarters of an inch. So far, no ice has formed here over one inch in thickness.

It will require $2,500 to satisfactorily complete the work of the American Archæological Institute at Assos, and the President, Prof. Eliot, of Boston, appeals to the friends of Science to come to its aid.

Mr. Frank Bush, of Independence, Mo., proposes issuing, about the first of this month a neat little volume devoted to a description of the plants found in this county, under the title of "The Flora of Jackson County." Price 25c. It should be purchased by all persons interested.

Prof. D. S. Jordan, of the Indiana University, is preparing for a summer tramp through Scotland, Norway, Germany, Italy, Switzerland, France and England, in June, July and August, 1883. This excursion is to be known as the "Indiana University Tramp," the party is limited to thirty persons and the expenses of each are not expected to exceed $350.00.

The University of New Mexico, located at Santa Fe, calls upon liberal Chris ians all over the country to contribute to its endowment and building fund, as the only incorporated Protestant College in the Territory. It needs $20,000 for the first named purpose this year and $5,000 for the second.

THE proposed substitution of soft Bessemer steel for iron in the manufacture of nails, etc., at Wheeling and Pittsburgh will create quite a revolution in the iron manufacturing business, inasmuch as it will do away with puddling and puddlers and thus cheapen the cost as well as lessen the dependence on laborers. At a recent meeting of the Tariff Commission it was asserted that within five years low-grade Bessemer or open-hearth steel would take the place of iron for every purpose for which it is now used.

THE new permanent station for the Signal Service at Pike's Peak has at length been completed, as well as the construction of a telegraph line to connect the station at the summit of the mountain with the world below. The signal station is 14,000 feet above sea level, and 6,000 feet above Colorado Springs, and is constructed of granite laid in cement to resist the furious storms of that locality.

THE revelations of the "Zoöpraxiscope" in the hands of Mr. Muybridge regarding the positions assumed by animals in motion will give painters and sculptors several new ideas and if heeded will cause great modifications in their ordinary representations of horses, dogs and other common animals when running, trotting, etc.

PROFESSOR WILLIAM HARKNESS, of the United States Transit of Venus Commission, requests the publication of the following:

"There are many persons scattered over the country who have good telescopes, and who would be glad to observe contacts during the coming transit of Venus if they had any means of obtaining Washington time. The Western Union Telegraph Company has most generously agreed to give wide distribution to noontime signals from the Naval Observatory, December 4, 5, 6, and 7. As this service will be wholly gratuitous on the part of the telegraph company, the officers request all persons who intend to make accurate observations of the transit to immediately notify the nearest Western Union Telegraph office, as the transmission of signals will involve the use of many thousand miles of wire and the making up of many special circuits, all of which must be planned beforehand. Furnishing these signals free of cost to all observers is a contribution to science on the part of the Western Union Company which will be appreciated to every one interested in astronomy."

PROFESSOR SCUDDER is receiving no small amount of "chaff" from the daily papers, based upon an article read by him before the National Academy of Science, entitled "The Triassic Insects of the Rocky Mountains," which he explained to have been largely the ancestors of the common cockroach. Supplementary essays by the reporters are numerous and some of them quite amusing, it evidently being a familiar subject with them.

PROFESSOR A. V. LEONHARD, late instructor in assaying at Washington University, St. Louis, has opened an assay office and laboratory at 322 Chestnut Street in that city.

DR. PHENE, the noted English antiquarian and archæologist, has started from St. Louis on his return home. Dr. Phene has visited the principal aboriginal monuments yet remaining in this region and the chief collections of antiquities as far north as Lake Superior, and doubtless found much to add to his already vast stock of antiquarian knowledge.

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY is one of the periodicals of which we delight to say a word in commendation. The REVIEW is chiefly a record of progress in science, although mechanic arts and literature are not foreign to its scope. The large work which it entails is to its editor, Mr. Theo. S. Case, chiefly a labor of love; but his zeal and public spirit ought not to be put to too severe a test. Every student and every person who wishes to keep informed on the topics with which it deals ought to be a regular reader of this magazine.—*Industrialist.*

DR. JOHN G. LEMMON has recently returned to San Francisco from Arizona, where he reports having found two or three species of potatoes growing wild in the mountain meadows or parks, probably as much as 6000 feet above the sea level.

ITEMS FROM PERIODICALS.

THE *New Medical Era and Sanitarian* is the title of a new medical monthly to be issued January 1, 1883, by Dr. A. L. Chapman of this city. It will be devoted to medicine and sanitary science, will contain fifty octavo pages and will be furnished to subscribers at the exceedingly low price of $1.50 per annum. Dr. Chapman's long experience and ability will enable him to provide his readers with much valuable information.

Knowledge says that "The comet which came to perihelion on September 17th last, seems to be a return of the comet of 1658 which is probably the same as the comet of 1843 and the comet of 1880. If so, there seems every reason to believe that in a few months will see the comet back yet again, and that the end will then not be far off,—the end of the comet we mean, not the end of the earth, as some seem to imagine."

Professor H. A. Howe, of Denver, Col., arrives at opposite conclusions and says that this comet is not the one of 1843, and that there is not danger that it will tumble into the Sun next year or at any other time.

THOS. PRAY, JR., editor of *Cotton, Wool and Iron*, formerly the Boston *Journal of Commerce*, of which we have had frequent occasion to speak highly as a first-class commercial and mechanical journal, expects to have his work, "Twenty Years with the Indicator," ready for delivery by January 1, 1883. Royal octavo, pp. 144, $1.50.

WE find in the Missouri *Republican* of November 19th, a report of a very interesting lecture by F. F. Hilder before the Century Club, upon the "Rise, Growth and Decay of Ancient Art."

THE *Atlantic Monthly* for 1883 will contain, in addition to its variety of Serial and Short Stories, Essays, Sketches, Poetry, and Criticism, the following specially attractive features: Oliver Wendell Holmes will write frequently and exclusively for it; Henry Wadsworth Longfellow left a completed dramatic poem entitled "Michael Angelo," which he was more than ten years in writing. The first installment of the poem, which is in three parts, will appear in the January number; Nathaniel Hawthorn left among his manuscripts the plan and sketches of a novel, which will appear in *The Atlantic* under the title, "The Ancestral Footstep: Outlines of an English Romance." The first portion appears in the December number, with an introduction by Mr. George P. Lathrop. It will be continued in the earlier numbers of 1883; Mr. James will also write a new story and some critical and literary papers, such as the readers of the magazine have heretofore found so admirable; Mr. W. D. Howells, author of "Their Wedding Journey," etc., whose stories and essays have so often delighted the readers of *The Atlantic*, will from time to time send to the magazine from Europe sketches of travel, character, and literature; Mr. Charles Dudley Warner, author of "My Winter on the Nile," "My Summer in a Garden," "Backlog Studies," etc., promises several papers for the coming year.

FOWLER & WELLS are about to publish "A New Theory of Species," by Benj. G. Ferris; "Traits of Representative Men," by Geo. W. Bungay, and "Forty Years in Phrenology," by Nelson Sizer.

THE Boston *Literary World*, in speaking of the REVIEW, says, "it makes an appeal for a more generous support, which it fully deserves. In a modest way it is doing a good work."

THE *Iowa State Register* of November 16th, contains the Proceedings of the DesMoines Academy of Science, including an excellent inaugural address by President A. R. Fulton.

Harper's Monthly is unusually rich, as its December contents show: Decorating the Church for Christmas, drawn by F. Dielman, (Frontispiece); The Columbia River, Cleveland Rockwell, (with 13 illustrations); William Black at Home, Joseph Hatton, (with 6 illustrations); Found Drowned—A Poem, Dinah Mulock Craik, (with 1 illustration by Abbey); The Great Sea-Port of Western France, Thomas W. Knox, (with 12 illustrations); The Bride-Cake—A Poem, Robert Herrick, (illustration by E. A. Abbey); Southern California, III, William Henry Bishop, (with 18 illustrations); Some Day—A Poem, Isabella Grant Meredith; His Poetrie his Pillar—A Poem, Robert Herrick, (illustration by E. A. Abbey); Cameos of Colonial Carolina, P. D. Hay, (with 9 illustrations); The Singular Vote of Aut Tilbox, (with 3 illustrations by A. B. Frost); Storing Electricity, Henry Morton, (with 7 illustrations); For the Major—A Novel, Constance Fenimore Woolson, (with 1 illustration); Among the Rose-Roots—A Story, A Working-Girl; New England in the Colonial Period, John Fiske; The Two Fleets—A Poem, Eugene Bolles; Tom's Moniment—A Story, Susan Hartley Swett; Shandon Bells—A Novel, William Black, (with an illustration by William Small); Editor's Easy Chair; Editor's Literary Record; Editor's Historical Renord; Editor's Drawer.

THE *Popular Science Monthly* presents the following table of contents for December: Mr. Goldwin Smith on "The Data of Ethics," by W. D. Le Sueur, B. A.; Time-Keeping in London, I—by E. A. Engler, (illustrated); The Relations of the Natural Sciences, by T. Sterry Hunt, F. R. S.; Brain-Weight and Brain-Power, by J. P. H. Boileau, M. D.; The Cell-State, by Professor Ferdinand Cohn; American and Foreign Asphalts, by E. J. Hallock, Ph. D.; Speculative Zoölogy, I—by Professor W. K. Brooks; Annual Growth of Trees, by A. L. Child, M. D.; Science in Relation to the Arts, II—by C. W. Siemens, F. R. S.; Musical Sensations, by M. Héricourt; Is Fingal's Cave Artificial? by F. Cope Whitehouse, M. A., etc., (illustrated); The Spectroscope and the Weather, by C. Piazzi Smith; Criminality in Animals, by A. Lacassagne; Sketch of Matthias Jacob Schleiden, (with portrait); Entertaining Varieties; Editor's Table: Spencer's Impressions of America—Principle in Small Things; Literary Notices; Popular Miscellany; Notes.

IN connection with the first volume of the "Surgeon's Stories"—Times of Gustaf Adolf—which Jansen, McClurg & Co. will issue in a few days, the following from a late number of the *New York Nation* will interest our readers:

"A noticeable literary phenomenon is the sudden and widespread revival of the 'Surgeon's Stories,' by Prof. Z. Topelius, a translation of which is in the press in this country, and will probably also be brought out in England. A new translation of them is being also made in Germany, and a new edition has just appeared in Denmark, published by P. G. Philipsen, Copenhagen; the translator being Fr. Winkel-Horn. Finally, the Swedish publisher of Topelius's works, Albert Bonnier, has in preparation a superb illustrated edition, the designs for which are by Larsson (the same artist who illustrated Bishop Wallin's fine poem, 'The Angel of Death,') and will number 350, or between fifty and sixty for each volume. Few works offer such abundant material to the artist. Topelius's tales cannot fail to have a great success in all Protestant countries, and Mr. Bonnier intends issuing an edition of 15,000 copies of the new illustrated series, at the same price as that of the original edition without illustration."

THE New York *Observer*, pioneer of the religious press, enters upon its sixty-first volume with the new year. Undenominational, unsectarian, evangelical and national, it is just the right kind of a newspaper for family reading and is a favorite wherever it is taken. $3 15 per annum.

PROF. GEO. C. SWALLOW, for many years connected with the University of Missouri, and formerly State Geologist, has removed to Montana Territory and is now editing the Helena *Independent*.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. JANUARY and FEBRUARY, 1883. NO. 9-10.

ASTRONOMY.

TRANSIT OF VENUS, DECEMBER 6TH, 1882.

EDGAR L. LARKIN, NEW WINDSOR, ILLINOIS, OBSERVATORY.

The beginning of the transit was witnessed at this observatory. The sun rose clear on that eventful day, and the winds were hushed into a calm, while the atmosphere was in fair condition for telescopic manipulation.

The sky at sunrise, 7h. 15m., was clear in all directions, and remained so until 7h. 30m., when faint tufts of clouds in rapid motion appeared in the northwest. A light but cold wind began, and in a few minutes heavier cloud-masses appeared—the fore-runners having reached the zenith, moving rapidly eastward. At 7h. 50m., a huge bank of lead-colored clouds had attained an altitude of 50 degrees in the west, and matters assumed a dubious appearance. The hopes and expectations cherished from boyhood seemed about to be crushed by overwhelming disappointment.

At 7h. 55m., a cloud detached itself from the rising wall and moved toward the sun, obscuring it at 7h. 58m. Surely the times became critical, for the transit by computation made for the longitude of New Windsor was to begin at near 8h. 1m. The cloud must move away in three minutes, or we would fail to behold the first contact.

We remark that five minutes before the calculated time of contact we set the telescope precisely on Venus by means of its computed place in space, as found in that admirable work, the "American Ephemeris." To parties not familiar with these things, we have to say that of course Venus was invisible, but we placed the telescope accurately on the unseen world by the aid of two graduated circles of metal called the Right Ascension and Declination circles, which are rigidly attached to their respective axes on the equatorial.

These, in connection with a sidereal clock, enable one to set the telescope on any invisible celestial object whose position is catalogued. Thus: any star can be found at noon, as well as at night, the observer not looking at the sky to find the object, but upon the verniers near the ruled edges of the measuring circles.

By this method the glass was placed on Venus before it came in sight between the earth and sun, in order that precious time might not be wasted in adjustment when it made its appearance.

At 7h. 59m. the sun was still obscured, but the cloud had nearly passed to the east, light appearing on its western side with increasing brilliancy, when at 8h. the sun burst into view.

Instantly we began close scrutiny, striving to detect the first indentation on the solar edge by the advancing world. A watch regulated with great precision, and indicating mean Washington time, was placed on the telescope close to the solar eye-piece, so that a reading of its seconds' hand could be made in an instant. There were three time-pieces in the observatory, all regulated with care. One read sidereal; another, mean Washington, and the other mean solar time at New Windsor.

Through the kindness of Vice-Admiral Stephen C. Rowan, U. S. N., Superintendent of the Naval Observatory at Washington, and the courtesy of the Western Union Telegraph Company, we received accurate time by telegraph direct from the mean solar clock at the observatory in Washington, hearing its seconds' pendulum beat in New Windsor. These time signals were sent at mean Washington noon on December 4th, 5th, 6th, and 7th, by direct circuits to receiving observatories. This was a work requiring great care and skill on the part of the officers, since receiving stations were in all directions from Washington, but must receive the signals at the same instant of absolute time from the same clock.

We insert the scheme for the transmission of time, devised by the American Transit of Venus Commission, and put into successful execution on the days mentioned. We quote from the circular issued by the Commission to observatories: "The signals to be sent out by the observatory are wholly automatic, and consist of a series of short breaks, so made in a closed telegraphic circuit as to represent the beats of a mean-time clock. They begin at 11h. 56m. 30s., and close at 12h. 0m. 0s., Washington mean time. During the interval there is a break at the beginning of every second, except that in each minute the breaks corresponding to the 29th second, and to the 55th, 56th, 57th, 58th, and 59th, seconds are omitted. Thus, the first break after the pause of five seconds always marks the beginning of a minute, and the first break after the pause of one second marks 30 seconds. At 12h. om. os., there is only a single break, and then the signals cease." At 11 A. M. each day, New Windsor time, we visited the telegraph office with two regulated watches: One indicated mean local solar time, and the other was wound, but had the balance-wheel stopped by a wedge of paper, the hour, minute and second hands being carefully adjusted at 12h. om. os. At 10h. 50m. the officers of the telegraph company ordered all business to stop on the line leading through New Windsor, and that no key be opened. At a time which was 11h. 56 m. 30s. in Washington, we heard the first "click" on the magnet, and at the same instant looked at the seconds' hand of the watch recording local time, and behold! it read 11h. 2m. 37s. Therefore the difference in time between Washington and New Windsor is 53m. 53s.; or, in other words, the longitude of this place is 53m. 53s. west. Here is a record of the time as checked on receipt:

Washington Time. *Received.*			New Windsor Time. *As Noted.*		
H.	M.	S.	H.	M.	S.
11	56	30	11	2	37
11	57	—	11	3	7
11	57	30	11	3	37
11	58	—	11	4	7
11	58	30	11	4	37
11	59	—	11	5	7
11	59	30	11	5	37
12	00	00	11	6	7

All the beats and break seconds of the Washington pendulum were distinctly heard over the long wire the same as though we had been in the Naval Observatory; while, in our telegraph office, the regular beating of the clock seemed most impressive. At 11h. 59m. 45s. we placed the point of a pen-knife on the paper stop in the balance-wheel of the silent watch, to be in readiness for the final beat at precisely noon in Washington. In due time it was heard, the wedge was instantly removed, the tiny balance began pulsation, and we had absolute Government time. This was repeated each day to learn the error in twenty-four hours of all the time-pieces.

This watch, reading Washington time, was placed on the telescope just before the time of the transit on December 6th, and we began to look at 8h., remaining motionless, so that vision might not be disturbed. We gazed intently for one minute, and no world came in sight. Could we have made an error in calculating the local time of beginning for this longitude? Another half minute passed away and no notch on the sun was seen; then eleven seconds elapsed, when, behold! a delicate line of black appeared on the southeastern limb of the sun! It was the transit of Venus! Instantly reading the watch keeping New Windsor time, it indicated 8h. 1m. 41s.; and by its side the watch having Washington time read 8h. 55m. 34s., the difference in the reading being 53m. 53s., as learned by telegraph, and also by astronomical methods.

Since astronomical time begins at noon, and counts to 25 hours, we may say that contact I. began December 5th, 1882, at 20h. 55m. 34s., or December 6th, 1882, at 8h. 55m. 34s , mean Washington, or 20h. 1m. 41s., mean local time. But all our labors will prove of no value to science, as we are still in doubt as to the actual time. We are not sure whether the time was 8h. 1m. 39s., 41s. or 42s., all because the cloud was followed by a train of vapors that caused the sun to "boil" furiously. All the care of the telegraph company, the trouble of regulating clocks and watches and other labors will be of no real value, we regret to say, so far as this observatory is concerned, since there is an uncertainty of three seconds—an error that will destroy the result of any delicate astronomical computation. To telescopists we remark that this vapor mass caused a violent "boiling" of the solar periphery, making it assume the appearance of a seething, turbulent mass of fire, in such agitation as to preclude anything like accurate determination of time of contact. The planet advanced, cutting a deeper and deeper curved black space from the solar limb until, when two-thirds on the sun, a most beautiful spectacle was seen. This was a semi-circle of light suddenly made visible on the external edge of Venus, and was caused by the refraction of the sun's rays by the planetary atmosphere.

The air on Venus must be deep—much deeper than that on earth ; for, near as we could judge without micrometrical measurement, we should say that the band of light was equal to one-thirtieth the radius of Venus. Some say the earth's atmosphere is 45 miles deep; others think it is a hundred, but one hundred miles is only the one-fortieth part of its semi-diameter.

Finally the moving black sphere approached contact II., that is, the external edge came within the solar periphery.

The vapor in our atmosphere at the time was dense, and the "boiling" furious; but the time of internal, or contact II., near as possibly could be determined, was 8h. 22m. 20s., Venus requiring 20m. 39s. to traverse a distance equal to its own diameter, as projected on the sun, and seen from the earth. This time would have been much shorter had the earth remained motionless in its orbit, but our world moves in the same direction around the sun that Venus does, though not so fast, hence the apparent motion of Venus on the sun was what it gained on the earth. We saw no "black drop," a phenomenon sometimes seen at transits of Venus, when a dark band lingers a few moments between the edges of the sun and Venus. When the planet was fully on the solar disc, we made close examination, hoping to detect a halo around it caused by its atmosphere, but failed to see it, but the seeing was not first-class, owing to the turbulence in the terrestrial atmospheric envelope. The angular diameter of the sun is 1,924 seconds of arc, and that of Venus at transit was 65, hence the apparent diameter of the sun was 29.6 times greater than that of the planet moving across its disc. The scene was calculated to impress one's mind with sublimity, and when we saw the first contact we could not repress a sense of admiration for those students who made known the minute details of that vast mechanism, the solar system, and calculated the phenomenon one hundred years ahead—true to less than one minute of time. Contemplation of such magnificent works of nature cannot fail to make men desire more knowledge, and to awaken in them a spirit of research into still more profound labyrinths. The closing scene then began, the mighty cloud-bank drew nearer the sun, and finally put out its light at 9h. 5m., hiding from our eyes the glorious view forever, as another transit will not occur until June 8th, 2004. An appalling storm raged for thirty hours, the thermometer reaching a depression of 13°. below zero. We append a table of results as deduced at this observatory:

Results.	Civil Time, Dec. 6th, 1882 h.	m.	s.
Mean local time of contact I	8	1	41
Time of transit across solar limb		20	39
Mean local time of contact II	8	22	20
Mean Washington time of contact I	8	55	34
Mean Washington time of contact II	9	16	13
Astronomical time of contact I., New Windsor, Dec. 5th, 1882	20	1	41
Astronomical time of contact I., Washington, Dec. 5th, 1882	20	55	34
Longitude of New Windsor (West)	—	53	53
Probable error	—	—	23

Latitude of New Windsor, 41°, 13′.

DECEMBER 20th, 1882.

ARCHÆOLOGY.

THE KITCHEN MIDDINGS OF MAINE.

PROF. F. W. PUTNAM.

During the months of November and December, 1882, Professor Putnam, Curator of the Peabody Museum of Archæology, delivered a series of five lectures on "American Archæology" at Cambridge, Mass. These lectures were partly in the nature of a report to the subscribers to the fund for such researches of his explorations during the past summer, and partly to arouse among others an interest in the subject by describing the methods pursued in systematic explorations, and by exhibiting the results.

We copy from the Boston *Transcript* a report of the first lecture of the course, having the above title.—[ED. REVIEW.

"The specimens on the table before you may seem insignificant, and some of them you may even look upon as 'scientific dirt,' but they will serve to show you the material of which shell heaps are composed. But first, I will answer a question which has probably occurred to many of you, and that is, 'What is a shell heap?' It is simply the refuse pile of a village, or family, of a large or small number of people living for a time at one place. Kitchen-midding is one name which has been given to such deposits, and they have received the common term of 'shell heaps' in this country, simply from the fact that the many and often immense banks of shells which occur along our coasts and on our river sides were known as shell heaps or shell banks long before it was known that they were formed by the hand of man. The specimens in the trays which I have passed about were taken from three parts of a large shell heap at Keene's Point on Muscongus Sound.

"This heap is four or five feet thick on the water edge, and extends several hundred feet along the shore and a hundred feet inland. In the upper part of the heap, just under the sod, the shells are much broken; in the central portion they are often reduced to a fine powder, and mixed with the ashes found throughout the heap; in the lower part the valves of the shells are often whole, and are filled with the soil upon which they fell when the refuse pile was started from the material thrown aside by the first inhabitants of the place. In this next tray are perfect valves of the common clam (Genus *Mya*), which enters most largely into the formation of the heap, of the quahaug (*Venus*), of the scallop (*Pecten*), of the whelk (*Buccinum*), and of the cockle (*Natica*). The bivalves were, probably, commonly opened by roasting, after which the animal was eaten and the shells tossed aside, so that you will seldom find together the two valves belonging to the same shell. Some valves of the quahaug and also the shells of the whelk and the cockle have been found broken as if by a hammer before cooking.

"In addition to the shells, bones of animals were obtained in great number. Most of these are broken into small pieces, probably for the double purpose of getting at the marrow and of reducing them to a size adapted to the ordinary cooking pot. Although the bones of mammals were more often those of the moose, deer, bear, wolf, fox and beaver, yet there were also found bones of the otter, skunk, fishes, coon, woodchuck, seal and porpoise. Bones of several species of birds occurred, also some bones of the turtle, while fishes were represented by the cod, flounder and great goose fish, giving with the mollusks quite an extended bill of fare. The bones and shells were broken with hammer-stones, which are found scattered through the heap. These stones were probably picked up on the seashore and kept about the house or near the fire so as to be handy for use in preparing the food.

"Beside these rude stone hammers we find occasionally an implement so rude in character that you might think it to be a stone picked up at random on the shore, but on looking more carefully you will see that it is chipped, with the evident intention of forming a pointed implement with a cutting edge. I will pass about a tray containing other tools and chips of stone, which, though generally known as arrow points, I am inclined to believe to be rude knives, which were probably set in wooden handles. These little circular pieces of stone, you will see, have had from twenty to thirty little chips taken off the thick, rounded edge, fitting it for cutting or scraping, and such implements are known as scrapers. So many chips of stone were found in the heap as to lead to the inference that the implements were made upon the spot. It is seldom that we find in a shell heap anything exhibiting a great amount of labor in its manufacture. From this heap, however, I procured one polished celt, which had been carefully chipped and pecked, and then rubbed on a coarse stone, like sandstone, to sharpen and polish the edge. In the shell heaps of Maine I have found more objects of stone than have been found in the explorations of heaps south of this point, stone implements being usually scarce in shell heaps. Implements made of the bones of deer and of birds are comparatively common in all heaps, and here I have found bone points or perforators and bone spear points in shape like huge crochet needles, which is the primitive form of harpoon the world over. Another harpoon in bone, the only one of its kind which I have seen from the Atlantic coast, but a common form upon the Northwest coast, is this specimen found and presented by Mr. A. T. Gamage of Damariscotta. It is a harpoon point having a hole in its shank through which a string was passed attaching it loosely to the shaft of wood into which it was inserted. When a fish was speared, the shaft would be set free by the struggles of the fish, and floating its line's length upon the water, would guide the fisherman to his prize. The discovery of the art of pottery seems to have been made during the immense time these heaps were being formed, as I have not found fragments of pottery in the lower portions of the older and larger heaps, while such fragments are common in the upper beds and in the more recent heaps. The specimens from Maine are of a rude type, thick and heavy, and composed of a mixture of clay and pounded clam shell. The lines of fracture show that the pottery was made by the coil method, common not only among our Indians, but among the primitive potters in various parts of the world. The ornamentation is of the rudest character, made up of incised lines or by the impress of twisted cord. The last method is instructive, as it shows that the people understood the art of twisting fibres into threads and cords. Few personal ornaments occur in shell heaps, but I hold here a canine tooth, grooved about its root as if for suspension as a pendant.

"While the Keene's Point shell heap is made up largely of clam shells, other heaps occur which are composed almost entirely of oyster shells, as, for instance, the immense heaps at Damariscotta and Newcastle, situated opposite each other on either side of the Damariscotta River. I would call your attention to the fact that this is an old-fashioned oyster, for which one might now hunt for days, although it was once abundant on the New England coast. It is slender and long, many being even fourteen inches in length. Old men at Damariscotta say that their fathers have sometimes seen one, but it has probably never been abundant since the time of the earliest settlement, so that we must believe that these great heaps were formed long before that time.

"Human remains are not common in the shell heaps of the Atlantic coast. In Florida, however, Prof. Wyman discovered in the shell heaps masses of broken human bones, which are considered to be the remains of a cannibal feast. There are some indications that cannibalism existed among the shell-heap people of our northern Atlantic coast, but the evidence is not yet sufficient to justify the assumption. In the great shell heap at Newcastle a human skeleton was found, a few years since, which was given me by Mr. Charles Metcalf; and in a shell heap on Fort Island in the Damariscotta River, Messrs. Gamage and Phelps discovered portions of five skeletons, of which these two skulls and these bones form a part. The skulls are long, like those of our New England Indians.

"For the general consideration of shell heaps, I will refer you to the chapter on the 'Danish Kjökken-möddings, or Shell Mounds' in Lubbock's 'Prehistoric Times;' and for an account of the American deposits, to the memoir by Dr. Jeffries Wyman on the 'Fresh Water Shell Mounds of the St. John's River, Florida,' and to his papers in the *American Naturalist*, Vol. I, January, 1868, and Vol. II, 1868. A sketch of the Atlantic coast shell heaps will also be found in Dr. Abbott's recent work, entitled, 'Primitive Industry.'"

The second lecture of the course was upon

THE STONE GRAVES OF BRENTWOOD, TENNESSEE.

"Brentwood is situated on the Little Harpeth River, fifteen miles from Nashville. The central portion of the farm is a natural elevation, surrounded by low land running off to the Little Harpeth. Two very cold springs rise on the side of the hill. This beautiful spot was chosen by the Stone-Grave people for a village site. Here they dwelt and cultivated the land, raising corn, squashes and beans. The character of their houses is not known, but probably these were framed of upright posts, roofed with branches, and covered in with bark or clay. Some such structures have left, by their decay, circular ridges of earth, showing the outlines of the houses. In the Annual Report for 1878 is a diagram of one of these towns which I explored and a description of objects found at that time, which are of the same character as those found since in this region

"The distinguishing feature of these people is the burial of their dead in stone graves. Stone graves occur from Kentucky to Alabama and Georgia, but are more numerous in the Valley of the Cumberland than in any other part of that great region. Occasionally similar graves have been found outside of these limits, as in Ohio, Illinois, and even in New Jersey, but these isolated cases may or may not be of the same people, since similar cists, or stone graves, are also common in various parts of the Old World. To open these graves and remove their contents may seem like sacrilege, but there is no other way to study the history of this people, and again if they were not opened for science, their contents would be turned over by the plough, as is now the case every year. From the Cumberland Valley there have been brought to the museum the contents of several thousand stone graves, forming by far the largest collection ever brought together. On the farm at Brentwood the graves covered a knoll or small hill; upon the top of the hill they were very numerous and close together; on the sides groups of graves were found, or here and there a single grave.

"The bottoms of the graves were usually paved with fragments of rude pottery, or with small, flat stones; the sides and ends formed by great slabs of limestone, and the whole covered in with one or more slabs of limestone. The average length of the large graves is six feet, their width averages about eighteen inches and their depth ten inches. The slabs forming the sides and ends are sunk a few inches below the level of the bottom of the grave. The covering stones sometimes fitted tightly, but often they were laid across and covered by others, in one case even to the number of fifteen. Besides these large graves small graves, one to two feet long, occur, in some of which the bones are found out of the natural position, as if they had been brought to this place for re-interment; other small graves are those of children. In most of the graves only the bones of a single skeleton were found, but some contained the remains of two or more bodies, and in several graves there were skeletons of adults and children. It was from finding the bones of children and from the size of the smaller graves that there arose in early American archæology the story of a race of pygmies.

"From the eighty graves explored at Brentwood I succeeded in removing forty skulls and many skeletons One grave five feet nine inches long by two feet wide and one foot deep, contained the remains of five bodies—three of adults and two of children. Two of the adult crania have a persistent suture down the middle of the frontal bone, which is rare in the crania of barbarous people, so that it is rather remarkable to have found two skulls presenting this feature in the same grave. A very great intricacy of the sutures of the back of the head is a common character among short-headed people, but, besides numerous supernumerary bones in this region, one skull shows a suture across the parietal never before seen in our collection. Several other skulls are remarkable, one for the great projection of the jaw, another for anchylosis of the skull and first vertebra of the neck, greatly impairing the freedom of movement of the head; still another has the two middle incisors set a little apart, while the lateral incisors seem never to have developed. In one grave the skull of a very old person was found lying on the pelvis of another skeleton, such a mixture of the bones of different persons being not uncommon in these graves; often a single bone, the clavicle or some limb bone, is found buried with the complete skeleton of another individual. The bones bear mark of accident and suffering such as afflict the people of the present time—fracture of the cranium, resulting in death; broken limbs, repaired during life; some shinbones curved and others thickened, as if by rheumatism or some other inflammatory process. An arrow point lodged in a vertebra from the middle of the back, between the shoulders, was probably the cause of the death of the person. Many of the bones are reduced nearly to dust, and others are so very fragile as to prevent our removing them from the graves. From this we could infer a great antiquity for these remains had we not learned that we cannot compute the length of time which has elapsed since the burial by the condition in which the bones are found, for in the matter of time required for the decay of bone, there are great individual variations. One condition alone serves us for a general test of the antiquity of bones. The black oxide of manganese, of which there are but minute quantities in the soil covering any buried body on the top of a hill is absorbed by the water percolating through the soil, and in solution penetrates the substance of the bone in which it is deposited, giving rise to smaller or larger black dots and dendritic forms, such as are seen in some of these bones. When there is considerable of this black dotting we know that the bone has been exposed for a considerable time to this slow process.

"In these graves many objects were placed with the dead, which friends may have thought necessary for their future life. It is curious that while upon the surface of this region immense numbers of stone implements or weapons of good form and finish may be picked up, the stone-grave people seem to have seldom buried these with their dead. One celt, a few knives and some chips embrace all the stone objects brought from the stone graves explored this summer.

"Food and articles of domestic use, or for personal adornment, make up the list of contents of the graves. The broken bones of animals would seem to indicate that cooked meat was placed in the grave, while the shallow dishes common in these graves probably contained some soft edible, as spoons were often found in them. These spoons were cut from the right valve of the *Unio* or fresh-water clam, and often the handle was notched or more elaborately ornamented. They are made for use with the right hand. The best pottery of the region is thin and black; the most common form is that of the small shallow dishes, notched about the rim, which have just been mentioned. A dish like a ladle. and one like a large cup with a hole on either side just below the rim, for suspension, are duplicated in our former collections from stone graves. The most difficult work of the potter of this region was probably to mould the heads of animals or the human head, as is so commonly done on the upper part of water bottles from this locality. This is similar to the highest order of potter's work among the mound builders of the Ohio Valley, showing a similar stage of development reached by these two peoples, for the potter's art is the key to the attainment in culture of an early people.

"Many little objects of pottery, images and tiny dishes, are, I believe, the playthings of the children; for whenever I have removed them from a grave, it has been either from the grave of a child, or if that of an adult, it is one in which a child was buried with the grown person. Coarse pottery in fragments lines many of the graves. In one grave there were large potsherds, to the number of more than thirty. In another grave there were pieces of burnt clay, in which were the impressions of reeds. Here is one pipe of clay, unfortunately somewhat broken.

"As a rule, pipes are very rare in stone graves, not more than ten having been found in the thousands of graves which I have opened.

"Many pottery beads were found of the same shape as the commoner shell beads. A single pearl bead, formed by perforating a larger pearl, was found. Near the head of one body lay a long, slender pin of bone. In a grave containing a perfect skeleton were found two fragments of a human cranium, which had been whittled into their present shape and laid in the grave, but for what purpose is unknown. Though former explorations have brought to light quite a number of copper articles in stone graves, none were obtained from this particular group.

"Descriptions of stone graves will be found in C. C. Jones' 'Antiquities of Southern Indians,' chapter 10; in 'Explorations of the Aboriginal Remains of Tennessee,' by Dr. Joseph Jones; 'Smithsonian Contributions to Knowledge,' 259, 1879, and in the 'Eleventh Annual Report of the Peabody Museum.'"

The third lecture was entitled

THE ANCIENT CEMETERY AT MADISONVILLE AND ITS PECULIAR ASH-PITS.

"In the valley of the Little Miami, three or four miles from Madisonville, are extensive woods of oak and walnut, where the hogs were allowed to run wild, and, by their rooting, uncovered human bones, stone implements and potsherds. In 1878 this attracted the attention of the gentlemen composing the Madisonville Literary and Scientific Society, prominently Dr. C. L. Metz and Mr. C. F. Low, who caused an exploring trench of some length to be dug, and having thus ascertained the place to be the site of an ancient cemetery of considerable interest, entered at once upon the work of scientific investigation, in which the museum has since taken an active part, and the Curator has made two extended exploraations in person. A part of the large number of specimens collected during the past season was arranged on the table.

"The surface was found to be covered with leaf-mould of an average depth of eighteen inches, below which is the hard clay of the region. In the leaf-mould and occasionally a few inches in the clay are found the skeletons, sometimes extended, and sometimes out of the regular position, as if the body had been buried in a bundle, or the bones had been brought here for reinterment. The burials were made here and there without order, but in great number, about one thousand skeletons having been already discovered. Under the leaf-mould many round pits, dug in the hard clay. have been found, the object of which is one of the great puzzles of Amtrican archæology.

"These so called 'ash pits' are sometimes isolated, but often in clusters. Seven hundred have been found in this cemetery, to which they are, so far as is at present known, peculiar. The pits are commonly about three feet in diameter by three or four feet deep, and are filled with fine light gray ashes to near the mouth, where some sand is mixed with the ashes. Human skeletons have been found in two pits, in one instance at the bottom of the pit, and in the other half way down. Human bones have also been found in such positions as to show that burials had occasionally taken place in the clay before the ash pits were dug, while in other cases skeletons in the leaf-mould had been removed in order to dig a pit. The plan followed in exploring the cemetery has been to divide it into blocks, whose corners were marked by four large trees. In one of these blocks explored this summer were found fourteen ash pits dug in the clay, and six skeletons buried in the leaf-mould.

"The human bones on the table show us that the skeletons from the leaf-mould are those of people of about the average height. The tallest person of all measured five feet eight and a half inches. They were brachycephalia. Their shin-bones show a tendency to flattening. At least half of the upper-arm bones are perforated at the lower end, a peculiarity not often found among civilized people. One femur with its corresponding tibia is thickened by inflammation, while two leg bones show repaired fracture, one near the middle, the other at the lower end.

"With one old man were buried a small stone-pipe and a jar. This jar, as well as all the pottery from the leaf-mould, is of a lower type than that from Tenness or Missouri, but it has two distinguishing peculiarities. The dishes have broad flat handles, sometimes two, but oftener four, which are wider above at the rim and below where they are joined to the dish than in the center. These handles are often replaced by the moulded forms of salamanders having the head at the rim, or looking into the dish. Besides these peculiar features, the pottery is not remarkable in its ornament, being cord-marked or incised. Occasionally big lozenge-shaped figures are cut upon it.

"Stone and bone implements are found buried with the skeletons in the leaf-mould, but no implements of copper. Ornaments of copper are not rare. Upon the neck bones of a child buried with an adult a lot of cylindrical copper beads were found, and with them a cross-shaped pendant. Finger-rings were so uncommon in American prehistoric times that, in exploring several thousand graves, I have only come upon them in one grave, which was opened this summer in the cemetery at Madisonville. The skeletons with which the rings were found was that of a woman, and the rings were broad bands of copper, two upon each hand, still remaining on the phalanges.

"In the ashes filling the ash-pits are found the bones of almost every animal known to have lived in Ohio, from the size of the buffalo to that of the woodchuck, but the most common are those or the deer, wolf, bear and beaver. The long bones are broken as if for cooking. Bones of fishes and reptiles occur, and the spurred leg of the wild turkey is often met with among other bird bones.

"Bone implements are very common in the ash-pits. One, whose pattern is unknown anywhere else in the world, was made out of the leg and foot-bones of the deer and elk by cutting a groove along the bone and beveling its edges from within, so as to render them quite sharp. This implement we call a scraper. As the edge became dull it was probably sharpened again and again, until, with continued use and sharpening, it became so thin in the middle as finally to break, and so we get great numbers of the ends of such scrapers, as shown by this tray full.

"Digging implements, made from the antlers of the deer and elk, some more like picks and others more like spades, were probably mounted in handles, and may perhaps have served to excavate the pits in which they are found in great quantities. It would require many digging implements to make so many of these large pits in the hard clay, and it has occurred to me that the massive, perforated shells of the *Unio*, so common in these pits, may have been mounted on handles and used as scoops. Perforators of bone are common; long, slender needles of bone are not rare, while two or three bone comb-like ornaments, having three or four teeth, have been found in the pits.

"Fragments of pottery are plentiful in the ash-pits, but only three perfect dishes have been found in them. Stone implements are also very common, including hammer stones, celts, scrapers, arrowheads and rude knives.

"Not far from the cemetery is a large earth mound, and near by the cemetery are nine earth-circles, which had probably never been disturbed since their formation. These earth circles are from forty to sixty feet in diameter, and are surrounded by embankments averaging two feet high and nine feet wide, which were probably formed by the decay of the walls of the houses of the people formly living here. Now the embankments are covered with verdure. Within the circle the accumulated soil is from seventeen to twenty inches in depth, and on removing this we come upon the compact clay with a central pile of ashes over burnt clay. Fragments of pottery were found near the ashes in great number, of a similar character to those in the cemetery. The singular perforated *Unio* shells also occur within the circles, and stone implements. Pieces of cannel coal from which jet ornaments were probably cut were also found. These are some of the signs of use and habitation which leave, I think, no reason to doubt that the earth-circles are the sites of houses.

"For all that has been said before on the subject of this ancient burial spot, I refer you to the journey of the Madisonville Literary and Scientific Society; to the Proceedings of the Boston Society of Natural History Vol. XXI, May 18, 1881, and to the Harvard Bulletin, 1881."

THE STONE AGE IN OREGON.

There is a little mine of antiquities of the most interesting kind upon the point of land at the junction of the Columbia and Umatilla Rivers. The ancient tribes doubtless made this stern and sterile river bank a place of sepulture for their dead, and the Umatillas more recently have also buried their dead in the same sandy cemetery. Many interesting curiosities from those old, forgotten tribes have been discovered by the casual seekers, and doubtless many of equal interest and value await the more thorough antiquary who will search patiently and systematically the ancient "memloose illahee."

In a few minutes' search at random along the shore of the Columbia, I have found a half dozen relics of the prehistoric Americans of this locality. Searching among the beautiful polished stones along the bank at the east of the Umatilla and south of the Columbia for suitable stones to be decorated with the typical Mount Hood, to grace a writing table or throw at caterwauling felines, I picked up a stone which was remarkably perfect in shape—a perfect circle, polished smoothly, and only marred by a hole through its rim. I was about to "skip it" into the river when the peculiar cutting of the hole, which I at first thought an accident, attracted my eyes, and I found the stone was cut by some being human with pains, which no one at this day can tell us distinctly of, to be perhaps the cover of some vessel or a weight for a fishing net. But a dozen steps farther on I found a stone about the size of a base ball, perfectly round but with a groove half an inch deep running around its widest circumference, giving it a singular symmetry. This was probably used either for a net-sinker or a sort of pestle. A symmetrical stone, hard, smooth and shuttle shaped, about two inches in diameter and nine inches in length was the next find, and with it an old fragment of granite cut into a pestle, which any apothecary of our own day would recognize as a sign manual. The granite one was made with a top cut probably to the shape of the hand, with a rim to prevent its slipping from the grasp, and a macerating end tapering to a larger diameter. I consider this was an ancient relic, because of its chipped edges, worn away by grinding in a mortar as hard as itself.

Bits of bone and small smooth pebbles, nearly of uniform size, a trifle smaller than the silver half dimes, lie scattered about in many places among the sage brush. Occasionally also a perfect and symmetrical stone head is discovered. These three are parts of necklaces, the larger stone beads being worn by the warrior as bears' claws and teeth are now worn by the Sioux and kindred nations; the smaller bone beads by the women. I saw in a valuable and intensely interesting collection of these relics of ancient art, pride and utility, which are in the possession of Capt. J. H. Kunzie, three fine complete necklaces of polished stone beads, of various symmetrical shapes—found, oblong, cylindrical, square, and some of the beads weighing two ounces each. In the same collection are also necklaces of long, white, needle like shells, by common appellation "wampum," the money of the aborigines.

Several fine old stone mortars are also in the collection of Capt. Kunzie. One is of gray granite, handsomely fluted around its outside surface, a broad bead or band as its top, and its bowl symmetrical and smooth. Another, probably made from stone which crops out near the place where it was found, was probably made by later tribes in imitation of the old vessels, which in nearly every case are made from rock which cannot be found upon the banks of the Columbia in a thousand miles of travel, and which is not known to our geology west of the Blue Mountains, except in such cases as the present, where it has been brought to the sand of the Columbia by tribes from the eastward. The Umatillas have a tradition that these people were of the Crow nation. In the memory of the oldest Umatillas the implements and ornaments mentioned have not been used by the tribes on whose lands they are found. The Umatilla, Wasco, Klickitat and many other tribes, barter arrows and spear-points of beautiful shapes, and colors to vie with the agate, yet not one of them can tell how or by whom they were made, and the art is lost.

A word about the most wonderful discovery in this ancient Golgotha, which was unearthed by the gale of March 28th, and found by Master Seymour Kunzie.

Upon a first examination it strikes one as an Assyrian or Egyptian carving, the features and style of ornament being much nearer those wonderful oriental relics of antiquity than our Northwestern Indians would be thought capable of. The use of this interesting relic was probably for a grinding bowl, though its grand, sphynx-like form suggests a nobler use. It is in nearly every case conjecture, when we speak of the purpose which these ancient vessels were intended to serve. This great curiosity is cut from reddish-gray granite, and would require a block a foot square for its dimensions. Its front is a human face, distinct, dignified, and in some aspects, even grand in outline. It is carved with a skill which could have copied nature, yet there is no point of resemblance between the face and that of any modern Indians. Its brow is broad and low, and the wide curving eyebrows suggest the resemblance to rams' horns which Assyrian images have also The nose is almost Grecian, except that the nostrils are wider, and the chin and lower jaw are the reverse of Indian physiognomy. Only the mouth bears any resemblance to our Indian carving. In this feature there is a slight leaning toward the style of some of the Alaska totem faces. On each side above and behind the ear is a protuberance like the fold over the old Egyptian statues, and a claw-like arm extends from the edge of the bowl to the side of the throat, its claws being nearly under the chin of the figure. The hair is not cut in detail. It seems to be in a straight mass, without braiding or ornament. The whole head is well proportioned, and is about full-life size. To me this ancient head has a remarkable fascination and impressiveness.

The spot where these ancient burials were made is worthy of the sacred use the forgotten nations made of it. As I stood there in the March evening, the wind from the great plain brought the faint desert odor of the sage brush and the rushing sound of the turbulent, swollen Umatilla, singing to itself for very loneliness. Before me the grand, noiseless, but irresistible Columbia spread wide, golden in the fiery sunset, and rolling silently and mightily, with boiling, writhing whirls upon its gleaming bosom into the very gate of heaven, it seemed; for at the western horizon where it is lost to view it is a score of miles from the Umatilla, and the low hills are lost in the brightness of the grand sunset light which meets the river at the horizon's verge, and is so wondrously reflected upon its level tide that heaven and earth seem one.—*Oregon and Washington Farmer.*

GEOLOGY.

JURA-TRIAS.

G. C. BROADHEAD.

In 1880 we observed the geological structure around Las Vegas, New Mexico, and in 1881 similar rocks were observed in Southern Wyoming.

Hayden (Colorado and New Mexico, 1869,) speaks of the granites and gneisses of Las Vegas; above these the carboniferous with fifty feet of red sandstone still above and free from fossils which he calls Triassic, and still above he assigns over 300 feet of red and gray sandstone to the Jurassic; from the latter he obtained only a *Mytalus*. Still above this, geologically, is the well known "Hog back" of light colored sandstone assigned by Hayden to No. 1 Cretaceous.

I observed the following: Up the cañon of Gallinas Creek above the Hot Springs, the archæan red granite forming the mountain nucleus arises in bold escarpments for over 500 feet, and still further back reaches still higher in the mountains. Nearer the Springs we find darkly banded gray gneisses.

On the south side of the valley the carboniferous limestones rise up for several hundred feet. Their texture and general appearance and fossils are those of the lower coal measures of Missouri. Among the fossils I observed *Fusulina Cylindrica*, *Chætetes Milleporaceus*, *Lophophyllum proliferum*, *Athysis subtilita*, *Spirifer cameratus*, *Productus longispinus*. Higher up on the mountain side, north, I obtained a fragment of a species of *Lepidodendron* from a coarse sandstone, resembling a species from lower coal measures of southwest Missouri.

Passing down the valley of Gallinas Creek we observe red beds similar to those Hayden describes, but I obtained no fossils. So I would be slow in offering an opinion as to their geological age, but they are certainly of more recent age than those carboniferous rocks above named.

Nearly a half mile below the Springs a beautiful red sandstone very prominently obstructs the course of the stream. This rock affords the fine building stone used extensively at the Springs in constructing the hotel, baths, etc. Passing a half mile or more east of the Springs we ascend the famous "Hogback" formed of nearly white sandstone on edge and almost obstructing the entrance to the valley of the Springs. Eastwardly the rocks gradually become horizontal and are certainly cretaceous. The crest of the "Hogback," for some distance, seems like a marked out road with walls on each side, and from the top a very fine view can be obtained of the valley extending toward the old town of Las Vegas and beyond, as well as Upper Las Vegas and the Atchison, Topeka &

Santa Fe Railroad. The next hill east of the "Hogback" rising nearly 200 feet high, is covered with rounded boulders of rocks resembling those of the Archæan above the Springs.

I observed no fossils in the sandstone forming the "Hogback"; Prof. H. assigns it to No. 1 Cretaceous. The rocks next above and on the east are chiefly dark shales. The sandstone is also well represented along the valley of the Moro on the line of the Atchison, Topeka & Santa Fe Railroad.

It may be that Prof. Hayden has traced these so called Jura-Trias rocks a long distance and found fossils in them.

Before reaching Sherman on the Union Pacific Railroad we observe rocks resembling those of Las Vegas and they are probably of the same age. Approaching Laramie City the Red Buttes are prominent, as are also the red beds to be seen twenty-five miles off to the southwest which I noticed in the August number of the Kansas City Review. I here produce the section therein:

1.— 200 feet White beds on hill-top.
2.—1000 feet of Red beds.
3.— 36 feet of White gypsum.
4.— 100 feet of Red and Gray beds.

In these rocks I observed no fossils. Hayden and most of the U. S. Geologists speak of these red beds occupying a narrow belt east of the mountains and in juxtaposition thereto, extending from north of the Union Pacific Railway southwardly into New Mexico. They also call them Jurassic and Triassic or Jura-Trias, but find no fossils in the Trias east of the mountains, excepting on Gallinas Creek, New Mexico, the Black Hills, mouth of Judith River, heads of Yellowstone, Missouri and Wind Rivers. I give the following as the Bibliography of the Jura-Trias in the western States and Territories:

Prof. Jules Marcon was probably the first who spoke of the existence of the Jurassic and Triassic in western America. From June, 1853, to March 1854, he accompanied Capt. Whipple, U. S. Army, on a tour from Fort Smith, Ark., via Albuquerque, New Mexico, to Los Angeles, California. A portion of his route was reviewed and published in Pacific Railway Reports. His own work is fully detailed in his Geology of North America, Zurich, Switz., 1858. Accompanying this we find a Geological Map of North America on which is colored an extensive area of New Red and also of Jurassic. A considerable area of this has since been referred by American geologists to the Cretaceous. He includes 1500 feet of strata observed on the Llano Estacado as Triassic. This is probably the equivalent of Hayden's Dakotah Group, and may also include part of No. 2 Cretaceous of Hayden. Prof. Marcon speaks of an extensive development of Triassic between Zuni and the Colorado Chiquito inclosing large fossil trees.

Of the rocks of Pyramid Mount (Lat. 35, Long. 103° 58′) in Llano Estacado, he places the lower beds in the New Red, the upper in the Jura. Prof. Marcon informs us that he submitted the fossils to European geologists and palæontologists and they recognized among them *Gryphæa dilatata* and *Ostrea Marshii* and were therefore Jurassic. Other American geologists assign these rocks to the Cretaceous.

Marcon places the rocks of Pueblo Creek and Zuni River in the Trias. Henry Engelmann, in Simpson's Report, 1859, refers to Meek and Hayden's statement of Jurassic occurring in the Black Hills, and says that he observed indications of similar rocks in the Uinta and Wahsatch. Engelmann relates that he obtained a few Jurassic fossils on North Platte between the Red Buttes and the mountains. These beds were overlaid by certain beds of a purple and gray gyps'ferous sandstone which he called Trias. On the east fork of Weber River he obtained *Pecten Ostrea* and *Pentacrinus* which he referred to the Jura. This volume contains one plate and descriptions of Jurassic fossils by Prof. Meek, embracing *Dentalium*, *subquadrata*, *Gryphæa calceola*, *Camptometes bellis mata*, *Belemnites*, *Ostrea Engelmanni*, and *Pentacrinus*. These fossils were obtained from Red Butte and the west side of the Wasatch, and Mr. Meek says they are clearly Jurassic.

In 1858 Prof. Meek published in Proc. Ac. Nat. Sc., Philadelphia, sections on Upper Missouri and says that certain beds at the mouth of Judith River lying near the base may be older than the Cretaceous.

Prof. Jno. S. Newberry in Ives' Survey of Colorado River speaks of the occurrence of Jurassic and Triassic in Abajo Mountains in southeastern Utah. Newberry (1859) in Geology from New Mexico to the Grand and the Green, referring to the formation around Santa Fe gives 1500 feet of red beds, noted also at Pecos and San Jose with obscure forms of Walchia and a Calamite.

At Abiquin, New Mexico, Dr. Newberry discovered in the roof-shales thousands of impressions chiefly of cycadeous plants clearly referable to Jurassic, and three plates are devoted to the figures. Dr. Newberry also speaks of Triassic and Jurassic in the Grand Cañon of the Colorado, and also figures certain Triassic fossils from Los Broncos, Sonora.

McFarlane in his Geological Railway Guide, Art. Colorado—Hayden, says Trias or Red Beds occur at Morrison Station sixteen miles from Denver and also at Golden. In the same book, Art. Wyoming, A. Hague speaks of Jurassic and Triassic at Red Buttes, with Jurassic at Como and Triassic at Iron Point and Humboldt, Nevada.

Messrs. Meek and Hayden, in Palæontology of Upper Missouri, 1864, devote sixty-two pages to descriptions of Jurassic fossils with three illustrative plates. Among the fossils *Pantacrinus Astericus* was obtained from opposite Red Buttes and North Platte, and other fossils from Wind River Valley, southwest of Black Hills and Big Horn Mountains. In Geological Report of the Yellowstone and Missouri Rivers, 1859, by F. V. Hayden, of Capt. Raynolds' Exploration, published in 1869, Prof. Hayden says that certain fossils collected, at the head of Wind River valley, Lat. 43° 30′, Long. 110° W., also from Big Horn Mountains, the Black Hills and Red Buttes, present clear affinities to the Jurassic of the Old World. This pamphlet of Hayden's also contains his system of nomenclature of the Cretaceous as well as a geological map of head waters of the Missouri and country north of Ft. Laramie and eastwardly to the Missouri River. Hayden (Colorado and New Mexico, 1859,) speaks of the Triassic and Jurassic at Las Vegas, but he only found a *Mytalus*. In Geological Report, 1874, he refers Glen Eyrie and the Garden of the Gods to the Trias. He also speaks of a narrow belt of Jurassic from the Union Pacific Railway southwardly into New Mexico.

In the same volume Peale describes certain beds of Triassic and Jurassic on the Grand River west of the Rocky Mountains, also on Gunnison River near the mouth of Smith's Fork and on Eagle River. The lower Grand Cañon of the Gunnison has been called Unaweep (meaning red earth) by the Indians. In the same region Peale assigns nearly a 1000 feet overlying the so-called Trias to the age of the Jura—but no fossils.

In Hayden's Report, 1870, Meek gives a list of nine species of Jurassic fossils from Henry's Fork of Green River, Red Buttes, Salinas and Como. In Hayden's Report, 1872, Cinnabar Mountain on the Yellowstone is made to include certain strata with Jurassic fossils. Jurassic is also stated to occur on Gallatin River and at the three forks of the Missouri Peale in the same volume gives a section at the head of the Gallatin including Cretaceous, Jurassic, Triassic and Carboniferous and names four fossils as being certainly Jurassic. In this volume Prof. Meek gives a catalogue of twenty-two species of Jurassic from near the cañon of the Yellowstone; eleven species from Spring Creek, Montana; seven from Ft. Hall, Idaho, and eight from Cinnabar Mountain.

In Hayden's Report, 1873, Marvin gives sections of Jurassic near Bear's Creek, Big Thompson, near St. Vrain's, etc., but mentions no fossils.

Hayden's Report, 1875: Peale describes the Jurassic and Triassic of Gunnison and Grand Rivers, and furnishes comparative sections from Powell, Newberry, Gilbert and Howell. Howell's section includes four species of Jurassic fossils from southern Utah with 2000 feet of Jurassic rocks. He also indicates Trias at same place. Powell has over 5000 feet of Jurassic and Trias from plateau of southern Utah, and Gilbert has 1800 feet of Trias from Ft. Wingate, New Mexico.

Hayden's Report, 1876: White speaks of the overlying Jurassic as soft, greenish, and reddish and purple sandstone beds with sandy calcareous shales. He refers to fossils collected by Major Powell in southern Utah which he regards as Triassic, and that the relative position of the shales justifies their reference to the Trias but the invertebrate fossils point to a Jurassic age. He therefore calls the beds Jura-Trias. Endlich, in the same volume, says that all along the Front Range the Trias is prominent, disappearing toward the south. Peale also speaks here of the Juras-Trias on Grand River.

In Hayden's Report, 1877, Peale gives section of Jura-Trias in southeastern Idaho and western Wyoming, 2500 feet of Jurassic and 3000 feet of Triassic. The fossils are described by White in Bulletin of Survey, Vol. V, No. 1, and include quite a list of fossils: *Crinoideæ*, *Cephalopoda* and *Acephala*, etc. Peale also, in same Bulletin, enumerates over twenty species from Jura-Trias of southeastern

Idaho and western Wyoming and gives 1500 feet of Jura, the upper 700 feet gray shales and green sandstone; the lower 800 feet of limestone and shale, below which he describes 4000 feet of Trias chiefly red with some calcareous beds with some fossils in the lower part.

In Hayden's Report, 1878, Dr. White has a special Report on Palæontology published in 1880, including two plates of Jurassic and two plates of Triassic fossils. In this he speaks of the Jurassic of southern Utah and says the Triassic is not recognized by fossils east of the Rocky Mountains.

In Palæontology of California, Meek devotes eleven pages and two plates to Jurassic fossils, and Gabb has sixteen pages and four plates of Triassic.

In Jones' Report on Northwestern Wyoming and Yellowstone Park, 1875, Prof. Comstock names the red beds of Deep Creek, Wind River Mountains, and calls them Triassic, but says they are devoid of fossils. Over them he found 1000 feet of Jurassic including eight species of fossils.

In Ludlow's Report of Reconnoissance of the Yellowstone Park, 1875, three species of Jurassic fossils are figured and described by R. P. Whitfield. These were obtained from Bridger Mountains, Montana, on East Gallatin River. Mr. E. S. Dana in the Geological Report mentions finding seven species of fossils. In Report on Palæontology of the Black Hills, 1880, Prof. R. P. Whitfield has four plates of Jurassic fossils, the specimens obtained from the Black Hills and Big Horn Mountains. In Bulletin U. S. Geological Survey, 1876, Vol. II, No. 3, Hayden gives a section at head waters of the Missouri and Yellowstone showing Jurassic overlying the Carboniferous of Gallatin River.

In Bulletin, Vol. III, No. 3, 1877, White speaks of the Jurassic of the Rocky Mountains.

King in the Geological Report of the 40th Parallel devotes forty-six pages to the Jurassic and Triassic. He refers to their occurrence on Big Thompson River, on the Chugwater and Brush Creeks. Near the line of Colorado and Wyoming, southwest of Laramie, Mr. King gives 1200 feet of red beds. King mentions the occurrence of Trias in the Uinta range, on Yampa plateau, on Du Chesne Creek. He speaks of the occurrence of *Pentacrinus Astericus* near the base of the Jura. In the Western Humboldt range he speaks of a limestone with distinct Jurassic fossils which have been described by Meek and Gabb. King estimates the Humboldt Jurassic to be 15 to 17000 feet thick. King enumerates four species of Jurassic fossils from Como Station, Union Pacific Railway; five species from Rawlings Peak in beds below the cretaceous Dakotah. In the Uinta Range a number of fossils have been obtained from the Flaming Gorge. King in Vol. IV, 40th Parallel Survey, devotes two plates to Triassic fossils and one to Jurassic. The fossils are identified and described by R. P. Whitfield, and are from Wyoming, Utah and Nevada, chiefly from Augusta Mountains, Nevada, and Flaming Gorge, Uinta Range. The Triassic from the Wahsatch and Humboldt are identified by Meek.

In Vol. II, of 40th Parallel Survey by Emmons and Hague, considerable space is devoted to the discussion of the Jurassic including strata of the Uinta

Mountains, Augusta Mountains, Black Butte, Como, Eastern Foothills, Eugene Mountains, Flaming Gorge, Pah-Ute, Range; Laramie Valley, West Humboldt, Montezuma Range, Wahsatch, Yampa River, etc. The generalized section also includes Jurassic and Triassic beds, and Trias also occurs at nearly all the above named localities. In Geological Report, West of 100th Meridian of Wheeler, Prof. Stevenson speaks of Trias in Animas Park and says that in Colorado the group shows no fossils and no clue can be given to its age except from the stratigraphical relation to the Jurassic and Cretaceous. He describes the rocks at Cañon City and Colorado Springs.

In Vol. III, Supplement to Wheeler's Report, Prof. J. J. Stevenson devotes a short chapter to the Jura-Trias, to which he refers certain beds in northern New Mexico between the Carboniferous and the Dakotah Cretaceous, but saw no fossils. In Vol. IV, Report West of 100th Meridian, Dr. White says that none of the invertebrate fossils of the collection are properly referable to the Triassic, but in the collection he refers eight pieces to the Jurassic which were collected at widely separated localities in Nevada and Utah. They include one crinoid (*Pentacrinus Astericus*) mentioned also in King's Report, and mollusca. Cope in the same volume speaks of Triassic and Jurassic in New Mexico on Gallinas Creek, including *Dinosauria* and *Crocodilia*, with five species of Unios described by Meek.

In Powell's Survey of the Rocky Mountain Region, G. K. Gilbert, in the Geology of the Henry Mountains, says that the sedimentary rocks in that region range from the summit of the Cretaceous to the summit of the Carboniferous, and refers 2930 feet to the Jura-Trias—lying between the Carboniferous and Cretaceous, and represented by sandstones with shales, colors, purple, red, white and buff. Powell, in Geology of the Uinta Mountains, 1878, includes 1200 feet in Flaming Gorge as Jurassic and 4000 feet of Triassic.

Dana in his Manual of Geology, 1874, says that the Triassic has been identified by fossils in British Columbia, and that Upper Trias occurs at entrance of Pavalonk Bay, Alaska, and are by Whitney referred to the Middle Kenper of Europe.

We now turn to the Geological Survey of Canada. In Report, 1872–3, Principal J. W. Dawson assigns certain coniferous woods from Nawaimo, Van-Couver's Island, to the Mesozoic age ranging from Jurassic to Upper Cretaceous. A plant to which he applies the name *Cycadeocarpus* he says is from the Lower Cretaceous or Jurassic of Skidegate, Queen Charlotte Island. Mr. Jas. Richardson same volume gives a section and says the fossils of certain beds are partly Jurassic and partly Cretaceous.

In Geological Survey, Canada, 1875–76, Mr. J. F. Whiteaves gives descriptions of two Jurassic fossils and one Triassic fossil from Peace River, British America.

In Canada Geological Survey, 1876–77, Mr. J. F. Whiteaves describes Jurassic fossils from the Coast Range of British Columbia, including twenty-seven species of Mollusca and one of Annelida.

In Canada Geological Survey, 1887–78, Mr. G. M. Dawson intimates the occurrence of Triassic rocks in British Columbia, but he is not specially descriptive.

In Canada Geological Report, 1878–79, Mr. G. M. Dawson discusses the Triassic of Queen Charlotte Islands, including 500 feet on the shores of Houston Stewart Channel, including eight species of fossils synchronous with the so-called Alpine Trias of Nevada. Other fossils are from Rose Harbor and Copper Islands and Burnaby Strait. Prof. Dawson estimates that the overlying volcanic rocks in the neighborhood of Logan Inlet, Island of Moresby, cannot be less than 5000 or 6000 feet.

The above is an epitome of Jura-Trias for Western America. Fuller information can be obtained from the books referred to and I hope it may assist those who desire to examine the localities referred to. I was glad to see the article of my friend Hallowell in the December number of the REVIEW and hope to hear from him again.

PLEASANT HILL, MO., Dec. 1882.

THE DEVIL'S PIT.

REV. JOHN D. PARKER, U. S. A.

In Crockett county, Texas, on the divide between Devil's River and the Nueces, there is a cavern in the rocks that has been named the Devil's Pit. The divide at this point is perhaps a thousand feet above the level of the river. The cavern in the ground is about eighteen feet across at the top, and has the form of an inverted perpendicular cone, being several hundred feet across at the bottom. Perhaps a hundred men have gone to the cavern with the purpose of being let down into it, but concluded when they saw it that some one else might have the glory of exploring it. Recently a man was found who had the nerve to see if the cavern was rightly named. As he passed down by a rope held firmly above, he found the bees had made their hives in the sides of the rock. He declared there were tons of honey in the cavern. If the air had not been rather cold he could not have gone down without being stung. About ninety feet down he found a small live oak tree growing on the side of the cavern, the roots fast in the rocks.

When he had been let down one hundred and eighty feet he came to the top of a mountain of rock in the shape of a solid cone—a cone within a hollow inverted cone—with plenty of room between them to explore the cavern. So he let go of the rope and went down the sides of this mountain about a hundred feet, when he came to a lake of water. This water appeared to be deep, but he had no means of measuring its depth. A canteen was let down to him, which he filled and brought up. The water was clear and agreeable to the taste. On the outside down the hill the water seeps out of the rocks, and people now think it is the outlet of the lake in the cavern. Whether the water has gathered in the cave from the orifice at the top, or a stream flows under ground, it is impossible to determine with the present limited observations.

This cavern is situated about ten miles east from Judge M. D. Kent's sheep ranch, and about forty miles northeast of Fort Clark. This is a very wild region, with few inhabitants. Recently a panther was killed in this vicinity which measured from tip to tip thirteen feet. This is the sixth panther that has been killed in this vicinity within a few months. The Mexican lion, or cougar, is also found in this region, and in the jungles of the Rio Grande is found the leopard cat.

It has not been determined whether the cavern is the result of erosion from running water, or was formed by volcanic action. Nothing can be known about it scientifically without an examination by a competent geologist. Texas is full of interest to the scientist, but almost nothing has been done in this direction. There are probably rich mines of coal, silver, lead and tin, and perhaps other metals. The State has a full treasury, and all it needs is a wise direction given to produce results which would return many times their cost. The flora and fauna are especially rich. Taxidermists are frequently sent here to enrich the collections of eastern institutions.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, December 18, 1882.

SANITARY CONDITION OF EUROPEAN CITIES—THE COMET AND PLANETS, ETC.

The question of questions at the present moment for citizens is that of the typhoid fever endemic. The Academy of Sciences is of late wholly occupied with that subject, which comes home to the business and bosoms of every resident. Paris may be the most beautiful of capitals, but it is beyond doubt next to the most insalubrious. It has more than the commencement of an admirable system of sewers, but their efficacy is checked by the absence of water for flushing; hence, in summer, but particularly in autumn, the kennel-mouths of the sewers are so many pestilence pipes, as every passer-by but too well knows. Insufficiency of water for flushing purposes in houses as well as in the branch and main sewers; uncleanly-kept premises; overcrowded habitations; inadequacy of water for domestic wants, and even that supply derived from infected rather than impure sources—such are conditions for the plague.

Dr. De Murry is convinced, the source of typhoid fever, as of cholera, lies in the dejections of the patients; hence, the water-closets become the nursery ground for the malady. One ill-kept closet on any story is sufficient to poison the entire household. He has but a relative confidence in the statistics of mortality; only those can be relied upon which originate from hospital records; the information furnished by private practitioners is neither precise nor complete.

Dr. Rochard, a most eminent navy surgeon, positively dissects the sanitary condition of Paris. His demonstrations, mathematically correct, are not at all encouraging even to the robust. Uncleanliness and overcrowding are for Dr. Rochard the causes of typhoid fever The barracks illustrate at once the bane and the antidote: The buildings and out offices are offensive in point of hygiene; there is an absence of ventilation; the men live packed together. An outbreak of fever follows, as a matter of course. The men are ordered to live under tents. A fortnight elapses, during which the barracks are flushed, aërated, purified; the men return, but in fewer numbers, and the malady does not reappear. Similarly on board ship, when continued rough weather compels hatches and windows to be closed, and passengers to remain below, fever will soon break out, because the germs of the disease were in the air, and only waiting the conditions for their development—their atmospheric fertilizer. Since 1869, typhoid fever, small-pox and diphtheria are permanently on the increase here. Taking the two epochs 1869-1873, and 1879-1881, the victims for every 1,000 inhabitants have been respectively:—for fever, 48 and 96 victims; diphtheria, 54 and 101; small-pox, 19 and 74. This is the more strange, as while the fever augments at the rate of 100 per cent in Paris, the per centage diminishes in every other country. The hospital returns attest one decease for every fifteen patients down with typhus. It is curious, while not the less remaining a truth, that this increase of fever has followed the augmentation of the population. The occupants of furnished lodgings, etc., have more than doubled; where only four were formerly accommodated, now the same space is allocated to ten and fifteen persons. And these lodging-houses progress in uncleanliness as the tenants increase.

In a few of the grand arteries of Paris the construction of the sewers, etc., is magnificent; but visit the upper and the older quarters of the city, and there the sewage system will appear in all its primitive simplicity and horror. A continued bed of black, putrid detritus, through which meanders a thread of water, insufficient to flush, but adequate to propagate pest. The supply of water is 400,000 cubic yards for a population of 2,000,000, and even when the promised 150,000 cubic yards additional are provided, the supply will be still inadequate. The drinking-water is mixed with that specially conveyed and that of the Seine. Now the latter receives beforehand the waste-water from the great night-soil depot, as well as the dejections from suburban villages representing a collective population of 120,000 souls! Further, Paris is surrounded by a belt of insalubrious establishments; there are 305 chemical works authoritatively pronounced deleterious and dangerous from their emanations, unhappily too readily recognized; there are also 25 *depotoirs* for working up the night-soil, in addition to the others which receive daily 2,0 0 tons of household refuse—there being no dust bins attached to Paris houses, instead we have horrible night-soil reservoirs—emptied every morning into the street to be carted away, and shot down outside the fortifications.

Brussels is a model in this respect for Paris and perhaps for other cities also.

There every practitioner on recognizing a patient attacked with fever is bound to advise the Health Office, which at once sends its inspector to report on the situation, with summary powers to carry the patient to the hospital; to disinfect the apartment occupied, the bed, clothing, apparel, etc.; to examine the sewage, cleanliness of the premises, etc., and to remedy, on the moment, all defects, making the proprietor pay if his responsibility be proved. And the result? A diminution of 100 per cent in the deaths from zymotic diseases. Up to the present it was concluded that a dry season was favorable to an outbreak of typhus. Never had an autumn been wetter than the present, and never was the disease more prevalent. In some of the city barracks the occupants of one wing of the building only were attacked; in the case of another barracks, the cavalry alone suffered. The Sanitary Committee of the municipality in its instructions suggest that the patients be placed in the middle of the room, and the members of the family kept away; that disinfectants be employed, etc. But the fever has its home in families that have but one room, and not a farthing to buy medicine or food, let alone disinfectants. The 250,000 night-soil reservoirs, as already alluded to, and which are presumed to be "hermetically closed" till emptied once or twice a year, until superseded by some other plan, must remain a permanent nursery for the seeds of infectious diseases.

The early-morn comet that has been our visitor so long, has given birth to a daughter, as M. Schmidt, of Athens, has discovered. One morning a little comet was observed running alongside the big one—the mother. The little stranger has been produced by segmentation; the two stars have the appearance to march together, but the mother has changed in form; the noyau from being spherical has become elongated. It is not the first occasion that our world has witnessed the birth of a star. The Biela comet in 1846 split into two. Discovered in 1826 by Biela, it returned later, in six years and nine months, as was accurately predicted. On the 13th of January, 1846, it opened in two, lengthways, and that evening the twins traveled in beauty side by side—two complete comets with independent heads and tails. A few days later they separated, and by the 10th of February they were already 180,000 miles asunder. One lost its tail rapidly and also its brilliancy; by March both were invisible. In 1852, after a punctual revolution of six years and nine months, they reappeared, but distant 1,500,000 miles from each other. Since, nothing has been heard of either. However, it is suspected that the showers of falling stars that so signally marked the year 1872 were the debris of the Biela comets. According to Schiaparelli a swarm of shooting stars follow in space orbits identical with comets, and are simply comets reduced to morsels by disintegration.

Other celestial curiosity, the planets Mars and Venus, are those that have the greatest degree of relationship with our earth. All planets would seem to pass through the same series of transformations, their actual differences being due to their state of evolution. Thus Venus would be almost akin, in point of evolution, to the earth; while, on the contrary, Mars would be more advanced. Spectral analyses have, within certain limits, confirmed these hypothetical views. Following the observations of M. Schiaparelli, the surface of Mars has become much modified since three years. Large shady spaces had hitherto been observed, and concluded to be oceans; now dark surfaces have become bright, and *vice versa*. These differences in light and shade may imply modifications in the distribution of waters, or variations in vegetation. Stranger still, a number of dark lines traverse the continent of Mars, and connect two distant dark spots. From the mathematical arrangement of the dark lines, imagination conceives them to be canals uniting oceans; but what is puzzling, these lines at certain epochs become double, in the sense of becoming parallel. There are these second canals, alongside one another, that makes us doubt what uses the engineers in Mars can destine them for. More likely the phenomena are due to the geographical construction of the planet—the effect of the shadows of ravines.

Messrs. Chatriau & Jacobs have made the owners of diamonds tranquil; white diamonds sell at about 30,000 f. per ounce; if yellow, at eight times less. A diamond merchant having purchased a white diamond, was surprised on washing his hands in soap-water to find the stone in his ring turn yellow. This, as M. Chevreiul shows, was due to "complementary," or associated colors, by which union a diffent shade is produced. But the new color is ephemeral—a little rubbing will restore the pristine hue. White diamonds will ever retain their purity, but as yellow can also be made temporarily white, caution is necessary in purchasing.

F. C.

PHILOSOPHY.

OUR ORIGIN AS A SPECIES.

RICHARD OWEN, C.B., F.R.S.

There seems to be a manifest desire in some quarters to anticipate the looked for and, by some, hoped-for proofs of our descent, or rather ascent, from the ape.

In the September issue of the *Fortnightly Review* a writer cites, in this relation, the "Neanderthal skull, which possesses large bosses on the forehead, strikingly suggestive of those which give the gorilla its peculiarly fierce appearance;" and he proceeds: "No other human skull presents so utterly bestial a type as the Neanderthal fragment. If one cuts a female gorilla-skull in the same fashion, the resemblance is truly astonishing, and we may say that the only human feature in the skull is its size."[1]

In testing the question as between Linnæus and Cuvier of the zoölogical

1. Grant Allen, "On Primitive Man," p. 314.

value of the differences between lowest man and highest ape, a naturalist would not limit his comparison of a portion of the human skull with the corresponding one of a female ape, but would extend it to the young or immature gorilla, and also to the adult male; he would then find the generic and specific characters summed up, so far, at least, as a portion or "fragment" of the skull might show them. What is posed as the "Neanderthal skull" is the roof of the brain-case, or "calvarium" of the anatomist, including the pent-house overhanging the eye-holes or "orbits." There is no other part of the fragment which can be supposed to be meant by the "large bosses" of the above quotation. And, on this assumption, I have to state that the super-orbital ridge in the calvarium in question is but little more prominent than in certain human skulls of both higher and lower races, and of both the existing and cave-dwelling periods. It is a variable cranial character, by no means indicative of race, but rather of sex.

Limiting the comparison to that on which the writer quoted bases his conclusions—apparently the superficial extent of the roof-plate—its greater extent as compared with that of the gorilla equaling, probably, in weight the entire frame of the individual from the Neanderthal cave, is strongly significant of the superiority of size of brain in the cave-dweller. The inner surface moreover indicates the more complex character of the soft organ on which it was moulded; the precious "gray substance" being multiplied by certain convolutions which are absent in the apes. But there is another surface which the unbiased zoölogist finds it requisite to compare. In the human "calvarium" in question, the mid-line traced backward from the superorbital ridge runs along a smooth track. In the gorilla a ridge is raised from along the major part of that tract to increase the surface giving attachment to the biting muscles. Such ridge in this position varies only in height in the female and the male adult ape, as the specimens in the British Museum demonstrate. In the Neanderthal individual, as in the rest of mankind, the corresponding muscles do not extend their origins to the upper surface of the cranium, but stop short at the sides forming the inner wall or boundary of what are called the "temples," defined by Johnson as the "upper part of the sides of the head," whence our "biting muscles" are called "temporal," as the side-bones of the skull to which they are attached are also the "temporal bones." In the superficial comparison to which Mr. Grant Allen has restricted himself in bearing testimony on a question which perhaps affects our fellow-creatures, in the right sense of the term, more warmly than any other in human and comparative anatomy, the obvious difference just pointed out ought not to have been passed over. It was the more incumbent on one pronouncing on the paramount problem, because the "sagittal ridge in the gorilla," as in the orang, relates to and signifies the dental character which differentiates all *Quadrumana* from all *Bimana* that have ever come under the ken of the biologist. And this ridge much more "strikingly suggests" the fierceness of the powerful brute-ape than the part referred to as "large bosses." Frontal prominences, more truly so termed, are even better developed in peaceful, timid, graminivorous quadrupeds than in the skulls of man or of ape. But before noticing the evidence which the teeth bear on the physical relations of man to brute, I would premise that the comparison must not be limited to a part or "fragment" of the bony frame, but to its totality, as relating to the modes and faculties of locomotion.

Beginning with the skull—and, indeed, for present aim, limiting myself thereto,—I have found that a vertical longitudinal section brings to light in greatest number and of truest value the differential characters between lowest *Homo* and highest *Simia*. Those truly and indifferently interested in the question may not think it unworthy their time—if it has not already been so bestowed—to give attention to the detailed discussions and illustrations of the characters in question in the second and third volumes of the "Transactions of the Zoölogical Society."[2] The concluding memoir, relating more especially to points of approximation in cranial and dental structure of the highest *Quadrumane* to the lowest *Bimane*, has been separately published.

I selected from the large and instruction series of human skulls of various races in the Museum of the Royal College of Surgeons that which was the lowest, and might be called most bestial, in its cranial and dental characters. It was from an adult of that human family of which the life-characters are chiefly but truly and suggestively defined in the narrative of Cook's first voyage in the Endeavor.[3]

Not to trespass further on my readers, I may refer to the "Memoir on the Gorilla," 4to, 1865. Plate XII gives a view, natural size, of the vertical and longitudinal section of an Australian skull; plate XI gives a similar view of the skull of the gorilla. Reduced copies of these views may be found at p. 572, figs. 395, 396, Vol. II, of my "Anatomy of Vertebrates."

As far as my experience has reached, there is no skull displaying the characters of a quadrumanous species, as that series descends from the gorilla and chimpanzee to the baboon, which exhibits differences, osteal or dental, on which specific and generic distinctions are founded, so great, so marked, as are to be seen, and have been above illustrated, in the comparison of the highest ape with with the lowest man.

The modification of man's upper limbs for the endless variety, nicety and perfection of their application, in fulfillment of the behests of his correspondingly developed brain—actions summed up in the term "manipulation"—testify as strongly to the same conclusion. The corresponding degree of modification of the human lower limbs, to which he owes his upright attitude, relieving the manual instruments from all share in station and terrestrial locomotion—combine and concur in raising the group so characterized above and beyond the apes, to, at least, ordinal distinction. The dental characters of mankind bear like testimony. The lowest (melanian), like the highest (Caucasian), variety of the bimanal order

2 "Osteological Contributions to the Natural History of the Orangs (*Pithecus*) and Chimpanzees (*Troglodites niger* and *Trog. gorilla.*)"

3 Hawkesworth's 4th ed., Vol. III, 1770, pp. 86, 13', 229. The skull in question is No. 5,'91 of the "Catalogue of the Osteology" in the above Museum, 4to, Vol. II, p. 823, 1853.

differs from the quadrumanal one in the order of appearance, and succession to the first set of teeth, of the second or "permanent" set. The foremost incisor and foremost molar are the earliest to appear in that series; the intermediate teeth are acquired sooner than those behind the foremost molar.[4]

In the gorilla and chimpanzee, the rate of course of progress is reversed; the second true molar, or the one behind the first, makes its appearance before the bicuspid molars rise in front of the first; and the third or last of the molars behind the first comes into place before the canine tooth has risen. This tooth, indeed, which occupies part of the interval between the foremost incisor and foremost molar, is the last of the permanent set of teeth to be fully developed in the *Quadrumana;* especially in those which, in their order, rank next to the *Bimana.* To this differential character add the breaks in the dental series necessitated for the reception of the crowns of the huge canines when the gorilla or chimpanzee shuts its mouth.

But the superior value of developmental over adult anatomical characters in such questions as the present is too well known in the actual phase of biology to need comment.

In the article on "Primeval Man," the author states that the Cave-men "probably had lower foreheads, with high bosses like the Neanderthal skull, and big canine teeth like the Naulette jaw."[5]

The human lower jaw so defined, from a Belgian cave, which I have carefully examined, gives no evidence of a canine tooth of a size indicative of one in the upper jaw necessitating such vacancy in the lower series of teeth which the apes present. There is no such vacancy nor any evidence of a "big canine tooth" in that cave specimen. And, with respect to cave-specimens in general, the zoölogical characters of the race of men they represent must be founded on the rule, not on an exception, to their cranial features. Those which I obtained from the cavern at Bruniquel, and which are now exhibited in the Museum of Natural History, were disinterred under circumstances more satisfactorily determining their contemporaneity with the extinct quadrupeds those cave-men killed and devoured than in any other spelæan retreat which I have explored. They show neither "lower foreheads" nor "higher bosses" than do the skulls of existing races of mankind.

Present evidence concurs in concluding that the modes of life and grades of thought of the men who have left evidences of their existence at the earliest periods hitherto discovered and determined, were such as are now observable in "savages," or the human races which are commonly so called.

The industry and pains now devoted to the determination of the physical characters of such races, to their ways of living, their tools and weapons, and to the relations of their dermal, osteal, and dental modifications to those of the mammals which follow next after *Bimana* in the descensive series of mammalian orders, are exemplary.

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4 "Odontography," 4to., 1840-44, p. 454, plates 117, 118, 119.

5 *Fortnightly Review,* September, p. 321.

The present phase of the quest may be far from the bourn to yield hereafter trustworthy evidence of the origin of man; but, meanwhile, exaggerations and misstatements of acquired grounds ought especially to be avoided.—*Longman's Magazine.*

IS EVOLUTION GODLESS?

This important question has sometimes been hastily or ignorantly answered in the affirmative. How it is answered by a master of the subject, who accepts the great truths of Christianity as fully as he does the doctrine of evolution, and who can give a reason for both the scientific and the theological faith that is in him, may be seen from the following abstract of Dr. Winchell's lecture on the question:

The religious nature of man has always manifested a tendency to revolt against any general theory of development in the processes of the world. Such doctrines have been equally opposed among the Greeks, among the religious minds of the Middle Ages, and in our own times. They have never commanded any general assent even among the purely scientific, until within less than a quarter of a century. Since Charles Darwin pointed out, in 1858, the existence of tendencies in the organic world which would go far to explain the means by which transmutations of species may be effected, thinking minds have generally been led to the belief that evolution is the method of nature, and the protests of the religious sentiments have not been able to stay the progress of opinion.

These protests, it must be particularly observed, are based on the supposition that a method of evolution must be a method of self-evolution. With this understanding religious opposition is inevitable and is right. The religious nature is an original and ineradicable constituent of humanity, and has the same right to exercise as the intellect itself. It means more. The objects toward which its activities are directed must be recognized as realities. They are ultimate truths, as valid as the intuitions of reason. A spontaneous evolution robs these faculties of their object, and they protest. It falsifies an affirmation of the fundamental authority of our being, and must be *an impossibility.*

But such an interpretation of evolution is unnecessary. It cannot be defended. The doctrine of evolution is simply a statement of *fact* concerning the *method* of the succession of events in the natural world. In affirms nothing respecting any efficient connection between the successive terms of the series. It affirms nothing respecting the mode of origination of the first term of the series. It says nothing of beginning, but only of the *mode of continuance.* It is entirely compatible with the supposition that the first term was the product of immediate creation.

But scientific writers speak of causes. They tell us that such and such modifications of structure are produced by such and such conditions or antecedents. How is such language to be reconciled with the statement that evolution has nothing to say about causation? It is important to be borne in mind that the word *cause* is employed in literature in two senses. By cause the scientist means only a uniform antecedent. But every one immediately understands that mere antecedence is insufficient. Some *efficiency* must be exerted in the preceding term which passes over into the following term. There must be a bond connecting the two which is more than simple successiveness. This is is the other conception of cause. This is the conception of real and only cause. The scientific conception of cause is merely that of uniform antecedence among material phenomena, and is therefore not a conception of true efficient causation at all.

Now, all real efficiency originates in *will*. Our own experiences teach that every result attained in the realm of human activities proceeds from human volition. Tools, machinery, the elements of nature,—these are only intermedia which will employs for the accomplishment of its ends. All the eminent authorities concur that the same conclusion must be applied to events in the natural world. All its phenomena are the products of some causal volition.

But the mere fact of volitional causation implies much more. The exercise of will implies a real being, possessing such an attribute. The effects to be produced must be first conceived or apprehended. This is an act of intelligence. The suitable conditions must be chosen; appropriate instrumentalities selected. These are other acts of intelligence. The premeditated effect must be desired; there must be a motive for producing it. Motive and desire belong to the emotional nature. Finally, the exertion of will for the effectuation of the result completes the circle of attributes constituting personality,—that is, separate, self-sustained existence. Intellect, sensibility, and will are the three moments of our own personal being.

Now, to apply this analysis to the organic changes which sometimes take place in animals and plants, we must keep clearly before the attention the discrimination between the *fact* of an evolutionary mode of succession, the *conditions* under which it is effected, the *instrumentalities* employed in the effectuation, and the *cause* whose efficiency employs the instrumentalities under the conditions to make a given effect a fact of nature. It is plain that when an animal comes into the possession of a modified structure that structure has grown. The result has been attained through the action of the growing forces. A denser covering of fur may have come into existence in connection with the advent of a colder climate. The change in the climate is the *condition* to which the organism becomes adapted, and the changed action of the vital forces produces the adaptation. But the physiological activities within the animal are themselves only instrumental. They are merely physical activities directed to certain ends. They do a work not planned by the organs. These facts point to the existence of some real cause yet undiscovered. It must be an immaterial cause, since the deepest scrutiny of our microscopes discloses only matter engaged in the physical activities just referred to. It must be an intelligent cause, since it selects and builds according to intelligible plans. Only intellect performs such works. Manifestly, then, some intelligent and immaterial cause employs the physiological forces to build the organism according to certain methods, into such growths as shall be best suited to the external conditions under which the animal lives.

The theological deductions from such a scientific conclusion follow immediately. There must be a first cause. The immaterial cause operative in nature must act *constantly*, not periodically. The world was not created in some beginning, and set running like a clock. Sustaining power is imminent in the world. This view is maintained by eminent authorities in science and philosophy. The cause of the world is possessed of attributes co extensive with the origination and maintenance of the visible universe. This to us means a body of infinite attributes. But the metaphysical infinity of the first cause is reflected in our necessary intuition of the infinite.

Thus evolution is a world embracing plan expressive of mind. It lifts us to the highest possible apprehension of the wisdom and power and unity of the Supreme being, and brings into the most intimate relations with the Father of All in all the phenomena of the natural world, and all the experiences of our daily lives.—*Boston Journal of Chemistry.*

VELOCITY OF PROJECTILES.

It is most unfortunate that none of the ships at Alexandria are armed with guns of the new type. If there were in the fleet even a few of the new 8-inch or 9 inch guns, the ships possessing them could lie completely out of danger from the Aboukir forts, and destroy them by a long range fire without giving them a chance. Something of this sort actually happened in the Chili and Peruvian war. A single new 8-inch Armstrong gun was placed on board a common steamer called a "pig-boat," and bombarded at its leisure the Peruvian forts on shore. The Peruvians sent out a gunboat to come to closer quarters with its ridiculous antagonist. Three shots from the 8-inch Armstrong were, however, sufficient to dispose of the gunboat. The first was short, the second over, the third got the right range, so that the shell fell on deck. The gunboat literally disappeared in a moment, being blown up by the one shell which struck her. Such is the advantage of having guns which impart a very high velocity to their projectiles. All the new English guns give muzzle velocities of about 2,000 feet per second, and this is 400 feet more than that of the 80-ton gun, 640 feet more than the Egyptian 10-inch gun, and 580 feet more than the 9-inch. Though we place the velocity of the new type guns at 2,000 feet, most of them give a velocity considerably higher. For instance, the 12-inch 43-ton gun has already given a velocity of 2,178 feet.

ZOOLOGY AND BOTANY.

NOTES ON THE DISTRIBUTION OF SHELLS, NO. III.

F. A. SAMPSON, SEDALIA, MO.

At one time I thought I had made a full list of the shells found near Sedalia, but having at different times, even down to the writing of this article, made additions to the list, I would not claim that I now give all. For a time after commencing to collect, I was unsuccessful in finding the small shells, and wrote to a friend that there were none in the county. He insisted that there were, and gave some directions about how to hunt for them, after which I soon learned how to find them, and at all suitable stations I now obtain several species, though none of them are common to all stations which appear to be equally suited to them. Of the three *zonites* which are most abundant, *arboreus*, *viridulus* and *indentatus*, some one is generally plenty to the almost or wholly total exclusion of the other two.

The following will be of interest as showing the association of species, the comparative number, as well as the actual number of each found in a search of about one hour at each place. The first locality is in and close to an abandoned stone-quarry a mile northwest of the city. It is surrounded by brush, but no heavy woods, and is close by a small stream of water. The shells were all found under stones. The second is southwest of Sedalia in the bottom on Flat Creek, in an open place in the woods. There being no rocks at this place the shells were obtained under logs and sticks. No shells were found in the woods where dense, but in an open space where the most of the timber had been cut down and grass had grown up:

LOCALITY.	NO. 1.	NO. 2.	LOCALITY.	NO. 1.	NO. 2.
Zonites indentatus . .	25	0	*P. contracta*	5	25
Z. viridulus . . .	2	0	*P. rupicola*	20	0
Z. arboreus	0	120	*P. pentodon*	5	2
Z. minusculus . . .	5	0	*Stenotrema leaii* . . .	6	1
Helicodiscus lineatus . .	8	0	*Vallonia labyrinthica* .	1	4
Pupa armifera	37	18			

The following list gives all that are now known to be in the county, but from the fact that some have been found but at a single place, and at a single time, we may expect further search to bring others to light:

1. *Macrocyclus concava*, Say.—But few specimens have been found and those are either of small size or else they are not full grown.

2. *Zonites arboreus*, Say.—In some localities this is found in large numbers to the exclusion almost of the two following species, while in other places one or both of them takes its place. Generally one of the three largely predominates and but one of the other two is found with it.

3. *Zonites viridulus*, Menke.—In numbers almost equal to the preceding.

4. *Zonites indentatus*, Say.—Not so plenty as either of the two preceding, though I have found it in one locality, at least, the prevailing one of the three.

5. *Zonites minusculus*, Binney —Not plenty but common in the different localities.

6. *Zonites ligerus*, Say.—Not common or plenty.

7. *Zonites pulvus*, Drap.—Found on bark on the underside of lying logs, but in small numbers.

8. *Helicodiscus lineata*. Say.—Common but not plenty.

9. *Limax campestris*, Binney.—Plenty in woods and open pastures.

10. *Patula solitaria*, Say.—Found on the sides of bluffs, the size being about one half that of the same species from Indiana.

11. *Patula alternata*, Say.—In some places in considerable numbers, and in size smaller than those from Indiana, but there is not so much difference as in the preceding.

12. *Strobila labyrinthica*, Say.—Not plenty, and generally found in same place as *Zonites fulvus*.

13. *Stenotrema hirsuta*, Say.—Not plenty.

14. *Stenotrema leaii*, Ward.—This fine little shell is quite common, being found not only close to timber, but sometimes extending along fence rows into the open fields.

15. *Triodopsis inflecta*, Say.—Specimens in woods on higher land, in small numbers, somewhat smaller than those from Indiana.

16. *Mesodon albolabris*, Say.—A variety which is almost identical with specimens of this species found at Eureka Springs, Arkansas, of which Prof. Wetherby says:

"Specimens of the average size have the spire very much depressed, the aperture correspondingly elongated transversely, and the surface very highly polished. The reflection of the peristome is much narrower, so rendered by its being somewhat folded. It is a very distinct variety, which I have not before seen."

It is quite rare here.

17.—*Mesodon elevata*, Say.—Specimens cannot be distinguished from the Indiana ones. Found on the sides of loamy bluffs.

18. *Mesodon thyroides*. Say.—Found in the woods or a creek bottom in considerable numbers.

19. *Mesodon clausa*, Say.—I have found a few dead shells but no living ones, and they are evidently scarce.

20. *Bulimulus dealbatus*, Say.—Has been found in one locality in the county and one in Cooper County, about twelve miles from this city. I have not be-

fore known of its occurring so far north, not having heretofore collected it north of Eureka Springs, Arkansas.

21. *Pupa pentodon*, Say.—A few have been found in open timber under logs and sticks.

22. *Pupa fallax*, Say.—Found in stony places, not only under the larger stones, but among small ones where they are thickly imbedded in dirt, a space of a foot square, sometimes furnishing two or three hundred of this and the next species.

23. *Pupa armifera*, Say.—Found along with the last, and also under logs, not imbedded in the ground but above it, and generally encrusted with dirt.

24. *Pupa contracta*, Say.—Rather plenty.

25. *Pupa rupicola*, Say.—Not common.

26. *Pupa nordeacea*, Gabb(?).—A very few of what seem to be this species were found, but the identification is not certain.

27. *Pupa* ——— ——— (?)—A very small *Pupa* or a *Vertigo*, not yet determined.

28. *Succinea lineata*, W. G. Binn.—In the summer of 1881, a few specimens of what seems to be this species, were found on roots of trees which were standing partly in water. Several searchings during the past summer failed to find a single specimen.

29. *Succinea avara*, Say.—A few were found along the preceding.

30. *Succinea ovalis*, Gould.—Found on the under side of logs in bottoms in open timber The largest were seven mm in length, the typical specimens being given as fifteen mm long.

31. *Tebenophorus carolinensis*, Bosc.

32. *Carychium exiguum*, Say.—Some years ago I found about forty under one log in a creek bottom, but have never since found any.

The water shells are much more numerous than the land shells, though there are not so many species. I have collected the following :

33. *Limnæa columella*, Say.—The only place where I found this was in a fountain in the yard of Mr O. A. Crandall, the eggs having evidently come from Flat Creek through the pipes of the water-works, a distance of two or three miles. In the same fountain occurred *Physa heterostrophe*, *Planorbis trivolois*, and a *Sphæreum*.

34. *Limnæa desidiosa*, Say.—On Spring Fork close by a spring I found this species in abundance, but have not seen it at any other locality. The specimens were eight to ten and a half mm in length.

35. *Limnæa humilis*, Say.—Some five years ago I found great numbers in a small wet-weather pond by the roadside, but when I next visited the locality it had dried up, and there has not since been any at that place. They were six mm in length and quite solid. The only other place where I obtained any was on Flat Creek, where they were smaller, thinner and scarcer.

36. *Physa gyrina*, Say.—Very fine specimens of this were found a few years ago in a wet-weather pond which soon after dried up. They were twenty mm in length with apex eroded so that only three full whorls remained. These

have been identified by different conchologists as the variety *hildrethiana*, Lea, but they were evidently the mature form of others which all identify as *gyrina*. The smaller ones were sixteen mm in length, of six whorls and entire apex.

37. *Physa heterostrophe*, Say.—In no two streams are these shells exactly alike. In some the shell is clear and pellucid; in others quite black. Again at some seasons of the year they will be pellucid and at others black. The size and the shape vary almost as much as the color, and while it is the most common species of the genus, conchological authorities do not agree in their identifications, even as between this and the preceding species. The same process that would make *Stenotrema monodon* and *S. leaii* one species, would also make these one.

38 *Planorbis trivolois*, Say.—Of this common species there are two varieties found. One is about thirteen mm in diameter and the other eighteen mm. The first is more uniformly with basal portion of the labrum horizontally subrectilinear, and not extending below the level of the base, though this is not the case with all, and a part of the larger variety are of that form.

39. *Planorbis bicarinatus*, Say.—Not very common.

40. *Planorbis parvus*, Say.—In November, 1882, I found this species for the first time, and then got only a few specimens from a pond on Flat Creek.

41. *Planorbis* ————.—From Flat Creek I obtained a couple of young shells, between one and two mm in diameter. They do not seem to belong to any of the species before named, and I have not yet been able to identify them.

42. *Ancylus tardus*, Say.—Fine specimens of a reddish color.

43. *Melantho integer*, Say.—Common.

44 *Amnicola porata*, Say.—In the summer of 1881, when the streams were very low, this was obtained in large numbers.

45. *Amnicola orbiculata*, Lea.—This very rare shell was obtained in small numbers with the preceding.

46. *Goniobasis cubicoides*, Anth.—This was found in small numbers at one place in 1881, but during the past year with diligent searching, I could not find any.

47. *Sphæreum partumeium*, Say.—Plenty.

48. *Sphæreum striatinum*, Lam.—Plenty and typical.

49. *Sphæreum stamineum*, Cour.—Rare. Has been found only on Little Muddy.

50. *Pisidium variabile*, Prime.—Not plenty.

51. *Pisidium compressum*, Prime.—A few were found in 1881, but the same locality in 1882 did not furnish any.

As the *Unios* in all our streams are too much eroded to make good cabinet specimens, I have not made an effort to get a full collection of them, and will not now give a partial list. The number of species here given is not equal to those in many local catalogues having a similar fauna, but in some of these latter I have noticed some very doubtful identifications, such as locating a West India species in one of the northwestern States. When necessary corrections shall have been made in each of the lists, the number here will probably be found about the average of more northern localities, with a somewhat larger number of rare species.

THE LIGNIFIED SNAKE FROM BRAZIL.

PROFESSOR ASA GRAY.

The *Popular Science Monthly* for November, and the Bulletin of the Torrey Botanical Club, for the same month, have reproduced an account given in the French *La Nature* last April, of a remarkable phenomenon. The abstract in the Bulletin of the Torrey Botanical Club is the most condensed, and the essential part is copied here: the cut illustrating the object, however, is poor; that in the *Popular Science Monthly* is a somewhat better representation.

"The object represented is a small Brazilian reptile—the jaracaca—which was found within the trunk of an ipe-mirim, a tree of common occurrence in the province of Matto Grosso, to the north of the Amazons, where the specimen was discovered. The piece of wood containing the reptile, after an examination by the scientists of Rio de Janeiro, was taken to France by Mr. Lopez Netto (Brazilian Minister to the United States,) and placed in the hands of Mr. Louis Olivier, who, after a careful study of the specimen, submitted the results thereof to the Botanical Society of France.

"What is astonishing," says Mr. Olivier, in an article on the subject in *La Nature*, "is that the entire body of the snake is lignified,[1] the anatomical study that I have made of it having shown me that it consists of cells and fibres like those of the secondary wood which surrounds it. It is impossible to explain the fact by saying that there has occurred a formation of these elements in a hollow, which, having been traversed by the animal, has preserved the form of the latter; for on the piece of wood it is not only the contour of the snake that is visible, but, indeed, the whole relief of its body.

Just beyond the head there is likewise observed in relief a small cylinder which appears to represent the larva of an insect. It seems, then that the snake, in pursuing the latter into a fissure in the tree, has insinuated itself between the wood and the bark into the cambium-layer, which is well known to be the generator of wood and secondary liber. The function of this cambium-tissue is two-fold; in the interior it gives rise, in a centripetal direction, to ligneous elements, the youngest of which are consequently found at periphery of the wood; but, toward the exterior, on the contrary, it produces, in a centrifugal direction, liber-fibres, elongated cells, and prosenchymatous elements, the youngest of which are therefore, situated on the internal surface of the bark. If, then, a foreign body be introduced as far as the external limit of the wood, it will, in a few years, become invested with a series of ligneous layers, which are themselves protected by

1 Except the center, in which are found the constituent elements of the animal.

an abundance of bark. Now, in the case under consideration, not only has there been an investment of concentric zones around the reptilė, but, besides this, cells and ligneous fibres derived from the cambium-tissues have been substituted for the elements which constituted the external portions of the snake in measure as these have become absorbed. The places that these occupied have, as they gradually disappeared, been taken by secondary wood, whose hypertrophy is proved by the very relief of the snake's body." So far Mr. Olivier.

"The result, as in cases of petrifaction, is that in some parts of the body certain delicate details of the animal's organization are clearly visible. This is especially the case with regard to the nostrils and orbits, and to the arrangement of the scales and cephalic plates over the entire half of the surface of the head."

The narrative in the *Popular Science Monthly* adds from another source the names of the distinguished botanists who were present at the session of the Botanical Society of France, and who are said to have adopted the view of M. Olivier. The Bulletin of that Society in which the proceedings of that meeting is recorded have not yet come to our hands. We shall be much surprised if it fully bears out this statement.

Through the kindness of the Brazilian Minister, we have seen and examined the original specimen, and have been presented with an electrotype of it. It is a great curiosity. The resemblance to a snake is wonderfully close, although "the scales and cephalic plates," which Mr. Olivier identifies with those of a particular Brazilian snake, exist only in a lively imagination. The snake like surface is covered by delicate meshes of woody fibres; and here and there particular fibres or woody threads can be traced from the body to the woody surface.

The adopted explanation requires us to suppose that a snake had forced his way between the bark and wood of a living tree, in a position exactly under a grub or larva; had perished there when within an inch of its prey; was somehow preserved from decay, even to the eye-sockets and the markings of the skin, until a woody growth had formed, the elements of which replaced the whole superficial structure of the animal,—until the animal was lignified! Two other and more probable explanations have suggested themselves. One is, that the snake-like body is of the nature of a root, an aërial root, like those of a *Clusia* or a *Ficus*, which was making its way between bark and wood; and that the supposed larva is an incipient root of the same kind. The other supposes that the sinuous course is the track of a wood-eating larva or some kind of insect, the burrowing of which had not destroyed the overlying liber; consequently the new growth filling the space (except at certain points) had naturally assumed the likeness of a snake. This explanation was suggested by Professor Wadsworth, of Cambridge, examining the specimen along with the writer; and it is to be preferred. Still, that head and neck should be so well outlined, and the former so well represent a pair of orbits, were surely most wonderful. But a close inspection of the electrotype showed that there had been some cutting away at the right side of the neck, and that the narrowing there was in part factitious; and less decisive indications suggested that other outlines had been touched up. The subsequent inspection of the original confirmed this; and likewise enlightened us about the eyes. For the left orbit was found to occur, not in woody structure, like that of the right side, but in a dark material having the appearance of pitch or cement of some sort.

We may rest assured that whatever there may be which is factitious in this most curious *lusus naturæ*, originated before it came into the hands of His Excellency the Brazilian Minister at Washington. If these marks were not discerned by any of the Parisian *savants* in question—which we are slow to believe—they are less likely to have been noticed by Señor Lopez Netto, whose honor and good faith are incontestable.—*American Journal of Science.*

PHYSICS.

RESULTS IN AERIAL NAVIGATION EXPECTED FROM THE STORAGE OF FORCE AND THE CHEAPENING OF ALUMINUM.

PROF. E. C. STEDMAN.

The following bit of news, with some remarks by Professor Newberry upon its importance, appeared in the *Tribune* of Thursday, Dec. 14:

"London, Dec. 13.—A process for the cheap production of aluminum has been discovered The invention causes no little excitement in the metal trade at Birmingham and Sheffield."

I contributed to *Scribner's Monthly* February, 1879, an illustrated article entitled "Aerial Navigation (*A Priori*)." In it I gave the gist of certain notes and diagrams made in 1858 concerning the greatest of unsolved mechanical problems—that of the true method of navigating the air, that "element everywhere abounding, covering one all over like a cloak, earth's garment, man's aureola, in which he moves, breathes, and has his being; the most delicate, the strongest of all; invisible, yet making all things plain; light, yet pressing everywhere; elusive, yet waiting to be overcome, and to confer gifts upon its sovereign beyond his most extravagant conjecture!"

In the quoted article I claimed that the model of the future "aërobat" or "aëronon" would be taken from the fish, and not, as many believed, from the bird, but added:

"Various hints, however, may be gained from the bird, one of which relates to the structure of the frame and machinery of a vessel that shall navigate the atmosphere. The hollow bones of the bird furnish the natural model for the union of lightness and and strength in aërial mechanics."

In 1879 three factors were still needed for the successful construction and use of an aëronon built upon the model suggested—that of a "parabolic spindle" in such a state of equipoise that a slight force obtained from a vertical screw would cause it to rise or descend. These requirements were:

A. *A motor distinguished by a greater economy of power than the best hitherto constructed.* After the appearance of my article I received from the eminent Chief Engineer of the Erie Railway, Mr. Octave Chanute, Vice-President of the American Association of Civil Engineers, carefully prepared tables of the ratios of increased atmospheric resistance to increased speed, showing what powerful and economical motors are required to overcome the former. This gentleman also has made experments, by affixing apparatus to railway cars, in order to determine the shape of a moving structure which shall meet with the least resistance from the air.

B. *A Method of Storing Force*, so that it could be applied to the propulsion of the aëronon, with economy of weight, without danger to the structure of ignition, and in quantity sufficient for prolonged flight. I wrote that "the electric engine will be required. Electricity, in fact, will be as indispensable to the aërobat as to one of Jules Verne's imaginary structures. The electric light will flash from its lookout station and illuminate the inner galleries; while the steering and propulsion will be governed by electric signals."

Within this year the marvellous invention of the Faure Accumulator has solved the problem of the *Storage of Force*, and we are assured that equally surprising advances may be expected in its capacity to render a greater amount of energy for the given bulk and weight of the reservoir.

C. *A cheap process of obtaining aluminum in quantity was yet to be discovered.*

I wrote that "lightness and strength" must be the watchword. "All the internal stays, ties, braces, to be made of strong but delicate metallic rods, wire and *tubing.*" The following reference was made to the metal best suited for the purpose:

"Some years after I began to think of this subject I fell into conversation with an intelligent machinist, the chance companion of a railway trip. He remarked that he thought that the solution of our problem might depend upon the increased production of aluminum—then a comparatively new metal.

"This, one of the most abundant of metals, is so difficult of extraction from the clay that the cost at that time was $1.80 per ounce. By 1867 it was obtained through an improved process from cryolite, at a cost of ninety cents per ounce. Recent authorities quote the cost of manufacture as low as $4 a pound. Its specific gravity, when hammered and rolled till strong as iron or stronger, compares with that of iron and copper as 2.67 to 7.78 and 8.78 respectively. It is, therefore, but *one-third* as heavy as the lighter of these metals, and even weighs less than glass. There are signs that it will yet be produced so cheaply as to be useful for much of the jointed frame work of our structure, and for portions of the machinery not subject to excessive heat. But though it cost its weight in silver it might well be afforded, if by its use a structure could be made to navigate the air.

"Aluminum bronze, ten parts aluminum and ninety parts copper, has a specific gravity of only 7.69. It is three times more rigid than gun metal, and forty-four times more so than brass; and, in consequence of its transverse, tensile and elastic strength, exceedingly strong tubing and rods could be made of it, at a vast economy of structural weight."

Professor Newberry now tells you that "aluminum, (it is time that metallurgists should make a final choice between the terminations in *inum* and *inium*,) has not been largely used yet, because of the cost that has attended its production, but for a long time everybody has been looking for a cheaper method. The price of it when I first saw it was $8 an ounce, a year ago it was $1 an ounce, and now there is a Philadelphia firm that offers to supply it in large quantities at 40 cents an ounce, while a Connecticut manufacturing company say they that can produce it for less." He continues: "Think how valuable it would be in bridges and all structures in which lightness combined with strength and durability is desired. *If we ever have machines to navigate the air it will be an extremely important element, for it can be easily wrought into tubes that will be strong and light.*"

It is not within my province to enlage upon the thousand departments in which this light, strong and non-corrosive metal will take the place of iron. And we have yet to learn how cheap is the new method of its production, but if your London telegram is well-founded, and if the cost of aluminum can be reduced to any sum approximating the cost of steel, making allowance for the difference in specific gravity of the two substances, we can safely assert that the year 1882 has provided two of the three factors required for the solution of the problem of aërial navigation.

The public may remember that an imperfect machine, in some features resembling my design, has lately achieved a measure of success in France. M. Tis sandier is now constructing a spindle-shaped aërobat to be driven by electricity. Owing partly to its disadvantageous separation of the car and aërostat, its speed will not exceed fifteen miles an hour in calm weather.

In Mr. Chanute's "Annual Address," 1880, before the convention of the American Society of Civil Engineers, he spoke as follows:

"There are signs that a new motive power will be invented, which shall be safer, of greater energy, and less wasteful than steam. You know that chemists tell us that the theoretical energy of a pound of coal varies between eight and eleven millions of feet pounds, while we utilize with our best steam engines but from three to eleven per cent of the theoretical value of the fuel. I think it not impossible that we shall perfect methods of employing directly the gases produced from our fuels (instead of using them to generate another gas out of water), and thus obtain better economical results than with steam. I know of several promising attempts in this direction.

"And, with a new motive power, perhaps will come the solution of the last transportation problem which remains to be solved. I suppose you will smile when I say that the atmosphere still remains to be conquered; but wildly improbable as my remarks may seem, there may be engineers in this room who will yet see men safely sailing through the air."

I write this letter as a further and timely statement of the advances made toward aërial navigation, and would gladly aid in extending, even thus slightly, the interest felt in the theme. I believe that the time is not far off when capitalists will take hold of the problem with results proportionate to their means and enterprise. The first aëronon of practical value will not be constructed except by skilled engineers authorized to expend upon it at least the half million dollars required for the construction of a steamship. The sum was raised at once for Capt. Ericsson's vessel when he invented his caloric engine, twenty odd years ago. Among the scores of communications which my article of 1879 brought me—not only from more or less intelligent (and "distressed") inventors, each with a model or caveat of his own, but also from amateurs and engineers—those from laymen often made light of the topic or subjected me to severe criticism. To my surprise many professional experts of high standing expressed the greatest interest in my views, and, allowing for the defects and crudeness incident to my limited study of the subject, in the main coincided with them. I judge that the prediction of an early solution of the problem is not without a basis. If it shall be solved, all the results which I have dwelt upon with some enthusiasm most surely will follow apace. A speedy revolution will be observed in the social, commercial and political systems of human life upon this globe.—*N. Y. Tribune.*

A THAMES LAUNCH PROPELLED BY ELECTRICITY.

SYLVANUS P. THOMPSON.

Having been one of a privileged party of four, the first ever propelled upon the waters of the River Tnames by the motive power of electricity, I think some details of this latest departure in the application of electric science may be of interest.

At 3:30 this afternoon I found myself on board the little vessel Electricity, lying at her mooring off the wharf of the works of the Electrical Power Storage Company at Milwall. Save for the absence of steam and steam machinery, the little craft would have been appropriately called a steam launch. She is twenty-six feet in length and about five feet in the beam, drawing about two feet of water, and fitted with a twenty-two inch propeller screw. On board were stowed away under the flooring and seats, fore and aft, forty-five mysterious boxes, each a cube of about ten inches in dimensions. These boxes were nothing else than electric accumulators of the latest type, as devised by Messrs. Sellon and Volckmar, being a modification of the well-known Plante accumulator. Fully charged with electricity by wires leading from the dynamos or generators in the works, they were calculated to supply power for six hours at the rate of four-horse power. These storage cells were placed in electrical connection with two Siemen's dynamos of the size known as D 3, furnished with proper reversing gear and regulators, to serve as engines to drive the screw propeller. Either or both of these motors could be "switched" into circuit at will.

In charge of the electric engines was Mr. Gustave Phillipart, Jr., who has been associated with Mr. Volckmar in the fitting up of the electric launch. Mr. Volckmar himself and an engineer completed, with the writer, the quartet who made the trial trip. After a few minutes' run down the river, and a trial of the powers of the boat to go forward, slacken, or go astern at will, her head was turned citywards, and we sped—I can not say steamed—silently along the southern shore, running about eight knots an hour against the tide. At 4:37 London bridge was reached, where the head of the launch was put about, while a long line of on-lookers from the parapets surveyed the strange craft that without steam or visible power—without even a visible steersman—made its way against wind and tide. Slipping down the ebb, the wharf at Millwall was gained at 5:01, thus in twenty-four minutes terminating the trial trip of the Electricity.

For the benefit of electricians I may add that the total electromotive force of the accumulators was 96 volts, and that during the whole of the long run the current through each machine was already maintained at 24 amperes. Calculation shows that this corresponds to an expenditure of electric energy at the rate of 3 1 11 horse-power.

It is now forty-three years since the Russian Jacobi first propelled a boat upon the waters of the Neva by aid of a large but primitive electro-magnetic engine, worked by galvanic batteries of the old type, wherein zinc plates were dissolved in acid. Two years ago a little model boat was shown in Paris by M. Trouve, actuated by accumulators of the Faure-Plante type. The present is, however, not only the first electric boat that has been constructed in this country, but the very first in which the electric propulsion of a boat has been undertaken on a commercial scale.—*London Times*.

THE COMING MOTIVE POWER.

The simplest and one of the most clever and interesting applications of electricity to purposes of daily use was shown last week by Mr. C. Vibbard in his Broad Street office, where a model of the apparatus and a track was laid the length of the room. It is an automatic safety signal for railway trains. The road is cut up into blocks, which may be only 500 feet or twenty miles in length, as may be desired. A train coming on this block or section from either end automatically operates a simple instrument, which puts all signals on either end of the section, and on any switches that may immediately come in, at "danger." By the same operation, when the train passes off the block the last car releases the instrument, which is hidden under the rails, and safety signals are in turn displayed. There is no dependence upon the rails as conducting mediums, as has been the case with former automatic signals, the electric power being conveyed by an independent wire running below the ground from an instrument buried under the track, to a telegraph pole where it is held aloft from all disturbing influences. At night red lights are displayed. No weight less than five tons can open or close the circuit. In this way the danger of collision is avoided and likewise the overtaking of a slow train by a fast one, particularly at night on curves. To show how quickly the value of a thing will appreciate if solid people can only be induced to use it, this invention could have been had a couple of years ago for a mere song. After a while the Pennsylvania Railroad was induced to try it on their Tyrone division, the worst railroad division in the United States. Not an accident occurred while it was in use. Then the road ordered it put on the entire line from New York to Philadelphia, Pittsburg and Chicago, and on all connecting lines, and to-day the patent that could have been bought two years ago for a trifle could not be had for $1,000,000.—*N. Y. Cor. Buffalo Express.*

A LOCOMOTIVE WITHOUT A SMOKE-STACK.

Mallett's device for consuming smoke is about to be tested on the Erie railway, on which a consolidated locomotive is being equipped. The smoke-stack disappears entirely, and in its place is a man-hole merely. The gases produced by the complete combustion will escape about the periphery of the extended boiler casing. The fan is worked by a small engine in the smoke box, and a powerful draft is maintained when the locomotive is at rest. The exhaust steam passes along the side of the locomotive to the tender, which is divided into three compartments. The upper one is for fresh water, the middle one contains copper tubes connecting with the external air in front and with a suction fan in the rear. The exhaust steam circulates around the copper tubes and becomes in part condensed, the resulting hot water falling into the lower compartments. The uncondensed steam that comes in contact with a spray of water falling from the upper compartment and the condensed water enters the lowest compartment, whence hot water is pumped into the boiler. The air used to condense the steam is employed for heating and ventilating cars, being delivered through a conduit which, with coupling ends, passes along beneath the cars. This system does away with coal stoves or heaters, and supplies the cars with fresh air and warm air without danger of fire in case of a smash up. When the locomotive now under way is completed, it is proposed to make with it a transcontinental trial trip.—*Railway Age.*

INDUSTRIAL NOTES.

THE CROPS OF 1879, 1881 AND 1882.

The Agricultural Department Statistican, Mr. J. R. Dodge, has just finished the compilation of the crop statistics for the year 1882, which will accompany the annual report of Commissioner Loring. The following exhibit of wheat and corn production, together with the yield for 1879 and 1881, is taken from the report, and will be found of great value:

WHEAT (BUSHELS).

States.	1879.	1881.	1882.
Maine	665,714	617,000	512,100
New Hampshire .	169,316	175,000	148,700
Vermont	337,257	378,000	378,000
Massachusetts . . .	15,768	19,000	20,100
Rhode Island . . .	240	260	300
Connecticut	38,742	39,000	43,600
Northeast . . .	1,227,037	1,228,260	1,102,800
New York	11,587,766	10,844,000	12,145,200
New Jersey	1,901,739	2,018,000	2,098,700
Pennsylvania . . .	19,462,405	18,797,000	20,300,700
Delaware	1,175,272	1 044,000	1,200,600
Middle	34,127,182	32,703,000	35,745,200
Maryland	8,004,834	7,213,000	8,665,600
Virginia.	4,822,504	7,165,000	8,311,400
North Carolina . .	3,397,395	4,579,000	5,494,800
South Carolina . .	962,353	988,000	1,729,000
Georgia	3,159,771	2,933,000	3,812,900
Florida	422	480	600
South Atlantic .	23,347,312	22,878,480	28,004,300
Alabama	1,529,657	1,479,000	1,700,800
Mississippi	218,850	197,000	250,100
Louisiana	5,034	5,350	7,000
Texas	2,567,760	3,230,000	4,173,700
Arkansas	1,269,730	1,017,000	1,566,100
Southern . . .	5,591,071	6,037,350	7,697,700
West Virginia . . .	4,001,711	4,413,000	4,854,300
Tennessee	7,331,353	6,408,000	8,971,200

Kentucky	11,356,113	8,625,000	17,250,000
Central	22,689,177	19,446,000	30,075,500
Ohio	46,014,689	38,520,000	45,453,600
Indiana	47,284,853	31,353,000	45,461,800
Illinois	51,110,502	26,822,000	52,302,900
Iowa	31,154,205	18,248,000	25,487,200
Missouri	24,966,627	20,399 000	27,538,600
Kansas	17,324,141	19,909,909	33,248,000
Nebraska	13,847,007	13,840,000	14,947,200
Surplus States . . .	231,702,204	169,091,000	244,439,300
Michigan	35,542,543	21,220,000	33,315,400
Wisconsin	24,884,689	17,987,000	20,145,400
Minnesota	34,601,030	35,952,000	37,030,500
Lake	95,018,262	75,159,000	90,491,300
California	29,017,707	28,406,000	34,546,600
Oregon	7,480,010	12,673,000	12,039,300
Nevada	69,298	48,000	49,400
Pacific Coast . .	36,567,015	41,127,000	46,635,300
Colorado	1,425,014	1,310,000	17,598,200
Territories	6,718,829	11,300,000	
	9,203,843	12,610,000	17,598,200
District	6,402	. . . . . .	. . . . . .
United States . . .	459,479,505	388,280,000	502,798,600

CORN (BUSHELS).

States.	1879.	1881.	1882.
Maine	960,633	1,064,000	904,400
New Hampshire . .	1,350,248	1,262,000	807,700
Vermont	2,014,271	1,990 900	1,930,300
Massachusetts. . .	1,797,593	1,406,000	1,237,200
Rhode Island . . .	372,967	327,000	277,900
Connnecticut . . .	1,880,421	1,427,000	1,115,800
Northeast	8,376 133	7,476,000	6,376,300
New York	25,875,480	20,085,000	20,687,500
New Jersey	11,150,705	7,820,000	9,942,800
Pennsylvania . . .	45,821,531	34,599,000	41,518,800
Delaware	3,894,264	2,940,000	3,936,600
Middle	86,741,980	65,453,000	76,085 700
Maryland	15,968,533	16,277,000	17,904,700
Virginia	29,106,661	27,200,000	35,994,000
North Carolina . .	28,019,893	23,977,000	34,260,700

South Carolina . .	11,767,099	8,809,000	15,856,200
Georgia	23,202,018	19,745,000	29,617,500
Florida	3,174,234	3,170,000	8,608,900
South Atlantic .	111,238,384	102,178,000	137,252,000
Alabama	25.441,278	20,250,000	30,982,500
Mississippi	21,340,800	16,646,000	28,233,600
Louisiana	9,906,189	9,693,000	14,636,400
Texas	29,005,172	33,277,000	63,416,300
Arkansas . . .	24,156,417	21,028,000	34,485,900
Southern	109,979,856	101,994,000	171,754,700
West Virginia. . .	14,090,609	12,980,000	14,927,000
Tennessee	62,764,429	36,232,000	73,188,600
Kentucky	72,852,263	51,624,000	79,500,900
Central	149 707,301	100,836,000	167,616,500
Ohio	111,877,124	79,760,000	93,319,200
Indiana	115,482,300	79,618,000	107,484,300
Illinois	325,792,481	176,733,000	187,336,900
Iowa	275,024,247	173.289,000	178,487,600
Missouri	202,485,723	93,069,000	174,037,000
Kansas	105,729,325	76,377,000	150.452,600
Nebraska	65,450,135	58,913,000	82,478,200
Surplus States .	1,201,841,295	737,759,000	973,595,800
Michigan	32,461,452	25,068,000	30,081,600
Wisconsin	34,230,579	29,040,000	30,201,600
Minnesota	14,831,741	13,252,000	21,127,600
Lake	81,523,772	71,360,000	81,410,800
California	1,993,325	3,633,000	2,790,900
Oregon	126,862	101,000	101,000
Nevada	12,891	13,000	11,700
Pacific Coast .	2,133,078	2,747,000	2,903,600
Colorado and Territories	3,379,696	6,113,000	7,500,000
United States. . .	1,754,861,535	1,194,916,000	1,624,917,800

RAILROAD CONSTRUCTION IN THE UNITED STATES DURING 1882.

The *Railway Age* has furnished an advance slip of an interesting article giving an account of the railway construction in the United States during the year 1882.

The following the *Age's* summary of new track actually laid from January 1 to December 1, length of main line only, indicated by distance between termini, being considered, and no account being made of new sidings or of additional side track:

STATES.	NO. LINES.	MILES.
Alabama	2	37
Arizona	2	192
Arkansas	7	529
California	7	285
Colorado	12	500
Connecticut	1	2
Dakota	16	480
Delaware	—	—
Florida	6	204
Georgia	6	305
Idaho	3	300
Illinois	16	385
Indian Territory	1	60
Indiana	9	528
Iowa	24	953
Kansas	8	217
Kentucky	3	86
Louisiana	4	52
Maine	3	28
Maryland	2	41
Massachusetts	2	5
Michigan	13	223
Minnesota	13	441
Mississippi	3	80
Missouri	12	308
Montana	2	309
Nebraska	5	210
Nevada	1	44
New Hampshire	1	17
New Jersey	5	85
New Mexico	3	21
New York	22	732
North Carolina	10	154
Ohio	17	554
Oregon	3	198
Pennsylvania	31	464
Rhode Island	—	—
South Carolina	3	57
Tennessee	8	133
Texas	19	817
Utah	2	175
Vermont	1	8
Virginia	10	228
Washington Territory	—	—
West Virginia	3	20
Wisconsin	16	397
Wyoming	1	25
Total	316	10,821

Where, as in several cases, the same line has been built in two or more States it is counted as but one line in the grand total, so that the footing under the column "No. of lines"—316—is less by 22 than the actual sum of the number of lines taken separately by States and Territories.

Thus it appears that track-laying has been in progress during the year in forty-four of the States and Territories, upon 316 different railways, with the result of adding no less than 10,821 miles to our railway system, and it is not unlikely that this may be increased to 11,000 miles by the final returns. These figures place 1882 far ahead of any other year in respect to railway building, the increase over 1881, hitherto the year of most extraordinary construction, being about 1,500 miles, or more than 16 per cent. For the purpose of comparison there is given below the figures of yearly mileage found in Poor's Manual, assuming them to be approximately correct, and adding our figures for 1882:

YEAR.	MILES BUILT.	TOTAL MILEAGE.
1873	4,107	70,278
1874	2,105	72,383
1875	1,712	74,096
1876	2,712	76,808
1877	2,281	79,089
1878	2,687	81,776
1879	4,721	86,497
1880	7,174	93,671
1881	9,386	104,813
1882	10,821	115,634

In regard to the prospects for future construction of the 316 roads which are covered by this record, at least 140 are still uncompleted, and on many of these work will be resumed in the spring, if it is not continued during the winter. Bearing in mind that the number of lines on which grading was actively in progress during the year, although no track was laid, is very large, and that a host of new projects have been inaugurated upon which no tangible work has yet been done, and it appears that railway building is likely to be active during 1883, though it will probably be better for the country if it does not proceed with the extraordinary speed which has characterized the past two years.

The amount of capital which has been invested in railways in the last year is almost incredible. Allowing $25,000 per mile as a fair average for the cost of a road equipped and in operation, the 10,800 miles of which we have record have cost $270,000,000, to which is to be added the vast and unknown sum expended in preparing road beds in which track is not yet laid.

BATES COUNTY COAL MINES.

The shipping of coal from Rich Hill began in the fall of 1880. Late in October the Rich Hill Coal Company commenced operations on a small scale from surface mines, but on account of insufficient rolling stock on the Missouri Pacific railroad, the coal company were unable to keep their employees at steady work, and consequently were unable to supply the demand for coal. The number of cars shipped out that fall and the following year of 1881 amounted to 8,706. During the past year of 1882 the shipments have been as follows:

1882.	CARS.
January	1,439
February	1,379
March	1,286
April	1,043
May	1,020
June	812
July	1,294
August	1,901
September	1,879
October	1,101
November	2,251
December	2,404

The average car load, by actual weight, exceeds sixteen and one-half tons.

The shipments of the Gulf road have not been quite as large as those over the Missouri Pacific, but still make a good showing. Coal was first shipped over the Gulf road about the 1st of October, 1880, and during that year 3,081 cars were sent out; in 1881 the shipments ran up to 17,436. During 1882 Keith & Perry, the principal shippers over the Gulf road, were developing new mines, and a large portion of the year shipped but very little coal, but the total for the year runs up to 12,960 cars, and their shipments now average 65 cars per day. This makes a total shipment over the Gulf road since its construction, of Coal from Rich Hill, of 23,477 cars, up to December 31st, 1882, and over the Missouri Pacific of 27,221 cars, or a grand total of 50,698 cars, or 329,537 tons.

During all this time there has been a very large output for the local trade, which has made the coal business of good proportions for a new mining field.—*Rich Hill (Mo.) Mining Review.*

REPORT OF THE KANSAS CITY STOCK YARDS FOR 1882.

This report, made by E. E. Richardson, Secretary, shows the receipts at the yards for the year to have been as follows: Cattle, 439,671; Hogs, 963,036; Sheep, 80,724; Horses and Mules, 11 716. The shipments were: Cattle, 439,521; Hogs, 961,906; Sheep, 80,708; Horses and Mules, 11,607. Total receipts in twelve years: Cattle, 2,722,291; Hogs, 4,657,606; Sheep, 457,719; Horses and Mules, 88,614. Grand total 7,926,230.

COLORADO COAL.

The coal deposits of Colorado are practically inexhaustible, and they are to be found in almost every portion of that State. The Denver *Republican* in a recent issue gives some interesting statistics concerning them. The northern belt —in three counties—some twenty mines, are now being worked, the coal from which is free-burning, semi-bituminous, and of fair quality, the output for last year having amounted to 550,000 tons. The middle region—that lying between Denver and Colorado Springs—from the only mine being worked the output during the last half of the year was some 34,000 tons; while in the southern belt, which includes Trinidad and El Moro, the entire region is rich in fine quality of coking coal. At the Starkville mine 100,000 tons were mined and shipped last year, the value of which loaded on the cars was about $2 per ton. At the same point forty coke ovens are in operation, the product of which is worth $4.50 per ton, and all of which goes to Arizona. The Eagle mine shipped 400,000 tons of coal and 12,000 tons of coke, and another mine produced 20,000 tons of coal. The output of coal from the Cañon region was 160,000 tons for the year; while that from the Gunnison country was 43,500 tons of soft and 2,000 tons of anthracite coal. The Colorado Coal & Iron Company manufactured at their mines at Crested Butte 10,000 tons of coke.

The area of soft coal land outside of Crested Butte is very extensive, coal of more or less degree of excellence being found under hundreds of square miles throughout Gunnison County. The anthracite coal is found over an extensive territory, but much of it is inaccessible and of an inferior quality. The best coal is found at the head of Anthracite Creek, about three miles from Crested Butte. An equally good quality is also found on Rock Creek; but the immense seams found down Anthracite Creek toward the North Fork of the Gunnison River hardly come up to the Pennsylvania standard of excellence. The anthracite trade of this region is yet in its infancy, but when preparations that are now being made for mining and handling it are once fairly under way, it will probably be able to furnish 200 or 300 tons per day, and the demand will inevitably increase. The coal is in all respects the equal of the Pennsylvania anthracite, chemical analysis and physical structure failing to show any material difference.

La Plata County is also very rich in excellent coal, the largest vein of which is the Mammoth, near Durango, which is 52 feet in width. In this county the seams are numerous and large, and for the most part so situated as to allow of cheap and expeditious mining. The character of the coal is mainly bituminous and well adapted to coking, though some of the seams yield a steam coal of remarkably good quality. The output in 1882 from the various mines there was about 5,900 tons, to which should be added the output of the railroad mine at Monero, which is in this belt, which produced 12,000 tons, making a total of

17,900 tons for the county for the year. At Como, in Park County, 75,000 tons of coal and 96,000 tons of coke were sent to market.

In summing up, the *Republican* says: Coal was produced in other sections of the State, of which no returns could be secured, but it is believed that 100,000 tons will cover it all. The output was, in other words, nearly 2,000,000 tons, valued at about $4,000,000 at the mines. The anthracite output, nearly 2,000 tons, value about $10,000, and the coke production reached the sum of nearly 100,000 tons valued at $4.50 at least, a total of at least $450,000, making the value of entire coal output $4,460,000.—*Age of Steel.*

BULLION PRODUCT OF COLORADO.

The Denver *Tribune* gives the following table of the bullion product of Colorado for 1882:

COUNTY.	AMOUNT.
Boulder	$ 550,000
Chaffee	225,500
Custer	705,116
Clear Creek	2,001,629
Dolores	125,000
Fremont	19.960
Gilpin	2,006,516
Grand	10,000
Gunnison	600 000
Hinsdale	275,000
Lake	17 131,853
La Plata, San Juan	675,000
Ouray	329,760
Park	283,564
Pitkin	100,000
Rio Grande	310,000
Routt	100,000
Sagauche	52,000
Summit	1,250,000
Totals	$26,750,898

The product for 1881 was $22,203.509, showing an increase this year of $4.547,389.

Lake County.—The following table gives the bullion output of Leadville for the year ended December 30, 1882:

	QUANTITY.				
	POUNDS OF BULLION.	POUNDS OF LEAD.	TONS OF ORE.	OUNCES OF SILVER.	OUNCES OF GOLD.
Total 1st quarter	23,487,082	23,380,743	12,924	2,042,323	3,056
Total 2d quarter	20,510,096	20,415,647	12,175	1,838,596	2,886
Total 3rd quarter	22,713,006	22,605,015	28,050	1,743,876	6,548
Total 4th quarter	19,747,065	19,646,027	36,953	1,648,454	3,923
Total for year 1882	86,457,349	86,047,412	90,101	7,273,249	16,413

VALUE.

	VALUE OF LEAD.	VALUE OF SILVER.	VALUE OF GOLD.	VALUE OF ORE.	TOTAL VALUE.
Total 1st quarter .	$1,169,037	$2,328,248	$ 61,120	$ 485.762	$ 4,044,167
Total 2d quarter .	1,020,779	2,093,301	49,720	599,059	3,773,772
Total 3d quarter .	1,130,251	1,988,142	130,960	1,326,111	4,575,334
Total 4th quarter .	942,977	1,827,561	78,457	1,885,134	4,734,129
Total for year 1882.	$4,263,044	$8,237,252	$320.257	$4,296,066	$17,127,402

Total for 1881 amounted to $13,170 576, showing an increase this year of $3.956,826. In figuring the commercial value of the last quarter's product, silver is calculated at $1.11 per ounce, and lead 4·8 per pound. Previous productions were calculated on a fair average of the ruling quotations at the time.—*Engineering and Mining Journal.*

MEDICINE AND HYGIENE.

SEWER GAS AND ITS DANGER TO HEALTH.

WM. PAUL GERHARD, C. AND S. E.

Many erroneous ideas still prevail about sewer gas and its danger to health which arises, by having so-called "modern conveniences" in our dwellings. It is the purpose of this paper, without in any way adding to the "plumbing scare," clearly to define wherein the danger consists, but at the same time to establish rules for the proper draining and plumbing of houses, which, if carefully observed, will secure to the anxious house owner work of superior quality and of a positively safe character.

Plumbing fixtures, which were considered a luxury years ago, are now believed to be necessary, not only for comfort and convenience, but also, and even more so, for health and for cleanliness. Even a small house is nowadays generally provided with a kitchen sink, a water closet, and sometimes a bath-tub, while in a costly modern residence, arranged with an elaborate system of plumbing, we find kitchen, pantry and scullery sinks, slop sinks, laundry tubs, stationary wash-basins in closets near bed-rooms, a great number of bath or dressing-rooms, with water-closets, urinals, bath and foot tubs, bidets and other fixtures.

The suggestions and recommendations of this report apply with equal force to the drainage and plumbing of tenements, small houses, costly residences, villas, apartment houses, hotels, factories, school houses or public buildings. As every plumbing fixture is not only an outlet for the waste water to the drain, but possibly may become an inlet for drain air, the danger increases with the number of fixtures. A multitude of fixtures requires a large number of soil and waste pipe-stacks, and the chance of leakage of sewer gas through defective joints increases correspondingly. But be the house large or small, its drainage and plumbing system should always be so arranged as entirely to exclude any possibility of the escape of sewer gas.

Sewer Gas.—I shall, first, briefly consider what is meant by the term "sewer gas. This term, as Prof. W. Ripley Nichols has truly said,[1] is "an unfortunate one, and gives rise to a quite widespread but very erroneous idea. Many seem to suppose the 'sewer gas' to be a distinct gaseous substance, which is possessed of marked distinguishing characteristics, which fills the ordinary sewers and connecting drains, and which, as a tangible something, finds its way through any opening made by chance or by intention, and then, and only then, mixes with the atmospheric air."

Sewer gas is a mechanical mixture of a number of well known gases, having their origin in the decomposition of animal or vegetable matter, with atmospheric air. This mixture is continually varying, according to the more or less advanced stage of putrefaction of the foul matters, which form a sediment and a slimy coating of the inner surfaces in drains and pipes. It is also variable with the character of this sediment or deposit, and with the physical conditions (moisture, heat, etc.) under which the decomposition takes place.

The principal gases found in sewers and drains are oxygen, nitrogen, carbonic dioxide, carbonic oxide, ammonia, carbonate of ammonia, sulphide of ammonium, sulphuretted hydrogen and marsh gas.

The three first-named gases are the principal constituents of the atmosphere surrounding the globe, and are found present in the following *average* proportion, viz:

20.9 vols. oxygen }
79.1 vols. nitrogen } in 100 vols. of air, together with 2 to 5 vols. carbonic dioxide in 10,000 vols. of air.

According to R. Angus Smith the amount of *oxygen* is:

In the average, 20.96 vols. in 100 vols. of air.
In pure mountain air, 20.98 vols. in 100 vols. of air.
At the sea shore, 20.999 vols. in 100 vols. of air.
In streets of populous cities, 20.87 to 20.90 vols. in 100 vols. of air.

The air in sewers and drains contains much less oxygen, as some of it combines with the carbon of putrefying organic matter forming carbonic dioxide. The amount of nitrogen in the air of sewers is little different from that in the atmosphere which we breathe; but the amount of carbonic dioxide present is greatly increased.

The lowest amount of oxygen in sewer air is recorded to be 17.4 vols. in 100 vols. of air; the amount of carbonic dioxide is in the *average* 2.3 vols. in 100 vols. Sulphuretted hydrogen varies greatly, but the quantity is generally so small as not

[1] See Prof. Ripley Nichols' Report upon Chemical Examination of the Air of the Berkeley Street Sewer, in Boston, Mass., 1878.

de rmined. Still more difficult is it to find by chemical analysis the proportion of ner g‸‸es of decay.

In well ventilate and well flushed sewers, Dr. Russell, ɔf Glasgow, found the following ratio :

20.70 vols. of oxygen in 100 vols. of air.
78.79 vols of nitrogen in 100 vols. of air.
0.51 vols. of carbonic dioxide in 100 vols. of air.
No sulphuretted hydrogen in 100 vols. of air.
Traces of ammonia in 100 vols. of air.

Carbonic oxide is present only in excessively minute quantities, and even then it may have entered the sewer or drain through leakage of illuminating gas from gas mains.

In the absence of more satisfactory methods of analysis, it is usual with chemists to determine the amount of pollution of the air, or the organic matter in it, by determining the amount of carbonic dioxide present, assuming that there is a certain fixed proportion between the amount of carbonic dioxide and the organic matter.[1] Thus, Prof. W. Ripley Nichols records as the average of many carefully conducted experiments in Boston, the amount of carbonic dioxide in a sewer in that city as follows :

The average of

31 determinations in January, 1878, was 8.7 vols. of CO_2 in 10,000 vols. of air.
44 determinations in February, 1878, was 8.2 vols. of CO_2 in 10,000 vols. of air.
47 determinations in March, 1878, was 11.5 vols. of CO_2 in 10,000 vols. of air.
12 determinations in April, 1878, was 10.7 vols. of CO_2 in 10,000 vols. of air.
8 determinations in June, 1878, was 27.5 vols. of CO_2 in 10,000 vols. of air.
8 determinations in July, 1878 was 21.9 vols. of CO_2 in 10,000 vols. of air.
6 determinations in August, 1878, was 23.9 vols. of CO_2 in 10,000 vols. of air.
7 determinations in January, 1879, was 8.0 vols. of CO_2 in 10,000 vols. of air.
14 determinations in February, 1879, was 11.6 vols. of CO_2 in 10,000 vols. of air.
20 determinations in March, 1879, was 11.8 vols. of CO_2 in 10,000 vols. of air.

He remarks: "It appears from these examinations that in such a sewer as the one Berkeley Street, which, being of necessity tide-locked, is an example of the worst type of construction, the air does not differ from the normal standard as much as many, no doubt, suppose. In a general way, as we have seen, there is a larger amount of variation from normal air during the warmer season of the year; but even when the amount of carbonic acid was largest, it was only extremely seldom that sulphuretted hydrogen could be detected." * * * "I think that it should be said that the soil pipes and house drains are much more likely causes of discomfort and danger than the sewers."

Hence the importance of a thorough ventilation of all the soil, waste and drain pipes in a building.

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1 Such is strictly tr e only for a r fouled by respi ation, while it may not give accurate results in other cases.

In regard to this interesting question I must refer to the Report of Prof. Ira Remsen on the subject of organic matter in the air, published in the National Board of Health Bulletin, Vol. II No. 11.

Are the above-named constituents of sewer air the origin or cause of the sickness so commonly attributed to the inhaling of sewer gas?

Although many of the gases named are poisonous, if inhaled into the system in large quantities, and may, even if present in smaller quantities, cause nausea, asphyxia, headache, vomiting, etc., none of them can be said to *produce* any of the so called "filth diseases." To determine the exact origin of these is a still unsolved problem of physiology. While some believe that the particles of decomposing organic matter, present in sewer air and known as "organic vapor" cause disease, others seek the origin of the latter in microscopic *spores* or *germs* which live and feed upon such organic vapor and are capable of reproduction under favorable conditions, such as presence of putrefying filth, excess of moisture, heat, lack of oxygen, etc.

Whatever theory may be accepted as true, it is evident that, by preventing the decay of organic matter within sewers, drains and soil pipes, or by depriving these germs (if such be the cause of disease) of the conditions facilitating their reproduction, we can best prevent the outbreak of excremental diseases. In other words, *by completely removing as speedily as possible all waste matters from the dwelling by pipes thoroughly and tightly jointed, and by a sufficient dilution of the air in these pipes with oxygen, the danger of infection, arising from defective drainage and plumbing, may be reduced to a minimum.*

It should be mentioned that some hygienists, notably Dr. Soyka and Dr. Renk, both assistants of Pettenkofer in Munich, have lately denied the existence of any positive proof of a connection between sewer gas and the spread of epidemic diseases—just as Naegeli and Emmerich doubt the possibility of infection from drinking water contaminated by sewage. Dr Renk considers the exclusion of gases of decay of the interior of dwellings necessary only so far as they are offensive to the sense of smell. In this view, however, I cannot concur; in regard to "filth diseases," their causes and origin, I accept the theory of Drs. Simon, Parkes and others. * * * —*Van Nostrand's Magazine.*

THE TREATMENT OF DIPHTHERIA.

[*Rules adopted on the subject by the Philadelphia Health Authorities.*]

The great degree of fatality attending sickness from diphtheria, particularly among children, makes it important that every precaution be taken against the spread of the disease, and that the treatment of those coming down with it be prompt and intelligent. In view of the general lack of information with regard to the proper treatment of diphtheria patients, the resolutions just adopted by the Philadelphia Board of Health are interesting and valuable. These resolutions have been printed and given to the teachers of public and private schools for distribution among their pupils. By way of parenthesis, it may be remarked that every particular with regard to the unsatisfactory sanitary condition of the Jackson School, recently brought out in the *Globe-Democrat*, has been verified by the report of the City Health Officers of St. Louis, who have just completed investigation in the neighborhood. The report of the Philadelphia Board of Health is as follows:

Recent investigations having proved that the poison of diphtheria is portable, communicable by infection, and capable of reproducing itself outside of the human body, diphtheria must now be ranked as both a contagious and infectious disease. The following rules are, therefore, more imperative than ever before:

1. When a child or young person has a sore throat, a bad odor to its breath, and especially if it has a fever, it should immediately be separated and kept secluded from all other persons except necessary attendants, until it be ascertained whether or not it has diphtheria or some other communicable disease.

2. Every person to be sick with diphtheria should be promptly and effectually isolated from the public. Only those persons who are actually necessary should have charge of or visit the patient, and these visitors should be restricted in their intercourse with other individuals. Children residing in a house where there is a case of diphtheria should not be permitted to attend school.

3. When a case of diphtheria is fully developed, the same precautions in regard to free ventilation, disposal and disinfection of discharges, bed or body linen, etc , isolated during convalescence (or management of the corpse, should death unfortunately occur), etc., etc., ought to be enforced which have already been recommended in regard to small-pox.

4. It is particularly important that persons whose throats are tender or sore from any cause should avoid possible exposure from the contagion of diphtheria. Children under ten years of age are in much greater danger of taking the disease, and after they do take it of dying from it, than are grown persons. But adults are not exempt, and mild cases in them may cause whole series of fatal attacks among children.

5. Numerous instances are recorded where the contagion has retained its virulence for weeks or months, in cesspools, heaps of decaying vegetable matter, damp walls, etc., and been carried for long distances in clothing, in sewers, in waste pipes from stationary wash stands, and in other conduits. Hence all sewer connections and other carriers of filth should be well ventilated and disinfected, and children particularly should not be allowed to breathe the air of any water closet, cesspool or sewer into which discharges from patients sick with diphtheria have entered, nor to drink water or milk which has been exposed to such air.

6. Beware of any person who has a sore throat; do not kiss such a person or take his or her breath; do not drink from the same cup, blow the same whistle, nor put his pencil or pen into your mouth.

7. Do not wear nor handle clothing which has been worn by a person during sickness or convalescence from diphtheria.

METEOROLOGY.

METEOROLOGICAL SUMMARY FOR THE YEAR 1882.

PREPARED BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

The weather of 1882 abounded in superlatives. It had the highest mean temperature, the highest maximum barometer, the smallest and best distributed rain-fall, the coolest summer, the warmest autumn, and, with one exception (1877) the warmest winter months upon our fifteen years record. Notwithstanding the extremely small rain-fall, crops of all kinds were abundant, in most cases surpassing all previous yields. This furnishes further confirmation of the statement of our reports of 1871 and 1875, that a comparatively small amount of rain, well distributed, is more desirable than a larger amount unfavorably distributed.

TEMPERATURE.—Mean temperature of the year, 54.94° which is 1.51° above the mean of the fourteen preceding years. The highest temperature was 105° on September 12th; the lowest was 6 5° below zero on the 7th day of December, giving a range for the year of 111.5°. Mean at 7 A. M., 49.21°; at 2 P. M., 63.95°; at 9 P. M., 53.30°.

Mean temperature of the winter months, 35.19°, which is 5 18° above the average winter temperature; of the spring, 54.67°, which is 0.72° above the average; of the summer, 72.92°, which is 3.61° below the average; of the autumn, 56.97°, which is 3.81° above the average.

The coldest month of the year was December, with mean temperature 31.25°, the coldest week was January 16th to 22d, mean temperature 25.01°; the coldest day was December 7th, mean temperature 3.2°. The mercury fell below zero only once, on December 7th, not having previously touched zero since February 19, 1881.

The warmest month was June, with mean temperature 74.14°; the warmest week was June 27th to July 3rd, mean 82.83°; the warmest day was June 28th, mean 84.2°; the warmest hour was 2:30 to 3:30 P. M., September 12th, mean 105°. The mercury exceeded 100° on two days, September 12th and 13th, and reached or exceeded 90 on forty days, viz: 1 in May, 12 in June, 9 in July, 11 in August, and 7 in September.

The last hoar frost of spring was on May 22d, the first hoar frost of autumn was on October 19th, giving an interval of 150 days, or nearly five months entirely without frost. The last severe frost of spring was on March 24th, the first severe frost of autumn was on the 11th day of November, giving an interval of 232 days, or nearly eight months, without severe frost. This is the longest period of immunity from severe frost in the past fifteen years. No frost during the year caused damage to fruit buds or trees. The hoar frost of May 22d injured strawberries in some localities.

RAIN.—The entire rainfall, including melted snow, was 27.60 inches, which is the smallest annual rainfall on our fifteen years record, and is 7.12 inches below the average. Either rain or snow, or both, fell on 102 days, one less than the average. On fourteen of these days the quantity was too small for measurement.

The longest drouth in the fifteen years of observation, was from July 30th to September 18th, during which period of seven weeks less than a tenth of an inch of rain was registered. This drouth was not disastrous, because the staple crops were already well matured before the drouth began.

The number of thunder showers was twenty six. Hail fell on seven days.

SNOW.—The entire depth of snow was eighteen inches, which is 3.31 inches below the average. Of this amount two inches fell in January, two in February, nine in March and five in December. Snow fell on fourteen days. The last snow of spring was on March 9th, the first snow of autumn was on November 16th.

FACE OF THE SKY.—The average cloudiness of the year was 45.41 per cent. which is 1.08 per cent. above the average. The number of clear days (less than one-third cloudy) was 162; half clear (from one to two thirds cloudy) 103; cloudy (more than two-thirds) 100. There were eighty days on which the cloudiness reached or exceeded 80 per cent. There were fifty-three entirely clear and forty-seven entirely cloudy days. The clearest month was August, with a mean of 32.37 per cent.; the cloudiest month was December, mean 61.61 per cent. The percentage of cloudiness at 7 A. M. was 50.41; at 2 P. M. 49.82; at 9 P. M. 35.99.

DIRECTION OF THE WIND.—During the year, three observations daily, the wind was from the S W. 272 times; N.W. 269 times; S.E. 155 times; S. 128 times; N.E. 102 times; N. 72 times; E. 71 times; W. 26 times. The south winds (including southwest, south and southeast) outnumbered the north (including northwest, north and northeast), in the ratio of 555 to 443.

VELOCITY OF THE WIND.—The number of miles traveled by the wind during the year was 137,736, which is 687 miles below the annual average for the nine preceding years. This gives a mean daily velocity of 377 miles and a mean hourly velocity of 15.71 miles. The highest hourly velocity was sixty miles on March 21st, the highest daily velocity was 919 miles on January 16th; the highest monthly velocity was 16.608 miles in March. The three windiest months were March, April and May; the three calmest months were July, August and September. The average velocity at 7 A. M. was 14.51 miles, at 2 P. M. 17.73 miles, at 9 P. M. 15.49 miles.

BAROMETER.—Mean height of barometer column, 29.113 inches, which is with one exception (1874, 29.121 inches) the highest annual mean on our record. Mean at 7 A. M. 29.141 inches; at 2 P. M., 29.085 inches: at 9 P. M. 29.114 inches; maximum 29.985 inches on December 17th, which is more than two-tenths of an inch higher than any previous maximum; minimum 28.349 inches on March 26th; yearly range, 1.636 inches. The highest monthly mean was 29.200 inches in January; the lowest was 28.992 inches in June. The barometer observations are corrected for temperature and instrumental error.

RELATIVE HUMIDITY.—The average atmospheric humidity for the year was 68.23; at 7 A. M. 79.65; at 2 P. M. 50.95; at 9 P. M. 75.31. The dampest month was December, with mean humidity 76.70; the driest month was September, mean humidity 59.20. There were fourteen fogs during the year. The lowest humidity for any single observation was 7 per cent. on September 12th. This extreme dryness of the air existed during the continuance of the withering simoon of that date

1882	Mean temperature	Maximum temperature	Minimum temperature	Miles of Wind.	Relative Humidity.	Rain—In.	Snow—In.	Mean Cloudiness.
January	32.68	65.0	5.0	11,673	66.25	0.70	2.0	51.72
February	41.65	73 0	12.0	11,907	69.70	1.66	2.0	45.59
March	45.90	77 0	17.0	16,608	64.93	1 62	9.0	40.22
April	56.83	88.0	35.0	14,226	61.77	3 20	0.0	51.77
May	60.27	90.0	36.5	13,695	66 40	3.53	0.0	63.44
June	74.14	99.0	44.5	10,874	69.90	4 72	0.0	38.99
July	72.05	99 0	52.0	7 464	75.00	4 03	0.0	38.92
August	72.55	95.0	52.5	7,463	72.40	0.09	0 0	32 37
September	69.30	105.0	46.0	10,026	59 20	1.65	0.0	35.67
October	58.54	84 5	34.0	11,435	69.20	3 08	0.0	41.51
November	43.07	80.0	20.0	11,118	72 00	2.08	0.0	43.11
December	31.25	58.0	-6 5	11,247	79 70	1.24	5.0	61.61
Means	54.94	84 6	29.0	11,478	68.63	2.30	1.5	45.41

COMPARISON WITH PRECEDING YEARS.

YEAR.	Mean temperature	Maximum temperature	Minimum temperature	Miles of Wind.	Mean Cloudiness.	Relative Humidity.	Rain—In.	Snow—In.	Rainy days.
1868	53.36	101.0	–16.5	. . . .	43.35	. . .	37.48	27.50	77
1869	50.99	96.0	– 5.0	. . . .	49.23	78.2	38 51	16 50	105
1870	54.50	102.0	–10 0	. . . .	47.88	68.4	31.32	9.50	100
1871	54.30	103.0	– 6.0	. . .	47.37	65.9	33.23	29.75	120
1872	51.90	97.0	–18.0	. . . .	44 33	64.4	32.63	23.25	116
1873	52.71	104.0	–26 0	154,508	42 46	64 0	32.94	26.50	101
1874	54 20	108.0	– 3.0	145,865	45.54	65.7	28.87	43 0	99
1875	50.60	99.0	–16.0	145,316	44.81	66.7	28.87	5.00	106
1876	52.76	98 0	– 5.0	148,120	41.27	66.8	44.18	24 75	102
1877	54.16	99 0	– 9.0	113,967	47 12	72 6	41.09	15.50	126
1878	55.33	98.0	– 6 0	125,793	40.65	70.2	38.39	25.50	107
1879	54 67	99.5	–16 5	124,768	40.01	67.1	32.68	10.35	90
1880	54.01	101.0	–12.0	146,039	40.15	67.9	32.65	7.00	89
1881	54.65	104 0	– 8.0	141,430	47.52	70.1	33 27	32.50	110
1882	54 94	105 0	– 6.5	137,736	45 41	68 6	27 60	18.00	102
Mean of 15 years.	53.53	101 0	–12.2	138,377	44.40	68 3	34.25	21.07	103

The foregoing tables give the mean temperature, the extremes of temperature, the velocity of wind, the percentage of cloudiness, the relative humidity, the rainfall (including melted snow), and depth of snow, for each month of the year 1882, and a comparison with each of the fourteen preceding years.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Nov. 20th to 30th.	Dec. 1st to 10th.	Dec. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	21.3	14.5	16.4	17.4
Max	45.9	46.1	45.4	45.8
Min. and Max	33.6	30.3	30 9	31.6
Range	23.6	31.5	29 0	28 0
TRI-DAILY OBSERVATIONS.				
7 a. m.	28.2	23.5	25.8	25.8
2 p. m.	41.4	35.7	40.7	39 3
9 p. m.	30 6	26.3	32.4	29.8
Mean	31.7	29 6	33.0	31.6
RELATIVE HUMIDITY.				
7. a m.	.87	. .	. .	. .
2 p. m.	.64	. .	. .	. .
9 p. m.	.70	. .	. .	. .
Mean	.76	. .	. .	. .
PRESSURE AS OBSERVED.				
7 a. m.	29.13	29.07	28.78	28.99
2 p. m.	29.07	29.05	28.75	28 96
9 p. m.	29.11	29.08	28.80	29.00
Mean	29 10	29.07	28.79	28 98
MILES PER HOUR OF WIND.				
7 a. m.	7.5	9.7	. .	. .
2 p. m.	12.7	16.5	. .	. .
9 p. m.	12.6	13.6	. .	. .
Total miles	2862	4125	2852	9839
CLOUDING BY TENTHS.				
7 a. m.	2.2	6 3	. .	.
2 p. m.	5.1	6.8	. .	. .
9 p. m.	4.5	5.0	. .	. .
RAIN.				
Inches	.12	.co	.70	.82

The Sun was not visible for a moment at this station, December 6th, so no one saw the transit of Venus. The morning of December 7th the minimum thermometer recorded 11°. At sunrise the standard thermometer was at 6.5°.

Snow fell on the 6th and 19th, and ice on the river has been about four inches thick. There have been during the month more meteors than usual visible, thus verifying the predictions of astronomers.

THE METEOROLOGY OF SHAKESPEARE.

We may safely assume that Englishmen in the olden time, like their sons in these days, took much interest in the weather. They discussed the influence of the past portions of a season, the effects of the present showers or sunshine, and the good or evil signs for the coming day, month, or year. For this they had even stronger inducements than ourselves. A wet harvest time might bring the perils of actual famine home, not merely to scattered individuals, but to entire districts. Further, the weather and its signs were looked on in what we should regard as a superstitious light. Unusual seasons over and above their own unpleasantness were held to forbode foreign wars or civil tumults, pestilence and other calamities. It may be, therefore, not uninteresting to glance at the weather-lore of our forefathers, and ask in how far their rules for a foreknowledge of the season were well founded. For connecting this subject with the name of Shakespeare we have good reason. We have no certainty as touching the scraps and jingles in which popular meteorology is embodied. They may be old as the hills, or they may date no further back than the last century, and may have been blended with the results of modern investigation. But for the passages on this subject which we find here and there in the writings of Shakespeare we have a minimum limit. They must represent the traditions current in the days of his youth, and which had been handed down for at least a couple of generations. They must have arisen in an age when the barometer, the thermometer, and all other meteorological instruments were still unknown.

The first point we notice is that the south wind is held in strange disrespect. It is regarded as unhealthy, as boisterous and wet, and as especially connected with fog. Thus we read—

"All the contagions of the south light on you."
Coriolanus, I., 8.

"A south-west blow on ye
And blister you all o'er!"
Tempest, I., 4.

Elsewhere we find—

"The south fog rot thee!"

And again—

"Like foggy south puffing with wind and rain."

In short this wind is never well spoken of by Shakespeare, except in one passage:

—— "Like the sweet south
That breathes upon a bank of violets,
Stealing and giving odour."
Twelfth Night, I., 1.

So exceptional are these lines to all other references to the south wind that in Knight's Cabinet Edition an amendment is proposed. The editor would read "sound" for "south."

It is scarcely necessary to say that this emendation involves greater difficulties than the one it is intended to remove. Shakespeare assuredly would never have likened a strain of music to a "sound," nor spoken of a sound carrying along with it the odours of the violets.

But how comes the poet to couple the south wind with fogs? We know that fogs are exclusively connected with the "polar current," *i. e.*, northerly or easterly winds, though of course so gentle as to be only just perceptible. The moment the wind turns to the south or southwest London breathes afresh, and finds that the threatened doom of the great city is not yet. Besides, one of the passages quothed is self-contradictory. "Foggy south puffing with wind and rain!" Puffing wind and rain, from whatever quarter, dispel a fog.

Nor are the charges of unhealthiness brought against the south much better founded. The southwest wind, especially, blowing as it does over a wide expanse of ocean, is exceedingly unlikely ever to have wafted any pestilence to the shores of England. We think of the proverb still current in Yorkshire and Lincolnshire:

> "When the wind is in the west
> The weather is the best;
> When the wind is in the east
> It's neither good for man nor beast."

It is still possible that as fens and marshes were much more abundant in the Elizabethan age than they are now, and that as the south wind is generally accompanied by warm weather, malaria may have been more common in times of southerly winds than when the weather was colder. But in all other respects we cannot do other than pronounce the epithets which Shakespeare applies to the south wind grossly libelous, and the traditions upon which they are founded instances of loose observation. We should, indeed, be glad to escape coming to this unfavourable conclusion; for our great poet, though his attention was mainly fixed upon human passion and human character, had yet a keen eye for external Nature, as we shall show below. The Ancient Britons are said to have applied the name "cloudy or misty sea" to the German Ocean, from the fact that winds blowing from that quarter were apt to bring fog and gloom. But if the south wind was little admired in the Elizabethan days, the northern wind fared no better. Shakespeare would not have committed himself by writing an ode like that perpetrated by Kingsley. The longing which some people in these days profess for a good old-fashioned winter, and the opinion of the "bracing" character of a northeaster, are, we suspect, notions of somewhat modern origin, and are often chimney-corner aspirations, about as real as Jamie Thompson's praises of early rising. Shakespeare shows no love for winter:

"You and you are sure together
As the winter to foul weather."
As You Like It, V., 7.

It is only luxurious ages and persons who can expose themselves to the weather only when and how they like, and come in to a comfortable home when sufficiently "braced," who can like winter.

The opinion is often expressed that the climate of these islands, and indeed of western Europe altogether, has undergone a change for the worse during the last two or three centuries. Even if our average temperature has not decreased, or our mean rain-fall—or rather number of wet days—been augmented, we have, men say, a less prospect of warmth, and dryness, and calm coming when they are wanted,—that is, from the blooming of the wheat to the ingathering of the various crops. True, we have had, since 1870, great store of unseasonable weather, among which 1879 holds a memorably evil pre-eminence. But let us listen to the following passage:

"Therefore the winds, piping to us in vain,
As in revenge, have sucked up from the sea
Contagious fogs; which falling on the land
Have every pelting river made so proud
That they have overborne their continents;
The ox hath therefore stretched his yoke in vain,
The ploughman lost his sweat, and the green corn
Hath rotted ere its youth attained a beard.
The fold stands empty in the drowned field,
And crows are fatted with the murrain flock.
The nine men's morris is filled up with mud,
And the quaint mazes in the wanton green,
For lack of tread are undistinguishable.
The human mortals want their winter cheer,
No night is now with hymn or carol blest;
Therefore the moon, the governess of floods,
Pale in her anger, washes all the air
That rheumatic diseases do abound.
And through this distemperature we see
The seasons alter; hoary-headed frosts
Fall in the fresh lap of the crimson rose;
And on old Hyem's chin and icy crown
An od'rous chaplet of sweet summer buds
Is as in mockery set. The spring, the summer,
The chiding autumn, angry winter change
Their wonted liveries, and th' amazed world
By their inverse now knows not which is which."
Midsummer Night's Dream, Act II., Sc. 2.

Is this mere imaginary descripti n? We should say that it is a most faithful picture of such a season as that of 1879, with all its distressing features. We have summer frosts, short fits of mild weather coming when cold would be more seasonable, overflowing rivers, fields swamped, sheep perishing of foot-rot and of "flukes" in the liver, the corn rotting before it can reach maturity, the field-paths becoming indistinguishable because impassable. It is, in short, 1879 to the life, as any faithful observer—especially if living in a rural district—would have found it, and no one could have given its sad characters at once so strikingly and yet so briefly. We see, then, that cold wet summers are not a misfortune peculiar to the nineteenth century. A glacial epoch may be returning, but "cruel 1879" is no proof that such is to be the doom of our immediate posterity.

The appearance of the sky at sun rising has always been considered an indication of the weather that is to follow. Proverbs in common use in France and Germany, as well as in Britain, warn us against a red sky in the morning. Shakespeare was no stranger to this view, which does not always hold good.

> "As doth the blushing discontented sun
> From out the fiery portal of the east,
> When he perceives the envious clouds are bent
> To dim his glory, and to stain the track
> Of his bright passage to the occident."
>
> *Richard II.*, Act III., Sc. 3.

Here we have a picture of a particular type of unpromising morning, which every observer of the weather must have observed, and which was but too common both in 1879 and in 1882, The sun rises "blushing"—*i. e.*, red—into a tract of clear, fiery sky, beyond which lies a dense bank of clouds, which maintain their position and thicken till the whole sky is overcast, and the rain sets in.

Another red dawn is described, as on the day of the battle of Shrewsbury:

> "How bloodily the sun begins to peer
> Above yon busky hill! The day looks pale
> At his distemperature.
> The southern wind
> Doth play the trumpet to his purposes,
> And by his hollow whistling in the leaves
> Foretells a tempest and a blust'ring day."
>
> *Henry IV.*, *Part I.*, Act V., Sc. 1.

Here, in addition to a red dawn, we have another indication of rain drawn from the peculiar character of the wind. In various rural districts we have heard a "bustling wind" spoken of as a sure sign of rain, and, as far as our observations have gone, it has invariably proved correct. The wind is by no means violent; it does not seem to move the stems or the larger branches of trees or shrubs, but it causes a great commotion in the leaves, especially if these are broad.

It is, perhaps, curious that in the writings of Shakespeare we find no reference to the sunset as an augury for the day to come. Nor is the rainbow mentioned, concerning the signification of which there exist not a few contradictory proverbs. All, we think, agree that a rainbow in the morning is a bad sign. But the English countryman is apt to regard—

"A rainbow at night
As the shepherd's delight."

The French peasant, on the contrary, says, more wisely, as we think:

"Arc en ciel du soir
Il faut voir."

Certainly in settled fair weather rainbows, either at morning or night, are not likely to make their appearance.

The cry of the owl seems to have been held as characteristic of stormy weather:

"The obscure bird
Clamoured the live-long night."
Macbeth, Act II., Sc. 5.

It may be doubted whether this circumstance is mentioned as characteristic of stormy weather, or as an omen that mischief of other kinds was about. We have never met with any popular saying which connected the voice of the owl with rain and storm, nor have we observed it to be a "weather-wise" bird. The notion that its hooting is a sign of death has been common for centuries. Some wise man attempted to explain this supposed fact by the assumption that the owl smells the approach of death in a sick man, and flutters screaming round his house in an effort to get at the body. This is a curious collection of blunders. The owl prefers, like a true sportsman, to kill game for its own dinner, and does not care for a prey which has died a natural death. Secondly, the bird has, by no means, a very acute sense of smell, and would be utterly unable to detect the odour of a dead or dying man outside the house. She is very possibly attracted by a light in the sick chamber, and puzzled thereby, as are sea-fowl by a light-house, flutters around instead of attending to her lawful business.

The notion of the unwholesomeness of the night air must have been already current in Shakespeare's time. We read:

"To dare the vile contagion of the night,
And tempt the rheumy and unpurged air."
Julius Cæsar, Act II., Sc. 3.

It is indisputable that in malarious districts the night air is especially dangerous. But it may well be doubted if the extreme dread of the night air common in England is anything more than a superstition. There are many people who—whatever may be the temperature, and how dry and calm soever the weather—would be horrified at sleeping with their bed-room windows open. It has happened to us more than once, when on a visit at friend's house, to find that during dinner the servants had carefully shut the windows, and thus secured—for us at least—the luxury of a restless night. Perhaps in Shakespeare's day malaria might have been more common than in the present time, and to shun the night air was therefore good policy. There are even yet districts in England where we should not prefer to sleep with open windows in an autumn night.

To conclude these somewhat random remarks we will quote a very faithful description of the hush which often precedes a storm:

> "But as we often see against some storm
> A silence in the heavens, the rack stand still,
> The bold winds speechless, and the orb below
> As hush as death; anon the dreadful thunder
> Doth rend the region."
>
> *Hamlet*, Act II., Sc. 7.

This passage, like the account of the wet season which we cited above, is evidently the fruit of personal observation, and not of tradition.—*London Journal of Science.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The weather in the first decade of this report was characterized by extreme cloudiness although the precipitation was small. During the last two decades the mean temperature has been much lower.

A very cold period began on the 17th which reached its culmination on the 21st, when the low temperature of—21° was recorded. The most disagreeable day to be out was the 20th, the temperature not rising above zero the entire day and a strong north wind prevailing.

A snow storm on the 15th brought four and a half inches of snow which gave a week of tolerable sleighing.

On the evening of the 18th a brilliant lunar halo was observed, the Moon being near the zenith and both a primary and a secondary arc were visible for nearly 180° on the south side of the Moon. The former was about 50° from the Moon and the prismatic colors well defined. The secondary arc was about 20° from the Moon and fainter—the prismatic colors being wanting.

The usual summary by decades is given below.

Temperature of the Air.	Dec. 20th to 30th.	Jan. 1st to 10th.	Jan. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min.	18.2	2.1	4.5	8.3
Max	38.0	31.5	28.7	32.7
Min. and Max	28.1	16.8	16.6	20.5
Range	19.8	29.9	24.2	24.6
Tri-Daily Observations.				
7 a. m.	22.5	7.2	8.2	12.6
2 p. m.	28.4	22.2	25.0	25 2
9 p. m.	24 1	14.3	15.3	17.9
Mean	24.8	18.5	16.8	20.0
Relative Humidity.				
7. a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Mean	. .	. .	. .	. .
Pressure as Observed.				
7 a. m.	29.09	29.21	29.13	29.14
2 p. m.	29.09	29.14	29.08	29 10
9 p. m.	29.11	29.21	29.14	29.15
Mean	29.10	29.19	29.12	29.13
Miles per Hour of Wind.				
7 a. m.	13.8	.	. .	. .
2 p. m.	12.2	. .	. .	. .
9 p. m.	11.6	. .	. .	. .
Total miles	2539	3071	4995	10605
Clouding by Tenths.				
7 a. m.	7.6	3.1	3.4	4.7
2 p. m.	4.9	2.3	2.1	3.1
9 p. m.	3.4	3.0	4.0	3 5
Rain.				
Inches	.10	.00	.53	.63

ASTRONOMY.

THE STARS FOR FEBRUARY.

The northern heavens present no change of special importance since last month. The Dragon has been carried away from his former *hovering* position, and now appears as if swooping downward, though in a direction contrary to that of his real motion around the pole. The ancient observers do not seem to have attached any importance, by the way, to the direction in which the star-sphere turns; and indeed, a motion so slow as not to be perceptible by ordinary vision might well be left out of account in forming imaginary star-groups. Some of the figures go forward, as Orion, the Great Bear, Boötes (the Herdsman), the Lion, and so forth; others go backward, as the Dragon, the Ram, the Bull, Pegasus (the Winged Horse), and so on; while others, like Ophiuchus (the Serpent bearer), are supposed to face the observer and so travel sideways; and others again, travel on their head, as Hercules, Cepheus, and Andromeda. It is quite clear that those who invented the constellation figures did not trouble themselves much about the rotation of the star-vault.

There may be noticed in the northern heavens, as seen in February, a vacant space above the pole, girt round by the constellations Auriga (the Charioteer) overhead, Perseus (the Rescuer), Cassiopeia (the Seated Lady), Cepheus (her royal husband), and the two Bears. In this poverty-stricken region there are no stars of the first three magnitudes, and only four or five of the fourth magnitude. The ancient astronomers could imagine no constellations in these spaces. It is to the moderns, and especially to Hevelius, that we owe the constellations which have been figured in these barren districts. The Camelopard, or Giraffe, is one, the Lynx another. I cannot say, for my part, that I see either a giraffe or a lynx there. Certainly, if you draw the connecting lines shown in the map, you get as fair a picture of a giraffe (inverted at present) as can possibly be made with a couple of lines; but it seems to me—though I do not claim to be an artist—that rather more than two lines are needed to picture a respectable giraffe. Besides the lines are not on the sky, and the liveliest fancy would not think of connecting these stars by imaginary lines, so widely remote are the stars, and so insignificant.

The Little Bear is now gradually getting round (at the selected hour of evening observation) to a position such as a bear might reasonably assume. Last month, this small bear was hanging head downward by the end of his absurdly long tail. He is now slowly rising from that undignified position, and by next month he will have fairly placed himself on his feet. For the present we can leave him to his struggles; but next month we shall consider his history and the duties which he has discharged for many hundreds of years.

Turning to the southern skies, we find full compensation for the relatively uninteresting aspect of the northern heavens. The most resplendent constellation in the heavens is now in full glory in the south. There, close to the meridian, or mid-south,

> "Begirt with many a blazing star,
> Stands the great giant Algebar,
> Orion, hunter of the beast:
> His sword hangs gleaming by his side,
> And on his arm the lion's hide
> Scatters across the midnight air
> The golden radiance of its hair."

No one can mistake this most beautiful constellation. The two bright shoulder stars, Betelgeux (*alpha*) and Bellatrix (*gamma*), the brilliant star Rigel on the giant's advanced foot, the triply gemmed belt (*zeta*, *epsilon*, and *delta*), and the pendent sword tipped with the bright star (*iota*), distinguish Orion unmistakably. But, besides these glories, there are others; the curve of small stars forming the giant's shield (a lion's hide), the misty light of the great nebula which lies on the sword (where shown), and on clear nights the dappled light of the

Milky Way, which really extends over a part of this constellation, to say nothing of numbers of faint stars scattered all over it, justify the words of the poet, who sang:

> "Orion's beams! Orion's beams!
> His star-gemmed belt, and shining blade;
> His isles of light, his silvery streams,
> And gloomy gulf of mystic shade."

From the beginning of astronomy, and probably long before astronomy was thought of, this constellation was figured as a giant: sometimes a giant hunter, a sort of celestial Nimrod; sometimes as a warrior. He commonly wields an immense club in his right hand, and a shield in his left. The star *Beta* of the constellation Eridanus really marks the giant's bent knee; and originally the constellation Lepus, or "the Hare," formed a chariot in which the hunter or warrior stood. In some old manuscripts of the Middle Ages, the stars of Lepus formed a throne for Orion. In fact, this little constellation, although named the Hare from time immemorial, has been called by other names, insomuch that Ideler, after quoting several, wrathfully adds, "And God knows how many more there are."

Orion is somewhat out of drawing, because of the necessity of keeping certain stars in particular positions with respect to him. Thus Betelgeux is derived from the Arabic *ibt-al-jauzá*, the giant's shoulder; Bellatrix, or "the Amazon star," belongs of right to the other shoulder, and Rigel to the advanced foot, while the three stars of the belt fix the position of the giant's waist. To tell the truth, he is an ill-shaped giant, anyway, and cannot be otherwise depicted.

Below Lepus (the Hare) you see the neat little group Columba, or "the Dove." This is one of the younger constellations, and was invented by Hevelius, perhaps to show that the ship Argo, which you see low down on the left, is no other than Noah's Ark. In fact, the name given to the small group originally was Columba Noachi, or "Noah's Dove." Approaching the mid south, you now see the brightest star in the whole heavens—Sirius, the famous Dog-star. The constellation Canis Major (the Greater Dog) which might much better be called simply Canis, was one of Orion's hunting dogs, Canis Minor being the other; but we can hardly suppose, Lepus was the sole prey pursued by so great a giant and two such fine dogs. The constellation Canis Major is chiefly remarkable for the Dog-star. In old times this star was thought to bring pestilence. Homer speaks of it (not by name, however) as the star

> "Whose burning breath
> Taints the red air with fevers, plagues and death."

Many among the ancients supposed that this star was in reality as large as the Sun. Thus Manilius said:

> "'T is strongly credited this owns a light
> And runs a course not than the Sun's less bright;
> But that, removed from sight so great a way,
> It seems to cast a dim and weaker ray."

It has been shown in our own time, however, that even this estimate, which was by many thought too daring, falls far short of the truth. It has been calculated that Sirius gives out two hundred times as much light (and doubtless two hundred times as much heat) as our Sun. So that it would make us rather uncomfortable if our Sun were removed and Sirius set in its place. Sir W. Herschel says that when he turned his large four-foot mirror on this star, the light was like that of the rising Sun, and it was impossible to look at the star without pain to the eye. Sirius is in reality in rapid motion, though owing to his enormous distance he seems at rest. He is rushing through space at the rate of about thirty miles in every second of time! In a year he traverses nearly six times the distance which separates our Earth from the Sun. This enormous annual journey is only about $\frac{1}{170000}$th part of the distance which separates him from our Earth; and as he is traveling away from us, we need not be greatly troubled on account of him. He is so far from us that his light has been no less than twenty years on its way to us, so that in reality, instead of saying we see Sirius, we ought to say we see where Sirius *was* some twenty years ago. Most of the stars are even farther away, so that if every one of them were in a single instant destroyed, we should still see them—that is, their light—for many years, and probably the greater number of them would still seem to be shining in the heavens long after the youngest of us were dead; perhaps even after our great grandchildren had passed away.

Canis Minor (the Lesser Dog) is a much less important star group than Canis Major, but still it is one of the ancient constellations. Its chief star is call Procyon, or "the Fore-dog," because his star is seen as a morning star earlier than Sirius. The Arabian astronomers gave it a name of similar meaning, to-wit, *Al-kelb-al-mutckaddem;* but I think Procyon sounds almost as well, and as it is the name by which the star is usually called, it may, perhaps be better to use it instead of the Arabian name, though this is very pretty. Procyon, like Sirius, was supposed to be a star of evil omen, especially as bringing bad weather. "What meteoroscoper," said Leonard Digges, the astrologer, "yea, who that is learned in matters astronomical, noteth not the great effects at the rising of the star called the *Litel Dogge?*"

The constellation Gemini, or the Twins, is now approaching the south, but will be more fully within the range of next our monthly map. The sign marked ♋ is that of Cancer, or the Crab which the Sun enters at mid-summer. You will observe that we have now reached the part of the ecliptic highest above the equator, which is, of course, the part reached by the Sun at midsummer. The point marked ♋ is at its highest in the south at noon on or about June 21st, and is then occupied by the Sun; it is at its highest in the south at midnight on or about December 20th, and the Sun is then exactly opposite to this point, or at his lowest below the northern horizon.

Those who live as far south as New Orleans, see, well raised above the horizon, the star Canopus, in the stern of the good ship Argo. There is presented to them, at this season, a view of more first magnitude stars than can be seen at any other time in one quarter of the heavens. For besides the splendid equal-sided triangle formed by Procyon, Betelgeux, and Sirius, they see Aldebaran, Rigel, and Canopus, the last-named surpassing every star in the heavens except Sirius alone.

Next month, the great ship Argo will have come better into view; and I defer till then my account of this fine constellation.

The eastern and western maps for this month, when compared with those for January, show how the stars, observed at any given hour month after month, change in position just as though they were watched hour after hour on the same night. Thus in the January eastern map the Lion is seen low down, and the arrows scattered over the map, which (except the arrow on the ecliptic) point the way the stars are apparently moving, show that the Lion is passing upward and slightly toward the right, or to just such a position as the constellation has in the eastern map for this month. In fact, if the stars had been observed in January two hours after the time when the Lion was placed as shown in the January map, it would have been found that the Lion had reached the exact position occupied by the constellation in our present map. Two hours' motion on any given night produces the same change of position as one month's motion for stars seen at any given hour. This remark applies to all stars; and the young student will do well to compare together the two eastern maps and the two western maps (for January and February), following up the work by noting month after month how the star groups rise up from out of the eastern horizon, and pass down toward the western. Also he will find it interesting to notice how six months hence the stars which are now rising at any given hour in the east will be found at the same hour setting in the west; while those which at any hour are now setting in the west will be found six months hence rising in the east. What is true of the present time, and six months from the present time, is true of any part of the year, and six months before or after that time.

In the east we see that at the hours named under the map (and of course at intermediate hours on the intermediate dates) the constellation Auriga has passed overhead, leaving only two stars visible in the space covered by the map, and even those two (*Beta* and *Theta*) have passed over to the western side of the north and south line overhead. The Lion is now the chief constellation of the east; and the student will do well to study it there, for this group is not so well seen at any other part of the year. When in the south, indeed, it is better placed for the astronomer, who cannot have the stars too high above the horizon. But the general student of the skies can note the shape of star groups more conveniently when they are at a moderate elevation.

I think few can recognize in the constellation Leo, as now figured, the shape of a lion. The stars *Mu*, *Epsilon*, and *Lambda* now mark the place of the lion's head, while his tail ends at the star *Beta*, and his forepaws reach from *Pi* to *Omicron*. It requires a strong imagination to see a lion among these stars. But I think a much larger lion can be readily seen, the head lying in Cancer, the mane reaching to Leo Minor, the forepaws on the stars *Zeta*, *Epsilon*, and *Delta*, which mark the head of Hydra (the Sea-Serpent), and the hinder paws on the stars *Beta* and *Zeta* of Virgo. It seems to me likely that originally the constellations named after men, animals, and other objects, were not, as now, separated from each other; but that if any group, large or small, seemed to resemble any object it was named after that object, whether it formed part or not of any other group already named, or whether it included part of such a group or was itself partly included in another constellation.

Of Virgo, which is just beginning to rise above the horizon, I shall have more to say next month.

In the west Pegasus, which was nearly in full view last month, has almost wholly set. Andromeda (still head downward) is following the Winged-Horse, but not toward the same part of the horizon. Perseus, or "the Rescuer," who was overhead last month, now lies between Andromeda and the point overhead, while Auriga (the Charioteer) now occupies the highest region in the heavens.

Two interesting constellations, which last month could not be seen in the western map, have now passed within its precincts, namely, Taurus (the Bull), and Cetus (the Sea Monster or whale).

It is very easy to identify the Bull, first by the Pleiads, and, secondly, by the bright and somewhat ruddy Aldebaran. The famous cluster—the so called *seven* Pleiads—in reality contains an immense number of stars, forming a very beautiful and amazing object when examined even with a small telescope. It is fabled that there were once seven Pleiads visible to the naked eye, but that one, called the lost Pleiad, has faded from view. With good eye-sight, however, not only can the original seven Pleiads be distinctly seen, but several others. A few observers have even seen as many as fourteen Pleiads.

The star (*Omicron*) Ceti is perhaps the most interesting star in the heavens. It is shown, in the map, of the second magnitude, but is in reality variable. At its brightest it shines as a star of the second magnitude; but it only shines thus for about two months out of ten. For about a fortnight it shines as a star of the second magnitude, then by degrees it fades away, until at the end of three months it can hardly be seen. After remaining about five months invisible, it gradually increases in brightness for about three months when it is again a second magnitude star. It occupies about 331 days and eight hours in going through these changes. —*Easy Star Lessons.*

GEOLOGY.

GEOLOGICAL SURVEYS OF KANSAS AND MISSOURI.

In the Legislatures of both of the above named States bills have been introduced providing for geological surveys of the respective States. We give the full text of that for Kansas, sent us by Mr. Geo. S. Chase, Chairman of the Committee appointed by the Kansas Academy of Science to attend to the matter:

Be it Enacted by the Legislature of the State of Kansas :

SECTION 1. That the Governor, Attorney-General, and President of the Kansas Academy of Science are hereby constituted a Board of Commissioners who are authorized and required, as early as may be, after the passage of this Act to appoint and commission a competent geologist for the purpose of organizing and prosecuting a geological survey of the State.

SEC. 2. Said geologist shall be authorized to appoint and associate with him a competent assistant geologist and palæontologist and an experienced analytical and experimental chemist and mineralogist, and such other collaborators and assistants as the best interests of the work may from time to time demand, provided the compensation for such assistance does not exceed the sum hereinafter appropriated for the maintenance of the survey; the appointment, direction and dismissal of assistants connected with the survey to rest in the hands of the geologist in charge.

SEC. 3. The objects and methods of the survey are the acquisition of a cemprehensive and detail knowledge of the geological structure and mineral resources of the territory embraced within the limits of the State. This shall include besides a careful study of the superficial reliefs of the State from such data as is or may be accessible, a thorough investigation of the stratigraphy of the various geological formations occurring within its bounds with the view of ascertaining their constitution, magnitude, and distribution, and the character, extent and value of the mineral or other products of economic importance occurring in connection with such formations. In view of the necessities for the realizations of the largest scientific and practical results in the prosecution of these investigations the work of the geological survey shall be proceeded with systematically, and with as great energy and despatch as may be consistent with its efficient execution. For this purpose the State shall be divided into at least three divisions, which shall correspond with the three principal hydrographic basins occurring within its limits, viz: The Missouri, Kansas and Arkansas drainage systems. These systems to receive a careful preliminary examination in order to determine the salient, physical and geological features pertaining to each division and to the whole State. With the consummation of these preliminary exploration the detail investigation of these divisions shall be begun, commencing with the oldest geological formation, and expanding the work by the detail survey of each county until the whole territory of the State shall have been thus systematically explored. For the greater expedition of this work the geologists shall further devote their investigations to special formations and districts, as far as may be, thereby allowing the examinations to be carried on in all parts of the State at one and the same time.

Sec. 4. It shall be the duty of said geologist in charge to make as complete a series of examinations of the superficial geological deposits as shall aid to an understanding of the origin, character, and extent of the different sorts of soils, the probability of obtaining water by means of artesian wells, especially in the western counties; also of all rock exposures, coal-beds and other mineral deposits as practicable, and the information thus gained shall be embodied in such notes, diagrams and sections as may be necessary for the clearer elucidation of the local, structural and stratigraphical features of the geological formations occurring in each county, and over the entire State.

Said geologist shall also secure as complete collections as possible of the minerals, rocks, soils, fossils, salines, and mineral waters occurring in the State that in any way have a value as aids to a thorough knowledge of its geological history.

A complete suite of said collections to be retained in the museum of the Kansas Academy of Science at the Capitol where they shall be classified and arranged, and be a permanent exhibition of the geological survey; a full series of the duplicate specimens similarly classified and authenticated to be placed at the disposition of the State University, State Agricultural College, and State Normal Schools. The geologist in charge shall also be authorized to use every means in his power, not otherwise interfering with the efficient conduct of the survey, to make accessions from abroad of geological material to the collections of the survey that may in any way contribute to the value of the economic, and educational results of the same.

Sec. 5. The said geologist in charge shall cause to be submitted to the chemist all ores, minerals, rocks, soils, salines, and mineral waters the chemical investigation of which may be of economic and scientific utility; also the chemist shall be afforded practical facilities for the prosecution of researches in the field wherever such may be essential to the interest of knowledge or of practical utility : and he shall in all cases be required to report the results of his analyses and investigations to said geologist.

Sec. 6. It shall be the duty of said geologist in charge to submit to the Governor on or before the first Monday in January of each year, a concise report of progress of the field-work for the current year in which the more important economic results shall be made public.

Sec. 7. At the earliest practicable date the geologist in charge shall prepare reports on the regional or county geology including reports of assistant geologist and chemist, each county so described to be accompanied by diagrams, sections and a map on which shall be indicated the location of all important mineral deposits the existence of which shall have been made known, and as far as practicable the extent of forest and prairie, nature and distribution of soils, and such other occurrences as may be deemed of importance for the information they afford regarding the economic resources, and industries dependent thereon, and the general aspect of the counties of the State. Said reports shall be placed in the hands of the Governor, who shall bring them to the attention of the Legislature at its earliest session thereafter with recommendation for their speedy publication.

SEC. 8. On the completion of the field-work of the survey the geologist in charge shall make and cause to be made final reports on the geology of the whole State, including reports of the assistant geologist, chemist and collaborators of the survey, which shall embrace discussions of the physical, geological and mineralogical features of the entire area of the State, and its relations in these respects to contiguous regions; said reports shall be accompanied by charts, diagrams, and other necessary illustrations, vertical and profile sections embracing generalized presentations of the stratigraphy and valuable minerals associated with the geological formations present in various parts of the State, and a large sized map of the State on which shall be indicated by colors, and other appropriate means the extent of surface occupied by the various geological formations occurring within its bounds; in fine, such reports shall present a full digest of the scientific and economic results attained during the prosecution of the survey, together with such other relevant matter relating to the more complete exposition of the geological history of the State as may be available. And on the completion of such reports the said geologist shall transmit the same to the Governor who shall cause them to be laid before the Legislature with recommendation for their suitable publication. The said geologist shall have the supervision of the preparation and publishing of all reports emanating from the survey.

SEC. 9. The salary of the geologist in charge shall $2,000 per annum. The salaries of the assistant geologist and chemist not to exceed $1,200 per annum each. For the services of specialists, local assistants and other persons temporarily employed on the survey the compensation shall not be greater than that ordinarily paid for similar services.

SEC. 10. In order practically to carry out the provisions of the foregoing sections of this Act the sum of $10,000 is hereby annually appropriated for the term of two years, out of such monies remaining in the treasury as are not otherwise appropriated.

This fund shall be drawn as required for the purposes of the survey on requisitions signed by the geologist in charge approved by the Governor, and the warrant of the Auditor of State, and the Auditor is authorized to issue his warrants upon the Treasurer for the sums named in such requisition.

The Bill introduced in the Missouri Legislature is similar in most respects, as the abstract below, sent us by Prof. Broadhead, will show.

The Governor appoints a board of four persons, himself Ex-Officio member and President of board. They shall appoint a State Geologist, who is not connected with or under influence of any school. State Geologist to appoint his assistants and have power to remove them—Governor and Board may remove State Geologist. State Geologist and assistants to make surveys, maps and reports of work, and also may have power from time to time to issue bulletins of work done; also to furnish newspapers with items—provided it does not interfere with other work. State Geologist also has power to furnish duplicate sets of specimens to museums within the State—provided the expense of fixing up and labelling such is paid for by the museum or persons conducting the same, and also provided such work does not interfere with the progress of the survey and that the State collection is not deprived of necessary duplicates. Bill provides for a State museum and headquarters to be, if possible, at the Capitol of the State, otherwise to be where quarters can be best obtained. Headquarters to be at Jefferson City. Reports to be made to each General Assembly of progress, condition and expenses. Has authority to take possession of all matter belonging to former surveys, but does not give power to take possession of any cabinet of specimens already in place.

Salary of geologist $3,000 per year; assistants $1,800 and $1,500, and no others over $5 per day. Board only receive their necessary expenses, when in attendance. Gives power to employ a palæontologist if necessary; also to negotiate for chemical work. Amendments to this give chemical work to School of mines. $15,000 annually appropriated.

BOOK NOTICES.

House-Drainage and Sanitary Plumbing. By Wm. Paul Gerhard; pp. 205, 18mo. D. VanNostrand, New York, 1882. 50c.

This is No. 63 of VanNostrand's "Science Series," and is an exceedingly well written and useful essay. A general idea of the author's style and manner of handling the subject may be gained from the article on "Sewer Gas and its Danger to Health," on page 571 of this issue of the Review, which is copied from the first chapter of the work. The other topics treated are mainly as follows: Defective and Good Plumbing work; Essential Elements of a System of Plumbing; Soil and Waste Pipes; Traps; Absorption of Gases; Drainage of Cellars; System of House-Drainage; Bath and Laundry Tubs; Sinks; Water Closets; Flushing Appliances, etc.

This small volume contains much common-sense information and instruction, and might well be studied by engineers and architects as well as property owners who intend to build.

THE LOWEST FORMS OF WATER ANIMALS. By N. D' Anvers. Square 16mo. pp. 59. Illustrated. G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson, 50c.

This is No. V of the Science Ladders, those preceding it being Forms of Land and Water; A Story of Early Exploration; Vegetable Life; Flowerless Plants.

The volume under consideration takes up in simple style the discussion of the subject of the lowest forms of water animals by defining what an animal is; what protoplasm is; then the successive forms of such animals; the Rhizopoda; Sponges; some forms of Infusoria; the life of a Hydra and a Medusa; Sea Anemones and how they live; Coral-Makers and how they grow; some of the Polyzoa; some tiny creatures with water-works, and closes with a series of questions to test the young reader's memory and comprehension.

Mr. D' Anvers aims to teach the great laws of nature in language simple enough to be intelligible to the youngest readers and to awaken in them the habit of observation and reasoning. In these objects he is sure to succeed so far as he has readers.

MILITARY LIFE IN ITALY. By Edward De Amicis: with illustrations; 8vo., pp. 440. G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson, $2.00.

All of De Amicis' works are full of enthusiasm and spirit, and this one is no exception to the rule. In addition to this feature these sketches carry with them a lesson of inspiration and consolation to the soldier and of admiration and esteem for him to the civilian. Every side of human nature is skillfully depicted in them, the serious as well as the comic, and no reader will regret spending a few hours in perusing the book. Among the best of the sketches are The Conscript, The Son of the Regiment, and Dead upon the Field of Battle.

HOW TO SUCCEED. Edited by Lyman Abbott, D.D. Square 16mo., pp. 131. G. P. Putnam's Sons, New York, 1882. For sale by M. H. Dickinson, 50c.

The readers of the *Christian Union* have already seen most of the essays in this admirable collection, but for the benefit of those who have not we will say that the book is No. XXVI of the Handy Book Series, and is made up of a number of essays on "How to Succeed" by some of the most able and practical men of this country in their several departments of labor.

Hon. T. F. Bayard and Hon. Geo. F. Edwards write upon How to Succeed in Public Life; Rev. John Hall, D.D., gives advice How to Succeed as a Minister; Willard Parker, M. D., tells How to Succeed as a Physician; Gen'l Wm. Sooy Smith, How to Succeed as a Civil Engineer; Wm. Hamilton Gibson, How to Succeed as an Artist; a New York merchant anonymously gives rules for succeeding in Mercantile Life; Lawson Valentine, How to Succeed in Business

Life; Leopold Damrosch, How to Succeed as a Musician; Hon. Geo. B. Loring, as a Farmer; Thomas A. Edison, as an Inventor; Rev. E. P. Roe, in Literature; while Rev. Lyman Abbott gives his views upon the Christian conditions of success.

Nearly all occupations are thus touched upon by men who have had practical experience and who are living examples of the practice they preach, and these essays, whether read by the young or by those interested in their welfare, must have a beneficial effect.

Easy Star Lessons. By R. A. Proctor. Crown octavo, pp. 239, illustrated. G. P. Putnam's Sons, New York, 1882. $2.50.

The popularizing of knowledge seems to have been the special work of scientific men within the past twenty years, and of the many contributors in this direction none has done more or done it better than Mr. Proctor. Though but a comparatively young man he has achieved a world-wide reputation as profoundly skilled in more branches of science than one, although he is mainly regarded as an astronomer.

The above named book is his latest production, and his publishers have evidently striven by the exercise of the best taste and the use of the choicest materials in the book-maker's art to make it worthy. Paper, print and binding are superb, and the illustrations, including forty-eight star-maps and thirty other engravings, are admirable in execution and thoroughly practical. To the stars of each month in the year is devoted a chapter and four maps showing the proper position of each constellation and the prominent stars in the northern, southern, eastern and western skies for that month So interesting and so unusually plain and practical are these descriptions, even without the maps, that we give on page 586 the whole chapter on "The Stars for February." By a careful use of it, the reader may pick out the constellations with little trouble, while by the additional use of the maps the whole sky may be read like a printed book.

The Odyssey of Homer. Done into English prose by S. H. Butcher, M. A., and A. Lang M. A. 12mo., pp. 427. Macmillan & Co., New York, 1882. Price $1.00.

The translators in the preface to this work, claim that there can be no final English translation of Homer from the fact that the taste of each successive generation differs regarding poetical style, whether versified or not, from all preceding periods. Thus, in the Elizabethan age Chapman modified the antique simplicity of Homer to suit its peculiar requirements, and rendered the poem in high sounding and luxurious conceits which would in no respect satisfy the more fastidious tastes catered to by the elegant Pope in Queen Anne's time. Later, when the ballad collectors of Europe were forming the tastes of the people, Homer was regarded a ballad minstrel, and his poems rendered by Maginn, Gladstone, and others with the simplicity and baldness of the verses of the minnesingers. Still later the romantic vein was discovered and worked with marked success by Mr. Worsley, who made an admirable translation of the Odyssey, in which "the liquid lapses of the verse, the wonderful closeness to the original, reproduce all of Homer in music and in meaning that can be rendered in English verse."

The object of this prose translation is to supply a demand now existing for simple descriptive or historical documents, without modern ornament and with nothing added or omitted, a thing with which poetry, or, at least verse, is almost incompatible.

The work of the translators, looked at from this standpoint, seems well done, and the prose form certainly gives a better opportunity than verse for a close adherence to the Homeric language and style. To those readers who want a strictly reliable, scholarly rendering of the story in "unadorned English," nothing can be more satisfactory.

FRONTIER ARMY SKETCHES. By James W. Steele. 12mo., pp. 329. Jansen, McClurg & Co., Chicago, 1883. $1.50.

That these "Sketches" are the work of an observant, sympathetic, cultured man who has actual and practical experience of the pleasures, hardships, excitements and inexpressible tedium of frontier military life is self-evident. His correct and just appreciation of the West Point graduate, whom he portrays under the title of Captain Jinks, his abhorrent and overpowering disgust for and detestation of the cruel and treacherous Indian of the plains, his perfect delineations of western character, good and bad; his skillful command of language, his expressive grouping of words and his forcible and graceful sentences, all betray an excellent education and cultivated tastes, as well as a military training.

Every one of these sketches is a model of good literary style, and most of them are exceedingly real, piquant, lifelike, and dramatic. They remind one of Theodore Winthrop in many respects, and are far superior in all respects to Bret Hart.

THE COURT AND CROSS. By W. J. Henry. Octavo, pp. 568. Methodist Book Concern, Cincinnati, 1882.

The object of this work, whose author is a lawyer of this city, is set forth in the preface as being to present the principal events of Christ's wonderful career in their relation to the Sanhedrin or great court of the Jews; also to portray his life as it was affected by the views, actions and deliberations of that influential body, as well as to bring vividly before the mind the times, places and conditions of the Jewish nation; also a description of the principal, political, judicial and ecclesiastical tribunal, the council or great court of the Jews, into which the author has attempted to carry the reader in imagination and give him a probable statement of the arguments and views of its members upon the case before them.

Further it is attempted by the author to combat the views of those who doubt the Divinity of Christ, the authenticity of his miracles and the truth of his doctrines.

In carrying out this plan Judge Henry has shown great skill in bringing together historical facts bearing upon the case, while his legal acumen has been of the greatest service in arranging the argumentative portion of the work. It will be found decidedly interesting to all classes of readers, not only for these reasons, but because the author has left the beaten track and taken up a line of thought and argument not heretofore presented so far as we know.

OTHER PUBLICATIONS RECEIVED.

The *New York Medical Journal*, Vol. XXXVII, Nos. 1 and 2, quarto, weekly, pp. 28, edited by Frank P. Foster, M. D., published by D. Appleton & Co., N. Y., $5.00. *The Electrician*, Vol. II, No. 1, quarto, Williams & Co., New York, editors and publishers, monthly, $1.00 per annum. *The Wheelman*, Vol. I, No. 4, Jan'y, 1883, octavo, pp. 80, illustrated, edited by S. S. McClure, published by the Wheelman Co., Boston, monthly, $2.00. *Carboniferous Rocks of Eastern Kansas*, G. C. Broadhead, reprinted from Proceedings of St. Louis Academy of Sciences, pp. 12. *Review of the Telegraph and Telephone*, Vol. I, No. 22, quarto, pp. 16, edited and published by Geo. Worthington, N. Y., semi-monthly, $2.00. Bulletins of the *American Museum of Natural History*, Vol. I, Nos. 2 and 3. Fifteenth Annual Report of *Peabody Museum* of American Archæology and Ethnology, Vol. III, No. 2, F. W. Putnam, Curator. New York *Medical Record*, Vol XXII, No. 26, octavo, pp. 28, weekly, edited by Geo. F. Shrady, M. D., and published by Wm. Wood & Co. New York, $5.00. Report of the Secretary of the Interior to June 30, 1882. Natural Science in Secondary Schools, F. Mühlberg, pp. 9. Instruction in Morals and Civil Government, A. Vessiot, pp. 4. Trumbull, Reynolds & Allen's 12th Annual Catalogue. Circulars of Information of the Bureau of Education, No. 3, 1882. The University of Bonn,—National Pedagogic Congress of Spain,—High Schools for Girls in Sweden. Thirteenth Annual Report of the American Museum of Natural History, Central Park, N. Y. Fifth Annual Announcement of the Fulton & Trueblood School of Elocution and Oratory. Constitution and By-Laws of the Iowa State Academy of Sciences. Yellows in Peach Trees, D. P. Penhallow, Boston, 1882, pp. 8.

SCIENTIFIC MISCELLANY.

LIBERTY ENLIGHTENING THE WORLD.

The people at large are to have the opportunity, it is stated, to subscribe toward the fund for the pedestal upon which Bartholdi's statue of "Liberty Enlightening the World" is to be erected in New York Harbor. It is especially desirable that the "people at large" in the United States should do this for the reason that the present is from the "people at large" in France; and it is thought meet that it should be received in the spirit in which it is given—namely, as a testimonial of affection from one liberty-loving people to another. It is the first time that such a substantial evidence of international amity has been furnished in the history of the world. If it were not for the carrying out of the idea that the whole people should have something to do with the reception of the gift the money for the pedestal could be readily raised in New York in a day. Sufficient indications of the truth of this proposition appeared at the great mass-meeting at the Academy of Music, in that city, held on Tuesday evening last, to set the ball in motion to prepare the base for the statue which is nearly completed. Just what arrangements have been made to collect the funds is not stated, but they doubtless will be effectual.

The figure itself will be the most remarkable structure of the kind ever created. The Colossus of Rhodes was only 105 feet high. This statue will be 155 feet, and will be mounted on a pedestal of equal height, the whole arrangement being placed on Bedloe's Island, which is just about large enough to receive it comfortably and is situated just where it is wanted for the purpose. It will thus tower some 300 feet above the water level—a most imposing feature by day and a light-house by night whose beacon will be seen far and wide. The cost of this gift to the French people will amount to about 1,250,000 francs, and it will cost us about the same ($250,000) to furnish the pedestal. Besides its value as a testimonial and as a light-house it will be a triumph of art. A finely built goddess of liberty holding a lighted torch 300 feet in the air and welcoming ships and people of all nations to the chief seaport of a free country and of the new world, is a fine idea from an artistic point of view, especially when it is remembered that it was constructed jointly by the peoples of the two principal republics in the world. It becomes a figure full of significance and promise and will throw a little relief of poetry upon the otherwise prosy and business-like appearance of the harbor.

The above is from the *Globe-Democrat*, and we quote below a very interesting description of the statue from *Harper's Weekly* of January 6, 1883:

M. Bartholdi, the ingenious and daring designer of this statue, is already famous for the skill with which he has handled colossal subjects; for apart from the genius necessary to form a grandiose conception of such a work of art as that with which the friendship of the two great republics of the world is to be celebrated, there is required no small amount of mechanical knowledge to bring it to completion. The resources of modern mechanics render this a matter of comparative certainty. The sculptor is no longer required to perform such prodigies of labor or to undergo such agony of suspense and fear as those described by Benvenuto Cellini in his letters, recently published, containing an account of the casting of his "Perseus" and "Medusa." But though the artist of to-day goes about his task with confidence in its accomplishment, the erection of a statue of more than 155 feet in height—not counting the pedestal—to stand in an exposed situation, unsheltered by adjacent structures, is decidedly the most gigantic enterprise of its kind.

The work is now going on in the yards of Messrs. Gaget, Gauthier & Co., in Paris. The hand alone will be 5 metres (16 feet 5 inches) in length; the index finger will be 2.45 metres (a trifle over 8 feet) long, with a circumference at the second joint of about 7 feet 6 inches; and the nail of this finger will present a surface about 13 inches by 10. These figures will give some idea of the enormous dimensions of the statue. Those who have a liking for other means of calculation may be interested in knowing that the whole statue (without the pedestal) will overtop the famous Vendôme Column more than nine feet; that in the head forty persons can assemble, and in the torch at least a dozen more. The statue, as is well known, is to be hollow, and is to be literally "built" of plates of hammered copper nine-tenths of an inch in thickness. The method of construction is curious and interesting. The first essential was, of course, the "sketch model" of M. Bartholdi, which was what may be called life size, being 6 feet 7 inches in height. This was the basis of the measurements, which, however, were twice multiplied. It was first magnified four times, and reviewed and remodeled by the artist. It was then divided into sections, which are reproduced four times larger yet, with the greatest possible care. Models in plaster of the final and definitive size are made in the vast yards. The workmen first sketch the general form in frames of wood covered with laths and recovered with a coat of plaster. They then verify the principal measurements thus established, and finish the modeling of the surfaces and the details. When a course is finished, joiners take the forms by means of planks cut in *silhouette* to fit the form of the plaster.

These are then so arranged together as to form a species of imprint of the parts to which they have been applied, and make what are technically termed *gabaris*, or wooden moulds, into which the hammerers pressed the copper sheets by the pressure of levers, or by beating with hammers. The copper is then finished by beating with smaller hammers or rods, outside and inside, to conform closely to the lines of the forms desired, which have been taken in detail by means of sheets of lead pressed upon the model. The workman in doing this part of his task places himself directly before the plaster models, and compares every part as he proceeds with the utmost patience and exactness. This done, the separate pieces are carried to an immense court to be placed together, and fixed upon a powerful frame-work of iron, which supports what may be called the entire envelope of the statue. When the statue is removed for transportation, it will be taken apart in more than 300 pieces. Its entire weight will be some 450,000 pounds, of which over 200,000 pounds will be copper, and the remainder the iron frame-work.

The workshops and yards of Messrs. Gaget, Gauthier & Co. are thrown open to the subscribers to the statue, to witness the process of construction, on Thursdays and Sundays of each week, and the pupils of the School of Fine Arts are also admitted free. Those who are not subscribers can obtain admission by purchasing an engraving of the monument, which is sold for the benefit of the work, in all sizes and states of perfection, from those costing ten cents only to the elaborate representations of the various parts. The place is much frequented, particularly on Sundays, which is the Parisian holiday for all sorts of diversions, from sight-seeing to a revolution. The great yards are a veritable spectacle in themselves, but the motley gathering of visitors is still more of one. The workmen in their caps and blouses are a noticeable element, and occasionally an impromptu orator will address his chance audience with a glowing eulogium of America in terms which the wandering citizen of this happy land does not always recognize as truthful, and sometimes thanks Heaven that they are not. But the impressionable hearers drink in the praises of the ideal republic with eagerness, and reward the speaker with cries of "Vive la Liberte!" "Vive la Republique Americaine!" The great work of M. Bartholdi has, moreover, been carefully inspected by many of the sculptors and engineers of the Continent, and has given rise to much discussion as to its probable stability, as well as its artistic merits. The verdict, on the whole, has been one of approval, and there is no reasonable doubt that when it is securely placed on the pedestal which Mr. Evart's committee is to prepare, it will be a worthy symbol of the generous sentiment to the expression and perpetuation of which it is consecrated.

TREATMENT OF NATURE BY AMERICAN AND ENGLISH POETS.

One of the results of my study of American poetry has been to assure myself that certain specific and well-defined causes have worked together to fix, as a characteristic of that literature, a universal tenderness toward "the speechless world," the creatures in fur and feathers that fulfill such great and beautiful functions in our world's economy. This pitifulness, co extensive with nature, may be almost accepted as a new departure in poetry, for I do not find that sympathy with world-life is by any means an invariable rule with poets.

The causes I refer to are not far to seek. In the first place, the popular mind in America is not so familiarized with classical images and allusions as in Europe, and the American poet, therefore, does not recur so readily as his European congener, to the fancies and mythology of antiquity. In the next, the beasts and birds of the New World are not the same beasts and birds that play such important parts in Old-World fables, give point to Old-World proverbs, and form the object of so many Old-World prejudices and predilections, and the American poet therefore finds his creatures as yet untampered with by antique misrepresentation or popular superstitions. He has not got to rummage for his natural history among the mossy roots of a reverend folk lore, or a heraldry that is sanctified by national associations. The larks, robins, and magpies of America are not the birds that are known by the same names in Europe, and so the poet of the West finds the ground still virgin soil before him. Popular superstition has not had time yet to lichen over the familiar objects of his country-side, and he has thus few temptations to the logicians' fallacy from antiquity. Indeed, there is even noticeable sometimes a tendency toward irreverence for "the widowed" turtle, and a disposition to make fun of the nightingale that "bruised his bosom on a thorn," as if they were antiquated favorites of an obsolete era of thought,

"Though still the lark-voiced matins ring
The world has known so long,
The wood-thrush of the West still sing
Earth's last sweet even-song!"

But this, after all, is only a very partial protection, for though some of his beasts, birds, fishes, and insects are new to poetry, the remainder—such as the wolf and the lion, the owl and the raven—are not things of any one time or place. Thus an American raven flies with just as "prodigious" a flight as a Scotch one or a Roman; the owl and vulture might be quite as "obscene" in "Evangeline" or "Mogg Megone" as they are in Wordsworth or Cowper. But I do not find Longfellow or any of his fellow-countrymen taking advantage of the license of poetical prejudice extended to them by high prescription. On the contrary, they compassionate the raven, and handsomely meet the vulture and the owl with a compliment. They speak ill of nothing. And I can not, for myself, help admiring this absence of cynicism. They are as gentle always as Keats, while in their more general passages they show all Shelley's appreciation of the harmonious unity in nature:

"Come, learn with me the fatal song
Which knits the world in music strong,
Whereto every bosom dances,
Kindled with courageous fancies;
Come lift thine eyes to lofty rhymes,
Of things with things and times with times,
Primal chimes of sun and shade,
Of sound and echo, man and maid,
The land reflected in the flood,
Body with shadow still pursued,
For Nature beats in perfect tune,
And rounds with rhyme her every rune!"

Apart, therefore, from the specific causes to which I have alluded, there must be sought some larger, more national influence at work to account for this complete catholicism in kindliness. Nor somehow is it difficult, so I think, to imagine the poets of a country with some distant horizons as America, so vast in certainties, so infinite in possibilities, refusing to limit their sympathies to merely continental boundaries, or to cramp their interests within the domains of any single crown, or "hop about from perch to perch in paltry cages of dead men's dead thoughts." Accustomed to such large maps, they may be easily supposed to be intolerant of geographical prejudices, and priding themselves before everything upon independence of thought, may have carried their sympathy with an unconventional freedom into their treatment of natural objects. "Our country hath a gospel of her own." For myself, I am content to believe this, and to attribute their just recognition of the place of animal and insect life to the large-hearted tone of American intellectual thought. And I would not know where to go for a more adequate statement of the poet's means and ends in nature than Emerson's "Wood Notes," or for thoughts more fully in sympathy with nature than Longfellow's or Whittier's, with his ear "full of summer sounds." Lovers of wild life will find it hard to outmatch Bret Harte's apostrophe to the coyote and the grizzly, Emerson's to the humble-bee, Wendell Holmes' to the sea-fowl outside his study window, or Aldrich's delightfully appreciative touches of wild life. Quadrupeds, birds, insects—everything that has life is looked at kindly and unselfishly apart from human interests, and this, too, with a respectful sympathy that bespeaks something more sincere than Cowper's lip-service or Pope's acidulated praise. Our furred and feathered fellow-beings, seniors to ourselves in existence, though subjected to us, are not, as in the European poets, accepted as mere accidents of the human economy, or as secondary properties of man. They seem to remember—unless it be only my own whimsical interpretation of their tenderness—that our earth is the other creatures' earth too, that they are a creation of themselves, that each had a day set apart for itself, a morning and an evening, at the first miracle of the world's making.—Phil Robinson, in *Harper's Magazine for February*.

GOLD IN ANCIENT TIMES.

Gold was in excess in ancient times, and mostly taken from the rivers in Asia. The fables of Pactolus, of the golden fleece of the Argonauts, of the gold from Ophir, the history of King Midas, etc., all point to an Eastern origin of this metal. According to Pliny, Cyrus returned with 34,000 Roman pounds of gold, (about $10,000,000). The treasures exacted from Persia by Alexander the Great amounted to 351,000 talents, or $400,000,000. Gold also came from Arabia, and upon the Nile from the interior of Africa. Pliny calls Asturias the country in which the most gold is found. A tablet bearing the following inscription was found in Idanha Velha, Portugal: "Claudius Rufus returns his thanks to Jupiter for having permitted him to find one hundred and thirty pounds of gold."

The sources of wealth have ceased to flow, and the endeavors of several Englishmen to reopen them have been unsuccessful. Bohemia, Mähren, Silesia, and Tyrol, all have produced gold, and the receding of the glaciers has caused old mines to be uncovered, while upon the Italian side, at Monte Rosa, Val Sesina, and Val Ansaca, gold mines are still worked to-day, although with indifferent success. The only works of any note are those of Kremnitz, Hungary. It may, therefore, be safely asserted that Europe is completely exhausted in this respect.—*From "The Decrease of Gold," by* F. VON BRIESEN, *in Popular Science Monthly for February.*

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

COMBINED SAD-IRON HEATER AND MEAT-ROASTER.—This novel invention has its base provided with a heating chamber to receive the irons. A lid or cover is hinged to the base and drops automatically over and covers the heating chamber. It is provided with slots open at their outer ends to receive the handles of the irons, and a slide is placed on the under side of the lid and is provided with a series of slots open at their outer ends and coinciding with the slots in the lid. Mechanism is provided whereby the slide may be moved laterally for the purpose of opening or closing the slots in the lid.

AUTOMATIC FEED-WATER REGULATOR FOR STEAM BOILERS.—This new automatic feed-water controller for steam-generators consists of an upright cylindrical chamber, communicating with the steam and water spaces of the boiler. The chamber has also a steam eduction port communicating with the actuating cylinder of the feed water pump. A float is arranged to control the egress of steam from said chamber, and a horizontal disc is suspended from the float and spans the chamber to receive a direct vertical water-pressure, thereby overcoming any suction that may be exerted on the float by the steam-eduction port.

STEAM PACKING MATERIAL.—A late invention consists of a steam-packing material composed of granulated strips or shavings of cork, asbestos and dissolved gum, covered with a layer of asbestos and linen.

METHOD OF STRETCHING BELTS.—An improved process for stretching belts for machinery consists of first opening the belt through its entire length, then stretching it over two or more rollers and connecting the ends by a suitable stretching device and finally applying tensile strain to its two ends and increasing it from time to time, until elasticity of the belt is exhausted.

Device for Raising and Lowering Electric Lamps.—A recent invention designed for raising and lowering electric lamps, consists of supporting-cables secured at their ends to the walls of the building. A carriage is provided having pulleys adapted to travel upon the supporting cables, and insulated brackets secured thereto have also pulleys for the reception of the cables. A cross-beam, having at each end thereof a grooved pulley, is pivoted to the insulated bracket to adapt it to travel upon the carriage supporting cables. The cables are rigidly secured to the cross-beam and pass over the insulated pulleys upon the carriage to the lamp suspended below. Conducting wires connect the positive and negative wires of the circuit with the supporting cables and the insulated pulleys of the cross-beam, are also connected with the supporting cables.

AFRICAN EXPLORATION.

Foreign dispatches have lately contained frequent allusions to the controversy between the explorers, Stanley and DeBrazza, regarding the French claims on the valley of the Upper Congo. The New York *Herald* gives a sketch of the whole matter. DeBrazza went into the service of the French branch of the African International Society in 1875 to seek a trade route from the coast up to Stanley Pool, the point where navigable water extending 900 miles into the interior begins. His first journey was along the Ogowe, following that river to the mountain, and then striking the Congo at Stanley Pool. Subsequently he advocated another route, starting from the west coast at Banga, and reaching the Congo at the same point. Mr. Stanley's route was by way of the Congo all through, passing the series of falls that obstruct navigation between the Lower and Upper Congo by means of roads, or eventually of canals, if ever commerce should justify such extensive works.

M. DeBrazza's original route was some 500 or 600 miles longer than Stanley's. His second route, from Banga, is also of much greater length than along the banks of the Congo. On the 10th day of September, 1880, DeBrazza, having reached Stanley Pool and established himself with King Makoko, obtained from the latter an agreement to the celebrated treaty ceding the territory on the north side of the Pool to France. Stanley had explored the Congo in his trip to finish Livingstone's work, and in 1879 he went back there in the service of the Belgian branch of the same society which had started DeBrazza out. When Stanley, proceeding up the river, had passed the last cataract and reached the navigable waters extending from the Pool inland, he found DeBrazza's lieutenant, Malamine, with two seamen in possession of a station on the north bank, and the natives refused to give him the right to establish a station there, because they had given it to the French. He, however, was well received by the chief on the south bank, and there built a station of 113 houses. He then, having launched his steamers, proceeded to explore the Coango, a main tributary of the Congo. After ascending it 150 miles he found a lake 70 miles long and 6 to 30 miles broad, which he named in honor of the King of the Belgians, Leopold II. Stanley says the Belgian stations, 5 in number, which he established, are commercial in a sense that they are expected to be self-supporting and that the King is interested in Africa in a spirit of a philanthropical geographer, simply as a man who lives the dear old continent for which he has always felt a sort of respectful melancholy. Stanley says the French have had a colony at Gaboon since 1857, and never heard of the Congo until they read of it in the *Herald* and London *Telegraph.* He argues nothing from DeBrazza's occupation of the north bank at the Pool, even should the French Government ratify his treaty and persuade the natives to respect it. He wants a series of international posts maintained, with the river free to the traders of all nations.—*American Inventor.*

MICHAEL ANGELO.

W. W. STORY.

The overthrow of the pagan religion was the deathblow to pagan art. The temples shook to their foundation and art withered in her crumbling shrine. When through the ancient world was heard the mournful cry, first echoed by the sunlit waves of the Ægean sea, "Great Pan is dead!" then the nymphs fled from the hallowed groves of Arcadia, and were seen no more. The hamadryad deserted her oak and the naiad her fountain. Of all the great tribes to which the poetic and religious instincts of Greece and Rome bowed, only Orpheus remained, and he was transformed into a monkish saint. Christianity struck a deathblow not only to pagan art, but to all art, which atrophied and shrunk for centuries, until, driven out of the rest of the world, its sickened and diseased body found refuge in some monastery. The statues of the gods were overthrown and buried under the earth—those wonderful creations of beauty which voice the highest demands of humanity. Only bloodless saints remained. Humanity trembled in the grasp of an iron-cased bigotry. Youth and beauty and joy were suppliants, where once they were free and prince-like. Religion and art, which cannot live apart, were divorced. The long, dark night of the middle ages came on—a night without a star, and the blackness of a sordid ignorance blotted out all fair sights or scenes. Only arms remained. For music and poetry, and sculpture and science there were only the butcheries of the battlefield. But the seasons of the soul are like those of nature. After the long, cold winter of the dark ages came the springtime of the renaissance—the new birth of humanity. The church awoke. Guelf and Ghibelline began their memorable contest. Commerce flourished, and art, literature, science, religion itself, burst into new and vigorous life. Then flashing from the firmament of mind the brilliant stars of art and literature shone out in lambent glory—Dante, Boccaccio, Petrarch, Filomena, Machievelli, and all that bright galaxy of lights that cast a morning radiance far back even into the hideous night that had preceded it. Music took upon herself a fairer form, art blossomed into most fragrant fruition, science itself awoke from its sleep and began its wonderful course. The marble gods that had lain so long beneath the earth arose from their graves and reasserted their dominion over the souls as they had formerly wielded it over it the minds of men. Here lived and wrought Leonardo Da Vinci, the most versatile and comprehensive intellect the world has ever seen; Angelo, the greatest power that ever worked on stone; Raffaelle, the soul of beauty and grace, with his pencil dipped in the colors of Paradise; Titian, who stole from the sunset the secret of its hues; Gallileo, Columbus, and many others. These were the men who lived with, or immediately preceded, Michael Angelo. It was the renaissance, the morning after the night. As Italy is above all others the land of the renaissance, so is Florence above all other places in Italy the city of its new birth. There is scarcely a street in that beautiful city, or a square, that has not something to say of the brilliant glories it once shared. One walks the city guided by memory rather than by vision. The old families still give their names to the streets. The whole city is filled with ghosts, even in whose pallor we can read what was the blush and bloom of her flowering days.

Then brilliantly and gracefully, the lecturer drew a brilliant and graceful sketch of the Tuscan capital in the days of its glory, and described the treasures of art that are heaped there—the Duomo, the Campanile, the Palazzo Vecchi, its beautiful churches, its wonderful statues, its marvelous paintings. Lingering a moment over the mighty memories of Brunelleschi, of Dante, whose statue the city jealously guards, though the justly indignant poet would not let her have his bones; of Savanarola, of Giotto, and the hundreds of other names that have immortalized *la bella Florenza*, he briefly sketched the life, the works, the character of Michael Angelo Buonarotti. Poet, painter, sculptor, architect, engineer, he was supreme in each and unapproached in all. Born in 1474, of noble, if not of royal blood, he lived and worked incessantly for ninety years. His capacity for work was marvelous. He accomplished the impossible, and overcame the insuperable. As a sculptor, his grand and glowing genius is above the rules of the schools, having sought and found on the white steeps beyond human power the law which governs and the soul which inspires his wonderful creations. No name other than that of Phidias may be mentioned with his. As an artist he taught even Raffaelle, and the latter learned from the lesson a still more graceful touch and a still loftier, serener beauty. As an architect, the grandest fabric ever wrought by man swings in the mid air of Rome to attest his supreme genius, the dome of St. Peter's, which is the lofty brow encasing the brain of the church. As an engineer, the stubborn defense of his native Florence is a competent witness that as a soldier he could have been as great as an artist. As a poet, though he swept no Lydian strains from his lyre, yet the clear, sweet, piercing melody of his song sweeps the eternal heights with no uncertain sounds. As a man he was well nigh perfect. His sentiments were cast in the same mould as was his lofty intellect. Pure, high minded, magnanimous, generous, brave, just, and true, his fe unspotted by a single stain, there is nothing sordid, nothing mean, nothing low in his whole composition. *Noblesse oblige* was borne with him in his every fibre. He was impatient of everything low or mean, and his temper was, like his nature, fiery and impetuous. Yet he was always forgiving, always gentle, unless his dignity as a man was insulted. He was never peevish nor irritable. He led a lonely life. Kind to all and lavish of his slender means in the alleviation of want or of misery, he yet had no intimates. He had no friends but two. and yet think who were those two. Savanarola and Vittoria Colonna. It is probable that he loved the latter, but it was a love in which sense had nothing whatever to do. In the lofty, serene regions where his giant spirit lived the atmosphere was too pure and rare for the senses to dwell. She must indeed have been a woman of the loftiest and most perfect type, this famed Vittoria di Collonna, to have won Michael Angelo's love.

Popularly most famous for his work in the Sistine and Pauline chapels at Rome, and for the dome of St. Peter's, his lofty genius is best shown in the chapel of the Medici attached to the church of San Lorenzo in Florence. Here the mausoleum of the Medici commands an attention which, once given, is given always. The great figures of "Day" and "Sleep" and "Night," of "Aurora" and "Crepuscule," enchain the beholder. These figures are tremendous. Looking at them you are brought to know what thoughts fill the human breast when the perfection of human intellect grapples with the mysterious problems of man's origin and destiny. They are the symbols of humanity's struggles with the tremendous and unseen forces of nature. A great intellect has flung itself into the marble and wrought out thoughts rather than human beings. Michael Angelo is the one man who has sculptured ideas. These statues are not Greek, and belong to a different race. The Greek sculptured beauty in repose—his gods, when they suffer, are serenely majestic, and they smile calmly even with the fox gnawing at their vitals. Even in the Laocoon the suffering is subdued grace. But Michael Angelo belonged to a different race. The mysterious Etrurian, whose civilization was old and gray and heavy with the weight of his own completeness ere a stone was laid on the seven hills by the Tiber, transmitted to Michael Angelo along with his blood, his sombre thoughts and his mystic moods. Etrurian, and not Italian, no tradition of Aryan race inspired his soul or informed his mind. He was of the old gods; he dwelt with Saturn and Hyperion beneath the dim umbrageous recesses of the woods. rather than with Jove and Apollo and the other deities of the new era. And the tremendous truths caught and known by an older and truer civilization than the world of his day knew has left their giant shadows as an incubus on his soul.

The artist pictured the difficulties he labored under in his great work of painting the Sistine chapel, described the wonderful productions of his genius on those walls and ceilings, drew a beautiful comparison between him and Raffaelle, who was in most cases his antithesis; related the subsequent life of Michael Angelo, sketched his character with a light but bold touch, and closed with a magnificent picture of the Medici Mausoleum, when the tombs were opened in 1857 and the bodies, many of them, were found plundered of their ornaments. "There lay the dishonored dust of the Medicean rulers of Florence, discrowned and plundered, not even safe in death from outrage and disgrace, while the artist that they patronized and thought beneath their rank now wears a crown of immortality at which the world willingly bows down."—*National Republican.*

CUVIER.

As the scope of this magazine enables it to cull from all sources we gladly place before our readers an account of the early life of the great anatomist taken almost bodily from the pages of the late George Henry Lewes and which has probably met the eyes of but few of our readers.—[Ed.

It was a dream of the youth Cuvier that a history of Nature might be written which would systematically display the unusual dependence of one organ of an organism upon another. It was in the Academia Carolina of Stuttgardt that in 1787 Cuvier, Pfaff (the once famous supporter of Volta), and a small circle of fellow students, who particularly devoted themselves to Natural History, formed a society of which Cuvier drew up the statutes and became the president. They read memoirs, and discussed discoveries with all the gravity of older societies, and even published among themselves a sort of *Comptes Rendus.* They made botanical, entomological and geological excursions, and still further to stimulate their zeal Cuvier instituted an order of merit, painting the medallion himself; it represented a star with the portrait of Linné in the centre, and between the rays various treasures of the animal and vegetable world.

At this period Cuvier's outward appearance was as unlike M. le Baron, as the grub is unlike the butterfly. Absorbed in his multifarious studies, he was careless about disguising the want of elegance in his aspect. His face was pale, very thin and long, covered with freckles and encircled with a shock of red hair. His physiognomy was severe and melancholy. He never played at any of the boys' games. He was reading all day long and a great part of the night. No work was too voluminous or too heavy for him. "I remember well," says Pfaff, "how he used to sit by my bedside going regularly through Bayle's Dictionary." It was during these years that he laid the basis of that extensive érudition which distinguished his work in after life. It was here also that he preluded to his success as a professor, astonishing his friends and colleagues by the clearness of his expositions, which he rendered still more striking by his wonderful skill with the pencil. Cuvier's facile pencil was always employed; if he had nothing to draw for his own memoirs or those of his colleagues, he amused himself with drawing insects as presents to the young ladies of his acquaintance—an entomologist's gallantry which never became more sentimental.

In 1788, that is in his nineteenth year, Cuvier left Stuttgardt for Normandy, where he lived till 1795 as tutor in a nobleman's family. Here he was discovered by the Abbe Tessier who sent some of his manuscripts and drawings to Paris which, falling under the eye of Geoffroy St. Hilaire, who though younger than

Cuvier was already a professor at the Jardin des Plantes, he at once wrote to Cuvier "Come and fill the place of Linnæus here; come and be another legislator of Natural History." Cuvier came and Geoffroy stood aside to let his great rival be seen.

Goethe has noticed the curious coincidence of the three great zoölogists successively opening to their rivals the path to distinction. Buffon called Daubenton to aid him, Daubenton called Geoffroy and Geoffroy called Cuvier. Geoffroy and Cuvier knew no jealousy then. In after years it was otherwise.

Geoffroy had a position—he shared it with his friend; he had books and collections—they were open to his rival; he had a lodging in the Museum—it was shared between them. Daubenton, older and more worldly wise, warned Geoffroy against this zeal in fostering a formidable rival, and one day placed before him a copy of La Fontaine's fables open at *The Bitch and Her Neighbor.* But Geoffroy was not to be daunted, and probably felt himself strong enough to hold his own. And so these two happy active youths pursued their studies together, wrote memoirs conjointly, discussed, dissected, speculated together—and as Cuvier has said "never sat down to breakfast without having made a fresh discovery." From this time on Cuvier was famous, but the real foundations were laid in those seven years on the Normandy coast when every animal he can lay his hands on is dissected with the greatest care and every detail of interest preserved with the pencil. Every work that is published of any importance in his line was read, analyzed and commented upon. The marvels of marine life, in those days so little thought of, he studied with persevering minuteness and admirable success. He dissected the cuttle fish and made his drawings with its own ink. Six years later, Pfaff on arriving at Paris, found that his old fellow student was "a Personage," yet his life was simple and wholly devoted to science. He had a lodging in the Jardin des Plantes and was waited on by an old housekeeper, like any other simple professor.

On Pfaff's subsequent visit, things were changed. Instead of the old housekeeper, the door was opened by a lackey in grand livery. Instead of asking for "Citizen Cuvier" he inquired for Monsieur Cuvier; whereupon the lackey inquired if he wished to see Monsieur le Baron, or M. Frederic his brother. "I soon found where I was," says Pfaff. "It was the baron separated from me by that immense interval of thirty years and by those high dignities which an empire offers to the ambitions of men." Cuvier had almost entirely exchanged science for politics and here we leave him.—*Scientific and Literary Gossip.*

EDITORIAL NOTES.

Owing to a variety of causes, including illness, delay in obtaining suitable paper, change of business location, etc., it was impracticable to get out the January number of the Review; hence we issue a double number this month, which we hope will at least come as near satisfying our subscribers as it does us, and that is not very close.

It is thought that tin ore has been discovered in Texas. Miners have sent sample specimens to Prof. John D. Parker, of Fort McKavett, asking him to have the matter authoritatively determined. These specimens have been submitted for examination to three eminent chemists, and when the analyses have been made and reported, the results will be duly published in this Review. Miners claim that the ores are undoubtedly those of tin, and say that the ores are rich, and that the mines can be worked with profit.

The American Society of Microscopists, which held a very successful meeting at Elmira, N. Y., in August, 1882, elected Albert McCalla, A. M., of Fairfield College, Iowa, President, and selected Chicago as the place for the meeting of this year and fixed upon the 7th day of August as its date.

On January 15th blue-birds were seen in this city and wild geese observed flying north; on the 19th the mercury averaged 8° below zero all day.

Henry N. Copp, of Washington City, has added to the list of similar books written and compiled by him, one entitled "The Settlers' Guide," which contains about all that a person going into any of the new Territories to locate himself need want to know of the laws and rules applicable to locating Government lands of any kind. 25c.

The Fifteenth Annual Report of the Peabody Museum of American Archæology is before us. Professor Putnam's energetic and enthusiastic temperament and habit are visible all through it, from the scheme for raising funds for prosecuting his favorite study to the extremely successful results of his summer's work and the valuable additions to the museum, as reported.

We are indebted to Dr. A. B. Stout, of San Francisco, for a copy of the several articles published, in the Transactions of the California Academy of Sciences, upon the peculiar foot-prints discovered in the rock at the Nevada State Prison. They were at first supposed by several *savans* to be human foot-prints, but it is now pretty unanimously admitted that they are the tracks of one of the huge lizards of that period of the earth's history.

Since our last issue the list of the Jackson County Flora by Mr. Frank Bush, of Independence, then announced, has been published in a neat pamphlet and laid upon our table. It appears to be very full and complete. Mr. Bush is to be thanked for doing so laborious and difficult a work so thoroughly.

The Historical Society of St. Louis is taking measures to raise funds for the erection of a suitable building for the accumulation and preservation of appropriate material, which is very abundant within and in the vicinity of that city. The building is to cost about $75,000.

If the Kansas City Academy of Science, which includes among other branches a section of Local History, could raise one-fourth as much or even $10,000 for the erection of a building, its collections and library would soon be an object of pride to every intelligent citizen.

For the coming year Professor Lovewell will do his meteorological work in connection with the Board of Agriculture, having been appointed State Meteorologist of Kansas.

A bill was introduced in Congress on January 8th, by Hon. Mr. Anderson, of Kansas, for the construction of a railroad and wagon bridge over the Missouri River at Leavenworth City.

At the meeting of the Kansas State Historical Society the address of Hon. T. Dwight Thacher was a most important and valuable contribution to its literature. It was a full, accurate, analytical history of the four constitutional conventions of that State and their doings, together with brief accounts of several of the prominent members thereof. As a model of condensed history it should be, as it will be, carefully preserved among the papers of the Society.

It is certainly a great gratification and a source of no small degree of hope, that a Government officer's report can be published and distributed before the end of the year to which it pertains. We refer to Prof. C. V. Riley's Report as Entomologist of the Department of Agriculture for the year ending June 30, 1882, which was issued in Decemcember, 1882. It is, as is always the case with Prof. Riley's published papers, full, complete, valuable and handsome in execution.

The Memphis extension of the Kansas City, Ft. Scott & Gulf R. R. is now completed, and regular trains running to West Plains, Howell County, Mo , 315 miles from Kansas City. The line will reach Augusta, Oregon County, Mo., about February 20th, and will be completed and open for business to Memphis, Tenn., about June 1, 1883. This is a result of great importance to Kansas City and the west. A Kansas City and Memphis railroad was projected many years ago, and work upon several lines commenced at different times, but for many reasons none has been effectually pushed until now.

Prof. Nipher's bill for a State Weather Service in Missouri ought to be passed without hesitation, as it will be of the greatest service to the agricultural interests and will cost a very small sum to establish it.

The bill only asks for $1,000 for the purchase of instruments for 114 observers, or one for every county, and it asks for the next two years a sum of $1.500 annually for the payment of actual expenses, including the hire of a clerk at the central office at $700 a year. The bill provides that no money shall be paid as salary to the Director, or to any other officer or member of the service. The Director and trustees are to be appointed by the Governor, and are to account to him in detail for the money expended.

It is intended to use this sum in giving daily and systematic study to our local storms, the reports being sent by mail each day from the stations. It is expected that in two years enough will be known of our storms to justify the commencement of harvest warnings. Each harvest rain does damage enough to pay the expense of weather service for years.

Is it to be credited to Shakespeare as scientific foresight that at the very time, 1603, when Dr. Gilbert was groping blindly amid the simplest experiments in magnetic attraction, he put into the mouth of King Lear, when apostrophizing the lightning, the prophetic words: "You sulphurous and *thought-executing fires*"?

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

The *Northern Indiana School Journal* is now in its third year and is certainly one of the best educational magazines that comes to our table. It is a monthly octavo of 48 pages, filled with wholesome and valuable matter adapted to scholars and teachers, edited and published by Prof. W. J. Bell; at Valparaiso, Ind., at $1.25 per annum.

PROF. OTIS T. MASON, of Columbia College, Washington City, in the November *American Naturalist*, to which we have so often referred as one of the very best scientific magazines published, refers with much pride to the growth of anthropology as a science. He deprecates the idea that every gatherer of old bones and arrow-heads is a scientist, but insists upon it that the subject is of the highest value scientifically and that each of its branches, named by him, respectively, Anthropogeny, Anthropography, Anthropology and Anthroponomy, will afford ground for the deepest researches and profound philosophy. The meetings of the Anthropological Section at the Montreal meeting of the American Association were largely attended, and most of the papers read were able, instructive and interesting.

REV. S. D. PEET, editor of the *American Antiquarian* continues in the January number his interesting and well written articles upon ancient village architecture in America, including Indian and Mound-Builder's villages, —also several suggestive editorials. Albert S. Gatschet a well-known anthropologist of the Smithsonian Institution, contributes a paper upon the Chumeto Language. Mr. Read's description of the Old Pecos pueblo differs so widely from our own personal observations in 1880, that if it were not for his reference to the ruin of the ancient Spanish church, we should hardly recognize it as applying to the same place. The oriental notes are a very attractive feature. The *Antiquarian* is the only periodical in the country wholly devoted to archæology and deserves a liberal support.

THE *Atlantic Monthly* presents for 1883 an array of contributors not excelled in number or ability to instruct and entertain by any magazine in the country. Oliver Wendell Holmes, who has resigned his professorship in Harvard University in order that he may devote himself more fully to literary pursuits, will write exclusively for it; Henry James, Jr., will write essays, criticisms, etc., in addition to his dramatized version of "Daisy Miller;" W. D. Howells will send from Europe the results of his observations in travelling through Europe; Charles Dudley Warner will contribute several of his characteristic sketches, while both Longfellow and Hawthorne will be represented by a dramatic poem and a novel, respectively, left by them nearly completed. Besides all this the usual variety of serial and short stories, essays, poetry and reviews of current literature will serve to keep the *Atlantic*, now in its fifty-first volume, fully up to its regular standard of excellence.

NUMBERS 38 and 39 of the *Humboldt Library*, published by J. Fitzgerald & Co., New York, present "Geological Sketches," by Prof. Archibald Geikie, LL.D. Nothing can be more interesting or instructive than these sketches, and the publishers are to be credited with rare good judgment in the selection of the articles they reprint from month to month. 48 pages octavo, well printed, for 15c.

THE *U. S. Monthly Weather Review* for November, 1882, has reached us in new and improved form. It is now stitched and bound with a neat paper cover and trimmed. Even the weather maps are fastened in, so that it is some satisfaction to handle tne *Review*. If the Chief Signal Officer will now have the the numbers enclosed in envelopes, for mailing, as are those of the *Official Gazette* of the Patent Office, instead of folding them, it will be an additional improvement.

WE observe that a weekly scientific magazine after the style of *Nature*, and to be called *Science* is about to be started in Cambridge, Mass., under the management of Prof. A. Graham Bell. We wish it success and feel sure from the character of the gentlemen connected with it that it will occupy a high position and maintain itself without resorting to any such dishonorable practice as its late namesake of New York has done for a very small consideration within the past year.

THE *North American Review* for February opens with a symposium in which six prominent theologians, representing as many religious denominations, give expression to their views upon the question of the "Revision of Creeds." Prof. Alexander Winchell, in an article entitled "The Experiment of Universal Suffrage," institutes a profound inquiry into the essential conditions of stable popular government, which he finds to be, substantially, virtue and intelligence; but these conditions, he maintains, are absolutely unattainable under our existing political system, where an electorate either ignorant or vicious, or both, by the mere force of superior numbers, practically nullifies the suffrages of the better and wiser portion of the people, whose right to control the government of the commonwealth is grounded in the very nature of things. Bishop McQuaid writes of "The Decay of Protestantism," and in essaying to prove his thesis, makes a very adroit use of admissions of the protestant writers. "The Political Situation" is the joint title of two articles, the one by Horatio Seymour, the other by Geo. S. Boutwell, who offer their respective views upon the causes of the recent overthrow of the Republican party. An article by Dr. D. A. Sargent, on "Physical Education in Colleges," treats a subject of prime importance to the welfare of the youths in our higher educational institutions. Finally, there are two articles on "The Standard Oil Company," Senator Camden of West Virginia defending that corporation against its assailants, and John C. Welch setting forth the reasons for condemning it as a dangerous monopoly. Published at 30 Lafayette Place, New York.

KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

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GEOLOGY.

THE ANCIENT MISSISSIPPI AND ITS TRIBUTARIES.[1]

J. W. SPENCER, B. A. SC., PH. D., F.G.S., PROFESSOR OF GEOLOGY IN THE STATE UNIVERSITY OF MISSOURI.

Physical geology is the science which deals with the past changes of the Earth's crust, and the causes which have produced the present geographical features, everywhere seen about us. The subject of the present address must therefore be considered as one of geology rather than of geography, and I propose to trace for you the early history of the great Mississippi River, of which we have only a diminished remnant of the mightiest river that ever flowed over any terrestrial continent.

By way of introduction, I wish you each to look at the map of our great river, with its tributaries as we now see it, draining half of the central portion of the Continent, but which formerly drained, in addition, at least two of our great lakes, and many of the great rivers at the present time emptying into the colder Arctic Sea.

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1 This lecture was delivered in the Chapel of the State University, at Columbia, as an inaugural address on January 10, 1883, and illustrated by projections. The author has purposely avoided the very lengthy details of scientific observation, by which the conclusions have been arrived at, relating to the former wonderful condition of the Mississippi, and the subsequent changes to its present form ; as a consideration of them would not only cause him to go beyond the allotted time, but might, perhaps, prove tiresome.

Let us go back, in time, to the genesis of our Continent. There was once a time in the history of the Earth, when all the rocks were in a molten condition, and the waters of our great oceans in a state of vapor, surrounding the fiery ball. Space is intensely cold. In course of time the Earth cooled off, and on the cold, solid crust geological agencies began to work. It is now conceded by the most accomplished physicists, that the location of the great continents and seas was determined by the original contraction and cooling of the Earth's crust; though very greatly modified by a long succession of changes, produced by the agencies of "water, air, heat, and cold," through probably a hundred millions of years, until the original rock surface of the Earth has been worked over to a depth of thirty or forty miles.

Like human histories, the events of these long *æons* are divided into periods. The geologist divides the past history of the Earth and its inhabitants into five Great Times; and these again, into ages, periods, epochs and eras.

At the close of the first Great Time—called Archæan—the Continent south of the region of the great lakes, excepting a few islands, was still submerged beneath a shallow sea, and therefore no portion of the Mississippi was yet in existence. At the close of the second great geological Time—the Palæozoic—the American Continent had emerged sufficiently from the ocean bed to permit the flow of the Ohio, and of the Mississippi, above the mouth of the former river, although they were not yet united.

Throughout the third great geological Time—the Mesozoic—these rivers grew in importance, and the lowest portions of the Missouri began to form a tributary of some size. Still the Ohio had not united with the Mississippi, and both of these rivers emptied into an arm of the Mexican Gulf, which then reached to a short distance above what is now their junction.

In point of time, the Ohio is probably older than the Mississippi, but the latter river grew and eventually absorbed the Ohio as a tributary.

In the early part of the fourth great geological Time—the Cœnozoic—nearly the whole continent was above water. Still the Gulf of Mexico covered a considerable portion of the extreme southern States, and one of its bays, extended as far north as the mouth of the Ohio, which had not yet become a tributary of the Mississippi. The Missouri throughout its entire length was at this time a flowing river.

I told you that the Earth's crust had been worked over to a depth of many miles since geological time first commenced. Subsequently, I have referred to the growth of the Continent in different geological periods. All of our continents are being gradually worn down by the action of rains, rills, rivulets and rivers, and being deposited along the sea margins, just as the Mississippi is gradually stretching out into the Gulf, by the deposition of the muds of the delta. This encroachment on the Gulf of Mexico may continue, yea, doubtless will, until that deep body of water shall have been filled up by the remains of the Continent, borne down by the rivers; for the Mississippi alone carries annually 268 cubic miles of mud into the Gulf, according to Humphreys and Abbot. This represents the Valley of the Mississippi losing one foot off its whole surface, in 6000 years. And were this to continue without any elevation of the land, the Continent would all be buried beneath the sea in a period of about four and a half million years. But, though this wasting is going on, the Continent will not disappear, for the relative positions of the land and water are constantly changing, in some cases the land is undergoing elevation, in others, subsidence. Prof. Hilgard has succeeded in measuring known changes of level, in the lower Mississippi Valley, and records the Continent as having been at least 450 feet higher than at present, (and if we take the coast survey soundings, it seems as if we might substitute 3000 feet as the elevation), and subsequently at more than 450 feet lower, and then the change back to the present elevation.

Let us now study the history of the great river in the last days of the Cœnozoic Time, and early days of the fifth and last great Geological Time, in which we are now living—the Quatenary, or Age of Man—an epoch which I have called *the "Great River Age."*

It is to the condition of the Mississippi during this period and its subsequent changes to its present form that I wish particularly to call your attention. During the Great River Age, we know that the eastern coast of the Continent stood at least 1200 feet higher than at present. The region of the Lower Mississippi was also many hundred feet higher above the sea level than now. Although we have not the figures for knowing the exact elevation of the Upper Mississippi, yet we have the data for knowing that it was very much higher than at the present day.

The Lower Mississippi, from the Gulf to the mouth of the Ohio River, was of enormous size, flowing through a valley with an average width of about fifty miles, though varying from about twenty-five to seventy miles.

In magnitude, we can have some idea, when we observe the size of the lower three or four hundred miles of the Amazon River, which has a width of about fifty miles. But its depth was great, for the waters not only filled a channel now buried to a depth of from three to five hundred feet, but stood at an elevation much higher than the broad bottom lands which now constitute those fertile alluvial flats of the Mississippi Valley, so liable to be overflowed.

From the western side, our great river received three principal tributaries—the Red River of the south, the Washita, and the Arkansas, each flowing in valleys from two to ten miles in width, but now represented only by the depauperated streams meandering from side to side, over the flat bottom lands, generally bounded by bluffs.

The Mississippi from the east received no important tributaries south of the Ohio; such rivers as the Yazoo being purely modern and wandering about in the ancient filled-up valley as does the modern Mississippi itself.

So far we find that the Mississippi below the mouth of the Ohio differed from the modern river in its enormous magnitude and direct course.

From the mouth of the Ohio to that of the Minnesota River, at Fort Snelling, the characteristics of the Mississippi Valley differ entirely from those of the lower sections. It generally varies from two to ten miles in width, and is bounded almost everywhere by bluffs, which vary in height from 150 to 500 feet, cut through by the entrances of occasional tributaries.

The bottom of the ancient channel is often 100 feet or more below the present river, which wanders about, from side to side, over the "bottom lands" of the old valley, now partly filled with *debris*, brought down by the waters themselves, and deposited since the time when the pitch of the river began to be diminished. There are two places where the river flows over hard rock. These are at the rapids near the mouth of the DesMoines River, and a little farther up, at Rock Island. These portions of the river do not represent the ancient courses, for subsequent to the Great River Age, according to General Warren, the old channels became closed, and the modern river, being deflected, was unable to re-open its old bed.

The Missouri River is now the only important tributary of this section of the Mississippi from the west. Like the western tributaries, farther south, it meanders over broad bottom lands, which in some places reach a width of ten miles or more, bounded by bluffs. During the period of the culmination, it probably discharged nearly as much water as the Upper Mississippi. At that time, there were several other tributaries of no mean size, such as the Des Moines, which filled valleys, one or two miles wide, but now represented only by shrunken streams.

The most interesting portion of our study refers to the ancient eastern tributaries, and the head waters of the great river.

The greater portion of the Ohio River flows over bottom lands, less extensive than those of the west, although bounded by high bluffs. The bed of the ancient valley is now buried to a depth of sometimes a hundred feet or more. However, at Louisville, Ky., the river flows over hard rock, the ancient valley having been filled with river deposits on which that city is built, as shown first by Dr. Newberry, similar to the closing of the old courses of the Mississippi, at Des Moines Rapids and Rock Island. However, the most wonderful changes in the course of the Ohio are farther up the river. Mr. Carll, of Pennsylvania, in 1880, discovered that the Upper Alleghany formerly emptied into Lake Erie, and the following year, I pointed out that not only the Upper Alleghany, but the whole Upper Ohio, formerly emptied into Lake Erie, by the Beaver and Mahoning Valleys (reversed), and the Grand River (of Ohio). Therefore, only that portion of the Ohio River from about the Pennsylvania—Ohio State line, sent its waters to the Mexican Gulf, during the Great River Age.

Other important differences in the river geology of our country were Lake Superior emptying directly into the northern end of Lake Michigan, and Lake Michigan discharging itself, somewhere east of Chicago, into an upper tributary of the Illinois River. Even now, by removing rock to a depth of ten feet, some of the waters of Lake Michigan have been made to flow into the Illinois, which was formerly a vastly greater river than at present, for the ancient valley was from two to ten miles wide, and very deep, though now largely filled with drift.

The study of the Upper Ancient Mississippi is the most important of this address. The principal discoveries were made only a few years since, by General G. K. Warren of the Corps of Engineers, U. S. A. At Ft. Snelling, a short distance above St. Paul, the modern Minnesota River empties into the Mississippi, but the ancient condition was the converse. At Ft. Snelling, the valleys form one continuous nearly straight course, about a mile wide, bounded by bluffs 150 feet high. The valley of the Minnesota is large, but the modern river is small. The uppermost valley of the Mississippi enters this common valley at nearly right angles, and is only a quarter of a mile wide and is completely filled by the river. Though this body of water is now the more important, yet in former days it was relatively a small tributary.

The character of the Minnesota Valley is similar to that of the Mississippi below Ft. Snelling, in being bounded by high bluffs and having a width of one or two miles, or more, all the way to the height of land, between Big Stone Lake and Traverse Lake, the former of which drains to the south, from an elevation of 992 feet above the sea, and the latter only half a dozen miles distant (and eight feet higher) empties, by the Red River of the north, into Lake Winnipeg. During freshets, the swamps between these two lakes discharge waters both ways. The valley of the Red River is really the bed of an immense dried-up lake. The lacustrine character of the valley was recognized by early explorers, but all honor to the name of General Warren, who, in observing that the ancient enormous Lake Winnipeg formerly sent its waters southward to the Mexican Gulf, made the most important discovery in fluviatile geology,—a discovery which will cause his name to be honored in the scientific world long after his professional successes have been forgotten.

General Warren considered that the valley of Lake Winnipeg only belonged to the Mississippi since the "Ice Age," and explained the changes of drainage of the great north by the theory of the local elevation of the land. Facts which settle this question have recently been collected in Minnesota State by Mr. Upham, although differently explained by that geologist. However, he did not go far enough back in time, for doubtless the Winnipeg Valley discharged southward before the last days of the "Ice Age," and the great changes in the river courses were not entirely produced by local elevation, but also by the filling of the old water channels with drift deposits and sediments. Throughout the bottom of the Red River Valley a large number of wells have been sunk to great depths, and these show the absence of hard rock to levels below that of Lake Winnipeg; but some portions of the Minnesota River flow over hard rock at levels somewhat higher. Whether the presence of these somewhat higher rocks is due entirely to the local elevation, which we know took place, or to the change in the course of the old river, remains to be seen.

Mr. Upham has also shown that there is a valley connecting the Minnesota River, at Great Bend at Mankato, with the head waters of the Des Moines River, as I predicted to General Warren a few months before his death. At the time when Lake Winnipeg was swollen to its greatest size, extending southward into Minnesota, as far as Traverse Lake, it had a length of more than 600 miles and a breadth of 250 miles.

Its greatest tributary was the Saskatchewan—a river nearly as large as the Missouri. It flowed in a deep broad cañon now partly filled with drift deposits, in some places, to two hundred feet or more in depth.

Another tributary, but of a little less size, was the Assiniboine, now emptying into the Red River, at the City of Winnipeg. Following up this river, in a westerly direction one passes into the Qu' Appelle Valley,—the upper portion of which is now filled with drift, as first shown by Prof. H. Y. Hind. This portion of the valley is interesting, for through it, before being filled with drift, the south branch of the Saskatchewan River formerly flowed, and constituted an enormous river. But subsequent to the Great River Age, when choked with drift, it sent its waters to the north Saskatchewan as now seen. There were many other changes in the course of the ancient rivers to the north, but I cannot here record them.

As we have seen, the ancient Mississippi and its tributaries were vastly larger rivers than their modern representatives. At the close of the Great River Age, the whole continent subsided to many hundred feet below its present level, or some portions, to even thousands of feet. During this subsidence, the Mississippi States north of the Ozark Mountains formed the bed of an immense lake, into the quiet waters of which were deposited soils washed down by the various rivers from the northwestern and north central States and the northern territories of Canada. These sediments, brought here from the north, constitute the bluff formation of the State, and are the source of the extraordinary fertility of our lands, on which the future greatness of our State depends. However, time will not permit me to enter into the application of the facts, brought forward, to agricultural interests. But although this address is intended to be in the realm of pure science, I cannot refrain from saying a word to our engineering students as to the application of knowledge of river geology to their future work. The subject of river geology is yet in its infancy, and I have known of much money being squandered for want of its knowledge. In one case, I saved a company several thousand dollars, though I should have been willing to have given a good subscription to have seen the work carried out from the scientific point of view.

I will briefly indicate a few interesting points to the engineer. Sometimes in making railway cuttings it is possible to find an adjacent buried valley through which excavations can be made without cutting hard rock. In bridge building especially, in the western country, a knowledge of the buried valleys is of the utmost importance. Again, in sinking for coal do not begin your work from the bed of a valley, unless it be of hard rock, else you may have to go through an indefinite amount of drift and gravel; and once more, in boring for artesian wells, it sometimes happens that good water can be obtained in the loose drift filling these ancient valleys; but when you wish to sink into harder rock, do not select your site of operations on an old buried valley, for the cost of sinking through gravel is greater than through ordinary rock.

In closing, let us consider to what the name Mississippi should be given. In point of antiquity, the Ohio and Upper Mississippi are of about the same age, but since the time when in growing southward they united, the latter river has been the larger. The Missouri River, though longer than the Mississippi is both smaller and geographically newer,—the upper portion much newer.

Above Ft. Snelling, the modern Mississippi, though the larger body of water, should be considered as a tributary to that now called Minnesota, whilst the Minnesota Valley is really a portion of the older Mississippi Valley—both together forming the parent river, which when swollen to the greatest volume, had the Saskatchewan River for a tributary, and formed the grandest and mightiest river of which we have any record.

GEOLOGICAL SURVEY OF MISSOURI.

PROF. S. H. TROWBRIDGE.

A bill has been introduced by Senator Britts, in the Upper House of the State Legislature now in session, to provide for the resurrection of the geological survey of our State. It is a measure that merits the approval and best efforts in its behalf of every citizen interested in the prosperity of one of the richest States in natural resources in the Union. On this account, there is perhaps no other State that would receive equal benefit from a complete and thorough survey of the natural wealth within her borders.

The first State Geologist was Prof. G. C. Swallow, who held the office from 1853 to 1861. Of the work done during this time, only that embodied in two bound volumes has been published by the State, though some still remains in manuscript form. The first volume contains the "First and Second Annual Reports" and was published in 1855. These reports were based upon information gained during a hasty reconnoissance lasting about eighteen months. The first was simply a report of progress four pages long. The second was in two parts, of 207 and 239 pages, and gave a brief discussion of the general geology of the State, reports of five counties, and a report on the then most important mineral resources. From the time of publication of this first volume to the discontinuance of the survey in 1861, twenty-one additional counties were surveyed by G. C. Broadhead, B. F. Shumard, and F. B. Meek. These counties are scattered somewhat promiscuously through the State, fifteen south of the Missouri River and six north, and none very near the western border. The second bound volume containing reports of these counties was printed in 1873. It contains 323 pages.

From 1861 to 1870 the survey was entirely inactive. At the latter date the Legislature organized a "Bureau of Geology and Mines," which had power to appoint a State Geologist. This Board appointed Prof. Albert D. Hager, from Vermont, who served one year, and published a report of progress of no special value. After Prof. Hager, Dr. Norwood had temporary charge of the survey till Prof. Raphael Pumpelly was appointed, in the latter part of 1871. He entered upon his duties in the spring of the following year, and during this year the material for his report, forming the third bound volume, was collected. This report was an octavo, published in 1873 by Julius Bien, of New York. The volume is divided into two parts; the first, of 214 pages, devoted to the great iron interests of the State; the second, 441 pages, discusses the perhaps equally great coal interests. Most of this was the work of Mr. Broadhead. The work is accompanied with a large atlas. Under Mr. Pumpelly, eight counties were surveyed. On his resignation in the summer of 1873, G. C. Broadhead was unanimously appointed State Geologist. He, with the assistance of Mr. C. J. Nowood, surveyed fifteen additional counties, and published in 1874 a report of about 800 pages with numerous figures and a series of maps. Dr. Adolph Schmidt, who was at one time director of iron works in Europe, and afterward in charge of extensive Bessemer steel works, gave great attention to the iron ores of the State during the last two administrations. Many other assistants were employed from time to time on the survey. Owing to mistaken notions of economy, the Legislature of 1874 voted to discontinue the survey and turn over its property, collections, etc., to the State School of Mines at Rolla. From that time to the present nothing has been done.

Without entering at all into the details of the work thus far accomplished, and without even noting some *general* results of more or less value, we find that less than half of the counties have been examined, and even these, through no fault of the geologists in charge or their assistants, have not been examined at all exhaustively. Enough has been done, however, to show that the State is remarkably rich in all those natural products which contribute most largely to her material prosperity. What is now imperatively needed is to have this vast wealth so thoroughly investigated, presented in correct and intelligible form, and given to the world, that it shall afford the much needed assistance to her own citizens, and shall attract the large immigration to her soil which she can so bounteously support. Individuals and corporations have expended much in private surveys for their own special purposes, and immigration societies and local associations have published, with more or less fulness and accuracy, representations of the peculiar attractions in certain sections. These, however, are necessarily limited and fragmental, and are often highly colored to meet the ends each party has in view.

An impartial, comprehensive, and thorough showing of the State's resources can be had only by disinterested and competent geologists, conscious of their responsibility to the public and true to the interests of science. To such a source explorers will confidently look for facts regarding the wealth which the earth possesses; and the settler will there find a satisfactory exhibit of the natural wealth of his future home, and, by the use of these revelations of scientific research, he can study beforehand the country, select, bound, and parcel his claim, locate his buildings, and carry with him an accurate picture of it all. For this purpose much attention should be given to the construction of topographical maps of the territory surveyed. This is also necessary to enable the geologist to describe the exact position of any valuable deposit beneath the soil, and for the land-owner to know just where on his farm to search for it. This necessity can be largely obviated in Missouri, for any special and local deposit, by giving its position with reference to range and section lines; but for valuable deposits in strata at a certain level, on all farms, verbal description is totally inadequate. Even if the facts have been observed with the greatest accuracy, they will lose much of their value to the individual owner because the descriptions cannot specify the exact locality for him. He may easily be misled into vast expenditure in search of some mineral in a stratum not present within his limits, though perhaps abundant all about him.

The position of strata, upon which all geological information is based, is determined largely by a study of the fossils they contain. To make this work intelligible to the public, these fossil forms must be correctly described and clearly figured, so that one with sufficient skill may examine the rocks on his own farm and see, by comparison, whether the beds of coal, lead, zinc, etc., described in the State reports, are likely to be found within his limits or are not. For this purpose the figures of fossils are of far greater value to the uninitiated than verbal descriptions; and it requires considerable acuteness of observation to notice, even in these, slight differences in form or marking which may indicate widely different strata, and may easily and greatly mislead an unskilled observer. The collection, examination, and classification of fossils in the rocky strata form a large large part of the geologist's work. While much of this work has been done in the State, it has been scattered and fragmentary, and there is great need of a systematic and thorough revision of it all, and especial need of its publication in a compact and easily accessible form. The publications under State authority present a very meager showing of the fossils and their instructive teachings within our limits. In all the State surveys thus far published, there are only three palæontological plates, and these illustrate but forty-five species. These are in Swallow's report, published nearly thirty years ago.

Other fossils of the State are described and figured in the Transactions of the St. Louis Academy of Science, in geological reports of neighboring States, and elsewhere at private expense, and still others are described but not figured in reports of certain railroad and other corporations. But the State herself should publish, with well executed figures, a full series of the fossils characteristic of the various rock horizons to be found here, many of which have never been described. Illinois has a most excellent exhibit of her fossils in her six volumes of Geological Reports, which are of great benefit and credit to the State and of immense value to science. Iowa, too, another of our nearest neighbors, is far ahead of Missouri, though much behind Illinois. Missouri, with natural resources, doubtless surpassing either or both of these States, should not be overshadowed for the simple lack of making a published showing of her own vast and rich possessions.

Another work much needed in the State is an exhaustive investigation of her archæological remains. In these Missouri possesses remarkable wealth and presents a most attractive and profitable field of research. Much of this wealth has already gone to enrich eastern museums, which would have remained here had its value been properly appreciated, and much more, doubtless, has been lost or destroyed for the same reason. Traces of our pre-historic inhabitants are rapidly disappearing under the destructive agencies of the plow and other implements of modern civilization; and unless the State takes speedy action in the matter and places upon permanent record the descriptions and exact localities of these ancient remains, they will be lost beyond recovery. Every clue to the history of the former occupants of our soil is daily increasing in value and interest, and Missouri has a rare opportunity of advancing her own credit by contributing what she can to the settlement of these important scientific questions. The archæological Section of the St. Louis Academy of Sciences is doing a most valuable work in this direction, and members of the Kansas City Academy are also hard at work, as well as many private parties elsewhere. But the State, with a liberality which would do her immense credit, has far the best opportunity to place upon record a complete history of these ancient works, and this should be embraced before it is forever too late.

The surface geology of the State, too, presents an inviting and profitable field of scientific investigation. The results of glacial action and drift agencies have received far less attention than their importance demands. The bluff or loess deposits are greatly in need of thorough study. In the first place, the different kinds of soils need to be subjected to exhaustive chemical analysis to show what crops can be grown to best advantage upon each, and what ingredients need to be supplied in the form of fertilizers. Secondly, the study of these surface deposits is attracting increased attention from geologists of the adjoining States, and the gap which has thus far existed in Missouri should be filled by careful examinations here to give completeness to the scientific work going on elsewhere in the Mississippi Valley.

Among other excellent features of the bill now before the Legislature, stands prominently the section requiring that suits of specimens of minerals, ores, rocks, fossils, etc., representing the wealth of the State, be furnished, on easy terms, to the colleges and public museums of the State. This is an important move in the right direction, and should of itself insure its passage. Our school instruction, of all grades, at the present time is notoriously deficient in facilities and studies capable of fitting students for *practical life.* This accounts for the facts that "the ratio of school graduates to our population is continually decreasing," and that "men withdraw their sons from the schools when they deem it time to teach them the practical arts and duties of life." Such collections in the colleges of the State, if properly used by teacher and pupils, would go far toward giving the sons of farmers and others a knowledge of practical science which would result in a great saving of useless expense, and be a rich source of revenue to individuals and the State.

The knowledge thus acquired would enable the son of many a land-owner to see the danger of the *little wisdom* which led his father to spend his living vain attempt to obtain various precious minerals from deposits which the additional knowledge he has gained assures him are utterly worthless. It would protect him from the well meant but financially ruinous zeal of his father in mining for coal, lead, ochres, and other ores, on the unsafe supposition that, because a neighbor in the valley below him finds these in abundance, he will have equal success by sinking a shaft to the same level. His interest in geology, excited by the tangible illustrations his school furnishes for study, would enable him to see, by a brief survey of the rocky strata which he can easily make, that the rocks which his neighbor finds so productive dip away from him, or, by an upward curvature of the earth's crust which formed the elevation on which he stands, the wealth-bearing stratum was exposed on the surface to the action of frost and flood, and has been completely washed away. It would enable him also to avoid the useless expenditures of his father in boring for a bed of coal, even in a region of coal, away down into rock-layers in or below which coal never was and never will be found; and to show his father, from a simple examination of the kinds and position of the strata beneath, that it would be useless to even start his drill in the desired place in search of water. Such practical information as this, so easily gained by any intelligent teacher or pupil when the proper opportunities are afforded, would be of inestimable advantage to mining and farming interests.

The popular impression, too, which this practical education would create, of the value of scientific information in ordinary life, would go far toward securing more intelligent legislation on other points most intimately connected with our material prosperity. Every farmer can make an estimate for himself of the value of the crops annually destroyed by the ravages of insects throughout the State. The most charitable estimate could not fall short of many millions of dollars. Our former State Entomologist agrees with others that in one year Illinois alone lost at least $73,000,000 from the destruction of corn and wheat by the chinch-bug. "Bugologists" variously estimate that from one-tenth to one-half of the $300,000,000 annually destroyed in the United States might and should be saved. The amount thus saved, if devoted to missionary enterprise, would soon convert the world. What should be saved each year in Missouri alone would furnish an income of seven per cent on all the real estate within her borders, or an average annual income of $200 on every farm from one of three acres up. It would build every year as much railroad for carrying agricultural products as would reach twice the length of the State. A live farmer of Howard County told me some years since, from his own standpoint and not from the scientific, that C. V. Riley, while State Entomologist of Missouri, saved the farmers of his own and adjoining counties $50,000 by a single item of advice concerning a single destructive insect. Yet the State lost his services, prized everywhere else, in their wise! and economical!! purpose to save $3,000. If we are losing at this rate by stopping of the entomological survey, it is sincerely to be hoped that we may make what amends we can by re-establishing the Geological Survey.

For every reason that could be urged, it is emphatically desirable that all friends of the State and its prosperity, of science, of education and of popular enlightenment, will exert their influence to secure the adoption of the pending bill and a vigorous prosecution of the important work it proposes.

THE BOTTOM OF THE OCEAN.

In the National Academy of Sciences, yesterday, in Columbia College, Prof. A. E. Verrill, of Yale College, described the physical and geological character of the bottom of the sea off our coast, especially that which lies beneath the Gulf stream. He made 1,500 observations this summer for the United States Fish Commissioners. He has cruised from Labrador to Chesapeake Bay and about 200 miles out to sea. About sixty miles outside of Nantucket is a streak of very cold water, and animals dredged up are like those caught in Greenland, Spitzbergen, and Siberia. The water is fifty fathoms deep, and the bottom of the ocean is of clay. Boulders weighing eight hundred or one thousand pounds are dredged up. Prof. Verrill believes that they are brought down by icebergs from the Arctic regions and dropped when the ice melts. The boulders are found as far south as Long Island. Further out to sea, seventy to one hundred and twenty miles south from the southeastern coast of New England, the bottom of the sea, which has inclined very gradually eastward, forming a table land, takes a sudden dip downward, so that whereas the water on the edge of the bluff is 100 fathoms deep, at the bottom of the basin it is 1,000 fathoms deep. The slope is as high and as steep as Mount Washington, and on its summit, which is level, a diver, could he go to so low a depth, could not put out his hand without touching a living creature. The bottom of the sea is covered just there with a fauna which has never been before found outside of the Mediterranean Sea, the Gulf of Mexico, the Indies and other tropical regions.

The number of species of fish dredged up is 800, and over half of them have never before been seen by naturalists. Seventy kinds of fish, ninety of crustacea and 270 mollusks have been added to the fauna. The age of many of the specimens shows that they must be permanent in that region. The trawl let down from the ships by a mile of rope brings up a ton of living and dead crabs, shrimp, star fish, and as the trawl simply scrapes over a small surface the ocean bed is plainly carpeted with creatures.

Sharks are seen by thousands in this region, and countless dolphins, but it seems strange that not a fish-bone is ever dredged up. A piece of wood may be dredged up once a year, but it is honeycombed by the boring shell fish, and falls to pieces at the touch of the hand. This shows what destruction is constantly going on in these depths. If a ship sinks at sea with all on board it would be eaten up by fish with the exception of the metal, and that would corrode and disappear. Not a bone of a human body would remain after a few days. It is a constant display of the law of the survival of the fittest. Nothing made by the hand of man was dredged up after cruising for months in the track of ocean vessels excepting coal clinkers shoved overboard from steamships. Here Prof. Verrill corrected himself. Twenty-five miles from land he dredged up an India rubber doll. That, he said, was one thing the fish could not eat.

Here the Gulf stream is forty miles further west than any map shows, Prof. Verrill continued; and this stream of warm water from the south nourishes the tropical life near Massachusetts. The temperature further in shore is 35° in August, on the edge of the submarine Mount Washington 52°, and toward the bottom of the basin 39°, while further out to sea the temperature of the water grows colder. On the surface the jelly fish, nautilus and the Portuguese man-of-war, with other tropical fish, are found. In this belt the tile fish, about which so much was said a year ago, were found in immense quantities, but this summer, although expeditions have been made for the express purpose of catching some, not one could be taken. Undoubtedly they had been killed, to a fish, by a storm which carried the cold water into the gulf stream; indeed, it is known that a cold current of water resting on the ocean's bed may contain Arctic fish, and a current of warm water floating over it on the surface may be alive with tropical fish.

As to the quantity of light at the bottom of the sea there has been much dispute. Animals dredged from below 700 fathoms either have no eyes, or faint indications of them, or else their eyes are very large and protruding. Crabs' eyes are four or five times as large as those of a crab from surface water, which shows that the light is feeble, and that eyes to be of any use must be very large and sensitive. Another strange thing is that where the creatures in those lower depths have any color, it is of orange red, or reddish orange. Sea anemones, corals, shrimp and crabs have this brilliant color. Sometimes it is pure red or scarlet—in many specimens it inclines toward purple. Not a green or blue fish is found. The orange red is the fish's protection, for the bluish-green light in the bottom of the ocean makes the orange or red fish appear of a neutral tint and hides it from enemies. Many animals are black, others neutral in color. Some fish are provided with boring tails, so that they can burrow in the mud. Finally, the surface of the submarine mountain is covered with shells, like an ordinary sea beach, showing that it is the eating-house of vast schools of carnivorous animals. A codfish takes a whole oyster into its mouth, cracks the shells, digests the meat and spits out the rest. Crabs crack the shells and suck out the meat. In this way come whole mounds of shells that are dredged up.—*N. Y. Sun.*

ANTHROPOLOGY.

THE KINDRED OF MAN.

ARTHUR ERWIN BROWN.

Mr. A. R. Wallace once called attention to the similarity in color existing between the orang and chimpanzee and the human natives of their respective countries. It would indeed seem as if but half the truth had been told, and that the comparison might be carried also into the region of mind; the quick, vivacious chimpanzee partaking of the mercurial disposition of negro races, while the apathetic, slow orang would pass for a disciple of the sullen fatalism of the Malay. Such, at least, was the impression left by careful observation of several specimens of each species which have been exhibited in the Philadelphia Zoölogical Garden.

A curious study are the moral qualities of the chimpanzee—for he has morals—not altogether such as would serve for the ordering of a human community, but very well adapted, seemingly, for his own needs. Watching them closely, in all their moods, all their passions, it was impossible to avoid the feeling that here was man in his primitive stage of moral development—"nature's ground plan" only—self-love predominant, the brute mainly, with but an occasional flash of the possibilities which the hand of nature was yet to shape.

"Adam" and "Eve" were both young, probably not more than three or four years old, and not half grown, as the chimpanzee is believed to require some twelve or fifteen years for the completion of that stage of existence. They were about the same size—perhaps they were twins—they had no family Bible to settle the question, but the extraordinary likeness between them was strongly in favor of the supposition; indeed, if Adam had not been ornamented with a black smudge across the nose, they could hardly have been told apart; but twins or not, they loved each other with a most devoted affection, or, at least, so it seemed, but subsequent events cast a doubt on the real depth of their feelings.

Being young they were eminently social, for it may be said that as a rule, among wild animals, moroseness and ferocity come only with age. When they were first coaxed out of their traveling cage they were visibly embarrassed, and retired into the nearest corner, locked tightly in each other's arms, which, as we afterwards learned, was a universal refuge in time of doubt, but it was not long before they began to feel at home, and thenceforward were always ready to make friends with anybody who made his approaches in due form. As has been said, they were very fond of each other, and it was on rare occasions only that they were not clasped in a fond embrace, and not once during their life in the garden was anything but the most perfect accord manifested between them. No pretence of partiality in feeding, no petting of one to the exclusion of the other, could excite a trace of jealousy; the slighted one would simply retire to a corner and sulk, but their mutual relations were undisturbed; resentment was all towards the giver, not to the one who received. Each was at all times ready to stand by the other; probably the keeper has not forgotten the ferocious assault Eve once made on him from the rear, while he was engaged in pouring a dose of medicine down the throat of her companion.

Their anger was something ludicrous; the male especially was liable to paroxysms of rage, during which he would tear his hair with both hands, hurl himself down on the floor with a perfect tempest of yells and roars, but in a moment it was all over, and he was ready to make peace and accept any small attention by way of *amende*. But his masculinity asserted itself more particularly when danger seemed to threaten—then he was grand; advancing inch by inch, brandishing his arms, stopping after each step, with a stern frown, to emit a terrifying roar, he seemed an impersonation of resolution and defiance—a very Ajax—but after all, he was only a Thersites, a more arrant little coward than he, at heart, had never lived, and if his appearance did not have the desired effect, if the intruder stood his ground, the dignified approach gradually became slower, the resolution ebbed away and the inevitable end was a final stop, a hasty turn and an ignominious flight into the corner—generally, it is painful to say, behind Eve. We could only blush, we dared not blame him; one nearer to us far than he, his namesake, under circumstances which brings the action home to each of us, had done the same.

Many experiments were made to test the mental capacity of these animals, with quite fruitful results; the primary mental operations, and even some which involved a greater or less combination of ideas, were performed by them with facility; indeed, it may be doubted if the undirected efforts of a human child of the same age, ignorant of language, could produce results of a much higher grade.

A mirror being placed in the cage, the male, after cautiously investigating the figure reflected, turned it over, and finding nothing but bare boards, he placed it face downward on the floor and executed a sort of war dance on the back. Having repeated this a number of times, the glass was firmly held before him; he then gave it more attention, at first attempting to drive away the figure he saw; at last a resemblance seemed to strike him, and after performing a variety of antics, seemingly for the purpose of comparison, it was quite evident that he became aware of his own identity—and in this, perhaps, afforded a trace of that self-consciousness which conservative philosophy allows only to the lordly intellect of man. In this case it is probable that he had become accustomed to see a faint image of himself reflected from the glass front of his cage.

Perhaps, though, the most striking evidence of their power of reasoning was given when a dead snake was taken into the room and shown to them. As is well known, monkeys have an intolerable dread of snakes, and these were terrified beyond measure. They fled at once to the highest point of the cage, uttering their expressive cry of fear, and there they remained for hours, refusing to come down even at sight of their accustomed dish of food, and when at last they did so, it was with the greatest caution; a slight movement in the straw covering the floor, was enough to cause a panic, and it was some hours before they fully recovered equilibrium. Finally, when both were sitting quietly near the glass front, the snake was suddenly shown to them on the outside, but there, the object which had caused such terror in the same room, was powerless; the glass which they themselves could not pass, was a barrier as well to their enemy, and they simply sat still, pointing at it with their fingers and uttering the *hoo-hoo* which expressed doubt, dislike and disgust. It was suspected that they had only become accustomed to the sight, and to complete the experiment the snake was again thrown in through the back door, when the terror of the two animals was as great as on the previous occasion.

It was quite clear that they possessed a limited means of vocal communication. Sounds, to the number of three or four, were uttered by one, which met with a different response from the other, either by voice or action, and in which it was quite possible for the human ear to detect a difference.

The imitative habits common to the whole tribe of monkeys were strongly marked in them, and made it relatively easy to teach them to use a spoon or drink out of a cup, and to perform various small tricks. In cleaning the glass in front of the cage with paper, the keeper generally threw two pieces on the floor beside him, when each chimpanzee would take one of them and set to work polishing the glass in like manner, deriving, apparently, great satisfaction from the performance. The delicacy of their taste became developed to an extraordinary degree by the varied diet afforded them; both were fond of the taste of sherry, which was always put in their tapioca and corn-starch, but when brandy, whisky and rum were substituted, they stuck out their under lip in disgust and refused to eat it.

For music they had no ear whatever; the notes of an accordeon and violin produced in them only distrust of the instrument, and when these were put into their hands, their insatiable curiosity prompted only efforts to find out what was inside.

For many months Adam and Eve were the pets of the "Zoo"; few days there were when they were not surrounded by a crowd of interested spectators, some of whom, to a critical eye, were fully as amusing as the animals they came to see.

It is learned from African travelers that the native tribes inhabiting the range of the gorilla and chimpanzee believe them to be human beings who have degenerated from their original state, and that out of pure laziness they refuse to speak, in the fear that if their possession of the faculty should become known, they will be set to work in the fields; indeed, the native name of the chimpanzee, *Enge-e-co*, means "hold your tongue," and evidently originated in this belief. It frequently seemed as if similar ideas prevailed among a certain part of the visitors, and that class especially whose acquaintance with the forms of orthography had not reached a familiar stage, seemed to find in the scientific name of the animal, *Anthropopithecus niger*, indications of a relationship to the humble man and brother whose ancestors sprang from the same soil.

But at last, in spite of tender care and attention, Eve became sick—poor little thing, how she did suffer. Of course she ought to have been a good and grateful patient and have known that everything done for her was for her ultimate benefit—they always do in the animal literature of the day—but she had read little, and so was hardly to blame in following out the instincts of her nature. She might have been expected to look appealingly into the eyes that bent over her, but she did not; she ought to have pressed affectionately the hand that cut the hair from off the region of her little stomach and gently applied a mustard plaster to the affected part, but instead, she bit it savagely; and to crown all, she was so little sensible of the soothing influence of that mustard plaster that it took the united efforts of three men to keep it in place until its work was done.

Alas for all the works of fancy! a long experience of sick and suffering animals compels the conclusion that one of the things which is beyond the grasp of mind to be found among the lower animals is surgery.

And so Eve passed out from the familiar places of the "Zoo." Her funeral urn stands ranged on a shelf in that universal mausoleum of nature, the Academy of Natural Sciences, and her "In Memoriam," by Professor Chapman, was published in the Proceedings of that venerable institution.

Adam was left alone to mourn, but to his shame be it said that although he was inconsolable at first, so long as the dead body of his late companion was in sight, he soon got over it, and in forty-eight hours not a trace of her seemed to exist in memory, excepting that to the day of his death, some months later, he was afraid to sleep alone on the floor, where the two had always slept together, and with the shades of night he followed out his ancestral habit, climbed as high as he could get toward the roof, and there composed himself to peaceful slumbers.

For some time the garden was without any specimen of the higher apes, until in the autumn of 1879, a young orang-utan was safely received.

There is something about the orang that irresistibly suggests a spider—one of those red, hairy, long-legged spiders which one sees with an instinctive feeling of repulsion. At no age can the animal be called handsome, and the old males, covered with coarse, reddish-brown hair six or eight inches long, with a huge protruding jaw and a mass of hardened skin on each cheek, are about as unprepossessing as anything that nature has produced. "Topsey," however, as is sufficiently indicated by her baptismal name, belongs to the fairer sex; her age—probably for that reason, is unknown. When she arrived she was supposed to be about two or three years old, but as the lapse of time has made hardly any change in her personal appearance, save in the way of *embonpoint*, it is probable that she was older, although she is certainly not half grown; if, indeed, as has been suggested, she may not be a dwarf—a sort of feminine Tom Thumb among orangs; and in this, possibly is the explanation of the unusually good health which she has enjoyed through a lifetime much longer than is common to her species in captivity. The amount of nutrition required to simply maintain the existing condition of body, would of course be less than if the processes of growth were in full activity, and the assimilation of food, which is probably defective in most caged animals, would, as has been the case here, be sufficient to keep her in good condition.

Between the orang and chimpanzee there is a marked difference in moral qualities. The latter is full of life, vigor, vivacity; lively and child-like in disposition, enjoying life to the full, and taking interest in all that goes on about it. Quite the reverse with the orang—it is slow, sluggish and calculating; philosophically indifferent to everything but its immediate wants—voluptuary and stoic in one—life is only for the means of living, and life itself is hardly worth the pain of an exertion. It is exasperating—the apathy of the orang; for hours it will lie wrapped in a blanket close to the front of the cage, lazily following with its eyes the motions of any person within its range of vision, or slowly blinking at a straggling fly upon the glass, moving—when it must move—only with the greatest deliberation. If left hanging by one hand to a rope or branch, there it will hang, perhaps for several minutes, before making up its mind to take hold with the other or let go altogether. Laterly the contrast in the disposition of the animals has been made very striking by the presence in one cage of specimens of each species. A second pair of chimpanzees, about the same size as the orang, were placed with her, and with their natural liveliness at once made overtures of acquaintance, which were as promptly repulsed, and during the first week she suffered so much fright and uneasiness from their perfectly good-natured attempts to induce her to join in their play, that it became necessary to partition off with wire screens a corner of the apartment, and there, hour after hour, while the two chimpanzees are climbing, swinging and tumbling about the cage, never at rest except to plan some new scheme of amusement, the orang lies flat on her back, fingers and toes closely interlocked in the air, enjoying a *dolce far niente*, the relish of which she seems to intensify by quiet wonder at the reckless prodigality of force indulged in by her neighbors.

This stolidity is characteristic of the species in a wild state; there they live mostly in the tree tops, cautiously crawling from branch to branch, testing every limb before resting their weight upon it, moving only to satisfy the demands of hunger, and when that stimulus to action ceases, subsiding into a half-sitting position with the trunk or branch of a tree to hold up the back, head bowed on the breast, hands hanging down—not asleep—it can be nothing but laborious thought that produces such perfect bodily repose. Who can tell how deeply the meditative orang has penetrated into the mysteries of the cosmogony of which he is a part? how many systems of philosophy have dawned, after hours of reflection, into his weary brain? how deeply he has pondered on the origin and destiny of his race, and to how many metaphysical final causes has his speculative career traced its way?

The orang is really not so stupid as appearances would have it, and it is an interesting fact that the actions of the one in question once gave evidence—and the only evidence the writer has ever observed among the lower animals—of what seemed to be some understanding of death. Another orang had been procured as a mate, and arrived in bad health; it was exceedingly irritable, and though weak from disease, managed to appropriate the only blanket in the cage, and fought off the rightful proprietor whenever she approached. This, with other grievances, caused Topsey to regard the intruder with marked dislike and fear. She watched it from a distance all through the several days of illness, and the more attentively as the last moments drew near and pain and weakness were showing plainly their ravages, until finally, after a hard struggle, the little sufferer lay motionless and dead, then, for the first time, she drew near, looked at the body for a moment, pushed it with one hand, and then after putting her nose close down against its face, as if to listen for a breath or any sign of life, she began pulling from under it the coveted blanket which it was no longer able to defend, and in the most satisfied manner wrapped herself up and laid down in peace.

Much less opportunity has been afforded for critical observation of the remaining anthropoids—the gorilla and the gibbons—as few of either have been kept in captivity; but the former may fairly be considered as not presenting marked mental differences from the chimpanzee, and the latter seem in all respects to be below the level of the others.

In considering the proper station of man and these animals in the zoölogical system, a brief glance must be given at the other members of the order to which they belong.

Three remaining families complete the group of Primates: the Catarrhini, embracing all the monkeys of Africa and Asia, and the Platyrhini, inhabiting tropical America and the West Indies. Besides these are usually included in the order, the Lemurini, a large and ill-assorted group known also as Prosimiæ or half-apes, all of which fundamentally are of the monkey type of structure, but many forms of which partake also in the characters distinctive of bats, rodents and insectivores. The two groups of old and new world monkeys are very well distinguished by anatomical peculiarities; thus in the Platyrhine group the nostrils are far apart and look almost directly forward; there are no cheek pouches for the stowing away of food, nor any of the brightly-colored callosities on the haunches, which are common to many of the others; all the American monkeys have long tails, which in many species are strongly prehensile and serve almost the purpose of a hand, while in all of Africa and Asia not a prehensile-tailed monkey is known, and a number of species, including the higher apes, have no tails at all; in this group, too, the nostrils are close together and look downward. The number and arrangement of teeth correspond to that of man, while the greater part of American monkeys have two more teeth in each jaw, and in those which do possess the same number the arrangement is unlike. Geographically and structurally the apes we have been describing belong to the old-world group, and geographically and structurally, too, man's alliances make it necessary to consider him a member of the same family.

But though it is assuredly no part of the writer's purpose to belittle the evidences of this genetic connection, the candid acknowledgment must be made, that a somewhat undue prominence has been given to the anthropoid apes in this respect—although probably more in popular misconception of what men of science have written than in anything which the writers themselves have intended to convey.

The points of resemblance are many and close, but the category contains many in which each ape stands closer to man than do any of the others, and there are as many more, perhaps, in which similarity is found, not among the higher, but in some of the lowest of the monkey tribe.

A full list of the points of close alliance would be far longer than the purpose of this paper demands, and it will be sufficient to mention a few cases of resemblance and of difference, simply to indicate the complex nature of the relationship.

The gorilla resembles man most in actual bulk, in size of the brain, in proportional length of the hand, and of the thumb and great toe to the spine, of the two segments of the arm to each other, and in the presence of the transversus pedis muscle; but he has no flexor longus pollicis in the hand, no plantaris and no flexor accessorius in the foot, both of which are found in man and most of the lower monkeys.

The chimpanzee is man-like in shortness of arms compared with the spine and with the leg, in many details of brain structure and in the possession of a palmaris longus muscle, but the plantaris, the transversus pedis, and sometimes the flexor accessorius are absent, and the flexor longus pollicis is variable.

The orang excels in the proportion of hand to foot, in some details of the pelvis, and in general brain development is, perhaps, higher than either of the others; it also has the palmaris longus and a part only of the flexor accessorius, but the flexor longus pollicis, the plantaris and transversus pedis are absent, and the flexor longus hallucis belies its name by giving no tendon to the great toe.

In the form of larynx, one of the gibbons comes quite near man, but in other respects is less like him than the other apes.

The chimpanzee and gorilla, like man, have eight bones in the wrist and ankle, while the orang has one additional in each; the human number of twelve ribs is found only in the orang, but to more than offset this, it has in the foot a special muscle, the opponens hallucis, making of the big toe almost a thumb, and of the foot almost a hand—a degraded structure which is not known in any other monkey nor in man.

A close approach to the human form of teeth is found in the anthropoids, but for the reduced size of the canines, the absence of a space both in front and behind each canine, and in some details of the grinding surfaces of the molars, a parallel is found only in some South American monkeys and in one of the lowly organized lemurs.

The orang and gorilla have the same number of spinal vertebræ as man, but in the curves of the backbone which they form, and which are vitally important to his habitual attitude, the baboons bear a closer resemblance. So, too, with the position of the occipital foramen in the base of the skull, enabling the head to preserve a balance on the vertebral column—a necessary condition of an upright posture—and in the cranio-facial angle, a similar gap between man and the anthropoids, with a closer approximation on the part of some of the lower forms, may be traced.

Owing to the articulations of the tarsal bones, no animal but man can habitually walk erect, and the apes can approach such a position only with the help of some external support; the gorilla, chimpanzee and orang all walk by touching the ends of the fingers or the knuckles on the ground, and in the gibbons the arms are so long that the animal swings itself between them as on a pair of crutches. Some of the South American monkeys, however, notably those of the genus Ateles, are able to walk erect on the hinder extremities for a considerable distance, the long tail serving, to some extent, to preserve the balance.

It has been asserted and maintained by a number of European anatomists, against the venerable authority of Professor Owen, that in the anthropoid brain, the backward projection of the posterior lobes of the cerebrum overlap and completely hide the cerebellum from view, when looked at from above, as is the case in man—an almost steady progression from the lowest types of brain towards this arrangement being found throughout the mammalian series. It must be said, however, that in three chimpanzees from which the brains were removed, a few hours after death, by Professor H. C. Chapman and the writer, in spite of preconceived notions, this was found to be clearly not the case, and in the orang, the cerebellum was covered to a very slight extent only, postero-laterally. There are few of the lower monkeys, however, in which the man-like relation of these parts does not exist, and in one, at least, the squirrel monkey (Chrysothrix) of South America, this posterior projection is even greater than in man himself.

Observation renders it quite probable that mental capacity in these animals has, to a considerable degree, maintained a relation to the complexity of detail in brain structure, although undoubtedly, from a mere comparison of human and anthropoid brains, a far greater degree of intellectual power than that which really exists, might be expected from the latter; it should be remembered, however, in favor of the ape, that the specimens from which our ideas of their intelligence have been derived, have for the most part, been very young, and it is possible that more mature age may bring with it a higher degree of mental faculty. On the whole, however, it is quite certain that the intelligence of the lower animals has been greatly overestimated. All experienced observers of their actions know how easy it is to place a motive and an understanding where none probably exist. It is difficult, except after long training, to withstand the influence of the subjective tendencies of the mind, which lead the observer to translate into the terms of his own intelligence, those actions which seemingly correspond to his own desires, and there are few works on this subject in which constant evidence is not given of its presence. In experimenting with the animals which form the subject of this paper, the difficulty was constantly met with, and a large proportion of the phenomena observed were set aside, reluctantly in many cases, because of the doubt.

In the slow development of anatomical structure, the presence or absence of a single bone or muscle must be of vast importance in working out the pedigree of an organism, and enough has been said to show how varied are the directions in which man's alliances seem to point.

It is held generally, in popular misconceptions of the doctrine of evolution, that man is a direct descendant of the higher apes, and the gorilla is commonly looked on as being his nearest progenitor. From the standpoint of science, however, no student of biology will maintain that the ancestry of man has yet been fully traced, but will limit himself to the conviction that at some period of the prehistoric world, the forces of nature, acting from without, on the plastic materials of life, have brought down from an unknown point of departure—perhaps among the lemurs—two diverging lines of development, one of which finds its present type in man, the other in the Catarrhine monkeys and their highest form—the anthropoids.

Perhaps the future of science may unfold the details of development, but to do this it is probable that ages of geological upheaval will be required to bring above the ocean continents long buried, in which the process took place and in which the records are contained.

Manlike as are the apes, there is a contrast which the resemblance serves, in great part, but to intensify—anatomy finds similarity throughout and takes note of little that is unlike, while function, based upon these structures, has become so specialized and elevated during progress from the lower to the higher, as to become almost difference, and man and ape are in fact, as in time, separated by a gulf so vast that the furthest reach of science can catch, as yet, but shadowy outlines of the other side.—*American Naturalist.*

THE CLIFF-DWELLERS OF THE NEW MEXICAN CAÑONS.

The archæological and ethnological explorations in the southwestern territory, of which the *Tribune* published an account at the close of last season's work, have been continued with success under the direction of Prof. Powell during the season which has just ended. The wisdom of Congress in making provision for this work three or four years ago is becoming strikingly apparent as the railroads extend their lines into this, the most interesting region to the archæologist within the borders of the republic. Private collectors and specimen hunters are now overrunning the places which are thus made accessible, and all that remains of scientific interest which is movable becomes their spoil. The already abundant collection of specimens in possession of the National Museum will become priceless as the opportunity for their duplication passes away.

The incompleteness of the work of exploring may be inferred from the fact that many of the ancient cliff villages seen by exploring parties during the last three months were merely sketched from a distance. They appeared to be in a remarkable state of preservation, but were not even visited. These villages, so far as could be learned from Indian guides, were never before looked upon by the eye of civilized man. They were inaccessible by any means at the command of the explorers, who, of course, will not rest satisfied until in some future trip they have reached them and carried away their treasures. The collections made from New Mexico and Arizona already number somewhere between 25,000 and 35,000 specimens of pottery, stone implements, weapons of war, articles of husbandry, musical instruments and a thousand and one things which appertain to and illustrate the daily life of the people who made and used them. Two parties, especially charged with the branch of science work referred to, were sent into New Mexico and Arizona last summer. One, in charge of Victor Mindeliff, went to the Moqui country, in northwestern Arizona, to make surveys of the Indian villages and ruins to be found in the region known as the province of Tusavon. The other party, under the direction of James Stevenson, has recently returned. It took for its field of exploration the cliff villages and ruins in the Cañon de Chelly and its branches. The main cañon has very rarely been visited by white men, and its branches—some of which are equal to it in extent, in grandeur of scenery and scientific interest—have, it is believed, never before been explored.

The "nests" (no other word is so expressive for the purpose) of the old dwellers herein were built, like those of wasps, in crevices of the cliff. The places selected were too small from front to rear to be properly termed caves. They were probably formed by the swirling eddies of the torrent, ages ago, before it found its way down to its present bed, hundreds of feet below. The solid upper crust is long and forms a lofty, sloping roof over a whole village. What could have been the character and habits of life of generations born and brought up amid such surroundings, with a sky of dull red rock overhead, with the outer world possibly narrowed to the limits between the two walls of the cañon, and even that outer world inaccessible except by a perilous feat of climbing such as none but expert gymnasts of this day would care to attempt; a little world upon which the Sun could only shine two or three hours of its daily round. It is to answer these question as well as may be that the explorers were sent out.

Colonel Stevenson was led to the selection of the Cañon del Muerte, in preference to others which branched off from the main cañon, upon either side, by the representations of his chief Indian guide, who said that ruins of a more interesting character than elsewhere were to be found there. The party entered the mouth of the cañon and went a day's journey along its bottom until they reached a place beyond which their wagons could not go, and here they established their camp. The walls of the cañon were of nearly uniform height, about 1,000 or 1,200 feet from top to base, always perpendicular, except where great piles of debris, broken from the cliffs, had filled up a portion of the space below; now approaching each other, narrowing the cañon to a mere crevice in the earth less than 100 feet in width, and again spreading out half a mile apart.

Proceeding on foot three miles beyond the camp, the explorers found the ruins of a cliff village, so well preserved and remarkable that it more than fulfilled the promises of the guide. The place must have been the home of between 2,000 and 3,000 human beings. It occupied two "caves" under the same roof, but partially separated by a projection of rock. The extremes of the habitable floor were 1,500 feet apart, while the width from the rear wall of the cave to the edge of the precipice below might have been one-twelfth that distance. The floor of the two wider portions of the cave was studded thick with dwellings built of square stones laid in mortar, all of which were in a state of ruin. An edifice of grander proportions, and almost as well preserved as in the day of its occupation, nearly filled up the narrow space in front of the dividing rock projection to the edge of the precipice.

The fortress-like structure referred to consisted of a long, narrow building one story in height, divided into many rooms or dwellings, opening into each other, but having no communication with the outside except through the towers which stood at either end. The largest of these towers—that at the southern end—was three stories in height, with the joists for each of the upper floors projecting two or three feet beyond the outer walls. Holes through the floors formed the means of communication between the different stories, while window-like openings from the second story of the towers, looking out upon the roof of the connecting one-story structure, formed the only mode of exit from the fortress, if such it was. An inhabitant of one of the central apartments of this building, wishing to emerge to daylight and pure atmosphere, must have been compelled to pass through the bed-rooms and kitchens of all his fellow-tenants upon one side into the tower; then to climb up through the ceiling to the second story of the tower, swing himself by a wooden bar which still remains in place, out of one of the windows upon the roof of his dwelling, and thence pass by a ladder down to the floor of the cave—the "street" of the village. If his duty or pleasure led him to a greater distance, he still had the perilous journey before him down the rocky ladder, 300 feet to the bottom of the cañon.

Many interesting architectural designs were noted by the explorers, which can not be described here. No evidence of the use or knowledge of metals was found; stone implements fashioned all the materials out of which the structure was built, of which fact the rough but careful chiseling of the stone gave abundant evidence. Cross-pieces were laid upon the joists for the flooring of the towers, and upon these pieces twigs about the diameter of a man's finger were arranged side by side, but in series which formed a curious mosaic of angles and squares. In the larger division of the cave, and in the smaller division, one of the curious circular structures which might have been the places of worship, or perhaps of amusement, of the cave-dwellers, was found.

The structures are common enough in that section of the country, but these were different in many respects from any before examined by the members of the party, and especially different in their interior ornamentation, which was quite elaborate. In one of them a wide band, laid on in bright, durable colors, ran entirely around the structure, resembling a Greek fret, with narrower bands above and below and with the interior spaces filled with curious artistic designs, the meaning of which none of the party could guess. Evidence of the long use of these places for some purpose was found in the fact that some seventy or eighty different thin layers of mud had been plastered upon the interior, each having in its time borne its own ornamentation in colors. The roofs of the buildings were gone, and the floors were covered with debris.

It was at this village that the discovery of skeletons was made. J. Stanley Brown, who accompanied Col. Stevenson, was one morning climbing over a portion of the ruins which had not before been visited, and observed some small round poles projecting from the face of the bluff, to which fact he called attention. By scraping away the debris, human skulls were reached, and further efforts disclosed entire skeletons. A regular burial-place of the ancients had here been broken into; two complete skeletons, with parts of two others, were found. Great care had evidently been taken to place the bodies away in the manner best calculated to insure their preservation. The place of their interment was in shape like a large oval baking oven, and the desiccated remains, in sitting posture, with knees and chin touching, had been placed within. The contents of the tomb were carefully exhumed and are now on their road to the museum. Hair of a brownish hue, which may, however, have been black at the time of burial, is still found clinging to the skulls; while the shriveled flesh and skin, as hard as stone, remains upon some of the lower limbs.

Another village in this cañon of equal extent and similarly situated, though in a more advanced stage of ruin, was visited, and some exceedingly interesting discoveries were made. Among the *debris* of the fallen building sandals, finely woven, but resembling nothing with which the present occupants of this Territory are familiar, were found, as also were portions of matting and of garments made from the fiber of the yucca. Evidences of the great antiquity of some of these ruins are mixed with those of later occupancy in a manner most confusing to the archæologist. The Indian guide, George, in reply to an inquiry upon the subject, said that the Navajo tradition went back twelve times the length of the life of their oldest chief, now eighty years of age, and that the ruins existed unoccupied then. This carries one back about 1,000 years, but the evidence is hardly reliable.—*N. Y. Tribune.*

THE MOA AT HOME.

EDWIN E. HOWELL.

Every one who has written anything about New Zealand for the past thirty or forty years, whether about its inhabitants, its archæology, its natural history or its geology, has had much to tell us about the great wingless birds that once inhabited that group of islands. From this great mass of material we have endeavored to sift out the leading and most important facts and present them to the readers of the *Bulletin* in a brief summary.

The Rev. Richard Taylor, F. G. S., thinks he was the first discoverer of the Moa (the name given to all these great fossil birds). While journeying to Poverty Bay, in the early part of 1839, he found the bone of a Moa near the East Cape, which the natives told him was the bone of a large bird which they called Tarepo, and which lived on the top of Hikurangi, the highest mountain on the east coast. He found later that the natives of the west coast called the bones Moa, and were entirely ignorant of the name Tarepo.

It seems probable, however, that to the Rev. W. Colenso, F. G. S., belongs the honor of first discovery of the Moa, as he was the first, also, to investigate the nature of the fossil remains and determine the struthious affinities of the birds to which the bones belonged. In 1842 he wrote: "During the summer of 1838 I accompanied the Rev. W. Williams on a visit to the tribes inhabiting the East Cape district. While at Waiapu I heard from the natives of a certain monstrous animal, while some said it was a bird, and others a person. All agreed that it was called a Moa; that in general appearance it somewhat resembled an immense domestic cock, with the difference, however, of its having a 'face like a man's;' that it lived on air, and that it was attended or guarded by two immense Tuataras, who Argus-like, kept incessant watch while the Moa slept. Also, that if any one ventured to approach the dwelling of this wonderful creature he would be invariably trampled on and killed by it. A mountain named Wakapunaki, at least eighty miles distant, in a southerly direction, was spoken of as the residence of this creature; here, however, only one existed, which it was generally contended, was the sole survivor of the Moa race. Yet they could not assign any possible reason why it should have become all but extinct. While, however, the existence of the Moa was universally believed (in fact to dare to doubt of such a being amounted, in the native estimation, to a very high crime), no one person could be found who had ever seen it. Many of the natives, however, had from time to time seen very large bones, larger, from their account, than those of an ox; these bones they cut up into small pieces for the purpose of fastening to their fish hooks as a lure, instead of the Haliotis shell."

Other Europeans have been told this same myth, and other high mountains have been designated as the dwelling place of this strange creature. It is hardly necessary to add, however, that subsequent explorations have failed to reveal the hiding place of "the last Moa," and that we owe our entire knowledge of the bird to the study of its fossil remains. These have been found in many places and under varying conditions.

According to Dr. Haast, "the oldest beds containing Moa bones, are proved to belong to the great glacier period, where they occur in morainic accumulations and silt beds, as well as in fluviatile deposits, formed by rivers having issued from the terminal face of gigantic glaciers during that period. Here they have been traced as low as 100 feet below the surface. In the loess deposits they are also of frequent occurrence, where their existence has been proved to a depth of more than fifty feet. Advancing to the quaternary period, Moa bones are found in turbary deposits or in silt or loess on the plains or lower hills, in caves and in fissures of rocks, in fact, everywhere where favorable conditions for their preservation prevailed.

"From the observations we were thus able to make the conclusion has been forced upon us that these gigantic birds must have been able to sustain life over a long period, because the same species which occur in the lower lacustrine and fluviatile deposits are again found in the bogs and swamps, in the fissures of rocks, and in the kitchen middens of the Moa-hunting race, which latter evidently marks the end of the Dinornis age."

Dr. Hector mentions heaps of bones with stone implements, on the top of Corrio Mountains (South Island), 5,000 feet above the sea level.

Mr. B. S. Booth, (Transactions of New Zealand Institute, 1874), gives a very interesting description of a Moa swamp at Hamilton.

Mr. Booth says: "The surface lagoon, before being disturbed, was rather higher than the surrounding surface, and consisted of from one to two feet of black peat mixed with a blackish silt which rested on and was mixed with the bones to the very bottom " Below the bones there was one foot of a fine whitish, very soft, and somewhat elastic clay. "The bones were deposited principally in the northeast part of the lagoon, in a space exactly the shape of a half moon, forty feet from point to point, and eighteen feet across the center, and varying from two to four feet deep."

He estimates that nearly seven tons of bones were taken out of this space, most of which were badly decomposed, and that the number of individual birds could not have been less than 400. The bones "lay in every imaginable complication of tangle," with "no bone on top."

"A great quantity of quartz gravel and smooth pebbles occurred among the bones, and in the shallowest parts of the deposit, under pelves or breast bones which had not been disturbed, they lay in bunches. "There was no gravel in the lagoon except amongst the bones, and no small gutter or water course could be found by which it might have come in."

The only explanation, apparently, which can be given for the presence of the pebbles is that they were brought there in the gizzards of the birds This theory is supported by numerous instances where similar pebbles have been found connected with Moa bones in such a way as to admit of no other explanation than that they were connected with the birds. The bones on the top were in a much better state of preservation than those at the bottom. There were a large number of bones that had been broken and healed. "A disease of the foot appeared to have been very prevalent amongst them, as a great number of the joints presented unmistakable indications of rot, so much so that some of the toe joints had even grown together."

There were no bones of young birds near the top, and no fragments of eggs were found anywhere in the deposit, although careful search was made for them.

After stating these and other facts, Mr. Booth goes on to discuss the different theories to account for this wonderful accumulation of bones. He shows that they could not have been deposited by running water, neither could the Moas have been surrounded and driven in there in such great numbers by sweeping fires, the birds could not have been bogged, certainly not the latter ones, with two or three feet of solid bones under them. And that the bones were not thrown there by savages seems proven by the fact that not a trace of their work could be found, not a hacked or scratched bone nor an implement or trinket of any kind.

Mr. Booth thinks that a true explanation of the deposit explains the extinction of the Moa, at least in that section, and that that time was much earlier than the date generally accepted, and was caused by the gradual lowering of the temperature until the warmth of the earth and air was not sufficient to hatch the eggs of these birds, from which time they gradually declined, until they finally all disappeared. "When the frost and snow of winter began to set in, though far milder than now, it would have distressed the Moa, as on account of its great size it could not find shelter like smaller birds, hence it would select places where it found the most warmth.

The spring water in the bone pit being of the same temperature as the earth, and far above freezing point (in fact, it may have been a thermal spring), when all around the bird could not put down his foot without being bitten with frost, or without placing it in snow and ice, what would be more natural for them than to step into this comparatively warm water, which, to some extent, would relieve their suffering from cold in their lower extremities. Thus, the period when frost and snow began to set in I place as the commencement of the deposit of bones in this pit. The accumulation would have been very gradual, perhaps for centuries, and the periodical deposits would only have increased at the same rate as the frost and snow. This process continuing, until not even in the most favored places would their eggs hatch, and the last of their race were, therefore doomed to annihilation, a period would arrive which must have been with the poor birds a time of indescribable suffering. Thus afflicted with pain, famishing with hunger (as whatever their food was it lay deep under the snow-mantle of the earth), and finding cruel nature arrayed against them, pinching their bodies with piercing winds, from which they had no shelter, and cutting their feet with ice and frost, were it only as an alleviation of pain when dying, I can see nothing more natural than for them to have plunged into this spring. The water being of the same temperature as the earth, would feel quite warm to them, and there being no inducement for them to get out, as their food was cut off, they would settle in deeper and deeper, and remain till numbness and hunger put an end to their suffering.

Hence I account for the bones being soundest on the top, as they would have been deposited so much later. Hence, also, I account for there being no bones of young birds on top, as it was long after incubation ceased that the old family was gathered to its resting place. Hence I account for the absence of egg-shells, as these deposits only took place in the winter season, which was never the breeding season with the birds. And by the trampling round of the birds when in the spring, I account for the equal distribution generally of the gravel amongst the bones; the trampling being the disturbing cause from which alone some bunches of gravel from the gizzards escaped by being covered with a breast bone or pelvis.

Mr. Booth further adds: "If it is asked, why are there no bones in the surrounding lagoons? my answer is, that as they are all (as far as I have examined)surface lagoons, they would have been frozen over when the cold drove the birds into the spring water which never froze."

This theory of Mr. Booth has much to recommend it, and we agree with him that the theory of cold seems more plausible to account for the heaps of bones at Lake Wakatipu, described by Dr. Hector, than the theory of fire which the Doctor advances. The Moas would certainly have been quite as likely to have sought shelter under a precipitous ledge of rocks to protect them from cold snow storms as from sweeping fires, and would have been much more likely to have reached such shelter. Notwithstanding, they perished in clusters. This occurring periodically, perhaps for many years, would naturally account for the many distinct skeleton heaps found by the Doctor in that place.

Many many pages have been written in relation to the time the Moa became extinct. That it was contemporary with man, and owes its final extinction to him, is a fact accepted by all, but whether the old Moa hunters were the ancestors of the present New Zealanders or, if not, whether the ancestors of the Maories hunted the Moa at all, or inhabited the islands before the Moas were all gone, is still a disputed question, with competent observers on each side.

As bearing on the time when the Moa became extinct in that part of the South Island, we quote again from Mr. Booth's paper, "I find below a certain level that would leave the whole Maniototo plains under water, there are no Moa bones to be found, with the exception of about the mouths of the burns coming in from the hills, where the bones have been brought down by freshets." * * * "Now what does this fact point to? The only answer I can give is that the Moa was extinct in this locality when the whole Maniototo plains, from the level spoken of, were yet under water." These statements by Mr. Booth agree well with the position maintained so stoutly by Dr. Haast, previously quoted, who is the strongest and most prominent defender of the theory of the early extinction of the Moa throughout the whole of New Zealand. He claims that it became extinct before the occupation of the islands by the present Maori race, and gives us a great deal of geological data in support of this position. At Moa-bone Point cave he found a stratum "three or four inches in thickness, mostly consisting of refuse matter from human occupation, and of ashes. It was especially in some localities, as for instance near the entrance of the cave, replete with kitchen middens of the Moa-hunters," among which were found polished and unpolished stone implements, a few small tools made of bone, personal ornaments, fire sticks, etc. "And now as it were at once, the Moa-hunters disappeared from the scene," and the cave remained uninhabited for a considerable space of time, as shown by "the clear line of demarcation between that layer and the shell bed above it, in which no Moa bones were found," and by the deposit of blown sand between the two, about a foot thick at the entrance of the cave, and gradually thinning out as it advanced toward the interior. Below this line, Moa bones and fragments of egg-shells were very abundant, and with them were the bones of seals and a few other animals. Above this line, which doubtless represents a long interval of time, there were no remains of the Moa to be found, and the deposits showed the cave to have been occupied for a long period by a race who lived mostly upon shell-fish, a food which was apparently used very little by the Moa hunters. Dr. Haast and others give us the details with reference to a number of other localities which tell the same story, viz: That the Moa and Moa-hunters flourished and passed away, and that another race, with different habits, *after a long interval*, occupied the same places; still after all it may have been the same Moa-hunting race returned, after long wanderings, to their former habitat. There being no more Moas to eat, they feasted on shell-fish.

The Reverends W. Colenso and J. W. Stack, gentlemen versed in Maori lore, have reached nearly the same conclusions as Dr. Haast, from entirely different data. According to these gentlemen, the old traditions, songs, and poetry of the New Zealanders furnish no evidence that they knew aught of the Dinornis. The word Moa occurs but seldom in their songs and legends, and has various other meanings besides that of a large bird, and it was sometimes used figuratively in allusion to the myth that the Moa lived on air. A love-sick maiden who mourned her lover and would not eat was christened Hinemoa (the young lady who lived on air).

Mr. Colenso has evidently given this whole subject a great deal of time and careful study. In his paper, written in 1842, previously referred to, he says: "From native tradition we gain nothing to aid us in our inquiries after the probable age in which this animal lived; for although the New Zealander abounds in traditionary lore, both natural and supernatural, he appears to be totally ignorant of anything concerning the Moa, save the fabulous stories already referred to," and thinks it certain that this would not be the case if such an animal lived within the times of the present race, but in an exhaustive paper published in the Transactions of the New Zealand Institute, three years ago, he sums up his final conclusions thus:

1. "That the bird *Moa* (some of those of its genera and species) was really known to the ancient Maori.

2. "That such happened very long ago, in almost prehistorical times: long *before* the beginning of their genealogical descents of tribes, which, as we know extended back for more than twenty-five generations.

3. "That this conclusion is the only logical deduction from all that I have been able to gather; whether myth, legend, proverb, song, or the etymological rendering of proper names of places, persons, etc."

In regard to the numerous accounts published of Maori descriptions of the Moa, he says: "From January, 1838, (when I first heard of the *Moa*), down to 1842, and later, no man could possibly do more than I did in my quest after it, and no man could have had better opportunities." * * * "And I again assert, that it was through me that the Maoris generally got to know of the *Moa* having been a *real* (or common) *bird*. I showed them repeatedly, at the station, the plates in Rees' cyclopædia, containing all the *Struthious* birds, and told them of their habits, etc., and of the opinion of the extinct *Moa;* that information was carried almost everywhere (with, no doubt, many additions), and that information, together with simple leading questions on the part of the inquirers (especially when put by the governor of the colony, or any superior,—which, according to Maori etiquette, would not be negatived even if wrong) and, also, with but a small knowledge of the Maori tongue on the part of the Europeans, fully explains all *to me*, and that very satisfactorily."

Mr. Colenso remarks that the condition of things forty years ago, or before the colony was established, was very different from what it is now, and says his inquiries "were carried everywhere throughout the length and breadth of the North Island; they were the constant theme of conversation among the Maoris, who then had little of a novel nature to talk over,—increased, from the fact of rewards being offered for bones, feathers (if any) and for information."

It requires but little knowledge of the workings of the savage mind to see the force of these arguments.

Notwithstanding, many competent observers believe that the Moa became extinct in very recent times, Dr. Hector, Director of the New Zealand Geological Survey, among the number. Mr. Walter Mantell (son of the eminent geologist) was the first explorer of the artificial Moa beds, soon after the settlement of the colony, and advanced the idea that Moas existed to very recent times. And Mr. Mantell seems very certain that Maoris in the south at the date of his early explorations, in 1846, were well acquainted with the former existence of the Moas and the circumstances which led to their extinction. He also thinks that cannibalism prevailed, but in the North Island only, at the time the Moa was used for food.

Several bones of the Moa, with the dried ligaments still attached, have been found, together with portions of the skin and a few feathers; although Dr. Haast claims that the conditions were exceptionally favorable for their long preservation, others contend that they cannot be very many years old.

Capt. Hatton thought that the weight of evidence goes to show that the remains from the Earnsclugh cave "are not very old, and that probably they do not date further back than the commencement of the present century," but in speaking of the bones with dried skin from the Knobby Ranges, found more recently (1874) in a crevice among the rocks, he says: "The extraordinary juxtaposition of decayed and lichen-covered bones with well preserved skin and flesh seems to me to point to some peculiarity in the atmosphere which enabled flesh to resist decay when shaded from the rays of the Sun, and by no means to prove that the bird to which this neck and flesh belonged lived at a later date than those whose bones we now find buried under the soil."

D. W. Murrison thinks that if what Dr. Haast and Mr. Colenso say is true for the North Island, it certainly cannot be made to apply to the South Island, and says, "I think from the evidence we are in possession of, there is every reason to suppose that the Dinornis has existed within the last hundred years." And thus the discussion is kept up as to the time when the Moa became extinct.

As a sample of the traditions which Mr. Colenso explains away, we quote from Mr. J. W. Hamilton (Trans. N. Z. Inst., 1874): "In 1844, at Wellington, I was present, as Governor Fitzroy's private secretary, at a conversation held with a very old Maori, who asserted that he had seen Capt. Cook. This Maori, so far as my memory now serves me, I should guess was seventy years old, at all events he was brought forward as the oldest of his people then residing about Port Nicholson. Being asked had he ever seen a Moa, he replied, 'Yes, he had seen the last one that had been heard of,' and on being questioned described it as a very large bird with a neck like that of a horse." Mr. H. further says: "In 1844, and for many years later, it was believed by our people for a certainty that the Moa was still to be found alive in the South Island, of which very little was then known," and that stories were currently reported of one or two old settlers in the south about Otago and Foveaux Straits who had actually eaten Moa flesh.

For the details of the osteology of these birds we must refer our readers to Prof. Richard Owen's description published in the Transactions of the Zoölogical Society of London, begun in November, 1839. Prof. Owen at first made two genera, *Dinornis* and *Palapteryx*, but afterward discarded the latter genus and referred all the different species to the genus *Dinornis*.

In 1875, Dr. Haast, Director of the Canterbury Museum, proposed two families, with two genera in each family, thus: Family *Dinornithidæ:* (a) genus *Dinornis;* (b) genus *Meionornis*, and family *Palapterygidæ:* (a) genus *Palapteryx;* (b) genus *Euryapteryx.*

Under these four genera, as proposed by Dr. Haast, there have been about twenty species described. These species are founded mainly on the size and proportion of the bones—particularly the bones of the leg, and it is not improbable that as more careful comparisons are made of larger series of bones, the number of species will be reduced. It is an interesting fact that Cook's Straits, which separates the two islands, "seems to have been an effectual bar to any migration from one island to the other," as the same species are not found on both islands. Prof. Owen infers from the beak of the *Dinornis*, "formed after the model of the adze or pick-axe," and "the robust proportions of the cervical vertebræ, especially of their spinous processes," that it had "a more laborious task than the mere plucking of seeds, fruit, or herbage," and that "the beak was associated with the feet in the labor of dislodging the farinaceous roots of the ferns that grow in characteristic abundance in New Zealand."

Portions of dried skin and a few feathers of the *Moa*, as already stated, have been found; the color of the barbs of the feathers are chestnut red and the rounded portion of the tip is white. These feathers, according to Capt. Hatton, show the bird to have been more nearly allied to the American Rhea and Emu than to any of the struthious birds of the old world.

Fragments of *Moa* eggs are quite numerous, particularly in the kitchen middens of the Moa-hunters, and a few nearly or quite perfect specimens have been found. Dr. Hector describes one 8.9x6.1 inches in diameter, which contained the remains of an embryonic chick. Another specimen measured 9.5 inches long.

These are certainly monstrous eggs, and yet the fossil bird of Madagascar (*Aepiornis*), although a smaller bird than the great *Dinornis*, laid a much larger egg, two specimens of which are in the Garden of Plants, Paris, and measure respectively 13x9 and 12x10 inches in diameter. And yet, after all, neither of these birds laid as large an egg in comparison to its size as does the *Apteryx* of New Zealand at the present day.

And now as a fitting close to this brief summary, we quote from Prof. Owen's first paper on the *Dinornis*: "The extraordinary number of wingless birds, and the vast stature of some of the species peculiar to New Zealand and which have finally become extinct in that small tract of dry land, suggest it to be the remnant of a larger tract or continent over which the singular struthious Fauna family ranged. One might almost be disposed to regard New Zealand as one end of a mighty wave of the unstable and ever shifting crust of the earth, of which the opposite end, after having been long submerged, has again risen with its accumulated deposits in North America showing us in the Connecticut sandstones of the Permian (Trias) period the foot-prints of the gigantic birds which trod its surface before it sank; and to surmise that the intermediate body of the land-wave, along which the *Dinornis* may have traveled to New Zealand, has progressively subsided, and now lies beneath the Pacific Ocean."—*Natural Science Bulletin.*

BOTANY.

SEEDS: THEIR PRESERVATION AND GERMINATION.

REV. L. J. TEMPLIN.

In all the realm of nature there are few if any other objects that conceal so many wonders or around which cluster so many interests as that of a perfect, living seed. Though apparently possessing no more life than a grain of sand or a small gravel, yet hidden within that lifeless exterior, and folded away in those simple cerements, is a living germ, possessed of latent powers and energies, that, when subjected to favorable conditions, and animated by the vital principle, will develop a living, growing vegetable organism. Every seed is the product of a plant and is the result of the fertilizing influence of the pollen on the ovules of a flower. The parent plant has not only given life to each seed, but it has so stamped on it the parent's nature and characteristics that the resulting plant must resemble its parent in all essential particulars.

It is true that each plant may vary slightly from its parents, in those qualities that are not essential to specific existence, but these variations are always within narrow limits with a general tendency to revert back to the parental form.

I am aware that many able scholars and noted naturalists hold the opinion that these variations may go on in a particular line until it results in the production of a new species; but that any species has ever been produced by such variation the proof is not forthcoming, although it has been "sought for carefully and (almost) with tears" by hundreds of the most careful observers and expert investigators of the age. A seed is strictly the product of nature. It is inimitable by art. With all his knowledge of the elements and his mastery over the forces of nature, man cannot construct a seed. Men who seem ready to accept the theory that living organisms may arise, spontaneously, from lifeless matter, cannot, with all the materials of nature in their possession and all her forces at their command, in a single case produce life from non-living matter. They may manipulate, organize, and combine to the utmost of their skill, yet in the absence of the living principle, which comes alone from a vital connection with a previously living organism, no life will or can appear. Nothing short of a Divine Giver of life could have originated the seed. The office of the seed seems to be two-fold; first to facilitate the dispersion of plants by the ease with which they may be conveyed from one place to another; second, to perpetuate the species by the number of their production and the facilities their forms offer for preservation from one season to another.

Seeds vary almost infinitely in their form and construction as well as in the constituent elements of which they are composed. A careful examination, however, will show that every seed contains a living germ or embryo, which is really a plant in miniature, in or around which is stored up a supply of food for the nutriment of the young plant till it shall have attained age and strength to secure this from the soil and air. The materials thus stored up consist of starch, gluten, albumen, oils, gums, and various other substances. The kernel of most seeds is composed largely of starch and the albuminous compounds. It differs, however, in different plants, being oleaginous in the poppy, castor bean and peanut; mucilaginous in the flax, fleshy in the pæony and barberry, corneous or horny in the coffee, and having the appearance and consistence of ivory in the ivory-palm. The seeds of the cereal grains and of grasses are chiefly composed of starch. The wisdom and goodness of the Creator are strikingly shown in the selection of this material to compose the principal part of the seeds of that class of plants upon which not only the well being but the very existence of man and the higher animals depend. Starch is not only a very important article of food but it is a substance not readily affected by cold or moisture, hence seeds composed of this material will endure great exposure without injury to their vitality. *Germination*, or the awakening of the plant germ to active life is affected, and, to a considerable extent, controlled by several external influences. The plant food stored up in the seed cannot be appropriated to the use of the germ until reduced to a liquid condition. Or in other words the plant cannot digest solid food. But it must not only be dissolved but it must be conveyed from those parts of the seed where it is stored to the germ before it can be used by that or for its benefit. For these purposes water is essential to the germinating seed. But there is a limit to the amount of water that is beneficial to the seed at this time.

Aquatic plants grow very well in the water, and many seeds of land plants will germinate when immersed in water, but they will not make a healthy growth in the presence of so much water as to exclude the air. For most seeds a moist but not wet soil is most conducive to a healthful germination and vigorous growth.

The presence of atmospheric air is also essential to the proper germination of seed. This will be better understood when we consider the changes that take place in the seed during the process of germination. A growing plant in the presence of air and sunlight absorbs, through its leaves, carbonic acid from the air; this is decomposed in the plant and the oxygen is expelled while the carbon is employed in building up the plant structure. This process can take place only in the presence of sunlight. The reverse of this takes place in the process of germination, which is generally most readily performed in the dark. During this process the seed absorbs oxygen which, combining with a portion of the carbon of the seed, forms carbonic acid or carbonic anhydride, as the chemists now call it, which is given off to the surrounding air, thus reducing the substance of the seed. The total loss in this process, according to Boussingault, was, in an experiment of his as follows :

	TOTAL WEIGHT.
Seeds	8.626
Plant	4.429
Difference	4.097

thus showing a loss of more than one-half of the solid substance of the seed during germination. . The process by which this matter disappears from the seed is a real combustion and results in the elevation of the temperature of the seed to a greater or less degree.

The necessity of the presence of air to the germinating seed leads to the necessary conclusion that if seeds are buried so deeply in soil, or so surrounded by water as to exclude the air, germination cannot take place. The seeds may rot but they cannot grow.

This leads to a consideration of the question as to the depth at which seeds should be planted. This will be found to depend upon a variety of circumstances. It is evident that a small seed should not be planted as deeply as a large one. The depth should also vary with the climate and the soil. In a dry climate or a porous soil the seeds must be buried to a greater depth than if the reverse be true.

This is necessary that the requisite amount of moisture may be secured at the same time the aridity or porosity of the soil is more permeable to air, thus insuring a supply of oxygen to the germinating seed at a greater depth than if the soil were compact or saturated. In some very dry countries it is necessary to bury seeds at a much greater depth than would be safe under other conditions. Thus it is said that the Indians on some of the dry plains of Colorado plant their corn ten to twelve inches deep, by this means securing sufficient moisture to insure its germination and growth, which it would not have if planted at a much less depth. As a general rule, in ordinary agricultural soil seeds may be planted to a depth of about five times their diameter with fair promise of success, varying from this according to the condition of the soil as to compactness and moisture.

The limits of certain degrees of temperature are also essential to the healthy germination of seed. The seeds of some arctic and alpine plants are known to germinate at the temperature of melting ice, while some of a tropical habitat require a temperature equal to that of our hottest days to awaken their germs into active life. Between these extremes seeds are found germinating at every variation and degree of temperature. For all species of seeds there are certain limits above or below which they will not germinate. These limits vary, of course, with the different kinds of seeds.

The following table, given by Johnson, (*How Crops Grow*, p. 133,) shows the extreme temperatures between which some of our most common agricultural plants germinate, and also the degree at which the process takes place most rapidly:

	LOWEST.	HIGHEST.	MOST RAPID.
Wheat	41 ° F.	104° F.	84° F.
Barley	41	104	84
Pea	44.5	102	84
Maize	48	115	93
Scarlet Bean	49	111	73
Squash	54	115	93

Sachs, from extensive experiments with agricultural seeds, concludes that the lowest temperatures at which they will germinate range from 40° to 55°, and the highest from 102° to 116°.

Göppert found none to germinate below 39°. DeCandolle sprouted mustard (*Sinapis alba*) at less than 32°, and thinks it would have germinated at a still lower temperature had it been possible to keep water around the seed in a liquid form at a temperature of 31.1° or 30.2°.

Mustard germinated in seventeen days at the lowest degree at which water could be retained in liquid form. The seeds of this plant germinated at

35.6° in fifteen days.	39.2° in nine days.
54° to 68° in two days.	69.8° in one day.

At 77° in a little over one day; at 82.4° only a small portion of the seeds came up after three days; at 104° none.

It is said the cocoanut will not germinate readily under about 120° Germination is influenced not only by the degree of heat but also by the uniformity of the temperature.

In the investigation of the relation of heat to the phenomena of plant-growth Köppen has reached the conclusion that a uniform temperature is more favorable to plant-growth than a variable one even though the variable one be a higher one. He concludes that any variation in the temperature is prejudicial to the growth of the germ, and that a low but uniform temperature will result in a more rapid germination than a higher one if subject to variation. A uniform spring temperature with a cloudy sky is, in the opinion of this authority, more conducive to rapid development of vegetation than an alternation of hot days and cool nights though the average temperature be the same. Sachs is of the opinion that the degree of temperature at which germination takes place has an important influence on the relative development of the different parts of the plant. A low temperature, according to this observer, is unfavorable to the development of new roots and leaves, but the organs already formed in the embryo are greatly extended; but under the influence of a high temperature new roots, leaves and buds are rapidly formed even in advance of the complete development of those already existing in the embryo.

Though not fully understood in all its bearings the question of temperature is recognized as exerting a capital influence on the phenomena of germination. A very important influence also is exerted on germination by the presence of light.

In former times it was believed that this would not take place in the presence of direct sunlight. But this view is now generally rejected, as it is well known that seeds frequently germinate while lying on the surface of the ground and exposed to the full light of the Sun. But the probability is that even in this case the germination principally takes place in the night, and that this does not disprove the general theory that direct sunlight is detrimental to change. The change that takes place in the substance of the seed during this process seems to demand such an explanation. But while there is some doubt on this subject, there is none whatever that certain rays of light do have a very important influence.

About forty years ago Robert Hunt made extensive experiments to determine the influence of light on the germination and growth of plants. The conclusions to which he was led so far as germination was concerned are:

1. Light prevents the germination of seeds.
2. Actinic, or chemical rays quicken germination.

These views have been called in question by several able investigators. But this seems to have grown out of the fact that sufficient attention has not been given to the distinction between germination proper and plant-growth. But this distinction is of capital importance as these different processes involve exactly opposite principles and are attended and followed by entirely different phenomena.

In germination oxygen is imbibed and carbonic acid exhaled, while in plant-growth carbonic acid is absorbed and oxygen exhaled. The conclusion at which we arrive is that the chemical rays penetrating, as they do, the upper stratum of the soil, while the luminous and calorific rays are cut off, determine the germination of the seed. As corroborative of the correctness of this view, as well as of the wisdom of the adaptation of the laws of light to the demands of the vegetable world, it is pertinent to remark that during the spring, when germination generally takes place, the actinic rays predominate, and during the summer, when wood-growth is the chief desideratum, the luminous rays that exert the most potent influence in the development of this part of the plant, are in excess of the others, while during the latter part of the season there is a preponderance of the calorific rays which exert a capital influence in determining the physiological processes of flowering and fructification.

It is a well established fact that electricity exerts a very marked influence in accelerating the growth of plants. In 1782 Dr. Marat found electrified seeds germinated many days sooner than those not so treated but otherwise subjected to the same conditions. These conclusions have been verified by many experimenters from that time on. It has even been found that seed that from age would not grow at all under ordinary conditions, after being subjected to electricity for some hours grew vigorously. Considerable light was thrown on this subject by Pouillet, who in 1825, proved that in the process of germination a notable quantity of electricity is disengaged. It is claimed by some experimenters that an electrified wire buried beneath growing plants or even stretched in the air above them exerts a very strong influence in accelerating their growth. I come now, in the last place, to consider the question: How long will seeds under any circumstances retain their germinative power? Long experience has shown that under ordinary conditions the various farm and garden seeds will retain their vitality from one to eight years. Regarding this there is no difference of opinion. But, from the assertion that, under extraordinary circumstances seeds have been known to retain their power of germination for scores of years and even centuries, there is strong dissent. Among the most noted opposers of this theory is Mr. Thomas Meehan, editor of the *Gardener's Monthly*, and one of the ablest vegetable physiologists of the age. He says, (*G. M.*, Vol. 17, pp. 212,) in speaking of the notion "that seeds usually with a limited vitality will live for an indefinite period when in the ground, or 'Egyptian tomb,'" that "There is no good evidence of this." Again, speaking of the reported growth of poppy seed that had lain dormant in a Grecian mine 2000 years old, he remarks, (*G. M.*, Vol. 18, p. 344): "We know of *no* evidence satisfactory to us, that any seeds have been found vital under the extraordinary circumstances claimed. The whole theory of great vitality through long periods when buried in the earth, is at best founded on nothing but shrewd guesses, and in the main on the evidence of persons of no more importance in a scientific point of view than those who believe that wheat is transformed into chess." But at another time (*G. M.*, Vol. 12, p. 173,) he admits that he had formerly held the opinion that Magnolia seeds would never germinate after they had become dry. But he found this opinion to be erroneous and gives facts to disprove it as follows: "Once we found a package which had been thrust under a rafter in a tool shed in spring, which grew as well as any. More recently, Mrs. Col. Wilder found a package of *Magnolia soulangeana* seed in Mr. Wilder's wardrobe, which had been there between two and three years, and which on sowing, produced a plant for every seed."

If everybody had been mistaken regarding the longevity of these seeds, may not those be in error who refuse to admit the extraordinary vitality claimed for some seeds under special circumstances. Let us inquire somewhat concerning this question. Mr. D. C. Eaton, of Boston, in a "Yale Agricultural Lecture" states that "Cucumber seeds have been kept seventeen years; corn, thirty; French beans, thirty-three, and from one bag of seeds the Jardin des Plantes was supplied with sensitive plants for sixty years.

The *Gardener's Monthly*, (Vol. 23, p. 24,) gives us the following example of vitality: "Mr. LeRoy, of Columbia College, looking over, in the winter of 1879–80, the plants of Wilkes' Exploring Expedition, collected in Patagonia, between 1838–42, found three seeds of a gourd, which were planted in his garden in the spring of 1880. Two of the three grew and bore fruit the same season. This fixes forty years of vital power for these seeds."

But if these seeds had been perfectly protected from air and moisture why might not this vitality have extended to centuries just as well as it did to decades? According to Johnson, (*How Crops Grow*, p. 305,) Girardin sprouted peas that were over a century old. It is said that Grimstone with great pains raised peas from a seed taken from a sealed vase found in the sarcophagus of an Egyptian mummy, presented to the British Museum by Sir G. Wilkinson, and estimated to be near 3,000 years old." And again, "Count Sternberg and others are said to have succeeded in germinating wheat taken from an Egyptian mummy, but only after having soaked it in oil."

After mentioning some failures to revive seeds that had lain long dormant, Mr. Johnson adds: "The fact appears to be that the circumstances under which the seed is kept greatly influences the duration of its vitality." The following item I find in my scrap-book, but the authority for the statements made is lost: "Seeds found with the coins of the Emperor Hadrian in an ancient barrow in England, and a heliotrope from a Roman tomb 1,500 years old and more, vegetated and grew vigorously. The same was the case with wheat, rose and clover seeds found with an Egyptian mummy, and Indian corn from a Peruvian mummy 1,200 years old." An anonymous writer gives an account of the draining of a bog on the estate of a gentleman in Scotland about the year 1820. The drain had to be cut through a ridge to the depth of forty feet. At the bottom of this and extending out under the bog was a stratum of sandy soil. In this were found buried acorns of the black oak species. These, on being brought up to the surface where they were subjected to the influence of light and warmth, germinated and grew.

Black oak logs had occasionally been found buried in the bogs in that region, but none had been known to exist on the estate in question for 300 years. Had these acorns been buried in some convulsion of nature, or during a change of land in that vicinity and lain for ages retaining their germinative power till accidentally thrown out to grow? Who can tell us? Or shall we take that easy method of avoiding all intellectual toil by discrediting the whole narrative.

The *Scientific American* is authority for the statement that, "In the course of late explorations in the ancient ruins of Egypt, General Anderson, an English traveler, found enclosed in a sarcophagus beside a mummy, a few dry peas, which he preserved carefully and, on his return to Great Britain, planted in the rich soil of the Island of Guernsey. The seed germinated, and soon two little plants appeared, from which at maturity sufficient peas were gathered to plant quite a large tract of ground in the following season."

I close by simply asking, are all these statements and authorities to be set aside only because they do not agree with our opinions? or shall we accept them as facts that can be overthrown only by positive disproof?

PROFESSOR MEEHAN ON EVOLUTION.

Professor Thomas Meehan, in response to the invitation extended him at the Cincinnati Meeting to address the Biological Section on this occasion spoke on "Variations of Nature, and Their Bearing on the Doctrine of Evolution and the Theory of Natural Selection." He premised that the Doctrine of Natural Selection as propounded by Mr. Darwin could not be controverted in so far as the continual dropping out of the intermediate forms was concerned, which left the extremes without connections and gave us the idea of distinct species. He thought there were some weaknesses in Mr. Darwin's method of advocating his views, but these removed only left Mr. Darwin's position stronger than he himself perceived. He then proceeded to show that variations in nature were much greater than Mr. Darwin evidently had knowledge of. The popular idea that no two leaves on a tree were exactly alike in every respect was shown to be literally true. Many illustrations were given and specimens exhibited showing the great variations in seedlings of the same species, often from the same seed vessel; some from the latter would be regarded by any botanist who found them wild, as distinct species. A series of sixteen cones of *Pinus rigida* was exhibited, each from a separate tree, all growing within a circle of twenty miles, and the central links being taken away left nominal *Pinus serotina* at one end, and *Pinus rigida* at the other. Other species could be made by taking the interior series of forms. The speaker contended that variation was not a mere condition, but had to be accepted as a primary law of existence. As no two things have ever been produced exactly alike, so far as we know, the result must necessarily be a wide divergence in time, and, as we know that death is also a certainty to individuals, distinct forms must certainly ensue.

Heredity, as established by Mr. Darwin, was next reviewed, and shown to be established as a counterpoise to variation. It held variation in check, but was finally overpowered by this, the greater force. Sex was an attribute of heredity. Sex in flowers had no bearing on the future good of the race, and therefore crossing by insect agency or otherwise had no reference to the good of the race by aiding variation in the direction of change to suit environments. It rather brought back what Mr. Darwin would imagine a useful variation toward its starting point. A variation which had started from the centre of a circle, had to be cross-fertilized if at all from the centre from which it sprung, and the progeny was thus brought back toward its parents starting point.

The next point made was that variations had no relation to the good of the individual or race. Numerous cases were adduced to show that the forms which had prevailed had not the slightest physiological advantage over the forms displaced, and that those who argued to the contrary were reduced to the solitary argument that there must have been some advantage, or the species could not have survived. It must be so because it is, is an argument which has no place in researches such as we are engaged in now. The actions and behavior of both plants and animals were not for their own individual good. Their whole efforts were in the interest of their progeny—for posterity—for the future—for objects wholly unknown to the individual. Yet we found from the science of the past that all this self-sacrifice—pleasant as it was made to be to the individual,—and ignorant as these individuals were of what they were working for, all had resulted in present harmony. In the speaker's language "we and all organic things are the invited guests of nature. She makes our stay with her as pleasant as possible: but she ruthlessly dismisses us the moment we cease to serve her future purposes."

The laws by which destruction was brought about, were then considered, and the manner in which species were created by the aid of this destructive power discussed; and how, under the operation of the law of heredity, surviving forms found a temporary standing ground, until the greater law of variation again finally removed them.

Finally the speaker took up the objection that Mr. Darwin's views were destructive of Christianity and showed that they were in reality the strongest confirmation of Christianity's essential features. To his mind Christianity differed from all other systems of religion by insisting on the necessity of self-sacrifice. We have "to do the Father's will" regardless of all consequences to ourselves, as the condition of happiness, and the Great Teacher himself sealed these doctrines which shine from almost every page of the New Testament, by the Saviour offering up His own life. This is precisely what science, as he had endeavored to trace it, was now teaching. A wiser power than any science had as yet been able to fathom, was directing all things to some far away object, to us unknown; not for the individual benefit of anything, except in so far as it was in harmony with this power, holding all things together for good in spite of the seeming clashings of individual interest, and he was assured that the time would come when evolutionists and especially those who advocated the theory of natural selection, would come to be regarded as true Christianity's warmest friends.—*Naturalist's Monthly Bulletin.*

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, January 13, 1883.

The doctrine which attributes all the diseases that men and animals labor under, to the presence in their tissues of *infiniment petits* animals or vegetables, is not exactly known, though popularly ascribed to M. Pasteur. Indeed at one period M. Pasteur was hostile even to the doctrine. If the distinguished chemist has not had the honor of the conception of the original idea, he has in a remarkable manner, multiplied its applications, and rendered demonstrations evident to minds obstinately rebel. Pasteur has shown materially, what was demonstrated logically. This tiny animal or vegetable, called *microbe* by M. Sedillot, has enabled M. Pasteur to arrive at two practical conclusions. Firstly—that the microbes so far known to us, can be cultivated artificially in certain liquids. Secondly—by this artificial culture, the microbes can be attenuated in such a manner, that, introduced into the organism of large animals, they there determine either a malady very much less intense than that resulting from the natural contagion, or a simple modification which gives place only to some phenomena hardly appreciable, but which nevertheless preserves the animals from the natural malady which so ofter kills them.

This species of preservation is called vaccination, on account of its analogy with the vaccination of Jenner. It has proved efficacious in the case of the disease *charbon*, which attacks cattle and horses—the former especially, and *sang de rate* in sheep. With man the disease is designated malignant pustule.

These observations will serve to introduce a still further discovery made by M. Pasteur, in the case of the "red malady," or *rouget*, and which in the province of the Rhine, carries off 20,000 pigs yearly, and those of the white, the most valuable breed, especially. M. Pasteur has found the microbe of the disease; the parasite has the form of a figure (8), and resembled the same found in hen cholera; it is smaller and more difficult of detection, but its physiological properties are different; thus it exercises no action on poultry, but kills rabbits and sheep. The microbe artificially produced, when employed to inoculate pigs, induces the same symptoms as if the scourge had been spontaneously produced. When vaccinated with a benign pus specially prepared, the pigs were able to resist the the disease in its mortal form. However, it has been considered prudent to wait till spring for the results of additional experiment.

In the history of science, the spectacle has never been previously witnessed of a single individual making so many discoveries in a period so relatively short as Pasteur. He now gives us the results of his investigation into that terrible problem—hydrophobia. It is the malady which presents the most obstacles for inquiry. The saliva was the sole matter where the presence of the rabic virus was to be detected. But this saliva, inoculated either by bite, or injection direct into the cellular tissue, did not infallibly communicate the malady. Then even if the latter did show itself, the period of incubation could not be exactly determined. There were also other drawbacks. All these, however, were set at rest by a new and sure plan of action. Pasteur found that the central nervous system was the principal seat of rabic virus, and that it could be gathered there in a state of perfect purity; again, that this virus, taken from the surface of the brain by trepanation, if inoculated, communicated the disease surely and rapidly.

The symptoms of hydrophobia are variable, though proceeding from the same virus, and these variations depend on the points of the nervous system—the spinal marrow, or the brain, etc., where the disease may be localized and developed. The saliva rabical contains microbes along with the virus, either of which can produce death. The saliva of a man or a child, can be virulent, is contagious, and can kill by inoculation, from an excessive development of pus. The virus of an individual affected with hydrophobia is everywhere characterized by the same virulence, whether that virus be taken from the brain or the marrow, and so long as decomposition has not set in. Pasteur has conserved a brain pending three weeks with all its rabical virulence intact. Inoculating the surface of the brain or the blood with virus, produces hydrophobia in the course of six to ten days and invariably fatal.

Hydrophobia induced by the injection of the virus in the blood, produces not the same symptoms as the malady resulting from the direct bite of a mad dog, or inoculating the surface of the brain. In the first case, the spinal marrow is immediately attacked. When a dog is inoculated and does not succumb, that does not prevent the animal from, later, contracting the disease. Pasteur records the spontaneous cure of hydrophobia after the first rabic symptoms were developed, but never after the acute symptoms set in. Cases have occurred, of the complete disappearance of the first symptoms and the development after two months of the acute symptoms, terminating fatally. In 1881, Pasteur inoculated three dogs, two died rapidly of madness, the third displayed the symptoms of the first stage of the malady, but nothing since, and though inoculated twice in 1882, by the brain, the animal never contracted the disease. This is an important factor in the road of prevention against hydrophobia. In the laboratory, there are also three other dogs to which the madness cannot be communicated, no matter how they may be inoculated. The aim of all the experiments is to discover a method to preserve dogs against hydrophobia, and so render their bites harmless to man. Pasteur does not despair of attaining this end. The brain of a cow, dead from hydrophobia contracted from the bite of a dog, communicated, by inoculation, death to all the animals operated upon. M. Pasteur has experimented on no less than 200 dogs, rabbits, and sheep; they have so far only thrown a brilliant light on the road to the solution of a terrible disease which never forgives. Within two years that desired solution has made more progress than it has within centuries.

The following is a simple and ingenious plan for utilizing the electric, which now supersedes the ordinary, bells in houses, and to convert them into clocks, to chime or strike, following the parent time-piece. The latter can be of any model provided it strikes or chimes. Attach the end of the negative wire of the electric gong to the metallic works of the clock, then arrange the positive wire with the hammer, that is, a little above it: when the hammer rises to strike the bell, it will touch the wire, the "circuit" will be thus interrupted, the current will pass, and will travel along the wires to set the electric gongs to tint. The tinting will be repeated as many times as the hammer of the clock rises, and touches the wire in its proximity. Every room, corridor, or passage, of a house, can thus be simultaneously informed of the exact hour by the mother clock.

Relative to time, the 21st of December is the winter solstice, and the days are the shortest of the year. The Sun, as is well known, cuts the day in two equal parts, by arriving at noon at the meridian. But if an almanac be consulted it will be seen, that on the 1st of December, the Sun rises at 7h. 34m., and sets at 4h. 4m,; the 15th of December, it rises at 7h. 49m. and sets at 4h. 2m.; the 31st of December it rises at 7h. 56m. and sets at 4h. 11m. Thus the days diminish during the forenoons throughout the month, while they augment during the afternoons. How does it arise then, that the forenoon is shorter than the afternoon, the morning unequal to the evening? This anomaly or equivocation, is due to the circumstance, that since 1816 the clocks mark not the time, but the mean time. They are regulated after a fictitious, not the real Sun. The latter never arrives at the meridian two days in succession at the same hour. The "official" Sun is more regular, hence, perhaps why it was invented; the calculation is made for each day, by how much it is in advance, or behind, the true Sun, and the difference at noon is called the equation of time; that permits to have the mean, when we have the real hour. This difference begets the inequality between the forenoons and the afternoons. Accordingly then, as the mean time is advanced, or behind, will the mornings or evenings, indicated by a watch, give the inexact risings and settings of the Sun. These errors, in either sense, will be produced during the year, save the 15th of April, the 14th of June, the 31st of August, and the 24th of December, when the mornings and evenings will be equal, because the true and real Sun then agree as to the hour of passing the meridian. On the other hand, the most important differences will occur on the 10th of February, 28m.; the 14th of May, 8m.; the 26th of July, 13m.; the 1st of November, 32m. The maximum difference can thus amount to half an hour.

France may be said by her initiative of the International Electric Exhibition, to have given the impulse to electric illumination; she at present stands still, waiting to ascertain the results of the several rival systems before the public. The Edison system has never exactly taken here, but it is impossible to close the eyes to its working in New York, where the light is laid on with the regularity of gas and water, and automatically controlled with marked simplicity. If Paris remain a little behind, that must not be construed as a want of faith in the future of the electric light, but to the immense resistance the gas company here can make. Further, the Jamin candle, in favor here, possesses incomparable merits, its lighting is automatic, it burns by its inferior end, and it yields a greater total of illumination than other systems, though the initial production of the electric current be common to all. F. C.

TAXATION OF COLORADO MINES.

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There is a good deal of dissatisfaction expressed in Colorado over the passage by the Legislature of the bill imposing a tax on the net output of ores in that State, and Governor Grant is strongly urged to veto it. The status of the case is this. A man may spend any amount of money, say $25,000 upon a mine before he takes out paying ore. Immediately upon doing this, before he gets a dollar remuneration for the $25,000 previously expended, the valuable ore is assessed, and as it becomes really for some time merely the interest upon the $25,000 as principal, the interest is of course reduced. That is, a man invests $25,000 which he may lose altogether, but upon which he anticipates to realize, let us say, 10 per cent, but by the taxation bill this is decreased at least to 7 per cent, and it may be to still less. As mining operations are in their very nature a matter of faith, and of sight, the disastrous results to the mining industry of the State passing such a law will be readily conjectured. One such was passed in Nevada, and capital went to other fields of investment at once. The spirit of the Colorado press and people is strongly against the bill and may prevail on the Governor to veto it.

F. E. S.

ASTRONOMY.

METEORS AND COMETS.

The fifth of Prof. Charles A. Young's illustrated lectures was delivered in the Church of the Strangers last night. The subject was "Meteors and Comets," and the learned lecturer made his audience acquainted with a great deal of astronomical information in a very entertaining way. A great variety of views were displayed on the screen, and the explanations of them were couched in terms easily understood by all attentive listeners. Prof. Young held in his hand a small grayish stone with a black crust as he ascended the platform to begin his lecture. He said that it was a piece of a large stone, weighing forty pounds, which fell from the sky in February, 1857, at Parnallee, in Southern India. The falling of meteoric stones was usually accompanied by loud reports, which to the startled hearers seemed to last fifteen or twenty minutes. Prof. Young said it was not probable that any such reports ever lasted more than two minutes. There had been numerous instances of the falling of meteoric stones in this country, one of the most remarkable of which was the falling of about 1,000 pounds of stone at Weston, Conn., December 14, 1807. In the cabinet of Amherst College there is treasured a meteoric stone which weighs 450 pounds.

A person seeing a meteor fall at night at first sees a ball of fire about the size of the moon. As the meteor approaches the earth, the light grows larger and brighter, like the head-light of a locomotive. Generally, a train of light follows the ball of fire. The falling of meteors is accompanied by loud explosions, and it has been claimed that these explosions occur at intervals when only portions of the meteor fall, while the main body passes on. Meteors first appear in the sky at a distance of eighty or ninety miles from the earth, and they disappear from view when at a distance of seven miles from the earth. They move through space at the rate of ten miles a second, and sometimes with a velocity of forty or fifty miles per second. There is not a single element in the composition of meteoric stones that is not found in the earth. The substance of the meteors, however, is put together differently, so that their mineralogy is unlike the mineralogy of the stones of the earth. Meteors are known to be heated when they reach the earth, but on one occasion, a meteoric stone, when dug out of the earth, was found to be covered with ice. The majority of the meteors that strike the earth are stone, and not iron, as is commonly supposed. Some, however, are of pure iron. Out of the 500 or 600 meteoric stones that have been found on the earth and preserved not more than ten were iron.

Meteoric particles are striking the earth all of the time. Some astronomers estimate that as many as 10,000,000 particles strike the earth each day, while the lowest estimate puts the number at 7,500,000 per day. Many more of these particles strike the earth in the morning than at night, and frequently observing persons in their morning walks can plainly see evidences of the meteoric showers. These meteoric particles seem to be circulating in space, and the earth as it moves in its orbit strikes against them. Some of the meteoric showers are very copious and very bright. One writer has likened a meteoric shower that he saw to a snow-storm, the flakes being of fire instead of congealed vapor. Astronomical observers have detected, by means of the spectroscope, sodium, magnesium and sometimes iron in these bright shooting stars. One consequence of this constant falling of meteoric particles is that the earth is growing larger, but the lecturer said that there was no immediate danger of any radical change taking place in the surface of this sphere, for at the present rate of the meteoric fall, it would take 500,000,000 years for the earth to gain one inch of surface. Meteors are known to come in periodical showers, probably the most remarkable being the shower that occurs about the 11th or 12th of November. It appears that meteors follow in the track of comets. They are related to comets in some way or another, but exactly how the lecturer was not prepared to say. Some scientists thought that the meteors were the debris or cast-off particles of comets, while others thought that perhaps the comets were simply aggregations of meteoric particles, and the falling stars were the particles that did not get into the aggregations. It is certain, at any rate, that flocks of meteors follow the various comets at few millions of miles behind.

Comets, Prof. Young said, had always been puzzles to the astronomers and terrors to the superstitious. It had been seriously urged that comets were the forerunners of unhealthy and disastrous periods on the earth, but such beliefs had been vigorously ridiculed by scientists. The modern improvements in telescopes had caused a rapid increase in the number of discovered comets. These strange bodies are now being discovered at the rate of five or six every year. There are 650 comets in the catalogue at present, very few of which are bright ones, however. According to the most trustworthy astronomical statistics there were twenty-three bright comets between the years 1500 and 1600, twelve bright comets between 1600 and 1700, eight between 1700 and 1800, nine between 1800 and 1850, and since then there have been ten bright comets visible. The comets seen during the last few years were more or less remarkable. Astronomers become very enthusiastic in their search for comets. One ardent scientist bewailed the death of his wife a few years ago because the event lost him a comet, which a competitor happened to discover. There are about fifty comets that move in elliptical orbits. The theory is that each of these comets has been caught by some planet and held captive, being compelled to move around and around in the same orbits continually. They appear to the people of the earth at stated periods; some have longer periods than others. Encke's comet has the shortest period, viz.: three and one-half years, while some comets have periods as long as thirty-three, forty and even seventy-five years. A view of the great comet of 1811 was shown on the screen. That was the largest comet ever known. The diameter of the head was not less than the diameter of the Sun. That comet never came within 100,000,000 miles of the earth, and yet it was a remarkable sight. Its tail was 60,000,000 or 70,000,000 miles in length. Prof. Young said that he had seen comets more than 50,000 miles in diameter running centrally over stars without dimming the stars in the slightest degree. It had been estimated that the mass of a large comet was equal to a lump of iron 100 miles in diameter, but the lecturer was inclined to doubt the correctness of that estimate. It had been clearly demonstrated that astronomical observers could see through the thickest part of a comet. Several views were exhibited to give the audience an idea of the different shapes and phases of comets. Biela's comet divided into two parts in 1842. The parts separated and gradually disappeared from view, and Prof. Young said that all that remained of them now was a shower of falling stars. The present comet was illustrated by various diagrams. One of the most remarkable things about this comet is the nearness of its approach to the Sun. It apparently almost scraped the solar surface. Moving at times with a velocity of 300 miles per second it had gone from one side of the Sun to the other inside of three hours. The comet of 1843 was very like the present comet. Its tail was about 100,000,000 miles in length, but it, too, succeeded in going from one side of the Sun to the other in three hours. The "whiskiness" of the tail of the comet of 1843 had caused much comment and discussion among astronomers. It was a matter of wonderment that a tail of so great length should be able to encircle the Sun in so short a time. Various different theories had been advanced on this point.

The office of comets in the planetary system is not known. Much has been written on the subject and many opinions have been advanced, but nobody can feel that a correct explanation of the use of these remarkably brilliant bodies has been given. It was suggested by Sir Isaac Newton that comets supplied the material for the preservation of light. Prof. Young did not know but that such might be the fact. It was an established fact that carbonic acid was an essential element of the atmosphere, and it was known that that element was disappearing. Who knows but that the comets are destined to supply the subtle influence needed to preserve the light with which the people of this globe are favored? The lecturer stated that he had received a letter which, he judged from the handwriting, must have come from a lady, asking whether there were inhabitants on the planets other than the earth. In reply, he desired to say that in point of actual fact the inquirer knew as much about the matter as he did. The only known planets that could possibly be inhabited by people such as dwelt on the earth were our nearest neighbors, Venus and Mars. It was possible that there were people, used to tropical climates on this planet, who could live on Venus.

There they would enjoy a perpetual summer. The lecturer thought it also likely that there might be some hardy Esquimaux who could manage to exist on the planet Mars. As for the other planets, if they were inhabited at all, they were inhabited by people of whom nothing was known, but who must necessarily be adapted to the peculiar qualities of the various planets.—*N. Y. Times.*

ENGINEERING.

TUNNELS IN GENERAL, AND THE ST. GOTHARD IN PARTICULAR.

Many curious things might be said about tunnels, old as well as new. For instance, the stupendous work—whose history links modern with ancient engineering—the object of which was to connect Lake Fucinus, now called Celano, with the Liris, now the river Gariglino, was undertaken 42 A. D. It took nearly eleven years to complete, and 30,000 men are said to have been engaged upon it. This subterranean canal was executed by order of the Emperor Claudius. For nearly eighteen centuries it seemed to have been forgotten; but on its discovery, about sixty years ago, the Neapolitan Government resolved to clear it out. This was accordingly done, but not until several years had been spent upon the task. The improved tunnel is four miles long; the original length was three miles. Prince Torlonia of Rome gradually bought up the shares, and carried on the operations at his expense until his death in 1871.

Modern tunneling—which by-the-way, is quite a distinct profession—is of three classes: First, tunneling through soft ground, such as clay, loose rock, etc. Second, rock-tunneling without machinery; Third, tunneling solid rock by the aid of machinery. In piercing a hill or other mass of earth, a large quantity of timber for temporary arching is required, until the brick or stone work has been provided. In some methods of tunnel-making it is judged more secure to brick the timber in. But this is very costly, especially when all the heavy timber has to be conveyed down a shaft or slope. Where the ground is rather yielding, and much water appears, an inverted arch is constructed across the bottom of the tunnel, so as to resist the pressure from beneath. There are now, however, other methods of construction in use. A new system has been devised of employing iron centers as a substitute for timber. Tunneling through loose rock, timbering, and then arching, is a method mostly in use in England and America; and where the length is comparatively short, hand labor is found cheaper than the employment of machinery. But at the present day, this kind of engineering is conducted on a vast scale with steel and diamond-pointed drills, driven by compressed air (at about forty pounds to the square inch), which latter serves for ventilation purposes. In this way longer holes can be cut, and heavier charges of dynamite employed.

The first sub-aqueous tunnel in England was that under the Thames from Wapping to Rotherhithe, known as the Thames Tunnel. It was begun in 1807; the operations were stopped after a time; but recommenced by Sir M. I. Brunel, in 1825. The work was again interrupted by accidents; but the causeway was eventually opened for foot-passengers in 1843. In the year 1867 it was purchased by the East London Railway Company. It is 1,200 feet in length. Another subway is planned between the north side of the Thames and South Woolwich; it will be much deeper below the bed of the Thames than the older subway, and is to be constructed to admit of the transit of troops and war-material from Woolwich to the north side of the river, thus avoiding the circuitous route over London Bridge. Of this class we must also mention the Severn Tunnel, commenced in 1875, and now well on toward completion; but the bursting of a spring last year caused a serious interruption to the operations. The cutting has been mostly through rock, and about 100 yards in the centre of the channel yet remains unpierced.

Among other important works, the son of the eminent engineer above mentioned constructed Box Tunnel, on the Great Western Railway, in the vicinity of Bath; it is nearly four miles long. The Woodhead Tunnel, near Manchester, is three miles in length; a second cutting, of the same dimensions, was afterward made parallel with it, but separated by a longitudinal pier. The Kilsby Tunnel, on the London and Northwestern Railway, was four years in construction; it is 2,400 yards long, and cost £350,000; nearly four times the original estimate. Peculiar difficulties were encountered in making the Sydenham Tunnel (London, Chatham and Dover Railway). It is cut through the London clay, and while the works were in progress the clay commenced swelling and crushing the masonry. This was so serious that over 8,000 cubic yards of work had to be rebuilt.

Considerable progress is now being made with borings for the tunnel to be cut by the Mersey Railway Company under the bed of the Mersey. The shaft on the Birkenhead side has been sunk to a depth of about 120 feet with most satisfactory results. The boring is through the New Red Sandstone; on the Liverpool side, a depth of 100 feet has been reached. It is scarcely necessary to mention the tunnel which forms the chief feature of the Metropolitan (or Underground) Railway of London, opened January 10, 1863, and since extended in several directions. A similar work is projected for Paris, at an estimated cost of £6,000,000. There are now over eighty miles of tunneling in England.

Tunnels for portions of canal in hilly regions are sometimes of great length—such as the Canal de St. Quentin, more than seven miles long; the Huddersfield, and the Mauvages (Canal du Marne au Rhin), three miles each; Sapperton, Thames and Medway, Dudley, Blisworth, Soussey, Pouilly, ranging from two to four miles.

Transatlantic enterprise of this class has made great advances of late years. We select two or three out of nearly a score which deserve mention. The Hoosac

Tunnel was constructed to provide a direct route to the Hudson River. Until the cutting of this one, all rock tunneling in the United States was effected by hand-labor. It was commenced in 1858, and after several delays, arising from pecuniary difficulties and a serious accident in October 1867, it was finished in 1874. Under Lake Michigan there is a tunnel, or rather aqueduct, constructed to convey pure water to the city of Chicago This important work was begun in 1864, and completed in 1867; and a tunnel under the Hudson River at New York is progressing rapidly. In August, 1857, the celebrated Mont Cenis Tunnel—incorrectly so termed, because it is sixteen miles from that mountain, the tunnel actually passing under the Grand Vallon—was commenced by manual labor, and continued so to be worked until 1861, when rock-boring machinery came into use, in consequence of which rapid advances were made. The First Napoleon constructed a magnificent military road over Mont Cenis Pass, and this was used regularly by travelers. At length, when the French railways had crept close to one flank of the range, and Italian railways close to the other, plans for a railway tunnel to connect the two were formed. The French and Italian Governments agreed to share the cost between them. The tunnel is nearly eight miles long, and as much as 5,000 feet above the level of the sea. After working from opposite sides of the mountain, the workmen at length met in the centre, December 26, 1870. On the 17th of September in the following year the great undertaking was inaugurated in state, the ceremony being graced by the presence of the Empress Eugenie.

And now, in spite of the German prophecy, that "a large lake would be met with which would put a sudden end to all the work," we are able to record that on Sunday, February 29, 1880, the St. Gothard Tunnel, another gigantic effort of engineering, was accomplished. Thus for the second time have the hoary Alps been pierced through their very heart.

The St. Gothard, until the present century, had been one of the least frequented passes, although the hospital of the monks of St. Gothard was founded in 1331. In 1816, however, a regular post between five Swiss cantons and Milan was established; yet up to 1820 the path was only practicable for horses and pedestrians, and until lately the journey from Lucerne to Turin occupied twenty-five hours and a half, whereas the same journey henceforward will occupy but eight hours. The convention for the construction of this railroad was signed by Italy and Switzerland in 1869, and in 1870 the North German Confederation adhered to the convention. Engineer Gelpke and the geometrician, Koppe, were the chief designers. At first seven companies sent in their estimates—one Swiss, one Franco-Swiss, one Italian, one German, two English, one American. Finally L. Favre, of Geneva, and the Italian Society of Public Works in Turin, headed by Grattoni, the constructor of the tunnel through Mont Cenis, were the only competitors, and to Favre the contract was assigned, his offer being considered the most advantageous.

Meanwhile, the administration of the St. Gothard railway had arranged for the commencement of the excavations of the grand tunnel, begun in June, 1872.

For the perforation the waters of the Reuss were utilized on the northern slope; those of Val Tremola on the southern. In 1879, Favre, who directed all the works in person, died suddenly of apoplexy in the tunnel as he was explaining the operations to some foreign visitors; nor was he the only victim, 179 workmen having lost their lives by accidents or suffocation, while hundreds of others have contracted maladies which sooner or later will bring them to the grave.

The work which was never interrupted day or night, occupied nine years and three months—3,330 days in all. The first estimates of the sum total to be expended amounted to 227,000,000 francs, of which Italy agreed to pay 55,000,-000, while various municipalities and provinces made up another 15,000,000; Germany and Switzerland contributed 63,000,000, the remainder of the sum being made up by shares, of which a vast number are held by Italians; so that in fact Italy has contributed far more than half of the sum total, the province and city of Milan alone furnishing 2,500,000.

The gallery of the St. Gothard runs in a straight line from the village of Göschenen to Albinengo, a village to the west of Airolo. The tunnel to be excavated along this line was 14,912 metres long, 2,700 metres longer than the gallery of Mont Cenis. In order to join it with the railroad which comes toward Airolo in an east-to-west direction, another gallery of 150 metres was excavated; in fact, between Göschenen and Brunnen there are twenty-seven galleries. The altitude at the entrance of the tunnel at Göschenen is 1,109 metres above the sea level; in the centre fifty metres higher, at Airolo forty metres higher. The geological formation differs essentially from that of the Cottian Alps. The bore of the gallery after some 2,000 metres of granite or granite-gneiss, entered into crystalline schist, intersected with veins of serpentine, a mass, in short, of the hardest rock, which at first threatened to baffle the perforating machines. The hydraulic works were also extremely tedious, owing to the difficulty of obtaining a sufficiently strong body of water from the Reuss, while, on the Airolo side, during the winter, avalanches often obstructed the bed of the tremola, rendering it necessary to excavate a bed under the snow. Signor Favre, in order to overcome the difficulty with the Reuss, constructed an enormous reservoir and a canal, while to baffle the avalanches he caused the water to be conducted by means of a wooden canal into the bed of a minor torrent, the Chiesso, less subject to avalanches. Other difficulties were encountered and overcome by his indomitable will, so that at his death it may be said that only the mechanical portion of the work remained.

This was completed really in 1881, but the inauguration was delayed, owing to various circumstances, until May 21, 1882. Then Italy, Germany, Switzerland, and we may say all Europe, participated with thorough satisfaction in the ceremonies attendant on the opening of the St. Gothard Tunnel; but, as is usually the case, the promoter, the initiator of that great international work has been almost entirely forgotten in his birthplace, Milan, as in his beloved Lugano, where he spent the last twenty years of his life in study and poverty, dying there in 1869. Carlo Cattaneo, the greatest philosopher and political economist of modern Italy, the guide and inspirer of the Five Days of Milan, in 1848, when the unarmed citizens defeated and drove out from their city the entire Austrian army under Radetsky, as early as 1859 insisted on the tunnel through the St. Gothard, in the interests of Italy and Switzerland alike.

It appears that, fearing injury to their traffic from Paris to Brindisi *via* the Mont Cenis, the French are now, in consequence of this new tunnel, boring through the Simplon—estimated at eleven and one-half miles in length—and "already there are rumors of schemes to bore through the Tarentaise and the Col du Mont; and even Mont Blanc is threatened with a tunnel," consequent upon the feverish competition likely to arise among the Swiss, German, French and Italian lines.

Five years ago, *La Nature* reported that in Spain an inter-continental railway company had been formed to carry out the scheme of connecting Europe and Africa by a tunnel under the Straits of Gibraltar, but nothing has been done in the matter.

But the bold idea of a tunnel under the British Channel will, if carried out, eclipse all former undertakings of this kind. The present "Channel Company" was formed in 1872; Sir John Hawkshaw, F.R.S., Mr. Brunlees and M. Gamond being appointed engineers. The route finally decided upon places the tunnel on a line extending from a spot between Folkestone and Dover, through the "Old Gray Chalk," to a point between Sangatte and Calais, on the opposite coast. The total length will be thirty-one miles, of which twenty-two will be under the Strait. Shafts are to be sunk on each shore to a depth of about 450 feet below high-water mark; and drift-ways from the bottom of these, for the draining of the tunnel, which is to begin 200 feet above the driftway. These driftways will be driven from both ends on a down gradient of one in eighty to the junction of the drainage driftway; and then on an up-grade of one in 2,640 to the middle of the Strait. The crown of the tunnel in all parts will be not less than 200 feet below the bed of the Dover Strait. It is hoped that the excavation will be mostly through chalk, in which case comparatively rapid progress will be made.

It has been estimated that the probable cost of this titanic task will be about $20,000,000; but Sir John Hawkshaw considers it best to double this estimate, in anticipation of greater obstacles which may arise. The preliminary works are now being prosecuted with great activity. A shaft has been sunk at Sangatte, to the depth of over 100 metres, and the experimental gallery has been commenced, and is to be continued for a kilometre—that is 3,250 feet—under the sea. The raising of the capital for the tunnel itself is, however, still a knotty problem; but if this can be accomplished, so much the better for all parties. As the passenger traffic between England and the continent amounts to nearly 400,000 annually, and is yearly on the increase, the opening of this marine subway will be of enormous public advantage.

BOOK NOTICES.

A Study of the Manuscript Troano. By Cyrus Thomas, Ph.D.; Quarto, pp. 237. Illustrated. Government Printing Office, Washington, 1882.

This is a most thorough and comprehensive description and explanation of one of the three published Maya manuscripts which escaped destruction by the Spanish priests at the time of the conquest of Central America. It was named the Troano MSS., a compound of the two names of its former owner, Don Juan de Tro y Ortolano, by the Abbé Brasseur (de Bourbourg) who found it in his possession at Madrid in 1864. This valuable manuscript consists of thirty-five leaves or seventy pages written upon a kind of paper manufactured from the leaves of the maguey plant. The paper is in the shape of a strip, about fourteen feet long and nine inches wide, covered with a white paint or varnish and upon it the characters are painted in black, red, blue and brown. It is folded fan-like, into thirty-five folds, and presents the appearance, when closed, of an ordinary octavo volume. The hieroglyphics and figures cover both sides of the paper, the writing or painting having been executed apparently after the paper was folded, so that each page is distinctly legible.

As the Maya family was probably the most ancient and highly civilized on this continent, whether we judge by its traditions, records or architectural testimony, a careful and scholarly examination of its literary remains should be a most interesting and important study, and the perusal of the results of such an examination, prepared by a competent and enthusiastic investigator and a critical and attractive writer should be an extremely instructive and entertaining occupation. Such we find the works of Mr. Thomas, and such we believe will be the verdict of all other readers.

The introduction by Dr. Daniel G. Brinton is a dissertation upon thought and sound-writing in general, and the system of the Mayas in particular. It also comprises an account of the other Maya manuscripts as far as published.

The whole work is copiously illustrated and may be regarded as quite exhaustive. The contents are mainly as follows: The graphic system and records of the ancient Mayas, by Dr. D. G. Brinton; the manuscript and its characters, the Maya calendar, explanation of figures, etc. in the manuscript and the Dresden College; probable meaning of other figures; symbols, etc. that can be classed as written characters; the written characters in the manuscript; illustrations of the Day columns; a discussion of dates; inscriptions on the Palenque tablet. *Appendices:* extracts from Landa's "Relacion, etc.," quotation from Señor Melgar, translation of Tanda's description of festivals, mode of building houses among the Yucatees from Landa, manner of baptism in Yucatan, Landa.

KNIGHT'S NEW MECHANICAL DICTIONARY. Section III. Edward H. Knight, A. M. LL.D.; octavo, pp. 240. Houghton, Mifflin & Co., Boston; $2.00.

It is a fortunate thing for the subscribers to this valuable work that its author had fully completed it before his death, which occurred but a few weeks since, for we know of no one who could have successfully taken up and finished the task. As it is, the publication of the successive volumes will be slightly delayed —a few weeks at most, however—by reason of the proofs having to be read without the author's assistance.

The volume extends from the *monstrum horrendum* participle "Hydraulicking" which is the "short" among miners for washing down a placer claim by means of a hose or giant nozzle, to Printing Press, including descriptions of all kinds of hydraulic apparatus, ice machinery, laboratory apparatus, leather and its imitations, locomotives, magazine guns, marine engines, metallurgy, microscopes, mill machinery, mowers, nautical instruments, oil-stoves, oyster culture, pavements, phosphor bronze, photography, pile-drivers, plate machinery, pneumatic apparatus, porcelain manufacturing, portable engines, etc. Every page contains elaborate illustrations of the machines described, and with all the important titles are given references to full descriptions in other works. Thus, under the title "locomotive" more than three hundred references are made to articles upon various branches of the subject in the *Engineer*, *Scientific American*, *Manufacturer and Builder*, *Thurston's Vienna Reports*, *Van Nostrand's Magazine*, *Le Technologiste*, *Railroad Gazette*, etc.

It seems impossible to think of an appropriate subject that has been omitted and in most cases the treatment is full, clear and exhaustive. The printing and engravings are exceedingly well done.

THE THEORY OF THE GAS ENGINE. Dugald Clerk; 18mo., pp. 164; Illustrated. D. Van Nostrand, New York; 50c.

After pointing out the inefficiency of steam engines, the best of which do not credit more than ten per cent of the heat used by them into work and many of them not over four per cent, and the impracticability of gas engines, notwithstanding their apparent compliance with all necessary conditions, the author proceeds to show that the gas engine presents the best prospect of satisfactory results. He names three well defined types of engines that have been proposed.

1. An engine drawing into its cylinder gas and air at atmospheric pressure for a portion of its stroke, cutting off communication with the outer atmosphere, and immediately igniting the mixture, the piston being pushed forward by the pressure of the ignited gases during the remainder of its stroke. The in-stroke then discharges the products of combustion.

2. An engine in which a mixture of gas and air is drawn into a pump, and is discharged by the return stroke into a reservoir in a state of compression. From the reservoir the mixture enters into a cylinder, being ignited as it enters, without

rise in pressure, but simply increased in volume, and following the piston as it moves forward, the return stroke discharges the products of combustion.

3. An engine in which a mixture of gas and air is compressed or introduced under compression into a cylinder, or space at the end of a cylinder, and then ignited while the volume remains constant and the pressure rises. Under this pressure the piston moves forward, and the return stroke discharges the exhaust.

Several minor types have been proposed and many modifications of these three methods are used. A thorough understanding of these, however, renders it possible to judge the merits of any other.

Types 1 and 3 are explosion engines, the volume of the mixture remaining constant while the pressure increases. Type 2 is a gradual combustion engine in which the pressure is constant but the volume increases.

The author, in the course of his experiments on gas engines, has found that 1,537° Centigrade is the temperature usually attained by the ignited gases in his engine, and he has accordingly investigated the behaviour of air under different conditions at this temperature.

The results of his investigations are carefully and mathematically set forth in this volume which will at least be interesting to engineers and physicists.

The Use of Tobacco. J. I. D. Hinds, Ph.D., Lebanon, Tenn.; 12mo., pp. 138. 55c. by mail.

Prof. Hinds is teacher of Chemistry in Cumberland University and has acquired a high standing as a chemist as well as teacher of natural science, in the South. His little work upon the Use of Tobacco gives evidence of his skill in both departments, since it not only furnishes a chemical analysis of the plant, but also gives its history, describes its botanical character and its physiological and pathological effects upon the system. He makes the statement that nearly nine hundred millions of the inhabitants of the globe are users of tobacco, and justly claims that an article that holds subject nine-fourteenths of the human race is certainly worthy of attention.

The chapter upon its physiological effects is largely made up of quotations from some of the best writers and thinkers of the day and is well worthy the careful perusal of all persons addicted to the use of "the weed." It is a very interesting and valuable monograph and should have a large distribution.

The Brewer, Distiller and Wine Manufacturer. Edited by John Gardner, F. C. S.; 12mo., pp. 278. Illustrated. P. Blakiston, Son & Co., Philadelphia, 1883. $1.75.

This is the first of a series of Technological Hand books designed to meet the wants and pockets of those who need practical information on special subjects and do not care to purchase cyclopædias or expensive technological works. It is intended to be equally valuable to the expert as to the beginner. This volume gives full directions for the manufacturing of beers, spirits, wines, liquors, etc., and will be found convenient and useful to all, and indispensable to many, who are interested in the manufacture and sale of alcohol and its compounds. The next volume will be devoted to bleaching, dyeing and kindred subjects.

OTHER PUBLICATIONS RECEIVED.

Proceedings of the Biological Society of Washington, Vol. I, November, 1880, to May, 1882. Industrial Art in Schools, by Chas. G. Leland, of Philadelphia, being No. 6 of the Circulars of Information issued by the Bureau of Education. *Humboldt Library*, No. 41, Discussions in Current Science, by W. Mattieu Williams, F. R. A. S., F. C. S., 15c. The *Eclectic Magazine of Foreign Literature*, February, 1883, E. R. Pelton, Publisher, N. Y., Monthly, $5.00 per annum. Report on the Development of the Resources of Colorado for 1881-2, J. Alden Smith, State Geologist, 35c. The Forestry of the Mississippi Valley, Preliminary Report, by Hon. F. P. Baker, Topeka.

SCIENTIFIC MISCELLA...

WHAT STATE GEOLOGICAL SURVEYS HAVE ACCOMPLISHED.

As a kind of appendix to Professor Trowbridge's article on the Missouri Geological Survey, in this number of the REVIEW, we have compiled a few items showing practically the results of such work in a few States.

The Missouri Geological Survey defined the boundaries of our coal fields, showing them to include three principal divisions, the Upper, the Middle and the Lower. The upper is barren; the lower productive and their limits are approximately laid down on the map. The map of coal fields with Report of 1872 gives the line between the upper, the lower and the middle measures. Only the geological surveys have accomplished this, for previously nothing was known.

Black slate is generally associated with coal. But there are also beds of black slate which do not belong to the coal formations. Such beds exist in New York, Pennsylvania, Ohio, and most of the Ohio Valley States and Missouri in a limited degree.

The Ohio survey saved thousands to the State by showing that these slates did not belong to the coal formation.

We have seen similar slates in Ralls County, Missouri, and have been where two shafts had been sunk upon them in search of coal. If a geologist had been previously consulted this expense could have been saved.

Ten or fifteen years ago Henry Engelmann, assistant Geologist of Illinois, advanced the opinion that the Big Muddy coal of over four feet in thickness could be reached in a shaft at Centralia at a depth varying from 560 to 660 feet. Certain shafts were sunk, but not so deep, and no coal obtained; the parties at work several times stopped work but he continued to encourage them. Their efforts were finally crowned with success, coal was reached at 570 feet and six feet in thickness.

Gen. Pleasants, in charge of coal mining at Pottsville, Pa., had borings extended to 1,558 to a fourteen-foot seam of coal and 1,909 feet to a seventeen-foot seam. This was done to verify his theory, and the company, I understand, would or did appropriate $100,000 in works.

In 1874, Prof. G. C. Broadhead published Missouri Geological Report, over 700 pages with atlases. This report included certain coal producing counties of northeastern Missouri, with others rich in coal in the southwest. In each County Report approximate calculations were made of probable amount of coal in each township. Bates County was included in this Report. Within a few years thereafter the citizens of the county published a small paper giving extracts from the Report when the thickness of coal beds and quantity of coal was named. The paper in each instance gave credit to the Missouri Geological Report with the figures. This paper was circulated very widely. From that time to this the eyes of capitalists and railroad managers have been turned to Bates County.

In 1880 the Missouri Pacific Railroad was completed to the Bates County coal fields. The town of Rich Hill was started—now a thriving town of over 4,000 inhabitants with its hundreds of coal miners, two railroads and another in contemplation; zinc works put up also, and carloads of coal being continually carried off. (See statistics in January REVIEW).

In Michigan the prodigious results of the salt borings in the Saginaw district were the direct consequence of instructions given by the State Geologist before any intelligent work had been done there and after thousands of dollars had been wasted in ineffectual efforts around the edges of the great salt basin where the dilute brine was overflowing. In this instance the State Geologist not only pointed out out the different strata to be pierced ,but also the depth necessary to be bored in order to reach the vast body of salt from which the valueless springs derived their saline qualities. Within one year afterward 4,000 barrels of salt were produced, and within four years the production in the State was 2,678,598 barrels.

A few years ago Prof. Aughey prepared a monograph on the "Superficial Deposits of Nebraska," a hundred thousand of which were published in pamphlet form for gratituous distribution. These were circulated not only in the United States but also in Europe, and a year or more ago the railroad officials estimated that Prof. Aughey's little volume had brought a hundred thousand people to Nebraska.

THE WIGGINS STORM OF MARCH 9TH TO 11TH, 1883.

The President has received the following communication from Prof. E. Stone Wiggins, LL. D., Astronomer of the Canadian Finance Department, under date of Ottawa, November 25th:

On the 23rd of September last, I announced through the Canadian press that a great storm would occur in March next; that it would first be felt in the Northern Pacific; would appear in the Gulf of Mexico on the night of the 9th, and, being reflected by the Rocky Mountains, would cross this meridian from the west at noon, Sunday, March 11, 2883. No vessel, whatever her dimensions, will be safe out of the harbor, and none of small tonnage can hope to survive the tidal wave and fury of this tempest. As the wind will blow from the southeast, the planetary force will be sufficient to submerge the low lands of the American coast, especially those bordering on the Gulf of Mexico and washed by the Gulf Stream, where the air currents for several hundred miles along the east side of the Rocky Mountain Range, owing to great atmospheric pressure in those regions, will spread universal destruction. The New England States will also suffer severely from wind and floods. No point outside the harbor in the whole area of the Atlantic, especially north of the Equator, will be a place of safety. For this will be pre-eminently the greatest storm that has visited this continent since the days of your illustrious first President. In view of this event, therefore, I take the great liberty of representing to your Excellency the advisability of ordering all United States ships into safe harbors not later than the 5th of March, till this storm be passed.

THE KANSAS CITY ACADEMY OF SCIENCE.

About seven years ago the Kansas City Academy of Science was organized and has maintained a healthy and prosperous growth ever since. For nine months in each year, i. e. from September to May, it has monthly public meetings at which scientific papers by its members, usually of a popular character, are read and discussed. In addition to these entertainments, it has had several courses of public lectures, at which our citizens have been addressed by such eminent thinkers and speakers from a distance as Professors R. A. Proctor, W. I. Marshall, B. F. Mudge, Laws, Marvin, Swallow, Snow, Nipher, Lovewell, Broadhead and Robins; Doctors E. R. and I. D. Heath; Reverends Alexander Proctor, Richard Cordley and C. L. Thompson.

It has made an exploration of the Ancient Mounds of Clay County, as well as the interesting geological deposits of the carboniferous strata and the loess of this immediate vicinity. The Proceedings of this body when collected into volumes will be a valuable contribution to western science.

The Academy Library comprises about 300 volumes, principally U. S. Geological, Archæological, Astronomical and Smithsonian Reports, also Explora tions, Surveys, Geological Reports from various States, besides monographs and pamphlets in large numbers. This library is now placed on the list of exchanges at the various departments in Washington and will receive as they are issued all of the most important publications of all of them.

Its cabinets now comprise nearly two thousand specimens of minerals, fossils and archæological relics, all of which are preserved at its rooms on the third floor of the Diamond Building at the junction of Main and Delaware Streets.

The present officers of the Kansas City Academy of Science, are Hon. R. T. VanHorn, President; W. H. Miller, Vice-President; Dr. R. W. Brown, Recording Secretary; Theo. S. Case, Corresponding Secretary, S. D. Bowker, M. D., Treasurer, and S. J. Hare, Curator and Librarian; Executive Committee, Hon. R. T. VanHorn, Prof. Geo. Halley, M. D., Prof. T. J. Eaton, M. D., Major B. M. Woodson, and Rev. J. D. Parker, U. S. A.

Its evenings for regular meetings are the last Tuesday of each month, except in Summer.

THE KANSAS CITY INSTITUTE.

This organization is now about one year old and has made a rapid and healthy growth under the management, mainly, of Judge E. P. West, its Curator. In addition to the ordinary work of scientific societies the Institute is paying attention to the cultivation of art in this community and has given two public exhibitions at which such specimens were among the chief attractions. At the exhibition of the collection in the Museum of the Kansas City Institute, on the evening of February 10th, the works of art were as follows:

Miss Vaughn, two paintings, namely—"Kansas City in 1867," and "Black-Hawk's Pulpit."

Mr. W. W. Findlay, four paintings, namely—"Conway Meadows," "Winter," "Summer," by Colby; and "Waldeinsamheit," by Langben.

Mr. Ruggles, nine paintings, namely—"Coast on Boston Bay," "Scene near Concord, N. H.," "Pueblo Indian Shepherd," "Mid-Ocean," three portraits taken from life and two fruit studies.

Mr. Campbell, four paintings, namely—"Beatrice," "Holy Family," after Raphael, "Portrait of Major Rollins," after Bingham, and "A Landscape."

Miss Vaughn and Mr. Campbell are well known in the city as artists of merit. Mr. Campbell is widely known in the East and maintains there a high reputation as a scuptor and designer. Mr. Ruggles is not so well known here, having been in the city less than seven months, but judging from his work on exhibition he will soon attain an enviable position among the artists of the country.

In Palæontology there were over 1200 upper coal measure fossils (our home formation) including specimens collected along the Missouri River from Omaha, Nebraska, to Camden, Mo., and bones, teeth and fragments of the tusks of extinct mammals found in this county. The leg bone is now over forty inches. It must have been originally more than four feet; molar more than eleven inches across the crown longest diameter. One of the largest of the extinct mammals ever found.

Archæology. Shell beads and fish vertebræ found in vase in a mound at Weston, Mo., pottery and rough stone implements from "Old Fort," Saline Co., Mo., and other points along the Missouri River from Omaha, Neb., to St. Louis, Mo. Human bones found in Kansas City eighteen feet beneath the surface embedded in the loess. A fine meteorite, and two beautiful cases of minerals.

All of these were tastefully and appropriately arranged in the rooms of the Institute in the basement of the Unitarian Church on Baltimore Avenue, between 10th and 11th Streets.

The officers of the Kansas City Institute are as follows: President, Hon. A. Krekel, Judge U. S. District Court; Vice-President, Hon. Turner A. Gill, Circuit Court No. 1, Kansas City; Recording Secretary, Captain E. H. Webster; Corresponding Secretary, Warren Watson, Clerk U. S. District Court; Treasurer, J. S. Chick; Collector and Curator, Judge E. P. West.

WAS LORD BACON THE AUTHOR OF SHAKESPEARE'S PLAYS?

Mrs. Pott has lately published in England a book concerning Lord Bacon's Promus. The following notes reproduce its striking points:

The writer of the Preface is of the opinion that the similarities to Bacon in Shakespeare arise merely from the latter having borrowed from Bacon. Many attribute them to their having studied the same books. But this obliges us to believe that from these books two men so different derived identically the same theories and turns of expression, tastes, and antipathies. In looking at the Promus it really seems as if Bacon had been taking notes for Shakespeare. We find in it hundreds of notes of which no trace has been discovered in any of his own writings, or in those of any of his contemporaries except Shakespeare.

In almost every department of knowledge and opinion we have Bacon's mind in Shakespeare's writings.

In many cases we have identical forms of speech, words, and uses of words not found in previous or contemporary writers.

There are recorded in the Promus 203 English proverbs, of which no less than 150 are to be found in Shakespeare, while scarcely one of them is to be found in Bacon's own writings. Why would he have noted them if he had not intended to use them?

In one case we find two proverbs combined in the Promus and also in the plays, and yet they do not occur together in the book from which Bacon took them.

There are a few proverbs not in the Promus that are in Shakespeare, but these may be found in Bacon's letters and speeches.

There are 240 foreign proverbs in the Promus and 151 of them are also in the plays. It is hardly probable that Shakespeare had sufficient knowledge of French, Italian and Spanish to enable him to introduce them alone and adopt sentiments from them as if they were household words.

The frequent occurrence in the plays of the wise saws of the ancients leads to the conviction that they were not taken at first hand from the various classical authors, but from the commentaries of Erasmus, and there are 225 of these Er -mus notes in Shakespeare. And it is remarkable that they are not set down the Promus in the order in which they occur in Erasmus, but are arranged a for a purpose.

In the Promus occurs the adage, "To drive out a nail with a nail." T adage is introduced in "The Two Gentlemen of Verona" and also in "Co lanus," and its setting in both pieces is so peculiar and Baconian as to be mc remarkable. We see Bacon's strong tendency to use antithetical forms of speech and metaphors founded upon his scientific researches, and in both cases appears an original and erroneous scientific theory of Bacon's regarding heat. It is almost past belief that any two men should, at precisely the same period, have conceived the same theories and made the same mistakes.

The few Latin proverbs which were favorites of Bacon, and often quoted by him in letters and speeches (though not in the Promus) are all in Shakespeare.

One of his favorites Bacon does not use later than 1600; nor does it appear in any play of Shakespeare written after that time. Of 350 similes and metaphors in Bacon, 300 are found in Shakespeare.

In some of Bacon's letters, in which he discusses his writing by name, there is allusion to another class of writings which he calls "Works of creation," without describing them definitely. Sir Toby Matthew, to whom these letters were written, wrote to Bacon: "The most prodigious wit that ever I knew is of your name, though he be known by another."

Perhaps this does not prove that Bacon and Shakespeare were identical, but such evidence as it affords might suffice to hang a man if he were on trial for his life.—*Cor. N. Y. Sun.*

The popularity of the new Pulsometer Steam Pump is largely on the increase, both at home and abroad. The Company has just received an order from the Philadelphia & Reading Railroad for thirteen of its No. 8 pumps, 5-inch suction, 750 gallons per minute, to be used on its steam colliers for pumping water ballast. It is now working on orders received from South America, Cuba, and Mexico, for pumps of various sizes.—*Coal.*

EDITORIAL NOTES.

1 Dr. Edwin R. Heath, the noted South American traveler and explorer whose addresses before the Kansas City Academy of Sciences and whose articles in the Review have been received with so much pleasure and instruction by Kansas City audiences and readers, is now engaged in preparing accounts of his labors for the American Geographical Society and for *Harper's Monthly Magazine*.

Captain Antherne of the British Steamer Stanmore, bears testimony to the value of oil upon a violent sea, having recently reached New York after a most stormy passage, during which every other expedient was resorted to ineffectually, and this with great success.

The Linnæan Society, of New York, has just published the first volume of its Transactions in extremely attractive style, illustrated with a frontispiece portrait of Linnæas; Royal octavo, pp. 168, $3.00.

Owing to floods and other delays incident to winter, the *Atlantic*, *Harper*, and *Popular Science Monthly*, for March, and several other valuable exchanges were received too late for notice. Even a casual examination, however, shows them to be fully up to their usual standard of excellence.

The total eclipse of the Sun which occurs on May 6th, will only be visible during its totality from two small islands in the Southern Pacific Ocean, named respectively Flint and Caroline. From these the totality of the eclipse will be seen to last almost five and one-half minutes, which is within one and one-half minutes of the greatest possible totality. For this reason it will be a most notable event, and astronomers from all quarters of the globe will visit these islands, probly more than doubling their present population, which is limited to about thirty souls.

Rev. E. Pepper, of Bradford, N. H., who is a regular reader of the Review, writes to a friend in this city, "I find much in it that is fresh and interesting—improving—and a little that is characteristic of modern world-building. * * * * I have enjoyed most of the articles in the Review. They are suggestive and instructive. The Review is a sure indication that other things than money getting inspire the new West."

Dr. D. G. Brinton, of Philadelphia, announces the publication of a series of volumes to be known as the Library of Aboriginal American Literature, of which the following are the titles of those to appear first: The Chronicles of the Mayas, Central American Calendars, The Annals of Quanhtitlan, The Synod of the Creeks and the Chronicles of the Cakchiquels; $3 each volume.

Prof. E. Stone Wiggins explains that the cause of his failure to correctly foretell a storm on February 9th, was that he "wrote down eight days eleven hours astronomical instead of calendar time which caused his storm to strike the western coast of America on the night of the 8th instead of the eastern coast on the morning of the 9th, the Earth requiring seventeen hours more to turn the Atlantic toward the forces that were to generate the storm." He asks as a favor that "the movements of his great March storm be carefully watched," which will be surely done involuntarily if it is accompanied by the terrible disturbances he predicts. To enable our readers to grant the favor asked we publish elsewhere his letter to President Arthur, dated November 25, 1882.

CRYOLITE has been discovered of a fair quality in El Paso County, Colorado, near Pike's Peak. At present most of this mineral is brought from Greenland, and if future developments prove the Colorado discovery to be of any extent, it will be of considerable value to the manufactures in which it is employed.

CAPT. E. L. BERTHOUD, one of the valued contributors and friends of the REVIEW, has been elected one of the board of trustees of the Colorado State School of Mines.

A Microscopical Society was organized in Denver, on the 17th, with a number of charter members. Prof. S. H. Short, of the Denver University, was the principal originator of the Society.

ERNEST LE NEVE FOSTER has been appointed by the Governor as State Geologist of Colorado. The appointment meets with the hearty approval of the geologists of that State.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

IN the course of an extended notice of the REVIEW, the editor of the *Modern Argo* expresses the following flattering opinion: "The general scope and high character of this magazine places it on a level with the best of this kind of important and useful literature. It certainly is not only a credit to its editor and proprietor, but is also a publication that is an honor to Kansas City. The gauge of outside opinion is as often fixed by the character of the publications a community supports as by any other influence, and for this reason, even if for no other, Col. Case's magazine is worthy of the most liberal support. The REVIEW is now nearing its seventh volume and its progress in keeping up with modern thought and experiment in its domain is a matter for congratulation."

WE have received the first number of *Science*, the new weekly periodical to which we called attention in our last issue. It is an octavo of twenty-eight pages printed in double columns, and presents a very attractive appearance. Mr. Sam'l H. Scudder is the editor-in-chief, with several collaborators whose initials, as appended to their notes, are more or less familiar to the scientific reader. Among the contributors of original articles and critical notices of books are—Prof. S. P. Langley, Capt. Geo. E. Belknap, U. S. N., Samuel Kneeland, Prof. Asa Gray, and others. Under the circumstances of its origination, its able editorial force and its pecuniary backing it must certainly be a success and become one of the necessities of the professional and popular reader. We were, in view of our own short-comings, delighted, to detect even one typographical error in its columns. Cambridge, Mass.; $5.

THE *Acadian Scientist* kindly says, "The Kansas City REVIEW is the popular science monthly of the West, and seems to indicate to a large degree the spirit of enterprise that characterises our Western friends. We are always sure of finding its columns filled with able articles of scientific interest.

THE *American Naturalist* entered upon its seventeenth year with the January number and at the same time enlarged its dimensions by adding thirty pages of reading matter and taking in two new departments, Physiology and Psychology.

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PHILOLOGY.

DIALECTS OF BOLIVIAN INDIANS.

A Philological contribution from material gathered during three years residence in the Department of Beni, in Bolivia.

EDWIN R. HEATH, M. D.

In the northwestern part of Bolivia, along the rivers Beni, Mamore and Yacuma, there are various Indian tribes, some civilized, others still savage, each tribe having its own distinct language, even though living side by side, having constant intercourse and intermarrying. The civilized tribes, living on the Mamore and Yacuma Rivers, are the Cayuaba, Moima, Canichana and Trinitaria. The first named live in and about the village of Exaltacion. They are physically well formed, although short in stature, seldom exceeding five and a half feet, while the Mobimas, who live at Santa Ana on the the river Yacuma, twenty-nine miles further south, seldom ever are under six feet. The Canichanas resemble the Mobimas, in stature but differ in form, being lean and bony. The Trinitarias partake of the peculiarities of the other three tribes. The two last named reside at San Pedro and Trinidad, still further south of the others. The Mobimas have a preference for agriculture and stock raising. The Canichanas make the best cartmen, while the Cayuabas, Canichanas and Trinitarias make excellent boatmen. On the east side of the Mamore, from Exaltacion as far north as the mouth of the river Guapore or Itenez, are found the wandering tribe of Houbarayo savages. Their name is a terror to those who ascend and descend the river.

Many a paddler has ended his voyage by an arrow from their ambushes—nor does the owner of the boat escape them always. Opposite them, on the west side of the river, are the Chacobo savages, but extending further north, even to the river Beni. At one time they were a part of the Cayuaba Mission. Late years they have returned to their old barbaric ways. Ascending the Madiera River from San Antonio, in Brazil, the head of steamboat navigation the traveler has to guard himself from the Cangaparangas, who shot and wounded Peter Collins, one of the brothers who had the Madiera and Mamore R. R. in contract; from the Carapuna and on the Mamore River from these two savage tribes.

Well do we remember the anxious scrutiny of every bush and deeper shaded point. Very few are the stoppages when once south of the Guapore, the Indians willingly paddling from 1 A. M. to 11 P. M. Often have we seen them sound asleep, yet never missing a stroke of the paddle, even though they make from forty-five to fifty strokes per minute, all dipping their paddles in unison. One night, having camped on the Chacobo side, after supper, the fires being extinguished, we all lay down for a good sleep. About 1 A. M. the crackling of a twig and sound of stealthy steps aroused the camp and all as quickly and noiselessly as possible took to the boats and paddled to the other side. Turning a bend in the river we came suddenly on a camp of the Houbarayos who were spending the night there. Taken by surprise they had no time to make an attack. 'Tis a question, which were the most frightened, they or our boatmen. The steersman immediately turned the boat away from the bank and it needed no order to make each paddle do its best. Reaching shallow water, some of the boatmen jumped overboard and held the boat till morning, changing duty in the water; as one became exhausted another took his place. Meanwhile we kept a close watch with our arms ready. As daylight came our danger passed, as none of these Indians will attack openly where there is any danger to themselves. At another time while ascending the Mamore with the two Indians and a small boat with whom and which the author had made the exploration of the river Beni, hugging the eastern shore to escape the currents, a voice as if some one was hallooing for assistance was heard. Carefully scanning the opposite bank, for some time, with powerful field-glasses, a naked Indian (Chacobo) was seen standing alone on a bit of sand-bar at the edge of the river. Besides calling he made signs for us to cross over to him. Seeing we paid no heed to him he ceased calling when there descended the bank from their ambush some twenty-five others each with their bow and arrows.

On the river Beni, between 11° and 12° south latitude, are the small tribe of Pacavaras. There are but four families left, consisting of from eighteen to thirty individuals each. Their skin is almost white, bodies well formed, and the women very handsome, features more Caucasian than Indian. They pierce the septum of the nose and thrust feathers through it from each side making them look as if having heavy mustaches: The women wear small flaps or aprons. They attend to the planting, cooking, and every day go to the woods for their fuel, including a wood which, once set on fire, never goes out till consumed, even though cut green. With this, they build a fire under their hammocks, the smoke of which protects them from the sand-flies and mosquitoes, while they loiter away the time, one in each end of the hammock with their feet hanging out each side as represented in Orton's Andes and the Amazons, a position often criticised as impossible. They practice polygamy, every man having as many wives as he can provide meat for.

On the river Madidi, a few miles above its junction with the Beni, is the mission of Cavinas—about seventy individualls comprise the mission. Nearly every year they suffer loss from wandering cannibal tribes, probably the Araunas who live on the banks of the river Madre de Dios north and west of them. That the Araunas are cannibals is beyond a doubt. At one of their visits to the mission one of the men went out to hunt, but returned empty handed, whereupon he went up to his wife, who was nursing a child, took it by the feet, dashed its brains out against the earth and cast the body upon the embers. When done, mother and all sat down to the feast. One could readily believe them to be cannibals, as a more gaunt, ugly, small formed tribe is seldom seen. They wear the hair long and go naked and are greatly feared by the Pacavara and Cavinas Indians. The Cavinas Indians use the Tacana language. In latitude 14° S., some twenty miles west of the river Beni is the village of Tumupasa and, northwest eighteen miles, that of Ysiamas. The former is the village where the civilized Tacana Indians live, the latter that of the uncivilized ones. Rumor says, they, having by chance found a stone bearing a remarkable resemblance to man, accepted it as deity and yearly, during the dry season, assemble there and pass a few days feasting, drinking and dancing. What their ceremonies are, if any, is kept a secret.

Opposite them, on the east side of the Beni, and some twelve miles from the river is the little town of Reyes. Here the Maropa tribe live, probably related to the Tacanas as the Portugese are to the Spaniards. The Maropas are a well formed and generally intelligent people, there being among the females many beautiful forms and faces.

Some forty miles up the Beni is the mission of Muchanes; beyond that Santa Ana; and just above the junction of the rivers from Cochabamba and La Paz, (forming the Beni), and on the former, that of Covendo. These are composed of Mosetena Indians. Their language is Frenchy in its pronunciation.

Falb, the German scientist, returning to La Paz from a visit to these missions announced that he "had found the origin of language." The women of all these civilized tribes do their own spinning and weaving, in which they become experts.

Their spindle is a small stick made of black palm pointed at both ends one of which is thrust through leather about a half inch. Seated on the ground with the left leg double up, the leather end is inserted between the large toe and the one next to it and the stick is then rolled down the right thigh or along a stick of wood prepared expressly for that purpose. Many of the old women have the skin on the thigh thick like the soles of their bare feet. As soon as a child is born it is plunged into cold water. Among the Maropas, as soon as the mother is well through with her parturition the father of the child goes to bed and the mother has to wait on him as if he were the one who had given birth to the child. If very sick they have their coffin made and placed in the house so as to be ready when needed.

While in Santa Ana we were called to see a very sick Mobima chief. He resided in the country, but preferring to die in the village he had sent the measure for his coffin ahead. While examining the patient a man entered and to our surprise began to measure him. Comparison of his measurement with a string he held in his hand gave him to understand that the coffin he had just made was too short, upon which, he had supplicated the sick man to excuse his mistake and oblige him by not dying yet for an hour, as by that time he could rectify the mistake. Wait! was his parting word as he ran out of the house to his workshop, and to his great satisfaction as he returned with the coffin, he found his chief still alive. All these civilized tribes are very cleanly as to their persons and dress.

To this article is appended a comparative vocabulary of languages. The words selected are from the 211 words adopted by the Smithsonian Institution. Care has been taken to perfect the words so that they may be of use to travelers and persons studying languages. The Mobima idiom was first obtained from the Indians themselves and then read to Mrs. Cornelia Serabia de Suarez, an educated lady, who corrected the words, spelling and meaning of many.

The Canichana was corrected by Don Hugo Boger, a German and fine linguist, long resident there. The Maropa by Mrs. Fetterman, a Bolivian lady who learned it as her native tongue. The Tacana and Mosetana by the Padres of the missions. The sounds of the vowels and letters are after the rules of the Spanish language. The foot notes will assist one to understand them. It will be seen that there is a great similarity between the Maropa and Tacana idioms. The Maropas have many words that have significations widely different. Etra means bone and also hair. Biya means a louse, wasp or urine. The Pacavaras count by doubling into the palm of the hands the thumb and fingers repeating the word nata as each is moved till the last, when they say echasu. Pointing to each toe in succession and repeating nata, echasu, they count to twenty. Further numeration is made by repetitions of the same twenty counts. The wanting numerals of the other tribes are made by using the Spanish.

Don Francisco Keller in his "Amazon and Madeira Rivers," gives a short comparative vocabulary and Orton copies it, but they have greatly been misled by some one, as reference to this vocabulary will prove. Keller was in Exaltacion and Trinidad but a short time. The author spent two years carefully perfecting his work.

ENGLISH.	LIVING BESIDE THE RIVER MAMORÉ.			LIVING BES. DE THE RIVER BENI.			
	CANICHÁNA.	CAYUÁBA.	MOBÍMA.	MARÓPA.	MOSETÉNA.	PACAVÁRA.	TACÁNA.
Man.	Hio-chá-ma.	Me-yé-se.	I-ti la-qua.	Dre-ja.	Zoñ-i.	Tsé-que.	Dé-ja.
Woman.	Hui-qui-gá-ue.	Te-na-ni.	Cué-ya.	Á-nu.	Phen.	Yu-sá-bu.	Á-no.
Boy.	Yi-mi-lá-ni.	Mù-mi.	Di-chí-e.	Dre-já-ve.	Na-nat, Phañet.	O-mi-bá-que.	Ca-na-ne.
Girl.	Qui-coj-que-re-jé.	Ma mi-to-ra-ni.	Tor-co-cia.	Pu-ná-ve.	Ná-nas.	Yó-sa.	E-pú-na.
Infant.	Yem-i-la-chú-chu.	Ma-mi-to-ra-ni.	Ta-mí-ba.	E-ja-ná-na.	Na-nat (ichan-qui-ta-na).	Tís-ti-a-ni-á-na.	Ca-na-ne-chí-di.
My Father (said by Son).	Eud-dhí-ti.	E-ra-pá-pa.	U-co-pá-a.	Qui-tá-ta.	Yet-chi-mú-mu.	Pa-pa.	Re-ma-ta-ta.
My Father (said by Daughter).	Eud-dhí-ti.	E-ra-pá-pa.	U-co-pá-a.	Qui-tá-ta.	Ye-si-mú-mu.	Pa-pa.	Re-ma-ta-ta.
My Mother (said by Son).	Eud dha-na.	E-ra-pi-pi.	Ines-má-a.	Qui-cu-a.	Yet-chi-ze (ño-ño).	Ca-i.	Que-ma-quá-ra.
My Mother (said by Daughter).	Eud-dha-na.	E-ra-pi-pi.	Ines-má-a.	Qui-cu-a.	Ye-sí-ze.	Ca-i.	Que-ma-quá-ra.
My Husband.	Eu-coh-ti.	A-ra-ti-ri.	Uco-ál-hua.	Qui-i-á-ve.	Yet-chi-uént-chi.		Que-ma-yá-vi.
My Wife.	Eu-coh-ti.	A-ran-ya-to-nù-ni.	Ine-ál-hua.	Qui-e-vá-ne.	Ye-se-phén.		Que-ma-e-quá-ni.
My Son (said by Father).	E-ma-to-jo.	A-na-chi-ró-mi.	Uco-mách-ni.	Qui-em-bá-qua.	Yet-chi-á-na-mu.		Que-ma-em-ba-mi.
My Son (said by Mother).	E-ma-to-jo.	A-na-chi-ró-mi.	Uco-mách-ni.	Qui-em-bá qua.	Ye-si-á-na-mu.		Que-ma-em-ba-mi.
My daughter (said by Father).	Eu-có-ro.	A-na-chi-ró-mi.	Ina-mách-ni.	Qui-em-bá-qua.	Ye-si-á-na-ñe.		Oni-ba-qua-pú-na.
My daughter (said by Mother).	Eu-có-ro.	A-na-chi-ró-mi.	Ina-mách-ni	Qui-em-bá-qua.	Ye-si-á-na-ñe.		Oni-ba-qua-pú-na.
My elder brother.	E-mat-to-ni.		Á-cai.	Bé-tri. (1)	Yet-chi-vó-git.		Que-ma-o-ní-ci.
My younger brother	E-mat-tsu-i-mam-bus-u-li.		Á-na.	Chin-tri.	Yet-chi-vó-git.		Que ma-coú.
My elder sister.	Eu-cau-la-mat-an-abh.		Á-cai.	Drún-dru.	Ye-si-vo gis-ot chi.		Que-ma-dú-du.
My younger sister.	Eu-cau-la-mam-bu-vi-u-li.		Á-na.	Lá-na.	Ye-si-va gis-ot chi.		Qne-ma-tó-na.
An Indian.	Hi-hur-cú-na.	Indio. (Spanish).	Indio. (Spanish).	Indio. (Spanish).	De-re-cañ-tchi.		Indio. (Spanish).
People.	Ach-kún-ii.	Me-yé-se.	Cüi-é ne.	Dri-a-ni quá-na.	Bo-yén-ye.		En-drá-ni.
Head.	Ni-mu-cúkh.	Gua-na-quà-na.	Ba-quá-qua.	E-chu-ja.	Hu-tchi.		E-chu.
Hair.	Eut-chokh.	Tá-tob.	Ri-sa-quá-qua.	E-tra.	Tim.	Vo.	E chu-é na.
Face.	Eu-cokh ena.	Na-rán-na.	Mó-ran.	Em-bu.	Vê-ya.		Ém-bu.
Forehead.	Eu-shi-ti-daú-le.	Na-rá-na.	Bé-ran.	Em-mà-ta.	Á-pi.		E-má-li.
Ear.	Eu-co-mé-h.	E-na-jen-gí-cui.	Lo-tó-to.	E-sha-cué-na.	Choñ.	Pas-qui.	E dá-ja.
Eye.	Eu-tókh-e.	Eu chá-co.	Tsó-ra.	E ta-chún-dru.	Ve (plural vein).	Hué-ro.	E-trà-drún-dru.
Nose.	E-eb-je.	Na-hau-vé-o.	Bá-chi.	É-vi.	Hey.	Re-quí-ri.	E-vi-é-ni.
Mouth.	Euch-é-ne.	En-di-á-chi.	Cuá-na.	E-quá-tra.	Chó-o.		A qua-tri.
Tongue.	Autsch-á-va.	Na-yí.	Ruch-lan.	E-á-na.	Nem.	Já-na.	E-á-na.
Teeth.	Eu-hùti.		Söich-lan.	E tré.	Mon-yín.	Tsé-na.	É-tre.
Beard.	Eut-chá-ga.		Chus-ca-tin-ca-clan.	Eüe-sá.	Ye-tí.	Cué-ni.	Qué-da.
Neck.	Eu-rī-ya.	Da-bu-ró-ra.	Huó-ro-ca.	E-ti-pí.	Tej.	Te-to ra.	E-tí-pi.
Arm.	Eu-rip-ha.	Nan-yau.	Bó-san.	Em-baí.	Se ûñ.	Po-yá-nu.	E-búe.
Hand.	Su-té-h-li.	En-dá-dra.	Chó-pan.	Em-e.	Uñ.		É-ma.

ENGLISH.	LIVING BESIDE THE RIVER MAMORÉ.			LIVING BESIDE THE RIVER BENI.			
	CANICHÁNA	CAYUÁBA.	MOBÍMA.	MARÓPA.	MOSETÉNA.	PACAVÁRA.	TACÁNA.
Fingers.	Eu-o-cle-uts-é me.	En-dá-dra.	Dimp-pan.	Em-e-chú-ja.	Chi-ri-jí-ri.		É-ma.
Thumb.	Eu-o-cle-uts-é-me.	En-dá-dra.	Dimp-pan.	Em-e-chú-ja.	Chi-ri-jí-ri.		É-ma-chú-ai.
Nails.	Eu-ra-ca-tó-h.	Do-quí-ra.	Cho-rín-pan.	Em-e-tí-chi.	Pa-tchi-ni.		É-ma-tí-chi.
Body.	Eu-hel-e-tó-io.		Lo-bá-ban.	E-á-mi.	Á-tsa.		E-qui-ta.
Chest.	Eu-uact-si-dan-ti.	E-na-ja-cá-e.	Be-rá-ran.	E-chén-tru.	É-fe.	Shi-pá-ti.	E-tré-du.
Belly.	Em-an-ca-ar-ëú.	E-na-na-ca-bi.	Tso-dó-be.	É-sé.	Vó-co.	A-tóc-na.	É-tu.
Female breasts.	E-e-mé-ni.	A-na-má-mi.	Tsá-jan.	A-tru.	Ta-chi ni.	Chó-cho. (1)	Á-tru.
Leg.	Eut-chó-ta.	E-na-ji-ré-ra.	Di-nó-jan.	É-tá.	Yu.		E-ti-dá-da.
Foot.	Eu-ajts. [li.	E-nár-je.	Rí-san.	E-vá-tri. (2)	Yu.	Tá-e.	E-quá-tri.
Toes.	Eu-qui-chi-un-at-an-		Din-pó-jan.	E-va-tri-ti-chi, (toe-	Chi-ri-jí-ri.		E-qua-tri-ri-tra-na.
Bone.	Ni-mak-lti.	Na-ra-quí-yi.	Nún-i.	E-trá. [nails).	Yiñ.		É-tro.
Heart.	Eu-ni-má-ra	Na-ra-cá-je.	Jas-la-huan-dra. (1)	Ma-su-mù.	Cot-chi.		Ma-sú-mo.
Blood.	Eugh-ab.	Da-ta-ru-a.	Don-i.	Á-mi.	Cho-sé		Á-mi.
Town, village.	I-púb-lo.	En-ta-ru.	Ló-los.	E-jun-tré.	Bo-yén-ye.		E-jú-de.
Chief.	Eu-tí-shi. (casique).	Casique. (Spa'h).	Casique. (Spanish).	Casique. (Spanish.)	Mo-chó-ye.		Casique. (Spanish).
Warrior.		Na-chú-mi.	Já-rra.	Ja-ma-ji-tí-pu-ji. (3)			
Friend.	Eu-co-pan-li-na.	In-yé-ca.	Al-dra.	E-pe-ré-je.	Ña-pu.		A-pa-ré-je.
House.	Nit-cojl.	Casa. (Spanish).	Dró-ya, (when occu-	E-tai.	Á-ca.	So-bo.	Ej-tej.
Skin-lodge.			[pied, " As-ña ").				
Kettle.	Nim-ú-da.	To-ren-dú-to.					Có-to.
Bow.	Eu-que-sin-to.	Ran-pu.	Tan-i-lo.	Pi-zá-trú-e. (z-th).	Co-in-ye.	Car-ni-á-ti.	Pi-sa-tri.
Arrow.	Eus-cú-ra.	Da-bi-hí-qui.	Jur-pa-huan-di.	Pi-zá. (z-th).	Yg-me.	Pi-a.	Pi-sa.
Axe—hatchet.							
Knife.	Neor-caab.	An-da-tuár-e.	Ca-chí-ru.	Cu-chi-lo.			
Canoe.	Ni-tu.		Jú-be.	Cu-am-bá.	Pó-ne.	Nú-ti.	Cuá-bua.
Tobacco.	Ni-cu-mú-cu.	Yú-pa.	Yu-má-res.	U-ma-za. (z-th).	Cos.	Rom-ui.	U-már-si.
Sky.	Eu-cu-neo-tao-li.		Ven-dra.	Em-ba-qua-pa-chá.	May-ye-si-yé-che.		Buey-ú-pa.
Sun.	Ni-coj-li.		Tí-no.	I-sje-ti.	Tsuñ.	Huá-ri.	I-ré-ti.
Moon.	Ni-mi-lau-e.		Yé-che.	Ban-trí.	Yvúa.	O-si.	Bá-di.
Star.	Ni-có-ma.		Di-rin-qua.	Bu-a-ná-vi.	O-ni-ta.		E-rú-jai.
Day.	Neo-o-cu-li.		Jej-mas.	Trí-ne.	May-ey. (1)		Trí-ne.
Night.	Ca-qui-tí-ji.		I-mai.	A-pu-mé.	Yo-möi. [ing).		Li-za. (z-th).
Morning.	A-mar-u-im.		Trrú-büi. [mid-day.	Maí-ta.	Pa-min.(early morn-		Ma-ta-chu.
Evening.	Chu-at-ji.		Hua-lai-lu. Chon-ci	Tri-ne-quá.			Tri-ne-tí-a.
Wind.	Neurajábhn.		Pó-mo.	Bé-ni.	Pi-tíg-ti.		Bé-ni.
Thunder.	Cnaan-er-em.		Yam-pa.	Tí-ri.	Pi-rig-ri.		E-ti-ri-á-ni.
Lightning	Nco-gat-hi.		Tam-si.	Ji-li-ji-li.	Phen-pheu		Tse-ru-tse-ru.
Rain.	Ni-ná.		Lu-ti.	Nai.		O-i.	Nai. [embers.)
Fire.	Ni-chu-co.		Vüé-e.	Cuá-ti.	Tsi.		Quá-ti-(Qua-tidoreda
Water.	Nih-tji.		Tó-mi.	Yú-vi.	Oz-ñi.	Jé-ne. (2)	E-á-ve.
Ice.					Je-tís.		E-á-na.
Earth—Land	Nich-ich. (German).		Tla-cámp-ba. [er.	Mé-tri.	Ac.		E-na.
River.	Nih-cug-u-jú.		In-qua. (Mamoré riv-		Yn-ca.		
Lake.	Nih-sip-h.		Pou-lo—Tolin-lo. (2)	Bai.	Zí-que.		Bai.
Prairie.	Nik-sháva.		Ro-i.		Y-pán-ye.		Nuts-à-ni.
Hill—Mountain.			[Forest.] [Isle. (3)	E-mí-na.	Me-que.		E-ma-ta.
Island.	Ni-schu-ám-choj.		Cham-mo-paich-len.	Isch-á-pu-pu.	Pot-cho or Chet-cho.		E-da-pú-pu.

Stone—rock.	Ni-cum-tshi.	Chám-pa.	Tu-má.	Mij̄.	Tó-mo	Tñ-mu.
Salt.	Neu-lú-cu.	Ndo-yon.	Bá-no.	Yc-co.		Bá-nu.
Iron.	Ni-hi-úr-u.		Pe-a-má.	[the forest).		
Forest.	Ni-scu.	Co-ó-mo.	Hay-jin-tru.	Dé-re, (Derecañ in		E-jí-je.
Tree.	Ni-yi-ga.	[wood).	Á-qui.	Tsoñ.	I-vi.	Á-qui.
Wood.	Ni-pa-ti-huá-re.	Co-ó-bos. (Co-ó—fire-	Á-qui.			Eí-na.
Leaf.	Nim-tijl.	Lo-ran-qua.	E que ná.	Chalñ.		
Bark.	Nim-ar-ar-ih.	Tso-bén-qua.	Em-bi-ti.	Z-pi. (z-th).		E-vi-ti.
Grass.	Nim hu-gu.	Mo-ás-qua. (4)	E-á-ji.		Tsé-qui.	Núts-a.
Maize.	Ui-tju.	Quás-tá.	Shí-je.	Di-je.		Di-je.
Squash.	Ni-tza-hajl.	Va-ris.	Jé-mi.	Cho-bo.	Na-mi.	Jé-nu.
Flesh—meat.	Ni-huá-ca.	Hua-ca-to-da.	E-á-mi.	Chilrs.	Chas-pa.	Aí-cha
Dog.	Ni-pao.	Paco.	Pa-cu.	Á-cho.		V-chi.
Bear.		Ba-na-ma,(ant bear).	A na, (ant bear).	Un-ut-chi ne. (2)		
Wolf.		Tu-ya-va, (canis ju				
Fox.	Ndu-á-ne-que.	[vatis).				
Deer.	Ni-hgup.	Dou-jez, (Ye-ba—	Ba-trú-nu.	Ñe.		Bá-que.
Guinea Pig.		Bá-tus. [gamma).	Huambu-schá-pi.			
Tortoise.		Só-no.	Drá-ti.	Te tác-ye.		Da-ti.
Fly.	Ni-Khuj.	Do-mo.	Be-bi.	Mue, (niglese).		Ve-re-ve-re
Mosquito.		Ca u.	Dri.	Mue.		Sani or Di.
Snake.	Ni-ra-ye.	Mi-mi-di.	Ba-cua.	Naz, (all kinds).		Ba-cua.
Rattlesnake.	Ni-chi-ti.	O-lo-ba-huas.	Sum-ba-cua.			Ba-cua-da-da.
Bird.	Ni-me-lú.	Jo-me, (hen). (5)	Bú-ni.	Aij-tch.		Dia.
Egg.	Da-va-ri-mí-chi.	Jor-qua.	É-ja.	Jsen or Pen.		É-ja.
Feathers.	Nimcol-li.	Mu-mún-qua.	E-nú-qua.	Phañ.		E-i-na.
Wing.	Ni-mparjep.	To hai-á-hua.	En-nam-bai.	Pa-va.		E-na-bay.
Duck.	Ni-vurij.	Co-corre. [key).	Zú-zi. (z-th).	Oppa.		Sé-e.
Turkey.	Ni-rovi.	Ma-má-cu, (wild tur-				
Pigeon.	Npa-cu.	To-lo-do.				
Fish.	Ni-ka-ku.	Vi-lou.	Sí si.	Señ.		
Name.	E-hu-a-cu.		Em-bá-ni.	Ti, (very nasal).		E-ba-ni.
White.	Hmbára.	Tá-vu.	Pazáme. (z-th.	Ai-bai. [shame.)		Pa-sa-na.
Black.	Nim-ca-a rá.	Tú-ni.	Se-bé-mi.	Zin-cui, (also means		De-ve-na.
Red.	Nim bitsi.	Ra-bal.	U-tru-mé.	Choi-ñoi.		De-re-na.
Light blue.	Ma sá-sa.	Sru-bo.	Sa-va-mé.	Met-se.		Da-na-ne.
Yellow.	Macsuzuj.	Sérre.	Za hua-mí. (z-th).	Ñes-ñey.		Tid-ni-a.
Light green.	Nik-cha-cha.	Noj-na.	Sche pí-ëi.	Za——, (Jpe(.		Chi-na.
Great—large.	Ni-hi-ma-rá.	Me-réj-e.	Hay mi.	Der-tchi.		Aí-da.
Small—little.	Ti-ti-di-i.	To-chi.	Ba-ta-ví-chi.	Ztchanguis.		Chí-cli.
Strong.	Hmbe-re.	Di tes.	Tre-tre-mi.	Ter.		Tu-ché-da.
Old.	Yits-nám.	Bí-jou.	É-si.	Piret.	Noí-ra.	É-cli.
Young.	Hic-oc-he-re-hé.	O-ve-ní-huan-qua.	Dre-ja-ve-ve.	Phañet; Chotcho.		E-de-á-ve.
Good.	E-er-ets.	Dó-co-i.	Jun-dra.	Hem.(h pronounced)	Shúma.	Sai-da.
Bad.	Itjmúp-se.	Ruj-ra or Don-tóe.	E-ma-sá.	Achit; Achis.	Shúma-é-ma	Ma-dá-da.
Dead.	Hmu-cu-u-la-na.	Caí-ne.	Ma-nují-ji.	S̄ñi.		Ma-nu-ji-ji.
Alive.	Yi-e-ré-re.	I-té-ne.	E-sche-vé-ve.	Za.		Ei-clé-ja.
Cold.	Meu-hul-lí.	Ji-ló-ca.	Vin-ná-ma.	Je-tis.		Bru-a-da.
Warm—hot.	Meu-hal-lic.	Ve-ó-ni.	Zin tri-trí-me. (z-th).	A-páe.	I-quí-ni.	Sin-á-da. [tive).
T.	O-fo-ho-já-li.	In-cla.	É-me.	Ye. (very nasal.	U-á-u, (Jene-u-a-ni).	E-ma, (E-á-ma ac-
Thou.	I-na-há-li.	Ul-cua.	Mi-ve.	Mi.	[Water. Hot.	Mi-cla.
He.	Yic-ho.	Us-co.	Tuve.	Mo. [Spanish).		Tu-e-da.
We.	O-hej-jal-ji ná.	I-tli.	E-ca-má.	Tsiiñ, (ii French—ñ	Jó-a.	Ecuana, (Etsea dual).
Ye.	Nha ic-ho na.	I-bi.	Mi-cá-ve.	Mim.		Mi-cu-a-na.
They.	Ponayi-migá.	Is-co.	Tu-ná-ve.	Mom.		Y-chu-cu-a-na
This.	Niull eje.	E-aí-ra.	I-yé.	Uts, (u French).		Yhe.

ENGLISH.	LIVING BESIDE THE RIVER MAMORÉ.			LIVING BESIDE THE RIVER BENI.			
	CANICHÁNA.	CAYUÁBA.	MOBÍMA.	MARÓPA.	MOSETÉNA.	PACAVÁRA.	TACÁNA.
That.	Yo-vi-e-je.		Cul-dréj.	I-chú.	Mo.		Yeh-u.
All.	Ma-ta.		Ba-ra.	Hua-ná.	Ere; Erem.		Pa-ma-pa.
Many—much.	Chu-yu-gó.		Cau-ra.	Drú-je.	Day.		Yu-cu-á-da.
Who.	Ktan-hati.		Ej-clej-lan.	Hay-se.	Chinca; Tchis.		Ay dé ni.
Far.	Pá-yi.		Quí-la.	Huazumi. (z-th).	Moch.	Hua-sir.	U-que-da.
Near.	Co-ñó.		Crú-e.	Dre-má.	Yme.		Narise.
Here.	Heum-ché.		É-ne.	I-e-zú. (z-th).	Oya.		U-pí-ca.
There.	No-coh-ché		Nos-dé.	I chú-zu. (z-th).	Move; Mive.		Chu-pia; Da-pi-a-vi.
To-day.	Mi-mo e-ru-lí.		No có-a.	Je-á-ve.	Quin.		Je-á-ve.
Yesterday.	Nco-he-ti-ji.		La-jé-mes.	Ban-tra.	Muñas.		Mai-ta püi-cha.
To-morrow.	Hama-eshi-ti.		I-máy-o.	Mai-ta.	Nog-no.		Mai-ta-püi-cha.
Yes.	É-he.		Dí-ra.	E-e.	Ehe. (h pronounced).		É-he.
No.	Ni-huas-h.		Cai-i.	Má-ve.	Am.		Má-ve.
One.	Me-re-ca.		So-ta-ru.	Pem bi-ve.	Zrit.	Nata. (doubling the	Pea; Peada.
Two.	Ca-a-di-ta.		Oi-ra.	Be-ta.	Pana.	Nata. thumb and	Be ta.
Three.	Ca-ar-ja-ta.		Taj-ra.	Ca-mí-scha.	Chibbin.	Nata fingers of both	Qui mi-scha.
Four.			Oi-ca-ra.	Pu-schi.	Ts-is.	Nata. hands then	Pu-chi.
Five.				Pi-schi-ca.	Canam.	Nata. repeat Nata	Pu-chi-ca.
Six.				Schu-cu-ta.	Ebe-uñ.	Nata. each time and	So-ca-ta.
Seven.				(4).	Ye-ve-tí-ye.	Nata. Echasu at the	
Eight.					Quon-can.	Nata. last, making	
Nine.					Araj-tac. (j French).	Nata. ten).	
Ten.				Tunca.	Tac.	Echasu.	
Eleven.				Pembi-ve-tunca-bi-ja.	(Combination of Tac with the unities.	Nata. (pointing to	
Twelve.				Beta-tunca-bi-ja.		Nata. each toe makes ten more using Echasu last meaning 20).	
Twenty.				Beta-tunca.			
Thirty.				Camischa-tunca.			
Forty.				Puschi-tunca.			
Fifty.				Pi-schi-ca-tunca.			
Sixty.				Schu-cuta-tunca.			
Seventy.							
Eighty.							
Ninety.							
One Hundred.				Tunca-tunca.			
One Thousand.				Tunca-tunca-tunca.			
To Eat.	A-ha-li-ma.		Cai-ca.	Chan-cha.	Sexi.	Jai-jai. (3)	Dia-dia.
To Drink.	Au-ha-co-qui.		Ya-ló-e.	Jai-schi-ti.	Thi-eí.	Se-a-ni.	Ei-cli.
To Run.	Cam-co-ya.		Já-i.	Van-drun-dru.	Pi-qui-i.		Ju-dú-du.
To Dance.	Au-da-hda-ra.		Té-lo.	Ti-ri-ti-ri.	Ro-a-yá-qui.	Mu-nu-a-na.	Tiri-tiri.
To Sing.	Au-jar-son-is-na.		Leu leu.	Zá-tru. (z-th).	Yma-qui.		Sa-tsu.
To Sleep.	Au-jar-ja-na.		Joró-quo.	Ta-bi.	Cu-chi. (ch French).	O-sa-ni.	Ta-bi.
To Speak.	Au-jarp-hur-ma.		I hua-ni.	Mi-mi.	Misí. (Misimi speak [you).		Mi-mi.
To See.	Au-jar-co-iv-óe.		Vai-es-qui.	Jam-ba-ti.	Nai; Cavei.		Ba.
To Love.	Au-ari-hua-na.		Ye na.	Imbu-nim-bu.	Raise.		Es-bu-né-ba.
To Kill.	Au-artch-ji-na.		Te-coi-na.	Ma-né-me.	E-ja-ti. (j French).		E-ma-nu-a-ni.
To Sit.	Au-jar-sue-na.		As-qui.	A-nim-bo-ti-a.	Bey.		A-ni-ú-ti.

To Stand.	Ti-a-ta-u-si.		En-qui.	Né-ti.	Quich-bei.		Enu-tsi-ne-je-ne-tsi.
To Go.	Au-jar-ti-qui-na.		Jai-i.	Pú-ti.	Yn-cai.		Pu-ti.
To Come.	Au-jar-tui-nas.		Yé-la.	A-pué-ya.	Atsi.	Que.	Pue.
To Walk.	Au-jar-cul-la-na.		I-ló-ni.	Á-ze. (z-th).	Mii.	Ca-qui-a.	A-re-a-sé.
To Work.	Au-jar-si-li-la-na.		Tis-cárib.	Mun-dru.	Cari-ta-qui.		Mu-du-mu-du.
To Steal.	Dak-siu-si-na.		Tol-ca-rá-na.	Tri.	Choay. (ch French).		Tsi.
To Lie.	Yik-tod-se.		Ti ja-sí-pa.	E-á-na.	Ue-ñey.		Bi-du-mi-mi.
To Give.	Au-dar-chi-ti.		Cui-lé-ti.	Ti-á-na.	Som-ei.		Tia.
To Laugh.	Au-jar-do-cu-na.		Jo-sí-chel.	Ja-schi-ba-ti.	Yé-se.		Y-de-bá-ti.
To Cry.	Ita-ji-nu-e-na.		Ca-má-me.	Je-ja-je.	Vuorac.	Jo-ya-na.	Tsia-tsia.

In all these idioms the Spanish rules of pronunciation are followed:

A-ah; E-a: I (or Y alone-ēē—o-ō; U-uin, you; J-h, (h is silent or scarcely perceptible); Que-ka; Qui-kēē; Gue-ga; Guí-gēè; Ll when not divided as ll in William; Ñ the sound of "on" in onion.

Mobima —1. One word for stomach and heart. 2. No general name for lake or river. 3. Paichlen, is an elevated land which is surrounded by water during the rainy season; Chammo means forest—together they indicate the places selected for residences on the cattle estates, which, during part of the year, are truly wooded islands. 4. Dimas, grass for thatching. 5. All birds have special names.

Maropa.—1. Eldest brother says Ca-ni to his youngest sister. 2. No word for toes; Fingers and thumb are "the head of the hand." 3. Warrior means a fighter, or quarrelsome person. 4. 7-8-9, 17-18-19 are expressed in Spanish. The seasons are the dry—Mu-rí-mi; and the wet—Nai má-ra.

Mosetena.—1. Day means "it is daylight." 2. Bears are found in the mountains where the Mosetenas reside, but not in the low lands where are located the other tribes; with them bear means the great ant-eater, which is called in Spanish, "flag-bear." Ch,Ph. Z and J have the corresponding French sound.

Pacavara.—1. Chu-chu ih the Maópa idiom means to nurse. 2. Jene-n-a-ni is hot water. 3. Jai-jai-o-ra-qua-ti. roast meat.

GEOLOGY.

TERTIARY COAL MEASURES OF GUNNISON COUNTY, COL.

JOHN K. HALLOWELL.

Some time since, a communication in the form of a query was published in the Denver and Gunnison papers over the signature of Charles Henry Baker, M. E., asking, in reference to the coal found in that county, "Is it anthracite?"

I send you the following, thinking it may help to settle the question, as well as give some additional information of possible practical value; this being the result of personal observation during a close examination lasting nearly five months, spent in and around these coal measures, with a view to determine their age, structure, and, in a measure, their commercial value, as seen locally and in comparison with data obtained from other sections.

The first five years of my geological work being among the coal measures of Missouri and Kansas, I have always been much interested in what had been brought to me in the way of specimens from the Gunnison country coals. For two years these specimens had come, the parties having the same claiming the product to be anthracite. This I disputed, as no one could inform me of any change in the connecting rocks that showed an opportunity for a change in the coal, by metamorphism, from a bituminous coal to an anthracite. In fact, I considered (without tests) that the appearance of the specimens was, in gravity, fracture, and luster, against such a result. The coals appeared more like the Albertites of Nova Scotia, or a coal highly charged with bitumen. On the other hand, the chemists' analyses shown me gave such high results in fixed carbon that it must be rated as an anthracite; and if the latter, the rocks accompanying the coal-seam must show a corresponding change. As stated, of this none could tell me, and, as a geologist, I must confirm what the chemist had shown or find out the reason why.

The geological structure of this coal measure formation, as seen by myself in the Crested Buttes and Ohio Creek basins, was a revelation, as nothing like it is known or described in any works that I have; many things appeared to be reversed and not at all analogous to other known localities where coals occur. So great was this difference that I must give the facts as seen by an ordinary observer, and then try correctly to describe the geological structure, adding thereto a description of the characteristics of other sections, that the difference may be realized.

Take the first openings back of Crested Buttes town, and to my amazement the coal lay upon shale, with a solid sandstone roof; and for 1500 feet thick, as these measures appear to be, the rock formation is shale, coal, and sandstone; no limestone belongs to this series, and nowhere does any animal life appear to have existed in the waters that deposited the sediments making the present existing sandstones and shales. All other coal measures known have most abundant remains of shell-fish in the limestones, sandstones, and shales of their respective ages.

The only fossils are the impressions of leaves of land plants and trees that floated out to sea, sank, and left a record in the sands, saying here was a tropical climate, as most beautiful palm-leaf impressions are obtained in one horizon, as well as many other leaves grown in a like latitude or climate, whose names I do not know.

The sandstone itself is a marvel, in places many feet thick, and repeated just the same many times in different strata; as, in looking for a cause that would account for the absence of life in these waters, I found the sandstone was not the *detritus* from the wearing away of other rocks, but was a precipitation of particles of quartz from a hot sea, carrying an excess of silica in solution, cemented by a small amount of material that was produced from dissolved feldspar; not a rounded pebble in the whole series, but even-grained and homogeneous throughout.

I examined 100 square miles of these measures, and in the midst of it all found 2000 acres of anthracite coal, the finest of its kind known on the continent, a four foot vein, giving from 90 to 94½ per cent of fixed carbon and no iron or sulphur in an appreciable quantity.

To finish with, 1000 feet of conglomerate had at one time been deposited over the whole of this, and in another locality recent lavas were found overlying these Tertiary sandstones.

If the above, which can be seen by any one, was not a geological problem, I have never met one. To solve it, I had to find the rocks of the next oldest age, which proved to be Cretaceous, large shale beds of this age existing partly metamorphosed to a slate, and containing the characteristic fossil—*Inoceramus*—of the Cretaceous seas.

The closing of this age gave me the key to very much, as locally it is marked by one of the most stupendous eruptions of volcanic paste that ever was known, covering hundreds of square miles on a Cretaceous sea-bottom, not only flowing over these muds, where lived the *Inoceramus*, but also elevated in enormous masses, which now show as mountain ranges, as well as single mountains or cones. This volcanic mass is now geologically identified as granite porphyry, its constituents being silica, horn-blende, feldspar, a small amount of mica, and occasionally a small crystal of sanidine. The feldspar separated into beautiful crystals, with perfect sides and terminations, some of them of large size, held most firmly by the silica which makes the bulk of the paste. So much harder is this inclosing paste that it was difficult to get good specimens of the crystals, the latter decomposing more readily, and leaving perfect casts in the rock.

This granite porphyry would make the most beautiful building stone, as it is more easily quarried than Maine granite, more readily dressed, is just as durable, will take as high a polish, and when finished is as beautiful as any marble known, has no mineral constituents to oxidize and stain, and is in inexhaustible quantities. It comprises such mountains as Crested Buttes, Gothic, Carbon, Edgely, Beckwith, and Marcellina, as well as the ranges known as Ragged Mountains, the Anthracite range, and Wheatstone group. Near to part of these now run two railroads, and in time along these lines will be mammoth quarries; for here is a better rock to send East than the East can possibly send West.

The next move of nature in this locality was to elevate these submarine mountains above sea-level, so that shallow marshy seas were at their bases. The climate was at this sea-level, I think, more tropical than anything that we are acquainted with at the present time; as not only was the latitude such as to have hot seasons, but, in addition, towering up thousands of feet in every direction, were these mountains of volcanic material, giving off large volumes of heat by radiation; large masses of volcanic rock cool slowly in the atmosphere. In the gorges and open shallow seas of this Tertiary age, at the feet of these mountains, and among all of this warmth—and very great moisture there must have been in the atmosphere, too—commenced the growth of the plants that now make these Tertiary coals. How long time is, under such circumstances, as we reckon it, we can have no data; but sufficient was the period of rest here, for these plant-growths to accumulate several feet thick.

Here I want to do a little local reasoning, that in principle may apply to other eruptive localities. To begin with, this eruptive matter must have been the product of internal heat below the earth's surface; the overlying crust must have been proportionably strong to hold such a vast quantity confined, with its cumulative force of steam and gas; when this power had accumulated sufficiently to exert itself, the eruptive power was in ratio to the power used, which again was in proportion to the thickness or resistance of the overlying earth-crust; after the eruption, there would be an internal cavity approximating in size to the cubic contents of the mass recently brought to the surface; the original surface rocks would have the tonnage to support represented by the mass of eruptive material; this weight on the underlying shell then became to a greater or less extent plastic, and, without internal support, would cause a local sinking at varying periods, which periods of subsidence were represented by changes in the more recent sediments which were afterward deposited on the new floor or sea-bottom; and each and every one of such changes of sea depths can be counted by the variations in the newer strata of rocks.

Noting the above reasoning, in these coal basins, we find after a time a subsidence, and on top of the coal plants flowed a greater depth of water. The mountains were still hot, the exposed surfaces somewhat decomposed, this influx of water was heated to a great degree and took into solution silica, which coming in contact with the organic matter in the then sea-bottom, was precipitated, and also by the gradual cooling of the waters.

Here this section for a time was stationary, and the sands gradually filled these watery depths until another shallow sea was repeated, and a subsidence followed which washed all of the loose moveable soil of the adjoining lands and islands into the deep sea. This material made the mud deposit—shales now—which follows the sandstone. On these muds in shallow water the growth of the coal plants again commenced, to be followed in repetition by what has already been shown; and this was repeated six different times, for eighteen different subsidences and periods of rest are now shown to have occurred here locally; perhaps more, if we could get at the deepest part of any one of these basins. The strata built up, as near as I could ascertain, aggregate 1500 feet in thickness.

Then followed a greater subsidence at once than at any single time previous; a wider area of territory was acted upon by deeper waters; and instead of sandstones, resulting from precipitation, we have 1000 feet of conglomerate, which covered all of the named mountains of granite porphyry.

This Tertiary age was closed by the eruption of the lava showing on the dividing ridge between Ohio Creek and East River near Howville or Jack's Cabin. Subsequent erosion shows this lava on top of the Tertiary sandstones, and subsequent erosion has worn down these sedimentary rocks deposited in the old mountain gorges between peaks and ranges of granite porphyry, laying clear the structure from the latest strata to where it began, and all to be seen and reasoned out as I have shown.

Now for the anthracite. I spent two days on Anthracite range, camping out to get at the following: Standing on the top of this range, it could be seen that, at the time of the recent or lava eruption, a deep gorge or crevice had opened from the eruptive point through between Wheatstone group and Mount Carbon. This opening came against the end of the Anthracite range, with the effect of setting or splitting off a single mountain mass by itself. This crevice, evidently, was also filled with eruptive matter, not coming to the surface, but exerting force and pressure sufficiently to slowly crowd this single mountain northward, which in its turn pressed against the coal measure strata built up at its feet and against its sides with such force that these originally horizontal sedimentary rocks were raised to an angle of twenty-one degrees. The heat and pressure generated by this rock movement metamorphosed a coal-bed under 2000 acres from a bituminous coal to a four-foot vein of the finest anthracite that is now known. Here geology and chemistry agree, and at this point, I think, Mr. Charles Henry Baker, M. E., is answered that it is anthracite.

The eruption of this lava raised the Tertiary beds so that all of the strata dip away from the lava outcrop, eight and one half feet in each 100 feet; although in the Ohio Creek basin, I think, from what I saw, that the dip gradually increases as the lava mesa is approached. The sedimentary rocks broke in short cross-sections; along these breaks, lines of erosion now exist, wearing the surface into numerous gullies, exposing the coal-seams and thus making opportunities for original discoveries.

In the Ohio Creek basin, the greatest development is in the South Park coal-seam, opened under the superintendence of Mr. William Housely. The work is laid out on the English or long-wall system, and certainly showed the best work and most economical results of any of the work which I examined. In this basin, another vein, the Richardson, has been opened on the Augusta and Owens claims, as well as on many others.

A section of these coal measures in the Crested Butte basin, where they are principally worked, would approximate as follows:

No. 1.	300 feet from top of hill is	1 foot of coal.
No. 2.	80 feet below this is	3 feet of coal.
No. 3.	65 feet below this is	4 feet of coal.
No. 4.	185 feet below this is	6 feet of coal.
No. 5.	70 feet below this is	10 feet of coal.
No. 6.	To this add in the Ohio Creek basin 200 feet below is	7 feet of coal.

Seam No. 1 is practically worthless.

Seam No. 2 is that opened and known as the Howard F. Smith bank, up Slate River.

Seam No. 3 is opened on the Smith & Jefferson claim, on the Weaver property, and one place between the anthracite coal near Irwin, on Anthracite range, is in this horizon.

Seam No. 4 is opened by the Colorado Coal and Iron Company, and in Baxter's Gulch. In the Ohio Creek basin, No. 4 is represented by the Richardson, Augusta, Kubeler, and Owens openings.

No. 5 is the coking coal vein now worked in the Crested Buttes basin, by the Colorado Coal and Iron Company.

No. 6 is only known in the Ohio Creek basin and in the South Park Company's openings.

The eruption of the lava caused the fissuring of these Tertiary rocks, so that now we have what has hitherto been unknown, namely, silver veins containing rich ruby and native silver ores, passing through coal measures. Where these veins break though, the coal-seams are liable to be broken and faulted; and in immediate vicinity to the fissure-vein, the coal will contain more or less iron and sulphur; at the same time, fragments of the coal will be found inclosed in the gangue-rock of the crevice.

Having some remarkable analysis of fixed carbon shown me from an opening up Slate River, three miles beyond Crested Buttes, I went especially to examine the openings on the property. This vein would be the No. 2 of the series. The coal originally outcropped in a small gulch eroded into the side of the ridge rising from Slate River, and opposite to the entrance to O-Be-Joyful basin.

The coal was followed in for nearly 200 feet, most of it being good merchantable coal, some of it having fixed carbon enough to be rated as an anthracite, and showing remarkably well in the face for this No. 2 vein. Numerous cracks or faults occur in the roof or sandstone, now making mud seams; near these, the coal was broken and worthless.

A new opening has been made into the hill from the head of the gulch, now nearly 300 feet in. On one side of this opening the coal is constant; on the other, a fissure-vein filled with eighteen inches of calc spar, coming from the direction of O-Be-Joyful Gulch. This will certainly carry mineral with depth, and makes a connecting link through to the veins of Washington Gulch, and absolutely proves in fact what I had first advanced as a theory, that in localities the mineral veins would be found passing through coal seams.

I followed these Tertiary rocks across the head of Washington Gulch, between Gothic and Baldy Mountains, back of Belleview Mountain, down the valley of Rock Creek, over Mineral Point, Meadow and Arkansas Mountains; and could see where they again came in below the lake near Rock Creek. Here erosion shows these old Tertiary sea-bottoms to have been deep enough for the coal-seams to again appear, and report says there are much stronger veins than those in the particularly described basins.

The coal series of the Front Range of Colorado, as well as in Middle and South Parks, belong to the Cretaceous age. While I found Cretaceous rocks in abundance on the west slope in the section examined this season, I did not find the coal of the same age, except in one locality, namely, Chicago Park, two miles from Pitkin. Here some holes have been sunk, disclosing the coal, but also showing, from evident and easily perceived causes, that it is worthless, being highly charged with iron and sulphur. The quantity here also must be very limited.

As to the character of plants that grew in these waters to make these coal-seams, there appears to be such a diversity of opinion among the highest authorities, that I do not think this character of metamorphism has been sufficiently proved as yet. This I would like to record, that from my personal work this season, the great difference between ordinary bituminous coal and that which is called the coking coal, would certainly seem to arise from a material difference in the original vegetation.

I spent five days at Jack's Cabin, examining the rocks in connection with the lava outcrop, principally, because I had been informed that large bodies of hematite iron existed here; in fact, one of the United States geological reports gives this locality as the place where the largest body in iron ever seen occurs. After five days' work, I could not find it, and came to the conclusion that the first examination was a hasty one and the conclusion jumped to that this black lava was hematite iron, when, as a matter of fact, it does not contain ten per cent of iron.

I thoroughly examined the eroded basin between the two lava mesas, hoping to find evidence of the coal-seams here, and that the heat and pressure from the over-lying eruptive rock would have changed such coal to an anthracite, but I could not find a particle. At present, I feel, from the showing, that the basin is not eroded to great enough depth to catch the coal-seams. On the other hand, there is a possibility, for all that now shows, that on this edge of the coal basin the underlying rocks rose, and only allowed the upper coal measure strata of sandstones and shales to be deposited over the older rocks, and the coal-seams do not exist.

I note the above from the fact that farther up on the Slate River, this same thing has occurred, from about the entrance to O Be-Joyful basin. The Cretaceous shales appear by the roadside, and above them is the overflow of granite porphyry, overlain in turn by the strata of Tertiary rocks, but only having in places the upper veins of coal Nos. 1 and 2, while the two seams worked by the Colorado Coal and Iron Company are entirely wanting. This occurrence is repeated up Coal Creek, a short distance from the Colorado Coal and Iron Company's openings; a break occurs across the hill between Coal Creek and Baxter's Gulch, which, I believe, will mark the end of the two lower veins of this basin westward.

Such results as are set forth in the above paragraphs show how limited is the real coal area of the Crested Buttes basin, while on the Ohio Creek side, such things do not appear to have occurred, which makes the area of this latter basin very much greater for a possible product of merchantable coal.

In speaking of the geology of coal sections, Dr. J. S. Newberry says "that many of the coal-seams of Ohio have been worked into, and exposed the following phenomena to view:

1. "A fire-clay below each seam, permeated with roots and rootlets of stigmaria.

2. "A coal-seam having a maximum thickness of six feet in the bottom of the basin, thinning out to feather edges.

3. "The coal on the margin of the basins is sometimes thirty or forty feet above its place in the bottom.

4. "An average of two and a half per cent of ash.

5. "A roof composed of argillaceous shale, of which the lower layers are crowded with impressions of plants."

The above might be used for a general description of all bituminous coal-fields of the Carboniferous age.

The field I examined differs from No. 1, in that there is no appreciable amount of fire-clay, and argillaceous shales make the floor; from No. 2, in that in one place I found the seam of coal full size, abutting directly against granite porphyry, although, when the field is fully explored, there may be localities thinning out to feather edges, the same as in Ohio.

No. 3 might be found to differ locally in all coal basins. Of No. 4 the same might be said.

I think these Tertiary coals average more than two and a half per cent of ash.

They differ from No. 5 in that the roof is sandstone and the shale occurs below the coal.

A recent examination of the Cretaceous coal at Golden, Colorado, shows veins varying from six to sixteen feet thick, average nine feet, standing nearly vertical, a slight dip to the west, with a *roof of fire-clay*, affording excellent material for the manufacture of fire-brick and terra cotta.

Concerning the economic values of these Tertiary coals, I obtained the following data. Tests were from the Smith bank:

Moisture at 105°	1.16
Volatile matter at red heat	4.70
Fixed carbon	90.20
Ash	3.94

Specific gravity at 60° Fahrenheit 1.410, a cubic foot of coal weighing eighty-eight pounds. Of five samples:

Moisture and volatile matter was	7.346
Fixed carbon	85.062
Ash	7.592

Other tests gave the lowest fixed carbon at seventy-seven per cent. Average amount of sulphur is 0.403 from three separate veins.

In calorific power the maximum amount of carbon is 80.80.

Pennsylvania anthracite gives	77.88
Colorado anthracite gives	74.08
Cañon City, Colorado, Cretaceous coal	60.61
Wyoming Cretaceous coal	63.74
Weber Cañon, Utah, coals	57.57
California coals	55.26

The above is a statement made by Charles P. Williams, chemist, Philadelphia, Pa.

Had the anthracite from the Anthracite range section been used for a comparison of calorific power, I am confident the record would have equaled the best Pennsylvania anthracite, as this coal is constant in fixed carbon from ninety to ninety-four and one-half per cent.

From another source I learn that the amount of illuminating gas from these Tertiary coals is seven and a quarter cubic feet per pound of coal, or 14,500 cubic feet per ton of 2000 pounds, not equaled anywhere as far as now known, except perhaps by the Albertites of Nova Scotia.

Of the coking coal seam, the following was obtained from Mr. James K. Robinson, Superintendent of the Colorado Coal and Iron Company's mine. Sample came from 1200 feet in, and was the latest test up to October 6, 1882:

Water	.72
Volatile matter	23.24

Fixed carbon	71.91
Ash	3.93

In comparison Connellsville coal shows:

Moisture	1.260
Volatile matter	30.107
Fixed carbon	59.616
Ash	8.233
Sulphur	0.784

While tests from a coking coal in Kentucky ranged in

Volatile matter	30.060 to 37.160
Fixed carbon	54.740 to 62.100
Moisture	2.000 to 8.000
Ash	2.900 to 4.340
Sulphur	.494 to 1.475

Thus showing these Tertiary coals far ahead in economic value.

The average value of bituminous coal at Golden, Colo., for two years has been $3.30 per ton; cost of mining and hauling, $2.57 per ton. In the East, this grade of coal is worth, on an average, $1.22 per ton; cost of mining, $0.88.

Connellsville coke at the ovens is worth $1.75 per ton, and a protective freight tariff in favor of Colorado production of $20 to $45 per ton.

With the above named freights, Gunnison County ought to get a share of that business on a very profitable basis.

DENVER, COLO., January 8, 1883.

ORIGIN AND CHARACTERISTICS OF PRECIOUS STONES.

Before the Chemical Society of the School of Mines in Columbia College, Professor Thomas Egleston, Ph.D., delivered a lecture on precious stones, in which he described their origin, characteristics and imitations. The history of gems, the lecturer declared, was the history of nearly all the intrigues, wars and good deeds of mankind since the world began. Many superstitions have been attached to precious stones. The amethyst was considered a cure for drunkenness and was dedicated to Bacchus; jasper was used as a charm by athletes. Although the diamond is made of common carbon, no successful attempt has been made to reproduce it. Its composition was discovered in 1694, and its weight was determined by the weight of a bean found in the east called a carat.

A diamond of more than ten carats is called princely; a diamond of more than 100 carats sovereign. There are not 1,000 known diamonds that weigh over ten carats, and not twenty that weigh more than 100. The value of the diamond is determined partly by color and partly by weight, and in this country there is an absurd custom of considering no diamond worth having that is not absolutely white. Flaws in diamonds are black specks, carbon that has not crystallized, or bubbles of gas or liquid, or natural faces of the diamond that have not been ground off. Black diamonds are mostly used for tools, but in Russia they are worn when the Court is in mourning. They are beautiful gems with a brilliant lustre.

The lecturer described some of the famous diamonds of the world, and then characterized the ruby as the most precious of all the stones when it has the true pigeon-blood color. A ruby of five carats is worth twice as much as a diamond of the same weight. The ancients held this stone to be a charm against poison, disease, and wicked thoughts. Sapphires, to be beautiful, must be of uniform deep blue. The lecturer said he had seen a small stone which was ruby on one side and sapphire on the other. In an experience of twenty years he had seen only five oriental emeralds and one oriental amethyst. Of the five varieties of cat's-eye that he had come across, only one—chrysoberyl—was valuable. The deeper the green of the emerald the better, and this stone loses no brilliancy by artificial light. Its color was supposed to be the same element that colors the leaves of trees. The opal, considered the unlucky stone, was to the ancients the only gem that seemed to store up the light of day. It cannot be successfully imitated. The hard opal is found in Hungary, the soft in Mexico. Five per cent of water is a constituent of the latter, and when placed in water the dull stone resumes its wonted brilliancy. Garnets are found in Bohemia; the most beautiful are gathered in Nevada. They have been seen of almost every color of the rainbow, but green and red are used in jewelry.

The lecturer urged in conclusion that his auditors should not lose confidence in human nature by reason of the widespread imitation of precious stones which he had described.

ASTRONOMY.

A NEW STAR AND THE STAR OF BETHLEHEM.

WILLIAM DAWSON.

The *Scientific American* is authority for advancing the idea that a new star of great brilliancy may become visible in the constellation of Cassiopeia, some time during the present or coming year. In the night of November 11, 1572, as Tycho Brahe, a noted astronomer of Denmark, was returning from his observatory, he found a group of persons looking at a brilliant star in Cassiopeia, which he felt sure was not there an hour before. It then shone like a star of the first magnitude; but grew brighter for some time and equaled Venus in brilliancy, when it could be seen easily with the naked eye in day time. In a short time it began to decrease in brightness—steadily growing dimmer for several months, until about the middle of March, 1574, when it disappeared entirely; having thus been visible, after a very sudden appearance, during a period of sixteen months. This star was white when first observed; it afterward changed to a red color, and finally again to white.

Old records indicate the observation of a similar star in nearly or quite the same place in 1264, and 945. These dates indicate periods of 308 years and 319 years between the times of visibility of these grand stellar shows. Applying three more such periods backward curiously enough brings us to about the time of the birth of Christ; when a bright star appeared as a guide to wise men in the East. Now there are one or two other circumstances by which it might seem possible to reconcile the "guiding star" with the one above described. The Nativity was probably in the latter part of December, at which time Cassiopeia, and of course any star in it, is on or near the meridian quite early in the evening; and not very far from the zenith, though considerably north of it But as the night goes on these stars appear to move westward on account of the earth's rotation; and further west also by reason of the earth's revolution around the Sun. The place where the wise men lived and started from is perhaps 200 or 300 miles easterly from Bethlehem, and it would seem that their star "the guiding star" should be westerly from them and move eastward, apparently, as they approached the place where the young child was; for when they arrived the star was over that place. But may we not safely admit that the star which led the Magi to the infant Jesus was a supernatural phenomenon in no way connected with the fixed stars in the distant heavens? Some persons have believed that the new stars of 1572, etc , were simply apparitions of the "Guiding Star" seen at Bethlehem, so they, or it, has sometimes been called the "Star of Bethlehem."

Other new or temporary stars have been seen at different times—notably in 1604, when a bright star blazed out rather suddenly in the constellation Ophiuchus; and one of less prominence was observed in Cygnus, May, 1866.

Now, there are quite a number of stars which are always visible and yet are known to change in brightness. They are called "variable stars." Prominent among them is Algol, a star in Perseus, which commonly shines as one of the second magnitude. But every three days (or rather two days and twenty hours), the light of this star diminishes to that of the fourth magnitude, where it stays for twenty minutes, and in three and one half hours resumes its wonted brightness. A variable star in the Whale, called Mira, is invisible to the naked eye most of the time. But about every eleven months it shines out with a brightness of second or third magnitude; remaining so for about two weeks. It loses light for three months and disappears to natural vision. In about five months afterward it becomes light enough to be just visible to the naked eye—a sixth magnitude star—and reaches its maximum brightness in three months more. But the changes of Mira are less regular than those of Algol. Its period is sometimes longer, and other times shorter, than eleven months. Its greatest brightness is sometimes that of second magnitude, and sometimes of only third magnitude.

This "wonderful" star is expected to be bright again in May, this year; in April, 1884; March, 1885; February, 1886, and so on—about a month earlier each year. And now, may we not reasonably infer that the new stars of 1572, 1604, etc., are but variable stars of long periods, and will brighten up into visibility at their appointed times? A telescopic star has long existed nearly or quite where Mr. Brahe saw his brilliant star in 1572; but whether it is the identical star is rather uncertain.

Cassiopeia is on the opposite side of the North Star from the Great Dipper, and nearly as far. It may be known by three stars in the form of a triangle, and one above (as seen in the evening at this time of year). The place where Tycho's star appeared is just to the right of the triangle, nearly in the point that would fill out the square. There is, indeed, one or two small stars in that corner, or region, which may be seen when the sky is clear and there is not too much moonlight. Make yourself familiar with these stars; and the new star, or its apparition, may be easily recognized when it does appear.

SPICELAND, IND., March 8, 1883.

ANNOUNCEMENTS OF ASTRONOMICAL DISCOVERIES.

For several years the Smithsonian Institution has done valuable service in collecting and distributing information of discoveries and phenomena that require immediate and wide-spread investigation. This labor was undertaken and continued because there seemed to be no other way by which the want could be filled. But the need of a more speedy and accurate system has been strongly felt, and has resulted in the transference of the work to Harvard College Observatory. Mr. John Ritchie, Jr , of Boston, has been appointed to take charge of this service, and it is he that has mapped out the details of the scheme. The plans include European as well as American observatories. An association of about fifty European observatories has recently been formed for the same purpose, and this association has requested Harvard College Observatory to coöperate with it and forward information of American discoveries. As there is also cable connection between Europe and South Africa, South America, and Australia, the system is quite complete, and may be looked to as a means of facilitating the work of the astronomer.

The outline of the plan, as taken from the circular, is as follows: Discoverers of asteroids, comets, suspected comets, or of any celestial phenomenon demanding immediate attention are requested to telegraph at once to "Harvard College Observatory, Cambridge, Mass." Such announcements will be at once cabled to Dr. Krueger, Kiel, Germany, and by him distributed to the European Union. They will also be distributed in this country in three ways—1. Through the Associated News Companies; 2. By special circulars of the *Science Observer*; 3. By special telegrams.

The first two of these methods are already in successful operation and need no explanation. The special telegrams will contain that information which experience has shown to be especially valuable. Whenever possible, these telegrams will be in cipher according to the *Science Observer* Code, a cipher language devised to lessen the number of words and to render the message less liable to mutilation and misunderstanding. To those persons who do not possess the code, the telegrams will be sent in ordinary manner, but abbreviated according to the following form:

TELEGRAM.—Comet Swift eleventh May fifteen six ascension zero fifty-nine north fourteen thirty-six plus six south four tenth.

TRANSLATION.—Comet discovered by Swift, May 11d. 15h. 6m., Washington Mean Time, in R. A. 0h. 59m., Declination + 14° 36′. Daily motion, R. A. + 6m., Declination—4′. Tenth magnitude.

The date will be expressed by the name of the month, preceded by an ordinal number giving the day of the month, and followed by two numbers expressing the hour and minute in Washington Mean Time (civil). Right ascension will be given in hours and minutes, preceded by the word "ascension." Declination will be given in degrees and minutes, preceded by the word "north" or "south." Daily motion in R. A. will be given in minutes of time, preceded by the word "plus" or "minus," and in declination in minutes of arc, preceded by the word "north" or "south".

Magnitude will be expressed by an ordinal number.

The actual expense of sending the telegrams will be borne by the persons receiving them, though, for convenience, the charges will be prepaid and annual accounts sent to the subscribers.

Mr. Ritchie has already had considerable experience in this kind of work while sending the Special Circulars of the *Science Observer;* and his success in this almost guarantees the success of the larger undertaking.

PHILOSOPHY.

INDUCTION IN SCIENCE.

PROF. H. S. S. SMITH.

The scientific method, as usually understood, is the method of induction. By it the statement of a law of action is formulated from a knowledge of many facts that bear on the subject. The progress of science clearly shows that the principles of induction may be used in two ways and we may call them, for convenience, qualitative induction and quantitative induction. In many respects they differ widely from one another. The qualitative is essentially metaphysical in its manner of procedure and as such, in many instances, produces naught but barren results. The quantitative is the true scientific method of dealing with facts, and it is by its aid that real advance is made.

Qualitative induction is that which, starting from a knowledge of a connection between two events, or of the fact that a certain phenomenon is consequent upon a certain combination of circumstances, produces from this knowledge a generalization of a higher order, but of less exactness. There is no estimate of the amount of action either in the facts on which the hypothesis is based or in the hypothesis itself. The kind of action is the only consideration. It is not uncommon to find that the natural results of the supposed action have been overlooked, for had they been considered it would have been seen that they be directly contrary to known facts. Sometimes considerations that are connected with the subject are entirely neglected and when brought to bear on the point, even in their qualitative aspect, are found to nullify the whole argument. Taken at its best, qualitative induction is unsatisfactory, and frequently proves misleading and baneful. The operation requires a well trained scientific imagination, and it is too often true that the scientific part is less developed than the imagination.

Quantitative induction is that method of procedure in which accurately known facts, known both in kind and in amount, are taken as the basis from which the advance is to be made. On these facts is built a generalization which conforms to the knowledge already possessed and awaits the development of new facts with a considerable degree of confidence. For it is one of the sure foundations of science that nature is ever consistent with herself; although her laws are contingent truths, they are ever constant. If, after the best endeavors, the generalization can only give an explanation of the kind of action, and is unable to determine the amount, it is a theory, and reaches its highest limit when it can predict a true result from a given combination of matter and force. Should it attain the perfection of being stated in a definite mathematical form, it becomes the expression of a law, and as such is accepted as truth. A generalization thus formed has in it the elements of exactness. It knows its grounds and stands on its own merits. Founded on facts it is as near the truth as the efforts of fallible man can place it. The offspring of labor, rather than the child of fancy, it has come to stay and to make its presence felt in thinking minds. It is the result of a slow growth. The accumulation of facts may have occupied years; some people collecting them with the definite object of reaching an explanation, others gathering information either by accident or for the mere satisfaction of learning "some new thing." It is never given to one person to gather all the facts and develop the result even in one line of research. Life is too short. Seldom indeed that one person formulates a theory in all its completeness. Usually, the final result is the outcome of the labors of many men. It is not so much the work of man as it is the answer which nature has given to patient questioning and persevering scrutiny.

In physics and astronomy—the sciences which deal with the very small and the very great—we find example of both kinds of induction. The minuteness and rapid motions of the molecules, and these are the units of physical problems, render them inaccessible to our grosser senses and it becomes necessary to study them as best we can by the effects that they and their motions produce. By correlating and comparing the knowledge thus obtained, it is possible, at times, to learn somewhat of the nature and conditions of the molecules themselves. Sometimes the result, satisfactory at first, has been found to be fallacious; sometimes it contains the elements of truth and grows. Newton, in order to account for the phenomena of light, advanced the corpuscular theory—a qualitative attempt. Put to the test of fact, it failed. Then Hooke and Huyghens put forth another qualitative hypothesis—the undulatory theory. Newton supposed that light consisted of exceedingly small portions of matter sent out from a luminous body in all directions and with inconceivable, though finite, velocity. The undulatory theory supposes the existence of the luminiferous ether, a continuous, elastic and very "subtle" medium, pervading all space. When considered casually, these two suppositions seem equally improbable. But nature herself has decided between them. The corpuscular theory has been disproved, while the undulatory theory, though still awaiting its ultimate and complete establishment, is steadily gaining ground.

In astronomy, the vast distances—too great to be even imperfectly comprehended, and huge masses—too large to be the subjects of experiment, render progress slow and complete explanation difficult. Time is the chief element of success, time in which the unknown laws, by their continuous action, may produce results that can be interpreted. As a finished example of quantitative induction we may take the law of gravitation. Tycho Brahe and Kepler had laid the foundation of facts on which it was to be built. Newton, taking these facts and dealing with them in the most rigorous manner, produced the clear and mathematical statement of the law. It sprang full grown from his brain. It has not been changed, increased, or modified by subsequent researches. The work was finished when he proved that the moon was rigorously subject to the law.

But is seldom that a theory can be framed as completely as this when first presented. Qualitative induction has its field of usefulness, and without it actual progress would be slow. There are but few men that are sufficiently patient and have enough faith in the future to spend their days in the laborious accumulation of mere facts and figures. The work is apt to become pure drudgery unless there is the impetus of comparing the facts with some hypothesis. A working hypothesis is of itself an incentive to new work and new discoveries. It gives glimpses of unexplored territory and the natural desire is to enter and investigate. Lockyer's hypothesis that the so-called elements are compound and that the real elements only present themselves as such under the tremendous temperatures of the Sun has produced, beside the inevitable discussions, sound work and real advance in solar physics. Maxwell's statement of the theory of the connection between electro-magnetism and light has stimulated research and seems to promise, in one direction at least, an explanation of that marvel of the philosophers, action at a distance. Ampére's idea that magnets are but collections of currents of electricity greatly simplified the understanding of magnetic phenomena and has resulted in combining the two subjects of galvanism and magnetism into one—electricity.

Although there are times when qualitative hypotheses are allowable and useful, it not unfrequently happens that they are confidently offered to public consideration without any sufficient cause for their existence, without even a semblance of proof, and utterly innocent of the charge of probability. Their continuance consists in the fact that they can be neither proved nor disproved, and consequently one person has as much ground for believing in them as another has for considering them to be entirely false. They usually treat of subjects that are practically beyond the reach of the experimenter with his measuring line and balance, and beyond the ken of the observer with his microscope and telescope. Prominent examples of this numerous class are Le Sage's theory of the cause of gravitation, and C. W. Siemen's "New Theory of the Sun and the Conservation of Solar Energy." It is, of course, impossible to say that these efforts are not in the right direction. But if judged of by analogy, and especially if brought into contrast with the necessities of the case and with known facts, these, and others like them, appear to be lamentably deficient. They may serve a good purpose in some cases and with a few individuals, but in general they cumber the ground and cause a waste of energy.

CORRESPONDENCE.

LETTER FROM TEXAS.

MARCH 6, 1883.

EDITOR REVIEW OF SCIENCE AND INDUSTRY:

Last October while on my way from San Antonio, Texas, to Fort McKavett, I was detained at Mason, one day, until long after midnight, to make connection with the line of stages running from Burnett. The printers were working on the *News Item* that night, and the proprietor very kindly invited me to spend the time in his office, as it was uncertain when the stage might arrive, and they would not wait for passengers. I spent most of the night very pleasantly talking with Mr. Stimpson, who was formerly a resident of Kansas, but is now engaged in mining in Texas. We discussed at length what plan we ought to pursue in order to develop the mineral resources of Texas, to diffuse scientific intelligence and to create a scientific spirit among the people. Among other things Mr. Stimpson stated that he believed he had discovered tin ore, and offered to send me samples if I would have the matter determined by competent chemists.

In accordance with this plan, several weeks later, I received three samples from three different localities, of alleged tin ore, with some other minerals, for assay. I sent one specimen of the alleged tin ore for analysis, to each of the following chemists: Prof. G. E. Patrick, State University, Kansas; Prof. G. H. Failyer, State Agricultural College, Kansas, and Prof. Chas. A. Schaeffer, Cornell University. In due time I received replies from all these chemists. Prof. Failyer wrote that the specimen sent to him was a first-rate specimen of garnet. Prof. Patrick wrote that the specimen forwarded to him was a fair specimen of oxide of iron.

Prof. Schaeffer, of Cornell University, wrote me at some length, about the alleged tin ore and the other specimens forwarded. He says in substance:

"As to the specimens you forwarded, I am sorry to say, I shall have to give a very unfavorable report. The tin ore, from Burnett County, contains no tin, and consists of garnet. The cinnabar, from Gillespie County, is very good looking hematite. And the lead and silver specimen proves to be a chunk of metallic lead with only a trace of silver—just about as much as is usually found in all commercial samples. The small fossils are casts of the interior of some species of the genus *Turritella*. As the sub genera and species are distinguished by the external markings of the shells and the shape of the mouth, it is impossible to name them any more definitely. The genus extends from the Silurian to the present time. Prof. H. S. Williams, thinks, however, that the specimens in question are probably Cretaceous.

"In spite of the foregoing I shall always be happy to assist you to the extent of my power in your efforts to develop the hidden resources of Texas. During the past year I had some experience in that State which was quite interesting. Early in the year I received a number of specimens of limestone which I found contained gold, some of them being quite rich. The result of the matter was that I was sent there to investigate, and spent about six weeks in June and July in Williamson County. The particular point of my operations was about eighteen miles north of Georgetown, very near the border of Bell County. I certainly found gold, but came to the conclusion that there was very little prospect of finding enough to pay. I have written a brief paper on the subject to be read at the next meeting of the mining engineers. I have no doubt that there are vast possibilities in the State. The hematite you sent, by the way, looks like a very pure article, and as soon as I can find time, I shall make a complete analysis of it. I fear though that the point where it occurs is so far from any iron works, that it will not amount to much financially."

Nature unfolds to the observer in Texas a wonderful variety and luxuriance. The mineral resources of the State are known to exist in almost unlimited quantities. But we have no geological survey, and I have received so far very little encouragement in trying to repeat my work in Kansas and Missouri in founding an Academy of Science. I am satisfied, however, that such a society could be organized in due time, after enough hard work. If Texas had an Academy of Science, composed of active scientists, in various parts of the State, it would exert a powerful influence in molding the people, and in inspiring them to prosecute scientific investigations.

I only wish to add, that it will afford me pleasure to assist any miners in the State in securing analyses of alleged tin ore. Tin is now found in Alabama, and it is probable that it also occurs in Texas, as miners generally believe.

Very truly, JOHN D. PARKER.

LETTER FROM SCHLIEMANN.

ATHENS, January 20.—In a letter headed "The Archæological Discoveries in the Levant," dated Athens, 18th ult., and published in the *Times* of the 10th inst., it is stated that "the resumption of my excavations at Hissarlik has failed to develop anything confirmatory of my Ilian hypothesis, and that the famous stratification of civilization which was supposed to testify to the extreme antiquity of the city is shown to be untenable." The anonymous writer is evidently no archæologist; moreover, he does not speak of my excavations from personal inspection, nor does he seem to have the slightest knowledge of what has been written on the subject since August last.

I excavated in 1882 for five months—namely, from March 1 till August 1, employing all the time 150 laborers, and aided by two of the most eminent architects of Europe, Mr. J. Hoffer of Vienna, and Dr. Wm. Dorpfield of Berlin, the latter of whom superintended for four years the technical part of the excavations of the German Empire at Olympia. Not only have these excavations been no failure, but, on the contrary, they have yielded far more important results than all my previous excavations at Hissarlik since 1870. The success of five prehistoric and two latter settlements, as given by me in "Ilios," is confirmed by my architects (see Dr. Dorpfield's letter in the *Augsburger Allgemeine Zeitung* of September 29, 1882, and an extract of it in the *Academy* of October 14) who have, however, proved to me that the enormous masses of calcined debris, which I had attributed to the third city, really belong to the second city, which perished in some fearful catastrophe, and which had on the hill of Hissarlik only its Pergamus, with five or six edifices of very large dimensions, while its lower city extended east, south and west on the plateau.

We have excavated most carefully all the buildings of the Acropolis, among which two, of very large proportions and with walls respectively 1 meter 45 and 1 meter 25 thick, seem to us, for many reasons, to be temples. Nothing could better prove the great antiquity of these buildings than the fact that they were built of unbaked bricks, and that the walls had been baked *in situ* by huge masses of wood piled upon both sides of each wall and kindled simultaneously; each of these buildings has a vast vestibulum, and each of the front faces of the lateral walls is provided with six vertical quadrangular beams, which stood on well-polished bases, the lower part of which was preserved, though, of course, in a calcined state. We, therefore, see that in these ancient Trojan temples the *antæ* or *parastades*, which in later Hellenic temples fulfilled only a technical purpose, served here as an important element of construction, for they were intended to protect the wall ends and to render them capable of supporting the ponderous weight of the super-incumbent crossbeams and the terrace. We found similar primitive *antæ* in two other edifices, and at the lateral walls of the northwestern gate.

We also found that the great wall of the ancient Acropolis has been built of unbaked bricks, and had been baked like the temple walls, *in situ*. I lay stress on the fact that a similar process of baking entire walls has never yet been discovered, and that the *antæ* in the Hellenic temples are nothing else than reminiscences of the wooden *antæ* of old, which were of important constructive use. We discovered in the Acropolis of the second city three large gates, all of which led down to the lower city. Homer knew of only one gate at Troy (the Scæan, sometimes also called the Dardanian Gate), but this gate was on the west side of the lower city; the gates of the Pergamus are never mentioned in the poems. The three prehistoric settlements which succeed each other in the calcined ruins of the Acropolis were poor and insignificant, and none of them extended beyond the hill of Hissarlik. The ruins of the lower city, therefore, remained deserted for ages, the bricks crumbled away, and the stones of the walls served the new settlers of Hissarlik for building their houses, or, as the legend ran (see Strabo, xiii, 599), they were used for building the walls of Sigeum.

The site was in later times occupied by the Æolic Ilium, which stood for more than 1,000 years, but nevertheless the traces of the ancient burnt city have not been obliterated; the huge masses of prehistoric pottery, perfectly identical with that of the second city on the Pergamus, which were found in the extensive excavations made by me on the lower plateau, testify to its existence on the spot. Its existence seems further to be proved by the vertical wall represented in "Ilios," p. 24, N. 2 B., as well as by the three gates, and above all by the ground plan and the number of loose edifices in the Pergamus. I have now excavated the latter entirely, and for this reason alone the excavations at Troy must be considered as terminated forever. I have also excavated seven more of the conical tumuli, called heroic tombs, and have thoroughly explored the ancient city on the heights of Bunarbashi, as well as the sites of four other ancient towns.

A full account of this, my last Trojan campaign, with excellent plans and about 200 engravings of the most curious finds, will be published by Mr. John Murray.

HENRY SCHLIEMANN.

EDUCATION.

FOURTEENTH ANNUAL GRADUATION EXERCISES OF THE KANSAS CITY MEDICAL COLLEGE.

The fourteenth annual Commencement of the Kansas City Medical College was held March 7th in the auditorium of the Walnut Street M. E. Church. The church was filled with friends of the college and the class, and others interested in the proceedings.

The music was furnished by the Opera House orchestra, and was of an excellent character.

After an overture from "Zampa" the evening's exercises were opened with prayer by Rev. C. C. Woods. The orchestra discoursed several selections from "Ernani," and Rev. C. L. Thompson was called upon to deliver the address of the evening. Dr. E. W. Schauffler, president of the faculty, presided over the commencement exercises. The members of the faculty occupied seats on the rostrum.

NATURAL SCIENCE AND PSYCHOLOGY.

In his address to the students of the College and the members of the graduating class, Rev. C. L. Thompson spoke as follows:

A minister is to speak to you, young gentlemen, on the threshold of the medical profession. At first thought it might seem inappropriate. I might be warned off this ground by the old saw: "*Ne sutor ultra crepidam.*" But in these days the shoemaker's last stands for more than one thing. The realm of learning has so widened, the circles of learning, like those of the skies, so cut each other, that each is kin to all. The professions are articulated and each belongs to all. It is especially so between us. You are doctors, I am a minister. We are each at a work upon the same man. Therefore I have a right to speak to you—you have a right to speak to me. We are building on the same house, a house not made with hands. If we build wisely, we will build together, each in loyalty to the one plan of the architect.

When a pseudo doctor works away at the symptoms or special form of disease without taking account of the whole man, you call him a quack. You disfellowship him. Let us beware that you and I be not quacks of a higher sort, but quacks all the same; you doctoring the man's digestion and respiration and circulation, and ignoring his mental and moral condition, and I, doctoring his conscience, while I ignore his liver. A full science takes in the whole man.

So, young gentlemen, in proportion as we are scientific, we are brethren.

Indeed, we must be specialists. Only a fool will think in a score or two of years he can learn enough to doctor a whole man. Remember the German professor who lamented on his death-bed that he had been fooling away his life by studying, or attempting to study, the whole Greek alphabet. If he had another chance he would devote his entire life to the study of the one letter "Iota." And remember what Dr. Holmes tells us of the professor at the breakfast table who had scattered and wasted his energies by devoting them to a study of beetles. If he had life to live over again he would devote his time to the study of the hind leg of one class of beetles. One can sail around the world, but in so doing nothing is discovered. The ocean is only an empty desert. But cast your anchor. Let down your bucket, and out of that bucket select one trembling drop of water and put on your spectacles, Oh! microscopist, and the heavens and the earth seem to be open under your concentrated gaze. So we must be specialists because we cannot successfully be generalists. The Bible says, "the eyes of the fool are in the ends of the earth." So he sees nothing. The earth has no ends. The eyes of the wise man will be at home selecting one thing from the infinite multiplicity of nature and magnifying it by a concentrated attention until it becomes "the deputy of the world." That is genius, and that faculty of absorption in one thing makes the scientific man and the worthy scientific result.

But while this much in favor of specialism must be conceded to the largeness of the world, there is also a great truth on the obverse side. The specialist who gives himself to one part of the body needs to form a partnership with other specialists who give themselves to other parts of the body. The oculist needs to be sympathetically joined to the aurist, for if the whole body were an eye, where were the hearing? and if the whole body were an ear, where were seeing? Thus specialties supplement and complement each other. But now the man is not all body. He has something besides physical organs.

The physical specialties need an ally. You want to take me into partnership. *Sana mens in sano corpore.* We can hang out no shingle of a universal doctrine. We distrust the medicines that cure everything. But we can hang out a broad sign, on which shall be written the names of the great firm of Dr. Corpus and Dr. Mens. Drs. Corpus & Mens, Professors in the Institute of Humanity; their partnership bodes great good to the future of humanity.

And as between them there need be no jealousies. Is there any truth in the sometimes slanderous affirmation that doctors have long coat-tails—that are easily trodden upon—that they balance professional chips on their shoulders and are jealous of their special prerogatives? I trust so. A man who is not sensitive to the honor of his calling is not worthy of a place in it. A proper professional dignity befits alike the doctor of medicine and of theology. I know a doctor of medicine, who being recently called to attend upon an intelligent lady, was met by the feminine caveat, "Doctor, you must stipulate that you will not give me any quinine, morphine or calomel." The doctor, seeing with alarm the pharmaceutical ground thus rapidly narrowing under his feet, exclaimed with becoming dignity, "Madam I am not going to take you into partnership with me in the practice of medicine." That was all right, because both the doctors of that firm would have been in the quinine, morphine, calomel department, and that might have caused a collision.

But, young gentlemen, you have got to take me into partnership with you. For you, without me, will not cover the whole man. If the whole body were an eye, where were the hearing? If the whole man were a body, where were the soul? Specialists of the physical department of humanity, you need the preacher. It will be the sign of a broader science when you leave room on your shingle, and in your theories, for him, the doctor of souls.

I think there only are two grounds on which you can resist the partnership for which I am pleading.

First.—You can say there is no second department. You can say a man has no soul; or, if he have what, by courtesy, may be called a soul, it is only refined and sublimated matter. It bears only such relation to the grosser body as the sunbeam bears to the lump of clay it beautifies—matter—only in another form. Precisely this a great many doctors are saying. They deny the duality of life, they run their craft against that philosophic current which has the sweep of all historic time in its movement; that stream which sprang from beneath the porches of the Athenian academy, and flows with accepted music through all schools of thought the affirmation, viz. of a dual nature in man. This you can do. You can build the man up from protoplasm. You can say I am a lobster, converted for the nonce into what is called a man. If I should be drowned lobsters will quickly reconvert me into lobsterian protoplasm. You can say, as Huxley said in a lecture on the physical basis of life, "All vital action may be the result of the molecular forces of the protoplasm which displays it. And, if so, it must be true in the same sense and to the same extent that the thoughts to which I am now giving utterance and your thoughts regarding them are the expression of molecular changes in the matter of life, which is the source of our other vital phenomena."

Now, when you adopt that creed, that there is but one thing in the universe, and that one thing matter, when you have thus remanded to the same protoplasmic base, the fungus that clings to the rock, and the thoughts of Plato, or John Milton (thoughts that wander through eternity) you are then ready to dismiss the preacher. The partnership must be broken up. If you have ever admitted the mind doctor into your counsels you may get rid of him at once. He is only an impertinence. He stands for an unreality. He is only painting pictures which death's dust will pretty soon quench.

I will not say if this is your theory that your calling is worth nothing. It is worth while to soothe a toothache to day, though the tooth may have to be pulled to-morrow. But I will say that so your profession is robbed of its chief grandeur. You are not serving an immortal being. Your work has no immortal projection. It is not a parabola, whose unfinished curve points past the stars. It is like the curve of a broken rainbow, one end of it veiled by a storm, and the other end shooting down into the ground. And you who work at the ground end of the bow may possibly find the pot of gold. But you shall have no higher reward. On this theory you and the horse doctor—the veterinary surgeon, and the veteran surgeon of human bodies, may as well go into partnership and hang out your sign together.

Or, second, you can resist the partnership for which I am pleading on quite another ground. Instead of being a monist, and holding to only one substance and that substance matter, you may be a dualist of such extreme pattern that you will say "there are two things, mind and matter, and they are so far apart that the one has no connection at all with the other." You may say, "I will doctor the body and you, preacher, may doctor the soul. Our fields have nothing in common. Calomel and catechism have no relations. There is no reason why either profession should consider the other."

And yet, whatever theories of the entire dissimilarity and non-connection of these two professions you may hold at the beginning of your calling, I believe you will modify them as you go on. You will gradually discover that calomel and catechism have points of contact. Perhaps you remember of a broken bodied and broken-hearted man who went to an eminent French physician to be cured of something, he knew not what. He seemed hopelessly low spirited. The doctor, after various experiments, concluded that his patient needed mental not physical stimulus, and advised him to go and hear a distinguished actor who at that time was convulsing Paris with his comic performances. "Alas!" replied the gloomy sick man, "I am that actor." And then the doctor was nonplused. But he was wise in his prescription. He recognized the subtle connection between brain and thought; between heart and hope. The minister of large experience knows very well that often he comes to the point where he must say to his patient, "Go to the doctor; there is no chance of your getting a good hope of heaven till your liver is cleaned out." A hopeless kind of battle the religious leader is fighting when he puts comforting doctrines against confirmed dyspepsia. Dr. Alexander used to say he always had a good hope of heaven except when the east wind blew. Many another would be a serene Christian if only a villainous digestive system would let him. On the other hand, some of these experienced physicians have often reached the French physician's point, where they were ready to surrender physics to philosophy, where, across the shadowy borderland between the physical and the spiritual, strange influences reached from the latter to the former, neutralizing the effect of medicine, suspending natural law, and introducing into all professional calculations abscure and confused and confounding conditions.

So I believe the last words of science on this subject are these two:

First—The proper duality of human nature, a body that is not the mind—a mind that is not mere bodily efflorescence.

Second—A closeness of connection and sympathetic action between the two of the most intimate kind; so intimate as to palliate the error of those who under a sense of their identity forget their difference.

I venture to propose therefore to you, young gentlemen, as a supplemental course of study, (for the true physician is a student to the end of the chapter) an examination of the borderland of your science; the influence of psychic states on physical conditions. I believe we are beginning to get some lights for that shadowy realm, and that by those lights the reverent student will be able to walk forward to many results that will greatly aid the practice of medicine. I have observed that a good deal has been said lately of the importance of having medical students better prepared in general knowledge—especially in fundamental natural science—before they begin the study of their profession. Thus they would lengthen your course at the beginning of it.

And I would lengthen it at the other end, where it reaches up into psychology. For you are to doctor a man who has a soul of such dominant activity that it often affects most profoundly and even commandingly that physical basis on which your science is to work.

That study is an obscure one, but it is one of rising importance; importance both to the preacher and the doctor. To the preacher, for I must know what checks and reactions my doctrines will meet when they impinge on a disordered or cantankerous physical system. And to the doctor, for he must know what allowance to make for those intangible and imponderable agencies, that like spirit hands manipulate his drugs, now paralyzing their action and again intensifying it beyond computation.

Young gentlemen, you have a great profession, because it involves the care of an immortal being from the ground up. You have not compassed it, when you have found specifics in nature's pharmacy for the ills of the flesh. I think specifics more and more retire from the advance of true science, because science gets comprehensive, and every prescription must contemplate the entire man. If you work away at this or that symptom without intelligent vision of all that being which the symptoms inhere, you are only tinkering. So study the whole of that being; sometimes to get at a man's physical condition it is as necessary to sound his conscience as it is to tap his lungs. "A bad heart" is a phrase that has two meanings. Those meanings may be related, and each be interesting to the physician.

One word more as to those upper ranges of your profession. You and I are servants of mankind. Victor Hugo somewhere says, "the priest's door should always be open, the doctor's door should never be shut." We cannot be true to our calling and wall ourselves into our own pleasures or our own comfort. We are not in the highest view scientists, we are not money makers, we are not ambition hunters. We are missionaries. A sort of divine obligation pushes us on. If we realize the grandeur of our calling the world's praise or blame glides past us like the idle winds. We have a ministry, and among bruised bodies and bruised spirits we are as those who serve. Now to serve—not a principle, and not a creed, and not a school, but a living and deathless being we need a certain poise of character and tenderness of touch, which comes only from contact with calming and ennobling spiritual virtues. Therefore you need not only to remember that your patient has a heart and a conscience, but you need them yourself. If you would be an expert surgeon your professors have told you you must do nothing to unsteady your hand. Only so can you move successfully around those centres of life, where a manual tremor might be fatal to your work. My old friend, Dr. Mussey, of Cincinnati, when he had a very delicate surgical operation to perform, would go to bed for a day, that with a rested system and unjaded brain and a level hand he might come to his perilous task. Young gentlemen, I commend to you that restfulness of spirit, that best balance of all your powers which comes from the silence and calmness of leaning on God. This will help you to do your work to the best. You will interpenetrate the physical with the spiritual. You will carry a serene, a cheerful countenance that is sometimes better than medicine. An element of helpful sympathy, undulled and unprofessional, will accompany and glorify your ministry to the body; your heart will be kept true to the highest sentiments of your calling, and your faith in God will sustain you under the failures with which human mortality steadily confronts you; but if you work on high levels, it cannot cheat you of your reward. That reward will not always be to save life. It will be enough if, joining hands with the minister, you teach a man how to die; teach him how along the altar stairs of a breaking body, to climb through this world's darkness up to God.

After music President Schauffler conferred the degree of Doctor of medicine on the members of the graduating class, giving each his diploma and administering the usual Hippocratic oath.

The names and addresses of the members of the graduating class are as follows:

Graduates in medicine—Henry P. Ball, Shawnee, Kas.; Samuel R. Coates, Kansas City; Charles M. Chambliss, Bozeman, M. T.; Joseph S. Fisher, Middleport, O.; Charles E Griffith, Rose Hill, Mo.; Alexander H. Ironsides, Kansas City; Edwin T. Phillips, Manhattan, Kas.; Henry E. Pitcher, Shawnee Mound, Mo.; James R. Ladd, Cambridge, Mo.; Richard P. Walker, Platte City, Mo.; John B. Wann, Harrisonville, Mo.; William H. Young, Spring Dale, Ark.

Graduates in dentistry—David C. Lane, and Joseph P. Root, Jr., Wyandott, Kas.

President Schauffler then said that while this was the fourteenth annual anniversary of the Commencement of the Kansas City Medical College, it was at the same time the first annual Commencement of the Kansas City Dental College, or dental department of the Medical College. Unfortunately this fact has not been mentioned in the programme. The degrees and diplomas were conferred on the members of the graduates in dental surgery, and Dr. T. B. Lester arose to deliver the address to the class.

DR. LESTER'S ADDRESS.

Dr. Lester said that thirteen years ago it devolved upon him to speak the parting words to a graduating class going out into the world to perform their duties as doctors, even as was the class he now addressed. The speaker reverted to the time when the Kansas City Medical College was started. It had succeeded against some opposition and under many difficulties. The good people of Kansas City had always been the friend of every enterprise that claimed Kansas City as its home, and this was the secret of her greatness.

During the existence of this college it had graduated 124 physicians. They were scattered all over the United States and Territories. The college was proud of them, and they had all been an honor to her. The speaker did not think the present class would tarnish this record.

Turning from this subject, Dr. Lester called the attention of his hearers to the great changes in medicine which were going on. The science of medicine was becoming more accurate every day. These advances all accrued to the interest of the people.

The arrest of experimental research by legal interposition was severely commented upon. Man himself killed animals for food and clothing, made slaves of them and slaughtered them for amusement. In England this fanaticism most prevailed. It had not yet reached America. No one but a fanatic would cry out in favor of a dog or a cat and oppose scientific vivisection with law, if by the experiment something might be learned which would benefit thousands of men and women.

The speaker urged his class not to fall into the error that they had nothing to do but to absorb the knowledge thus gained in the past. They must go on and enlighten the world themselves. Another error was the thought that there was nothing else to be done. Science may make more advancement in the future than it has in the past.

Despite the fact that American students of the past, in a new country where colleges were few and books scarce, had struggled under difficulties of every kind, yet the country had produced a race which were giants in medicine. The medical men of the United States were admired all over the world.

It was not necessary to go abroad to learn thoroughly the science of medicine. In the great schools and hospitals of both Europe and America, only that practice could be gained which would make a great surgeon. Europeans had made great concessions to us, and we had always admired their thoroughness and ability in surgery and medicine.

To the graduating class Dr. Lester, in conclusion, addressed words of good advice and hearty sympathy. He urged them to be true to their profession and themselves, and bade the class, on behalf of the faculty, God speed and good-bye.

The awarding of prizes was next in order. There are several prizes in the gift of the college. The first of these is the Holden prize of $100, given to the student who passes the best examination. The prize was founded by Howard M. Holden, of this city. Besides this there is the faculty prize of $25, given to the next best student. Dr. Halley, professor of surgery, offered a competitive prize, consisting of "Agnew's Surgery," in two volumes, to the best student in surgery, and Dr. Fryer, professor of diseases of the eye, offered a fine opthalmoscope to the best student in his classes.

The prizes were awarded as follows:

First—Holden prize of $100, to Edwin T. Phillips, Manhattan, Kas.

Second—Faculty prize of $25, to Samuel E. Coates, Kansas City, Mo.

Third—Agnew's Surgery, two volumes, to A. H. Ironsides, Kansas City, Mo.

Fourth—Opthalmoscope, to D. P. Walker, Platte City, Mo.

With a concluding selection by the orchestra the members of the class received the congratulations of their friends, and the audienence dispersed.

After the commencement exercises were concluded the faculty of the college, together with the graduating class and the members of the alumni association, adjourned to the Centropolis Hotel, where everything was waiting and an excellent banquet served.

SECOND ANNUAL COMMENCEMENT OF THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF KANSAS CITY.

A large and brilliant audience gathered at the Walnut Street M. E. Church, March 13th, on the occasion of the Commencement exercises of the University of Kansas City. The platform was filled by a number of the most prominent citizens, notably: Hon. T. B. Bullene, Rev. Dr. Mathews, Dr. J. W. Jackson, chief surgeon of the Missouri Pacific Railroad; Judge H. P. White, Drs. A. Jamieson, N. H. Chapman, E. R. Lewis, J. Miller, J. P. Jackson, F. B. Tiffany, Willis P. King, J. M. Allen, Judge R. E. Cowan, Drs. A. P. Campbell, C. W. Adams, J. R. Snell, H. T. Hereford, James M. Wood, G. W. Davis, W. M. Lewis, L. A. Berger, O. Baldwin, and J. M. Wilson.

The exercises began with an overture from Stradella, which was exceedingly well rendered. This was followed by prayer by Rev. Dr. Mathews, at the conclusion of which the diplomas were presented by Mayor Bullene, who said that it was expected that Governor Crittenden would honor the occasion and himself by presenting these diplomas. It occurred to him that some were born great, and some had greatness thrust upon them. This was his fate to-night. He believed that it was the practice upon such occasions for the president to say something. If this address was delegated to him it would be a custom more honored in the breach than the observance. It was with pleasure that he could testify to the exceptionally severe test which the class had undergone, and to the exceptional triumph that they had achieved. The diplomas were then presented. In conclusion the mayor urged the young gentlemen to be worthy of Kansas City, their country, their alma mater and themselves.

The graduating class, whose names follow, then received the diplomas in the order given:

Dupuy Snell, Clay County, Mo.; John W. Gossett, Paola, Kas.; Frank A. Caughill, Chamois, Mo.; James E. Logan, Kansas City, Mo.; Albert F. Schmitz, Sedalia, Mo.; Eugene L. Friedenberg, Kansas City, Mo.; Alexander B. Peters, Salem, Kas.; Grayson B. Scholl, Girard, Kas.

The following prizes were then awarded.

Surgery—Professors J. P. Jackson, M. D., and J. W. Jackson, M. D., given to the one attaining highest grade. James E. Logan, A. F. Schmitz and Dupuy Snell having each attained the same grade, each was presented with a copy of "Bryant's Surgery."

Obstetrics—Prof. H. T. Hereford, M. D., prize awarded to F. A. Caughill.

Eye and Ear—Prof. Tiffany, M. D., first prize, E. L. Friedenberg; second prize, Jas. E. Logan.

Orthopædic Surgery—Prof. J. Miller, M. D., prize awarded to E. L. Friedenberg.

Anatomy—Prof. E. R. Lewis, M. D., prize awarded to Dupuy Snell.

At the conclusion of the distribution, the orchestra rendered selections from the "Merry War." Dr. James Elmore Logan then delivered the valedictory address. Mr. Logan began with Pope's well known lines:

> "Know thou thyself; presume not God to scan.
> The proper study of mankind is man."

If this be truth, as it undoubtedly is in ordinary life, how much more is it true as regards the physician whose study is this intricate body of ours? Who deals with life itself? The speaker depicted the responsibilities, etc., of a physician's life; contrasted the profession with others, and closed by thanking the faculty for their kindness to the class, and by a few words of admonition to his fellow students.

In an eloquent address the valedictorian reviewed the work done by the class and the life work yet before them. The faculty were again warmly thanked for their efforts in behalf of the instruction of the class, and the speaker closed his address with a few well chosen words of advice and farewell to his fellow graduates. The valedictory was warmly received by the class and the audience, being frequently interrupted by applause.

MACHINE SCIENCE.

Col. Theo. S. Case then delivered the following address:

Ladies and Gentlemen:—For some years past we have been accustomed to hear very frequently the expression "machine politics;" more latterly the phrase or term "machine education" has been launched forth. In the one case it is applied to the management of political affairs by systematic party discipline or drill, by which, to a certain extent, at least, the will of the individual voter is subordinated to that of his party leaders. In the other, it is used to describe "the rigid, mechanical, law-established routine" applied to the education of children in the public schools of some of the States.

In either case the same benefits and the same evils flow out of the system. Great cumulative force and power are attained, and a high average degree of excellence and success results. At the same time the process may not be exactly adapted to every individual voter or pupil. The objection is that by such machine management the important elements of individual judgment and self-reliance are left out of the question. It is a system of forced results rather than of independent action. But it is not alone in politics and education that we find the machine at work. It pervades every branch of business, and may naturally be looked for in mental processes also. Professor Bain, in speaking of the early history of the English universities, refers to "the fatal sterility of the middle ages and of our first and second university periods, which had to do with the mistake of gagging men's mouths and dictating all their conclusions. Things came to be so arranged that contradictory views ran side by side, like opposing electric currents, the thick wrappage of ingenious phraseology arresting the destructive discharge." Though we must repudiate "sterility" as a factor in our day and in our institutions, yet we may do well to examine our processes of thought and investigation and see if we are not tending, in some respects at least, to a similar position in scientific matters.

Many illustrations, pointing suggestively to this tendency, might be furnished; but one, which is exceedingly prominent, will suffice for this occasion.

The year 1882 will long be remembered as one of unusual mortality among distinguished literary and scientific men. We were, within its brief compass, called upon to mourn the loss, successively, of such men as Darwin, Draper, Emerson, Marsh, Longfellow, Pusey, and others almost equally eminent in their different lines of labor and usefulness. Of all these, however, probably none left so many admirers or so lasting a fame, certainly none made so marked an impression upon the thought of his generation, as Charles Darwin.

When he died, last April, the naturalists, the philosophers and the theologians of both hemispheres united spontaneously and almost involuntarily in rendering tributes to his memory. All awarded him, unhesitatingly, the character of a fair-minded and careful investigator, a scrupulously honest and faithful recorder of intelligently observed facts, and a conscientious and logical generalizer. To him more than to any other student of nature of the present century is science indebted for a reasonable and probable theory of the origin and descent of species, and upon his head was poured a larger share of criticism, opposition, even personal ridicule, than has fallen to the lot of any other writer during the same period of time. On the other hand, no other writer has ever received from his followers and during his lifetime, so large a meed of praise as the constructor of a theory of development which, it is claimed, has within less than twenty-five years "reformed science and constrained the whole perception, thought and volition of mankind into newer and higher courses."

Darwin's theory was not altogether new, for it had been broached many years before by Lamarck in his "Philosophie Zoölogique." In fact, Aristotle, himself, suggested it more than 2,000 years ago, while quite a number of comparatively modern investigators, including his own grandfather, Erasmus Darwin, had discussed it before he published his first work upon the subject in 1859. But at just about that period in the history of science, the geologists, biologists and theologians had somewhat harmonized their differences and disagreements, and there was comparative peace. Consequently, when the development theory was promulgated, great excitement ensued. It ran counter to established beliefs and convictions, arousing the most vehement assaults from all sides. However, the more it was combatted, the more it was brought into prominence and its claims tested in the light of investigation and philosophy, the better its facts, premises and conclusions were understood, and the stronger hold it took upon men's minds, until to-day, though not even yet demonstrated, it is more generally accepted and approved than any other.

This theory is known indifferently by the ordinary reader as the development or evolution theory, and, as opposed to the theory of special creation, may be defined to be an explanation of the processes of nature in originating and perpetuating life upon the earth by evolution, or by the derivation of one species from the one preceding it; modified by the attendant circumstances or environment.

It appears very clear to a great number of the leading naturalists of the world that the adoption of such a theory need not affect men's belief in a prime originator or Creator. On the contrary they deem it only a stronger evidence of his wisdom and power, that He was able to animate the first atom or germ of organic matter and give to it the potentiality to develop, by innumerable steps or grades, and through an immensely prolonged period of time, from a moneron into a man. Such thinkers are known as theistic evolutionists. There are, however, other thinkers and investigators who assume that the processes of development are entirely independent of any divine originator, and that they are self-originating and self-existent. These are styled atheistic evolutionists.

It is not the object of this address to discuss the facts of the evolution or development theory, but simply to inquire what effect, if any, its various phases (for it has received many alterations and additions,) are having or may have upon students of any branch of science requiring physical investigation or philosophic examination. Such an inquiry seems to me eminently proper at this time, in view of the fact that the officers of the University of Kansas City contemplate the establishment of its other departments very soon. Professors in other branches will shortly have to be chosen, and the welfare of the public, through its youths, is vitally concerned in this choice. It would be an excellent thing to have our university well endowed and well provided with the means of instruction, but after all it is the professors who will make the reputation of the institution and it is their teachings that will make sound and practical men or shallow dullards of our children. Mr. Hewett says, "Inability on the part of a professor to impart to a student the distinct methods and training of a scientist, or philologist or a student of history, is to pervert and misdirect the energies and often to vitiate the fruits of years of study."

The purpose of a university is to develop the intellects of its students in every department of education, art and science that comes within its scope or function. Medical students are not merely to be taught the names and uses of bones, muscles and organs, or the practical applications of medicines, but also the subtle actions of brain and nerve; not merely anatomical structures, but the mysterious physiological processes; they are to be taught to "minister to a mind diseased" as well as to set a broken limb. Students in other departments are also to be instructed not only in the routine of practical forms, but in all the mental processes by which such forms are arrived at and made common and practical. Mr. Sill, in discussing Herbert Spencer's theory of education says: "There is a permanent aspiration in man for spiritual enlargement, for higher and richer planes of intellectual being. This aspiration has in every age reached out, no doubt more or less blindly, after whatever was greatest and best in preceding human attainment." * * * "From many desires and motives, no doubt, but most of all from this permanent hunger for intellectual illumination and spiritual enlargement have grown up our universities and our systems of liberal culture." He would be a strange teacher of medicine who at the present day would content himself with informing his class that blue mass was "good for biliousness," and that morphine was "good for sleeplessness," and fail to lay before them any explanation of the subtle and mysterious action of those agents upon the liver and brain. That was the old-fashioned, machine way of teaching, and the result was that men went through their lives bleeding, salivating and blistering their patients by rote, and deeming themselves lucky when they had thrown them into fits, for the reason that you have all heard so many times. If it had happened in the formation of the human system that the liver had been left out, such doctors, as I have heard one of our most respected and progressive city physicians say, would have been "in a mighty bad fix."

But such crude and empirical instruction has been abandoned in all intellectual communities, and every effort is put forth by professors, whether of medicine, law, science or literature, to combine instruction with investigation, and to enlarge by all their powers the bounds of human knowledge. The responsibilities resting upon them are not easily measured. In these days of unsettled beliefs the importance of furnishing young men with a firm foundation of classified knowledge and of well balanced habits of thought cannot be overestimated. A failure to accomplish this in our universities is not only to perpetrate an inestimable wrong upon the students themselves, but to do more or less permanent injury to the cause of education in the community. The one object to be kept in mind by all earnest and faithful instructors is the exclusive pursuit of the truth in whatever line of study they may be engaged, and this is to be done by adherence to facts, known and resulting from investigation, and by the generalization of the facts in exact accordance with the laws of reasoning and thought. These precedent points being fully established, the professor need have no hesitation in taking his pupils wherever logic leads. Truth thus sought will bear exposure under all circumstances.

This brings us back to Darwin again. His theories have become so completely commingled with the scientific and philosophic thought of the day that scarcely any investigator in natural science, especially in the domains of zoölogy, geology, botany or anthropology, has failed to be affected by them. The phrases "natural selection," "evolution," "origin by descent," "the survival of the fittest," are as common as household words, and, without stopping to consider the differences between these divisions of the general theory, I proceed to discuss the bearings of university teaching upon the questions of theistic and atheistic evolution. The influence of the theory itself will be felt in the investigation and study of almost every branch of science, and nearly every professor will be compelled to give to his classes a reasonable account of the opinion he entertains regarding it, and this opinion will or should naturally give at least a bias to their subsequent thought and labors.

Now, while natural science has not yet been able to prove the correctness of the evolution theory by facts, and has been obliged to call philosophy and metaphysics to its aid to work out a plausible demonstration of its claims, still evolution is so widely admitted to be the most probable explanation of the processes of nature that it will be adopted by future scientists, at least as a guide in their investigations. Consequently, the question to be settled first of all seems necessarily to be whether the true path of investigation lies in the theistic or the atheistic acceptation of the theory; whether we are to regard an infinite God as the originator of the world and the designer of the processes of development in the organic and inorganic kingdoms, or whether we are to adopt the doctrine of the atheistic evolutionists, who deny the supernatural or creative origin of man or any of the animals, and account for them all by attributing their origin to spontaneous generation and their subsequent development solely to the operation of law.

Taking up first the consideration of the atheistic line of thought and argument, and passing over the question of spontaneous generation of life, which the experiments of Tyndall, Bastian and others seem to have answered negatively, but assuming it to be possible, for the sake of the subsequent argument, we come to the consideration of development by law. Now law, as understood in science, is inexorable and inflexible, exact and complete. The law of gravitation is so exact in its requirements and fulfillments that the movements of the most distant planets or other heavenly bodies can be calculated with the utmost accuracy, whether we reckon centuries backward or forward. The laws of chemical affinity are so precise that the most minute quantities of any given substance can be detected with exact certainty, while the proportions of the constituent elements of any known compound, base or acid are utterly invariable, and their combining equivalents unalterably fixed. Any violation of these laws, either by error in calculation or misapplication of their rules, inevitably results in failure to attain the object sought. Every true calculation, in the one case, or correct combination of chemical equivalents, in the other, will produce identically the same result, even if repeated a thousand or million times. This should be the case with all laws; when once discovered and formulated, they should stand forever, immutable, invariable and unyielding.

No scientific man questions the reign of law in organic nature any more than in mathematics or physics, hence the two questions for teachers and students of science to consider are what really is law, and whence the law. These being definitely settled, the field is clear and the goal within certain reach.

Now, again admitting what has not been distinctly proven, that the laws governing development of species have been discovered, let us ask what will be the result upon young investigators when they are taught by their trusted instructors that these laws are self-evolved, self-existent and self-operative? That they began just after chaos, have been operating inflexibly ever since, and will continue to rule irresistibly, unchangeably and relentlessly until the end of time? What must be the necessary effect of the knowledge or the credulous belief in the existence and enforcement of such unbending, rigorous, cast-iron laws? As Schmid puts it, he (the investigator) sees "all the rich treasures of human life and history become a result of blindly acting forces; the history of the world, ethics and all spiritual sciences are, in the progress of perception, dissolved into physiology, and physiology into chemistry, physics and mechanism." Can a student see anything to hope for such, under rigid, cramped and inelastic conditions? Will it not appear to him useless to investigate, to try to get at the causes and effects of the phenomena he perceives around him?

If these assumed laws of the atheistic evolutionist actually are laws, with no elasticity and with no superior to control or modify them, then all thought necessarily turns back upon itself, and the fatalism of Buddha is the result. All things, past, present and future, are immovably and unchangeably fixed. Law rules; human effort and skill and energy avail nothing. Development goes steadily, irresistibly, ruthlessly onward. Active and powerful, but lifeless and soulless, it tends neither upward nor downward, neither to the right nor to the left. Onward it goes, without ultimate object or aim; ponderously crushing out sentiment, reverence, love, faith, hope. It seems to me that this is the irresistible logic of atheistic evolution, and that the young man who accepts it as his guide in physical or philosophic investigation leaves hope behind. He sees everything in nature's processes blocked out for him in advance. He has no worthy object in view for which to strive; he mounts the machine, gets into the ruts of "the survival of the fittest" and "natural selection;" he rides between walls of adamant, too dense for penetration and too high to allow any light to fall upon from above. Even those by-paths which open dimly along his course he is forbidden to explore. Law rules; its narrow limitations allow of no divergences or digressions. The machine carries him on, he knows not where, overpowering him with its noise and force, until he becomes part and parcel of it; a mere machine himself, plodding in his methods, cramped in his ideas and routine in his practice. The machine is self-evolved, self-regulated, inexorable law, having neither intelligent beginning, intelligent aim nor intelligent conclusion, evolved by chance from chaos, developed without object or design and closing in the obscurity in which it began. It is the stultification of intellect to separate this atheistic conception from its "thick wrappage of ingenious phraseology" and follow it to its legitimate and logical conclusion.

"But," say the upholders of this theistic, this Godless view of the question, "there are modifications of this law; there is a law of variability. Although this strict succession or sequence of events is absolutely required by a literal rendering of the law of development, there are some few solutions of continuity allowed." Ah? are there, indeed? Then either you have no law whatever or that law is controlled and guided by a superior power, the Great Law Maker Himself, perhaps. Exact law knows no variability; admit of a variation and your law is a nullity! Yield one inch to environment as a modifier of a single step in the syllogistic process and you give up law forever, as the atheistic evolutionist has constructed it, and as he must hold to it, if he believes his own postulates. Law let alone is a merciless and despotic autocrat.

Where have we landed? We know that the laws of development and descent are most probably true and in operation all around us. The investigations of scientists from the days of Aristotle to the present time point clearly to them. The words of the wise man in the Scriptures unmistakably point to them when he says "The works of the Lord are done in judgment from the beginning: and from the time he made them he disposed the parts thereof."

Let us turn for a few moments to the doctrine of theistic evolution. Here, according to my belief, we shall find plain sailing. Law rules as before, but the machine is gone. Flexibility, elasticity, variability, all are present, essential corollaries to the law, and in strict harmony with the design of the Creator. He could and did foresee all things from the beginning, and has provided for their development in strict accordance with law, but at the same time He guides, directs, and controls the phenomena of nature as the world progresses steadily toward the ultimate and pre-arranged goal. The soulless machine is gone and hope returns. Intelligent, free-willed man investigates, studies, contemplates, draws closer to his Maker, comprehends more and more fully the grandeur of the cosmic scheme, realizes the magnificence and brilliancy of the original plan; observes and appreciates the comprehensive precision, the facile power and the apparent ease of its execution; and now, in his turn, resorting to philosophy to supply the "missing link," his consciousness, his reason, his faith, all point unerringly to the final disclosure of the object of the Divine plan, which, commencing with God "in the beginning" has run its course with rhythmic harmony of development and only awaits the fullness of time to logically, fittingly and triumphantly culminate in the glorious after-life depicted in the apocalypse.

The discussion of such questions is, in my judgment, as strictly within the scope of university teaching as any others, and while they may not at present come as fully within the range of the course of instruction in this university as they will when the other departments are established, they certainly should be considered, and doubtless are considered, in some of the lectures before the medical classes. That eminent physiologist, Professor Martyn Paine, gives the question the most careful and profound examination in his work, the "Physiology of the Soul and Instinct as Distinguished from Materialism." He brings to the treatment of these matters, practical experience, various and deep learning, vast research, equal familiarity with physical and metaphysical methods, and a most intimate knowledge of anatomy and physiology. His arguments against that materialism which would resolve the qualities of mind into molecular action are plain, practical and irresistible. Very few noted physiologists advocate materialism. Their researches almost universally result in opposite conclusions. They cannot ignore the law of design.

While the position I have taken may be questioned by some scientists, I have the satisfaction of knowing that such eminent geologists as Dana, Dawson and Winchell, such distinguished botanists as Gray and Braun, such learned and skillful naturalists as Wallace and Owen, and such able metaphysicians as McCosh and Braubach uphold the theistic side of the case from their respective standpoints. But it cannot be denied that the tone and tendency of thousands of investigators, and especially metaphysicians, are toward atheistic evolution. If they are correct, which seems to me impossible, we shall necessarily have to submit. We ask only for honest investigation, candid and logical generalization and reasoning, and are willing to accept the results.

Another phase of teaching which is becoming more and more necessary with the advance of science and which is especially appropriate in university instruction, and which I am glad to point out as being fully appreciated in this institution, is the investigation and study of special divisions of different branches of professional science. We must not forget that nowadays each branch of science is so extensive that to keep abreast of the progress in it alone is no light task, while to excel in it requires the exercise of all the powers of mind and body of the most vigorous person. The duties of citizenship, intelligent, useful citizenship, at present of themselves demand large stores of general information and culture, and it is a fact beyond question that a larger share of accurate and minute knowledge is required of our professional men than ever before. Hence specialism becomes a necessity before success, in all departments of scientific investigation. The nearer our knowledge can be reduced to mathematical precision, the better for the world, and this can only be reached by division of labor and systematic, logical and truthful investigation of branch by branch, subject by subject, item by item. But the specialist must not go to the extreme of overlooking the interdependence of all the sciences. If he does, he is liable to mount the machine again and get into the old ruts of routine and empiricism.

But I have said enough. We all have our duties to perform—teachers as well as students—and the problem for all to work upon, and, if possible, to solve, is how to do the right thing in the most beneficial manner to ourselves and our fellow creatures. We may never solve the problem of the design of the universe in our day. The day of its solution may never be reached by man on this earth. As Dr. Hill beautifully says: "That day ever recedes into the glorious future as we approach it. The rate of scientific progress increases from decade o decade, and yet the new problems and the new instruments for their solution increase even more rapidly. The divine intellect can never be exhausted by the human." While this is true, each one of us can do something toward the untangling of the knot. If he cannot reduce the interweaving threads to order, he can at least hold the skein. In the words of the oldest epic poem in the English language:

> "Each of us must
> An end await
> Of this world's life;
> Let him who can
> Work high deeds ere death."

At the close of Col. Case's address the honorary degree of Doctor of Physics was conferred upon him by President Bullene, of the Board of Regents.

Dr. Willis V. King then addressed the assembly, and gave the good and bad side of the medical profession, and also a humorous description of a young physician's dream, etc. He then pictured the reality. The real life of a physician must commence in the abodes of the humble and the poor. The practice of medicine requires more courage and more devotion than that of a soldier. He spoke of the ideas prevalent as to the mystery of medicines. He alluded to popular superstitions, such as carrying potatoes in the pocket, buckeyes, etc. He described his first visit and several other incidents of his early professional life. He urged upon the class the necessity of temperance. If any man's brain should always be clear it was that of the physician. He concluded by presenting what he termed the bright side of the profession, and enlarged upon the possibilities for good in the life of the medical man. It is a sacred trust and you must be worthy of it, more is expected of you than of other men, the epidemic is the true physician's battle field. The physician who knows and does his duty is one of the noblest sights presented to men. It is the height of folly for a doctor to mix himself in anything that will impair his power for good. The physician's face should bring sunshine to the sick room. He must not be frivolous in the house of mourning, and will never deserve his high calling if he does not realize and express his appreciation of the situation. He must learn these things for himself; no books can teach him. He must realize how much depends upon his words and presence. His conclusion was a beautiful appeal to the class to remember the higher side of the profession, and to cultivate a tender heart.

The exercises then closed with the benediction by Dr. Mathews.

At a later hour the Board of Regents, faculty, graduates, students of the University, and a large number of invited guests met at Morton's, where a generous feast was enjoyed by all. The toasts and speeches were continued until after midnight.

KANSAS CITY HOSPITAL COLLEGE.

The First Annual Commencement exercises of the Kansas City Hospital College were held March 15th in the Unitarian Church. The house was well filled and great interest was manifested in the proceedings. After the overture "Silver Bells" by the orchestra, Dr. D. E. Dickerson, the dean of the faculty, took the chair. Dr. Bowker then prayed for the blessing of God upon all liberal ideas and institutions. After the prayer the orchestra played the march from "Stradella."

The dean presented the diplomas to the graduating class and congratulated them upon their success in passing the severe examination to which they had been subjected. There were eighteen matriculants and seven graduates. The names and residences of the latter are as follows:

Charles F. Kuechler, Edwin G. Granville, William H. Kimberlin, James Carpenter, Kansas City; James Gilbert, Jackson County; Joseph H. Robinson, Tennessee; Rawson Arnold, Oakland, Cal.

Mr. Edwin G. Granville then delivered the valedictory address, which was in substance as given below.

Ladies and Gentlemen.—In universities and colleges, says Lord Bacon, "Men's studies are almost confined to certain authors from which if any dissenteth, it is enough to make him be thought a person turbulent."

That this is true no one can successfully deny. Weak and bigoted men always gratify their vanity in opposing the introduction of additions to our knowledge, which not being taught in the schools in which they were educated, are consequently above their comprehension. The concurrent denunciations of medical theories and practices by many of the enlightened professors and practitioners of medicine in modern times, and the innumerable failures of the practice, proves that medicine as it has been generally taught, understood and practiced, is not what it should be—is not an adequate supply to the demand of the age.

The ancients endeavored to elevate physic to the dignity of a science, but failed. The moderns, with more success, have endeavored to reduce it to the level of a trade. Science has heaped wealth in the lap of commerce; to the healing art, she has been a meagre patron. The commercial man cordially receives her magnificent contributions; the medical devotee looks with jealous eye upon her beneficent discoveries.

Their so-called regular State and County societies are not combinations to advance medical knowledge, for no one who happens to have mastered methods of practice unknown to these associations, essentially different from their methods, could bring any discovery or demonstration before them without being insulted or rejected without a hearing.

The new must e'er supplant the old,
While time's increasing current flows,

Only new beauties to unfold,
  And brighter glories to disclose;
For every crumbling altar stone
  That falls upon the way of time,
Eternal wisdom has o'erthrown,
  To build a temple more sublime.

The cry for more liberality in medical education has continued so long that it has become one of the demands of the age. And to Kansas City belongs the honor of establishing the first college of medicine as an adequate supply to imperative demand—one in which all approved systems are united, and in which all remedial agents are weighed in the scales of utility, and admitted or rejected according to their merits.

Fellow graduates, we are now by the authority of the State of Missouri and the judgment of this faculty Doctors in medicine. It now becomes us, through application and fidelity to our profession, to secure the recognition and patronage of the public, to whom we pledge our most earnest and conscientious efforts. Let us so live and work that when our service here is done, the sentence shall follow: "Well done, good and faithful servant."

At the conclusion of the valedictory, the dean introduced the Rev. John E. Roberts, who spoke upon

SENTIMENT AND SCIENCE.

Ladies and Gentlemen.—Sentiment is thought plus feeling; science is unimpassioned thought; sentiment is the child of the brain and the heart; science is the offspring of the brain; sentiment is ardent, sanguine, buoyant; science is frigid, formal, sedate; sentiment is elastic, roseate and joyous; science is rigid, colorless and solemn; sentiment is eager, impetuous and daring; science is methodical, slow and cautious; sentiment delights in results; science delights in processes; sentiment gathers flowers; science collects bulbs and roots; sentiment thinks science too slow; science thinks sentiment too fast; sentiment sometimes goes wrong; science—ditto.

Sentiment and science sometimes call each other names—then both have got wrong. I want to show you that there is not only room for both sentiment and science in the wide field that lies before us as students, but that the work of each will be imperfect and incomplete without the aid of the other.

The scientific method is not new. It dates, in fact, from before the beginning of the Christian era, but the great thinker who first defined it thought vastly in advance of his age. He was, therefore, destined to be misunderstood and unappreciated for centuries. There came one at last whose intellectual endowments added him to the list of which Aristotle was the last, and now for two centuries and a half the inductive method has been the process by which facts have been treated and scientific conclusions reached.

Following this method the workers of the world—each in his own chosen field—have been patiently observing and arranging facts. Beneath the disguise of endless variety they have detected hints of unity. Conversant with the "unbounded nature and unitability of particulars," they have drawn nearer and nearer to the subjects that are general and invariable, until, flushed with success and bewildered by the vastness of their deductions, they have invaded almost every realm of thought and emotion, and that, too, in the name of the inductive method.

There is a dogmatic positiveness too often displayed by scientific teachers—that is on the one hand unhealthful to real knowledge and on the other unwarrantably presumptuous. The results of this dogmatism are pernicious to the last degree. It drives the man who accepts its authority as final to the bitter conclusions that the universe is an eternal machine and himself a transient and insignificant part of it.

To him "nature conceals God, for through her whole domain nature reveals only fate—only an indissoluble chain of mere efficient causes without beginning and without end, excluding with equal necessity, both providence and chance. An independent agency, a free original commencement within her sphere and proceeding from her powers is absolutely impossible. Working without will, she takes counsel neither of the good nor of the beautiful, creating nothing, she casts up from her dark abyss only eternal transformations of herself unconsciously and without an end, farthering with the same ceaseless industry decline and increase, death and life, never producing what alone is of God and what supposes liberty, the virtuous, the immortal."

Reacting from this soulless materialism, some have reached the other extreme. Denying to science the claim of authority which she sets up for herself, they have lapsed into a sentimental mood, in which unsubstantial imaginings, unsupported by demonstrations or unwarranted by analogy, are vested with supreme authority. This is intellectual lawlessness. Under this order of things diseased imaginations have no check. The grotesque creations of unbalanced minds possess equal authority with the carefully proved deductions from observed facts—the hope of unity and harmony is blotted out—the world of matter becomes chaos again and the world of mind a pandemonium.

There is ample room for the careful student between these two extremes. He may accord to science all she can justly claim and yet be unfettered. He may also take counsel of his hope and aspiration concerning the realm in which science can gather no facts for demonstration, and still give no offense to reason nor presume upon analogy.

It becomes us to treat all demonstrated truths with reverence and honesty. It also becomes us to discriminate between proof and assumption, between fact and hypothesis, between certitude and probability. It is susceptible of demonstration that the majority of the conclusions reached by science are as yet only strong probabilities. What are popularly regarded as facts are in many instances regarded by the specialists as simply hypotheses. It is strangely true that the unscientific, dogmatic spirit of science is not entertained by the great teachers, but is the result of hasty conclusions and sweeping generalizations made by the masses.

The people ought to remember what the faithful investigator cannot forget, that science is yet largely tentative and hypothetical, and that her best established conclusions are only strong probabilities.

A recent English scholar has expressed his conviction, "That before a vigorous logical scrutiny the reign of law will prove to be an unverified hypothesis, the uniformity of nature an ambiguous expression and the certainty of our scientific inferences to a great extent a delusion."

The value of science is, of course, very high, while the conclusions are kept well within the limits of the data upon which they are founded, but it is pointed out that our experience is of the most limited character, compared with what there is to learn, while our mental powers seem to fall infinitely short of the task of comprehending and explaining fully the nature of any one object. "Ours must be a truly positive philosophy, but that a false negative philosophy, which, building on a few material facts, presumes to assert that it has compassed the bounds of existence, while it nevertheless ignores the most unquestionable phenomena of the human mind and feelings." This writer defines a law of nature not as an uniformity which must be obeyed by all objects, but "merely an uniformity which is as a matter of fact obeyed by those objects which have come beneath our observation," and adds that it would not be incompatible with logic nor any reproach to our scientific method if objects were discovered which should prove exceptions to any law of nature.

It is not my purpose to awaken unreasonable doubt where certainty may be had, but I want to suggest the propriety of caution and candor, the distinguishing traits of the real student in whatever field. As the domain of knowledge widens man discovers with an ever increasing degree of probability that no one branch of science is independent of all or any of the others and that no one of them all can be rightly understood without taking account of its relations to the rest.

The too exclusive study of a single subject leads to an over confident and dogmatic spirit, to unjust and harmful discriminations. The labor of specialists is, it is true, enriching the world with its results—but the labor of many specialists—not one

There is a large amount of conceit in the reputed dying statement of a certain German student, regretting that he had not devoted his entire life to the single letter "Iota." But the world would have been little better for his "Iota," if others had not studied the rest of the Greek letters and all of the cases. In the better mood of our age no department of learning will say to any other "I have no need of thee." Each acknowledges to every other its peculiar domain and its peculiar importance, and each in its own way points onward to a more complete understanding of man, "the proper study of mankind."

This institution, in observance of whose first annual Commencement we have gathered here to-night, is founded upon this principle of comparative study. It seeks to apply the general principle to the special department of medical science.

It is to be both congratulated and commiserated. The first because it strives to exhibit the broad principles of fraternity and to make common cause for the common good; the second because by virtue of its advanced position it has immolated itself upon the pale of obloquy; it has executed its own irrevocable degree of ostracism.

The constituents of this, its first class of graduates, will go down to their chosen work as Ishmaelites. "Treat such men as gentlemen if you know them to be gentlemen," said a respected physician at a recent Commencement of another school, "but have nothing to do with them professionally."

Such sentiments as that may be necessary to the preservation of some ancient code of professional ethics, but the common people, untrained in the discrimination of such hypercritical refinements can discover neither necessity nor justice for such unwholesome teaching.

Without assumption, I think I may say to the members of this class that the position you will occupy as the first representatives of this college demands of you in a peculiar way the virtues of modesty and forbearance.

By following the curriculum and receiving diplomas from a school that does not acknowledge the supreme and all-sufficient authority of any one principle or formula, you stand committed to a practice that must be variable without being fickle and persistent without being inflexible.

Persuaded that the last word has not been said in this nor in any other science you must be listeners. Persuaded that the sum of human knowledge is yet incomplete, you will be patient learners. Francis Bacon compared himself to the statues of Mercury, which indicate the way although they do not pass over it themselves.

Every true student, even in this age, does best who can, when his task is done, point, not to the finished work his hand and brain have wrought, but to the work suggested—perhaps begun—but quite too large for one life to compass. To him who is willing to learn the world has much to teach. To him who listens well there are many voices.

Modesty then is the virtue I would commend, the modesty that makes men teachable, the modesty that keeps the greatest learning humble, the modesty that gives one respect for every man's doubt and a far greater respect for every man's honest belief. By the virtue of forbearance I mean that equable temper born of confidence in one's mission that renders him calm and silent under the stinging lash of criticism, ridicule and obloquy. The world moves slowly, but it moves. When any man leaves the beaten track to make for himself and others a new way—albeit that way leads out by flowers and singing brooks—he brings upon his devoted head storm after storm of bitterness. In other ages the rack and the stake were the rewards that grateful people meted out to the men who thought differently from their times. More than many times have God's rivers been called upon to bear out to the everlasting sea the ashes of God's best interpreters and humanity's best friends.

The method has changed. The spirit remains. Persecution has been refined to indifference and contempt, but it is persecution still. Some one has said and said wisely that "only he is great who can bide his time." Justice is sometimes tardy, but it comes at last. It will devolve upon you to compel respect for your position by your calmness, your patience and your dignity, to be liberal without being illiberal—to be honest, conscientious and to wait. It will not be fair to conclude that all who criticise are unworthy men.

Bear in mind that this is yet only an experiment, and that many faithful and good men honestly believe it both impracticable and absurd. One of the most dangerous enemies that this movement will encounter will be found in the man of little brain and less conscience who will make it a means to obtain for himself the cheap notoriety of sensationalism or to invest his quackery with respectability. The best thing may be put to the worst use.

If through these things you are able to hold your way, unvexed by honest criticism, unangered by dishonest pretenders, then you will have done more than much toward breaking away from unhealthful technical restraints and in teaching men so.

The world is wide and full of ignorance, want and pain. Superstition casts its weird shadows over the cold, unlighted hearthstones of reason. Despair puts out the torch of hope. The dew falls nightly on new made graves. Whatever his special calling, the true man will find a field wider than his profession. He will need knowledge that no curriculum gives, medicine that no text book suggests, remedies that no formula supplies. Only as his heart is touched with the deeper tenderness and filled with the sublimer sympathies; only as he rises above the formalities and literalism of mere profession; only as he is truly man, will he be able really to help men, and in helping bring himself and them into wider liberty, into clearer light and nearer God.

Rev. Dr. Bowker next addressed the class, giving them timely warning of the difficulties which must beset their paths during professional life. At the conclusion of his remarks Rev. Mr. Roberts pronounced the benediction.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The extreme cold weather which closed our last report (Jan. 20th,) has continued through the first two decades here recorded. There have been two periods of extremely low temperature, the first lasting from January 18th to January 24th, and the second from February 1st to February 9th. The temperature reached –21° on January 22d and February 4th.

During the storm of February 15th the lowest barometric pressure was reached—as observed 28.460, reduced to zero and sea level 29.395.

The highest temperature was 65°, February 14th.

The usual summary by decades is given below.

Temperature of the Air.	Jan. 20th to 30th.	Feb. 1st to 10th.	Feb. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	2.3	–3.9	19.2	. .
Max	32.0	19.3	47.2	. .
Min. and Max	17.1	7.4	33.3	. .
Range	30.3	25.4	28.0	. .
Tri-Daily Observations.				
7 a. m.	10.0	24.1	24.1	. .
2 p. m.	26.6	38.7	38.7	. .
9 p. m.	18.0	31.1	31.3	. .
Mean	18.2	30.1	31.1	. .
Relative Humidity.				
7. a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	. .	. .	. .
Mean	. .	. .	. .	. .
Pressure as Observed.				
7 a. m.	29.17	29.41	29 28	. .
2 p. m.	29.17	29.38	29.19	.
9 p. m.	29.20	29.43	29.21	. .
Mean	29.18	29.41	29.23	. .
Miles per Hour of Wind.				
7 a. m.	14.0	14.5	14.9	. .
2 p. m.	10.0	15.7	18.2	. .
9 p. m.	14.0	13.4	17.8	. .
Total miles	3071	2686	3570	9327
Clouding by Tenths.				
7 a. m.	5.0	6.7	6 5	. .
2 p. m.	3.0	6.0	5.6	. .
9 p. m.	5.0	2.5	4.2	. .
Rain.				
Inches	0.0	0.20	1.50	1.70

The weather at this station since February 20th, when the above report closed, has been much warmer, and yet there have been but three days when the freezing temperature was not reached. The rainfall has been light but the first decade was very muddy, owing to previous rains and depth of frost.

On the north side of a building, twenty feet distant, there was frost in the ground as late as March 20th. There has been no weather thus far to favor the premature putting forth of fruit buds, and altogether the season is much more backward than usual. In addition to the usual report by decades the following items are given:

Highest temperature, 74°, on March 14th. Lowest temperature, 9°, on March 19th.

Highest pressure, 29.730, reduced 30.654, on March 3d. Lowest pressure, 28660, reduced 29.608, on March 18th.

Greatest velocity of wind, 60 miles, on March 13th.

The usual summary by decades is given below:

Temperature of the Air.	Feb. 20th to 28th.	Mar. 1st to 10th.	Mar. 10th to 20th.	Mean.
Min. and Max. Averages.				
Min	24.4	25.0	24.2	24.5
Max	48.9	55.7	58.5	54 4
Min. and Max	37.2	40.1	41.9	39.7
Range	24.4	28.6	31.4	28.1
Tri-Daily Observations.				
7 a. m.	28.8	32.4	33.7	31.6
2 p. m.	47.0	51.8	52.1	50.3
9 p. m.	36.9	38.4	38.1	37.8
Mean	37.4	41.5	41.6	40.2
Relative Humidity.				
7 a. m.	..	..	..	..
2 p. m.	.	..	.	..
9 p. m.	..	..	..	..
Mean	..	..	..	..
Pressure as Observed.				
7 a. m	29.27	29.27	29.09	29.21
2 p. m.	29.26	29.25	29.06	29.19
9 p. m.	29.24	29.05	29.17	29.15
Mean	29.26	29 24	29.08	29.18
Miles per Hour of Wind.				
7 a. m.	9.2	11.0	14.6	11 5
2 p. m.	16.1	20.0	22.8	19 6
9 p. m.	11.0	12.5	15.4	13.0
Total miles	2560	3906	4035	10501
Clouding by Tenths.				
7 a. m.	5.9	4.8	5.7	5.1
2 p. m.	4.0	4.8	1.5	3.4
9 p m	3.5	4.6	2.7	3.6
Rain.				
Inches	1.40	0.75	.01	2.16

ARCHÆOLOGY.

AN OLD MAP.

Wm. J. Florence, the actor, has sent to this office from Middletown, Conn., a little pocket-map of Missouri in 1829, which is a curiosity. The leather cover is three inches by two, and the map inside is ten by twelve inches. There are twenty-eight counties in the State—St. Louis, Jefferson, Franklin, Washington, Ste. Genevieve, St. Francis, Perry, Madison, Cape Girardeau, Scott, New Madrid, Gasconade, Cole, Wayne, Cooper, Saline and Lillard south of the Missouri

River, and St. Charles, Lincoln, Montgomery, Pike, Callaway, Ralls, Boone, Howard, Chariton, Ray and Clay north of it.

Wayne is the largest County in the State, Gasconade next, and these two counties embrace two-thirds the area south of the river. Lillard is the only County whose name does not survive in the existing county nomenclature. It embraced area bounded by the Missouri on the north, the Osage on the south, the western border on the west and Saline County on the east, now one of the finest districts in the State. The western border runs in a straight line north and south across the Missouri River at the point where Kansas City now stands. The "Platte purchase," embracing the rich and productive region included between this old border and the Missouri to the Iowa line, had not then been added to the State. This map was published by A. Finley, northeast corner Chestnut and Fourth Sts., Philadelphia, in 1829, and the copy sent to us was picked up by Mr. Florence in Middletown, Conn.—*St. Louis Republican.*

THE DAVENPORT ACADEMY OF SCIENCES.

The Academy of Natural Sciences had last evening, March 5th, an unusually large and interesting meeting.

The Publication Committee reported the completion of the printing of the third part of Volume III of the "Academy Proceedings," and the reception of the engravings; the volume being now ready for binding, which will be done without delay.

The Librarian, Miss Dr. McCowan, reported the addition to the library during the month of thirty-two bound volumes, forty-one pamphlets, thirty-nine circulars and bulletins, thirty-three daily and weekly papers—total, 145; exclusive of the city papers.

The Curator presented for inspection a collection of thirteen of the "curved-base" mound-builders' pipes just received from that indefatigable explorer and collector, Rev. J. Gass. These pipes were collected the past year from the mounds in Muscatine, Rock Island and Mercer Counties, by Mr. Gass, his brother and some neighbors, and he has recently acquired full possession of them for the benefit of the Academy, with a full description of the mounds, their structure, etc., etc.

One of these pipes is a finely carved stag's head, representing the antlers bent around the bowl and carved in relief; another is an eagle, perched, and holding some small animal in its claws, and two others are neatly carved birds. These four are of ash-colored pipe-stoner Another is a finely sculptured black bear and is very appropriately cut in a smooth fine-grained black stone. The sixth is supposed to represent a fox with the face turned backward, carved in a beautiful bright red catlinite; the seventh, a non-descriptive animal is also cut in red catlinite, very much spotted.

Two of plain form, all composed of plain red catlinite. The other four are made of a light brown stone, rather small and of the simplest form.

There is also an "axe" of the exact usual form of the plano-convex copper "axes" so-called, which is also made of the catlinite, or red pipestone, and a small charm of the same material.

This constitutes a very important addition to this already unequaled collection of the relics of the mound-builders and bringing the collection of pipes of this typical form up to the number of fifty-six, including several unfinished specimens, and by far the largest collection of its kind in the world.

Mr. Gass presents these in the name of his little son, and a committee was appointed to draft and present to him resolutions expressive of the heartfelt thanks of the Academy and their high appreciation of his noble, disinterested and self-sacrificing labors for the building up of this magnificent collection of the relics of the remote past of our immediate locality.

It was voted that the Curator, Mr. W. H. Pratt, be requested to prepare a paper on the mound-builders' pipes for the meeting of the American Association for the Advancement of Science, to be held in August at Minneapolis.

H. A. R.

BOOK NOTICES.

History of the Negro Race in America. By George W. Williams. In two volumes, octavo, Vol. II.; 1800 to 1880; pp. 611. G. P. Putnams' Sons, New York. For sale by M. H. Dickinson, Kansas City, $3.50.

To those persons who doubt the ability of the colored man to accomplish excellent literary work we commend these volumes of Mr. Williams. He has devoted seven years to their preparation and has produced the best account, in many respects, of the negro race on this continent, of any author who has essayed the task. The arrangement of the various branches of the subject, the selection of the matter, the style of the composition, are all characteristic of education and taste of a high order. Historical work is by no means easily managed so as to convey the facts in an attractive manner, but Mr. Williams has succeeded admirably in maintaining the interest from beginning to ending and at the same time in keeping all the important points in the foreground.

The first volume covers the period from 1619 to 1800, but the second relates to that portion of the history of the race which is by far the most interesting to the reader and important to the negro himself, viz.: from 1800 to the present time, including the fierce political struggle for the restriction or extension of slavery; the anti-slavery agitation movement; the national legislation upon the subject; the John Brown invasion of southern territory; the war for the Union; the valorous conduct of the colored troops; the emancipation proclamation; the reconstruction measures; the results of emancipation, etc., etc. All this is told in earnest, faithful, truthful, forceful language which carries conviction with it and gives to the reader a full conception of what the nation has gained by the late war aside from the restoration and perpetuation of the Union.

Despite a few inaccuracies of minor importance and some inelegancies of expression, this book will remain a monument to the author's laborious study and marked ability as a writer, while to future students it will be a text-book, full, reliable and accurate. The publishers have put it forth in very handsome and durable shape, as it deserves.

Annual Report of the Chief Signal Officer, U. S. A., for the year ending June 30, 1881. Washington; Government Printing Office, 1882. Octavo, pp. 1296.

This very bulky, and inconvenient to-handle, volume contains a vast amount of information, much of which has been already published in the "Monthly Weather Review," and much that will be new to most readers. For instance, few, we presume, are aware of the extent of the diffusion of weather forecasts, warnings of anticipated frosts, floods and storms, or of the great practical benefits derived from them by the agricultural, commercial and other industrial interests of the country. Most people are aware that storm signals are shown at principal sea and lakeports for the benefit of shipping interests. Some may know that bulletins for the benefit of farmers are distributed by telegraph and mail, but very few comprehend how widely the system extends and how highly tobacco and cotton growers prize these warnings received. It will doubtless be a surprise to many to learn that in 1881 six thousand six hundred and seventy-two Farmers' Bulletins were distributed daily, being telegraphed at 1 A. M. to centers of distribution in various portions of the United States and there printed and made ready for mailing by the first trains to all points within six hours reach. The Railway Bulletins, sent by coöperation of the various railways of the country with the Signal Office, also cover an immense field and are of the greatest service, not only to the railroad companies themselves in enabling them to prepare for storms, but also to the people along their lines. Ninety-three companies, represented by 2937 telegraphic stations, are volunteering and gratuitously assisting in this service. Boards of Trade, Chambers of Commerce and other commercial organizations throughout the country take an active interest in assisting in procuring and disseminating these daily reports. The planters in the cotton region have demanded and received similar bulletins from a large number of stations all through the belt; the prominent newspapers of the larger cities have found it beneficial to their readers to publish the daily meteorological charts and data; the river men have been furnished warnings regarding freshets, ice-gorges, etc.; the cultivators of sugar-cane (as well as those of cotton and tobacco) have received frost warnings which have enabled them to guard against injury to their crops. The orange interests of Florida and the fruit interests in other sections have also been largely benefited by these warnings. The correctness of these warnings and storm predictions have been carefully verified by observations and found to agree very closely with the actual results, the percentage of accuracy running as high as 95 on the average.

There is no question of the value and importance of the Signal Service work to the country at large, and the number of persons consulting the charts and tables in our post-offices, daily, shows the confidence placed in the observations and predictions by the public generally.

THE BUILDERS' GUIDE. By Fred. T. Hodgson; 12mo. pp. 326; New York. The Industrial Publication Society, 1882. $1.00.

This work is chiefly intended as an aid to the builder and contractor in making estimates of the cost of work they may be competing for. The author is editor of the *Builder and Woodworker* and is fully competent to offer advice and information on all branches of the builder's business. In addition to the ordinary rules for estimating found in such books, he has given prices of material, labor, tools, etc , which, if not applicable at all localities, will serve as a general guide at least to proportional values and enable the mechanic to avoid the reckless guessing which so often appears in their bids.

Many pages are devoted to valuable tables and memoranda of a useful character compiled from the standard works of Nicholson, Barlowe, Rankine, Trautwine and other well known authors, also to various rules and recipes that must prove of service to builders and all others interested in the construction, repairs or decoration of buildings. A very concise summary of the Mechanic's Lien laws of most of the States of the Union is given which adds largely to the value of the work to laboring men and those supplying materials. Nearly sixty pages are devoted to a glossary of architectural terms, and the whole is concluded with a careful index. Apparently it is just the book needed by estimators, contractors and mechanics.

REPORT OF THE DIRECTOR OF THE U. S. GEOLOGICAL SURVEY, 1881. Quarto, pp. 588. U S. Printing Office, Washington, 1882.

This is the Second Annual Report of the Survey and is made by Major J. W. Powell, the capable successor of Mr. Clarence King, who resigned March 11, 1881. It comprises a general account of the work done, with the administrative reports of the several assistants and several valuable accompanying papers. such as The Physical Geology of the Grand Cañon District, by Captain C. E. Dutton; Contributions to the History of Lake Bonneville, by G. K. Gilbert; Abstract of Report on Geology and Mining Industry of Leadville, by S. F. Emmons; A Summary of the Geology of the Comstock Lode and the Washoe District, by Geo. F. Becker; Production of the Precious Metals in the United States, by Clarence

King; A New Method of Measuring Heights by Means of the Barometer, by G. K. Gilbert. List of illustrations.

The volume is admirably printed and, as can be seen by the above statement of its contents, it is an exceedingly valuable work. The expenses of the Survey for the year were $156,000.

GEOMETRY AND FAITH. Thomas Hill, D. D.; 12mo., pp. 124. Lee & Shepard, Boston, 1882. $1.25.

The Rev. Dr. Thomas Hill, who was at one time President of Harvard College and who was regarded by the late Professor Peirce as one of the finest mathematicians of this country, has again rewritten and sent forth his little work with the above title. It was first published in 1852 as a supplement to Charles Babbage's "Ninth Bridgewater Treatise," and with the same object in view, i. e. to refute the idea that ardent devotion to mathematic studies is unfavorable to faith, and also to indicate the aid which the evidences of Christianity may receive from such studies. It is admirably adapted to such a purpose, inasmuch as it combines precise mathematical statements with the imagination of the poet, the eloquence of the orator and the learning of the sage. Very few can read the several chapters of the work and fail to be convinced that there are "proofs of a divine intelligence behind and beneath the order of nature, manifest alike in the grandest and minutest forms, alike in the most abstract and the most concrete laws of the universe." He applies the strictest mathematical tests to the processes and results of nature, and shows beyond question the rule of law as formulated and operated by a prime originator and Creator. It is just such a work as a lover of the higher mathematics would be attracted by, and at the same time it is extremely fascinating to any reader.

Doctor Hill is also an eminent Hebrew scholar and has devoted some of his leisure hours to the translation of the Old Testament scriptures and the books of Apochrypha. He has now in hand a translation of Ecclesiasticus, which he regards as "a grand old book, fully worthy (as far as I can see) to take its place by the side of the Proverbs."

OTHER PUBLICATIONS RECEIVED.

Missouri Historical Society, annual address of the President, Geo. E. Leighton, January 16, 1883. Proceedings of the Academy of Natural Sciences of Philadelphia, Part III, October to December, 1882. Capital and Labor, Henry McKinney, Great Bend, Penn., 10c. Discussions in Current Science, by W. Mattieu Williams, *Humboldt Library*, No. 41, 15c. Bromide of Ethyl, by Julian J. Chisolm, M. D. Cambridge Entomological Club, Annual Report for 1882. The Researches of Colorado, 1881 and 1882, J. Alden Smith, State Geologist, pp. 160, 35c. Annual Report of the Board of Health of Kansas City for the

the year 1882, by John Fee, City Physician. *The New Idea*, weekly, Frank H. Fenno, Altay, N. Y., $1.00 per year. The Eclectic Magazine, February, 1883, monthly, E. R. Pelton, Publisher, $5.00 per annum. The British Quarterly Review, the Leonard Scott Publishing Co., N. Y., $2.50 per annum. The History of the Science of Politics, by Fred Pollock, *Humboldt Library*, No. 42, 15c. On Some Enclosures in Muscovite, by H. Carvill Lewis.

SCIENTIFIC MISCELLANY.

THE BACON-SHAKESPEARE CRAZE.

RICHARD GRANT WHITE.

And now we are face to face with what is, after all, the great inherent absurdity (as distinguished from evidence and external conditions) of this fantastical notion,—the unlikeness of Bacon's mind and of his style to those of the writer of the plays. Among all the men of that brilliant period who stand forth in the blaze of its light with sufficient distinction for us, at this time, to know anything of them, no two were so elementally unlike in their mental and moral traits and in their literary habits as Francis Bacon and William Shakespeare; and each of them stamped his individuality unmistakably upon his work. Both were thinkers of the highest order; both, what we somewhat loosely call philosophers: but how different their philosophy, how divergent their ways of thought, and how notably unlike their modes of expression!

Bacon, a cautious observer and investigator, ever looking at men and things through the dry light of cool reason; Shakespeare, glowing with instant inspiration, seeing by intuition the thing before him, outside and inside, body and spirit, as it was, yet moulding it as it was to his immediate need,—finding in it merely an occasion of present thought, and regardless of it, except as a stimulus to his fancy and his imagination: Bacon, a logician; Shakespeare, one who set logic at naught and soared upon wings, compared with which syllogisms are crutches: Bacon, who sought, in the phrase of Saul of Tarsus,—that Shakespeare of Christianity,—to prove all things, and to hold fast that which is good; Shakespeare, one who like Saul, loosed upon the world winged phrases, but who recked not his own rede, proved nothing, and held fast both to good and evil, delighting in his Falstaff as much as he delighted in his Imogen: Bacon, in his writing, the most self-asserting of men; Shakespeare, one who, when he wrote, did not seem to have a self: Bacon, the most cautious and painstaking, the most consistent and exact, of writers; Shakespeare, the most heedless, the most inconsistent, the most inexact, of all writers who have risen to fame: Bacon, sweet sometimes, sound always, but dry, stiff, and formal; Shakespeare, unsavory sometimes, but oftenest breathing perfume from Paradise, grand, large, free, flowing, flexible, unconscious, and incapable of formality: Bacon, precise and reserved in expression; Shakespeare, a player and quibbler with words, and swept away by his own verbal conceits into intellectual paradox, and almost into moral obliquity: Bacon, without humor; Shakespeare's smiling lips the mouthpiece of humor for all human kind: Bacon, looking at the world before him and at the teaching of past ages with a single eye to his theories and his individual purposes: Shakespeare, finding in the wisdom and the folly, the woes and the pleasures of the past and the present only the means of giving pleasure to others and getting money for himself, and rising to his height as a poet and a moral teacher only by his sensitive intellectual sympathy with all the needs and joys and sorrows of humanity: Bacon, shrinking from a generalization even in morals: Shakespeare, ever moralizing, and dealing even with individual men and particular things in their general relations: both worldly-wise, both men of the world, and both these master intellects of the Christian era were worldly-minded men in the thorough Bunyan sense of the term: but the one using his knowledge of men and things critically in philosophy and in affairs: the other, his synthetically, as a creative artist: Bacon, a highly trained mind, and showing his training at every step of his cautious, steady march: Shakespeare wholly untrained, and showing his want of training even in the highest reach of his soaring flight: Bacon, utterly without the poetic faculty even in a secondary degree, as is most apparent when he desires to show the contrary: Shakespeare, rising with unconscious effort to the highest heaven of poetry ever reached by the human mind. To suppose that one of these men did his own work and also the work of the other is to assume two miracles for the sake of proving one absurdity.—*Atlantic Monthly for April.*

THE TOTAL SOLAR ECLIPSE OF MAY 6TH.

A total eclipse of the Sun occurs on the 6th of May. The Sun and Moon, the chief actors in the grand display, regardless of the convenience of terrestrial observers, have located the scene of operations in the Southern Pacific Ocean. The line of totality sweeps over a vast extent of watery waste, including in its passage only two small islands, where the eclipse can be seen to advantage. These two islands are Caroline Island and Flint Island. The former is about ten miles in circumference, and is inhabited by thirty natives of the Malay race and one white man. The latter is five or six miles in circumference, and is, we believe, uninhabited. Both islands are out of the beaten track of those who go down to the sea in ships. But small as the islands are, and difficult as they are to reach, the wise men who wish to study the eclipse, and all others who desire to witness the most glorious celestial phenomenon that ever takes place, will have to congregate on these two little islands. Thousands of miles of ocean must be traversed, and all manner of privations and hardships must be endured, in order to behold the awe-inspiring spectacle. But never yet in the history of the human race have any difficulties in the way prevented zealous men of science from attempting to fathom the mysteries that enshroud our celestial neighbors.

Two French expeditions are being equipped, one to observe the eclipse at Caroline Island and the other at Flint Island. The British nation will not allow their neighbors across the channel to outdo them in scientific research, and will, doubtless, send an observing party to Caroline Island. The Americans are now strongly agitating the question of sending some of the best astronomers to the same fortunate island, and there is little doubt that the means will be forthcoming. Amateur astronomers are debating the question of joining the expedition, and the prospect is that when the 6th of May dawns a colony of scientists, from many quarters of the globe, will be assembled in this lone land of the Pacific to find out what secrets they can discover while the face of his majesty, the Sun, is veiled from mortal view.

The eclipse of May next is especially favorable for observation on account of the long duration of totality, which will amount in some localities to nearly six minutes. The longest time that a total solar eclipse can last is not quite seven minutes. The eclipse observed last year in Egypt lasted only seventy-two seconds, and it is a rare event for an eclipse to last nearly six minutes, as will be the case with the coming eclipse. Caroline Island is situated in 73° 20′ W. longitude from Washington, and 9° 40′ S. latitude. The duration of totality there will be five minutes and twenty seconds. Flint Island is situated in 73° 40′ W. Longitude from Washington, and in 11° 30′ S. latitude. The duration of totality there will be five minutes and thirty-three seconds.

The approaching eclipse is therefore a very important one, on account of the unusually long continuance of the total phase; for the law is, the longer the totality the more favorable are the conditions for observation. Astronomers will do their best to increase their stock of knowledge on three important points, two of which are connected with the surroundings of the Sun, never revealed except on the rare occasions of a total solar eclipse. They hope in the first place to add something to what has already been learned during previous eclipses concerning the corona, especially in regard to the immense appendages which branch out from the corona in all directions; to find out whether they are dependencies of the coronal atmosphere, or whether they are swarms of meteors circulating around the Sun. In the second place, they will make a study of the zodiacal light and its relation to the Sun's surroundings In the third place, they will carefully search for the small intra-Mercurial planets that probably circulate in the immediate neighborhood of the Sun, and which can only be seen when making a transit over his disk or during a total solar eclipse. The spectroscopist, the photographer, and the observers with the naked eye will do their allotted parts in the difficult and delicate work. The tropical locality of the places of observation is favorable for clear weather on the momentous occasion, and there is reason to hope that discoveries will be made and observations confirmed that will render illustrious the astronomical annals of 1883.—*Providence Journal.*

EDITORIAL NOTES.

THE present number concludes the sixth volume of the REVIEW, and again we tender our thanks to our subscribers for their support and their frequently expressed appreciation of our efforts to instruct and entertain them. We are also indebted to our contributors for their unremunerated assistance in maintaining the character of the REVIEW for originality and ability. We have at all times endeavored to give prominence to Western discoveries, inventions and theories, and upon looking over the back numbers we are quite surprised at the extent and value of this kind of matter we have secured and given to the public. Not less than 1,200 pages have been written by Missouri contributors and devoted to the material interests of this State; nearly 1,000 by Kansas writers upon subjects connected with the advancement of the scientific and commercial interests of that State and nearly 500 by scientists of Colorado upon her mining and metallurgical interests. All of the other Western States have been represented by original articles upon industrial or other important practical subjects, while the Central and even the Eastern States have been frequently heard from through their best thinkers and writers.

The REVIEW has succeeded in gaining a standing among the standard periodicals of the country, which is highly creditable both to the community whence its principal support comes and to the character of the articles published.

It is, however, again necessary and proper to call the attention of the friends of popular science and education to the fact that the REVIEW is not even yet upon a self supporting basis, and to ask their aid in establishing it on so firm a footing that the tax upon its editor and publisher will only fall upon his time and energies, and not upon his pocket also, as heretofore. The magazine is one of the recognized factors in the general advancement of this region and consequently deserves the support of all classes of citizens.

THE Kansas City Academy of Science has given its regular monthly entertainments during the past winter, which have in most cases been fairly attended. The lecture by Rev. Doctor C. L. Thompson upon "The Science of Religion" was repeated by request on the last Tuesday of February and was enthusiastically received. That of Professor George Halley, M. D., upon "Prisons and Prisoners," owing to the threatening weather and the multiplicity of other entertainments on last Tuesday, was postponed until a more favorable occasion. The writer hereof has had the privilege of hearing a great portion of it read and can testify to its originality and worth. There will be two more meetings this spring—the last Tuesdays of April and May respectively. The latter named evening is the occasion of the Eighth Anniversary of the Academy, when an address by the President upon the progress of Science may be expected.

PROF. F. F. HILDER, of St. Louis, recently delivered a lecture before the Davenport (Iowa) Academy of Sciences upon "The Art Wonders of Ancient Egypt." As Professor Hilder spent several years as a civil engineer and interpreter in the service of the Egyptian Government, his opportunities for acquiring intimate knowledge of his subject were exceptionally good and the lecture was largely attended.

THE mistake of 1000 years in our statement of Wiggins' prophecy in the March REVIEW, though made without collusion with him, will probably, in view of the results March 9th to 11th, be regarded by him as a saving clause, and will be adopted as the true text by his adherents.

It is probable that Prof. W. I. Marshall, who delivered an illustrated lecture at the Opera House upon "The National Park and its Great Geysers," under the auspices of the Kansas City Academy of Sciences three years ago, will be induced to visit the city in May and give a series of entertainments illustrated by stereopticon views of the wonders of the Pacific Coast. If the Academy succeeds in this our citizens can prepare for a rich treat.

Mr. T. Cummings, in the *Scientific American* claims to have discovered that the Egyptian obelisk in Central Park is not granite, as has been supposed, but simply a concrete composed of crushed granite, asphalt and hydraulic lime (not cement). He gives the Egyptians great credit for knowing how to make first-class concrete, but offers to duplicate the obelisk in the same material for $15,000. If history is correct as to the age of this job, Mr. Cummings would have to employ a longer lived insurance company than ordinary to furnish a satisfactory guaranty of the durability of this duplicate.

The transportation car of U. S. Fish Commission, in charge of Mr. Moore, remained here a few days last week, affording quite a number of our citizens an opportunity to inspect it and the manner of handling the young fish. It has been discovered by experience that if the water containing them is kept at about 40° it is not necessary to change it more than twice a week, even when there are twenty or thirty fishes to the gallon.

A coal mine has been discovered in the vicinity of Gentryville, Mo., and a company is being organized to develop it. The vein is about three feet thick, and the coal is said to be of good quality.

A slight shock of earthquake was felt all along the Pacific coast east and south of San Francisco, on the 30th of March. At Watsonville nine shocks were felt, and at Hollister plate-glass windows were broken and brick walls cracked.

Mr. Keely, the inventor of the motor which he claims will revolutionize all motive power, proposes to make a trial trip on the 4th of July. The apparatus will have a capacity of 500-horse power. The parts of the engine are massive, and are composed of Austrian gun metal and the hardest of hardened steel.

The fourth centennial anniversary of the birth of Raphael was celebrated at Rome, March 18th, with great pomp. A bronze bust of the great artist was unveiled at his tomb.

Dr. Lewis Swift, Director of the Warner Observatory, has received from Minister Morton at Paris 540 francs, the Lalande prize of the Paris Academy of Science awarded each year to the astronomer most distinguished during the year. The prize also includes a silver medal of the Institute of Paris, of which Dr. Swift becomes an honorary member.

The Annual Reports of the City Comptroller, City Engineer and City Physician are the fullest, most complete and most satisfactory of any ever made by similar officers in the history of this city. We shall take occasion to quote from the last named in our next.

Senator Bryant's bill appropriating $100,000 for enlarging and repairing the State University of Missouri passed the Senate on March 23d, and has since been approved by the Governor.

A new test for gold leaf was accidentally discovered at the Farrell Venetian Art Glass Manufacturing Company's works in Brooklyn. By the Farrell process the leaf is placed on the incandescent glass, which is then blown. The expansion splits the leaf into beautiful and fantastic forms, and the object is then fired, covering the glass with the vitreous material. In using a guaranteed 999 quality of gold leaf the workmen found that the expansion separated the gold from a copper alloy, and the object was ornamented with gold and handsome green, the latter color being due to the oxidation of the copper.

THE U. S. Signal Officer, at St. Louis, predicts that the current of the Mississippi River will cut its way into the Atchafalaya Bayou within a year or two and make that the main channel from the mouth of the Red River to the Gulf. This will shorten the line to the Gulf about 200 miles, but as the cities along the present course and Captain Eads will decidedly object to the change, it is likely that such steps as we suggested last season will be adopted to prevent the change and at the same time allow of the overflow in very high water from the Mis issippi through the Atchafalaya Bayou to the Gulf and thus save the country below the mouth of the Red River.

THE National Academy of Science will hold its regular annual meetiug next month. A larger attendance than usual is anticipated, as the members of the Academy will be invited to participate in the ceremonies attendant upon the unveiling of the statue of the late Prof. Henry, for many years in charge of the Smithsonian Institution. The 19th of April has been selected as the time for the ceremony, and in deference to the simplicity that characterized the life of the deceased, the details of the occasion will not be elaborate, but will consist of an oration by President Noah Porter, of Yale College. The statue is the work of W. W. Story, whom Congress specially named in the law appropriating $15,000 for it. Besides the members of the National Academy, President Arthur and his Cabinet and committees representing Congress, as well as other distinguished persons, will be present. The figure is of bronze, seven feet high, and represents the late Professor standing in a meditative attitude, one hand resting upon a support, the whole effectively and gracefully draped in an academic gown. The pedestal is of red beach granite, and the base and top of Quincy gray granite. The red granite is polished and bears upon its surface, in clear-cut Roman letters, the simple inscription "Joseph Henry."

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

WE have received *Harper's Monthly* for April, also the latest numbers of the *Weekly* and the *Bazar.* Without entering into details, we cannot avoid calling attention to the constant improvements being made in each of these periodicals, not only in literary matter but in engravings, printing and general style. The editors of these magazines seem to have no idea of ceasing their progressive efforts, though the public have regarded them as nearly perfect for a long time.

WE learn from "Notes and News" in *Science* of March 16th, that the American Archæological Institute of America, at Boston, has about 80 life and 220 annual members, and besides its Reports and its papers, has commenced the publication of a Bulletin giving the full reports of its agents in Greece, New Mexico, Cyprus, the Troad, etc.

THE contents of the *Popular Science Monthly* for April are as follows: Nature and Limits of the Science of Politics, by Professor Sheldon Amos, LL.D. The Economic Function of Vice, by John McElroy. Progress of the Backboned Family, by A. B. Buckley, (Illustrated). Curiosities of Superstition, III, by Felix L. Oswald M. D. Perceptional Insanities, by Dr. W. A. Hammond. Dwarfs and Giants, by M. Delbœuf. The Census and the Forests, by N. H. Egleston. Origin of the Donkey, by C. A. Pietrement. Speculations on the Nature of Matter, by Henry H. Bates, M. A. The Legal Status of Servant Girls, by Oliver E. Lyman. The New York Geological Survey, by James Hall, LL. D. The Origin of the Calendar and Astrology, by Professor W. Foester. Sketch of Increase Allen Lapham, LL. D., (With Portrait); Correspondence; Editor's Table; Literary Notices; Popular Miscellany; Notes.

The *Art Interchange*, published by William Whitlock and edited by Arthur B. Turnure at 140 Nassau Street, New York, is an admirably conducted periodical. In the number for March 15th we find several most beautiful designs for the use of amateur and art students. Eleven columns are devoted to Notes and Queries upon art topics. Among the subjects considered are—Plaster Casts, Dacca Silk, Easter Church Trimming, Spray Work, Drawn Work, Decoration for Fire-place, Oil Colors for Grapes, Mirror Silvering, Decorations for four sets of Scrym Curtains, Inlaid floors, Text Book on Composition, Painting on Silk and Satin.

All subscribers to the *Art Interchange* are entitled to the privilege of asking advice on topics connected with art, literature, and etiquette. $2.00 per annum.

THE April *Atlantic* opens with the first installment of the dramatization of Henry James's Daisy Miller, with new characters and scenes. This is followed by Pillow-Smoothing Authors, an essay by Dr. Holmes, who furnishes a prelude on Night-Caps, and comments on an old writer, namely, Burton, from whom he makes copious extracts. Charles Dudley Warner contributes a remarkably excellent article on Modern Fiction. Miss Sarah Orne Jewett has a delightfully characteristic New England story entitled A New Parishioner. Richard Grant White contributes an article on the Bacon-Shakespeare Craze. Bradford Torrey, writes for this number an interesting article on Bird-Songs. Elizabeth Robins writes of Stage Buffoons in different countries and times. There are poems by Mr. Aldrich, Rose Hawthorne Lathrop, and others, together with reviews of important recent books, and the usual variety of the Contributors' Club.

IN the *North American Review* for April, the scriptural and legal aspects of Divorce are presented respectively by the Rev. Dr. Theodore D. Woolsey, well known for his insistance on the indissolubility of the marriage tie, and by Judge John A. Jameson, a jurist whose long experience with divorce cases in Chicago, both on the judicial bench and at the bar, lends to his observations a very special value. Dr. P. Bender, under the title A Canadian View of Annexation, makes a forcible presentation of the reasons which incline many citizens of the Dominion to favor the idea of absorption by the United States. Senator John A. Logan sets forth the need which exists for National Aid to Public Schools in the several States and Territories. The Rev. Dr. Howard Crosby writes of The Dangerous Classes that menace the perpetuity of civil order and the peace of the community, meaning the manipulators of corporation stocks and the men who, having amassed enormous wealth, use it for nefarious purposes. James C. Welling, President of Columbian University, treats of Race Education, the problem that confronts the philosophic statesman, of the presence in our body politic of a strong Negro contingent. The Water Supply of Cities is discussed by Charles F. Wingate; Ethic Systems, by Prof. F. H. Hedge; Street Begging, by Rev. Dr. Charles F. Deems, and Criticism Christianity, by O. B. Frothingham. Published at 30 Lafayette Place, New York, and for sale by booksellers generally.

WE are indebted to Prof. C. V. Riley, the U. S. Entomologist, for a copy of Vol. I of the Proceedings of the Biological Society of Washington, containing an account of the Darwin Memorial Meeting, May 12, 1882, with the addresses delivered on the occasion.

Harper's Weekly for March 31st contains an illustrated account of the lacustrine village of St. Malo, at the foot of Lake Borgne, which for fifty years has been occupied by certain Malay fishermen from the Phillipine Islands. The description of the manners and customs of this strange settlement, in which there are no women, is very interesting. Except for the possession of modern firearms and one antiquated clock, the life of the lake dwellers of St. Malo would seem to be about on a parallel with that of the Swiss lacustrine settlements of the Bronze epoch.

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Hon. Spencer
Washington

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WHAT IS THOUGHT OF THE "REVIEW"

By its SUBSCRIBERS and EXCHANGES.

Prof. F. H. Snow, of the Kansas University says: "Can you replace the August and and September numbers of the Review for me? It is so valuable that I cannot afford to miss a single number."

Prof. E. A. Popenoe, of the Kansas Agricultural College, in remitting, says: "I will speak to my friends in behalf of the Review and hope I may be able to induce some of them to become subscribers."

Prof. H. C. Bolton, of Trinity College, Hartford, Conn., says: "Your Review contains many valuable papers."

Prof. Paul Schweitzer, of the University of Missouri, says: "I inclose money order for the Review. I am glad you continued to send it. Accept best wishes for its success."

Prof. F. J. Baker, of Baker University, says: "If I were limited to one scientific periodical it would be the Review."

Prof. Wm F. Bahlman, of the State Normal School, Warrensburg, Mo., says: "Enclosed please find draft for $5.00 in payment of two years' subscription to the Review. Wishing you success, etc."

Prof. S. H. Trowbridge, of Pritchett Institute, says: "I know of no magazine that contains a better compendium of the world's best thoughts, right up to present time."

Dr. Chas. H. Sternberg, Cambridge, Mass., says: "I have enjoyed your Review very much and will help you all I can by all means in my power."

Prof. F. W. Putnam, of the Peabody Museum, Harvard University, sends: "Many thanks for the missing No. 5, Vol. VI, of the Review which arrived this morning."

Mr. Wm. Dawson, the Quaker-Shoemaker-Astronomer, of Spiceland, Ind., in sending in a subscription says: "You have my earnest wishes for the success of the Review. I feel too much interest in it to charge anything for soliciting."

Hon. B. B. Cahoon, Fredrickstown, Mo., says: "I read the Review with pleasure and profit, and I hope for such support to be accorded to it that it will prove to you as great a financial as it is a scientific success."

A. Woodward, Librarian of the American Museum of Natural History, New York, writes: "Can we secure your valuable Review in exchange for our 'Bulletin?'"

Prof. Robt. S. Ball, Astronomer Royal of Ireland, says: "I acknowledge with thanks the receipt of your Review at this Observatory."

Prof. H. A. Reid, Secretary of the Iowa State Academy of Sciences, says: "I find I am minus several numbers of this volume; I must have them at once."

The Kansas City Review of Science and Industry is a strictly popular magazine, better adapted to family reading than any other scientific journal in the country. It comprises original articles by the best writers, and selections from the best periodicals of this country and Europe, upon Geology, Mining, Archæology, Medicine and Hygiene, Meteorology, Exploration and Travels, Mechanic Arts, History and Biography, Book Reviews, etc. It has played its full part among periodicals of the West in calling attention to the natural resources and advantages of this region, and is deserving of the patronage of all intelligent and enterprising citizens.

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