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THE

CANADIAN

Naturalist & Geologist,

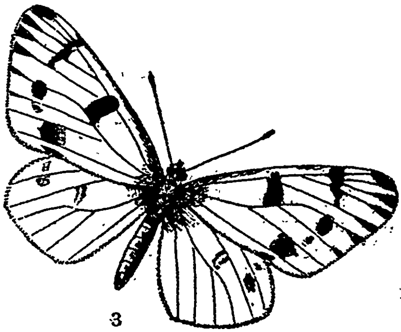
AND PROCEEDINGS OF THE

NATURAL HISTORY SOCIETY

OF MONTREAL.

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

VOL. II. NOVEMBER, 1857. No. 5.



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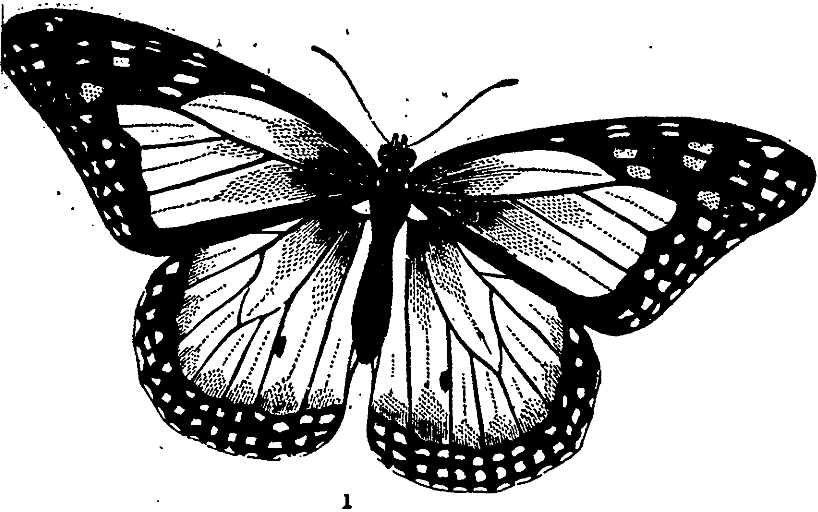

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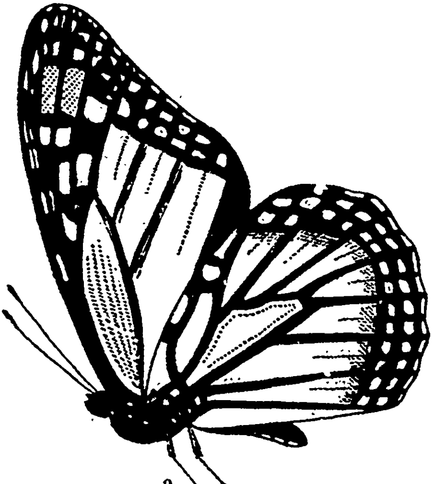

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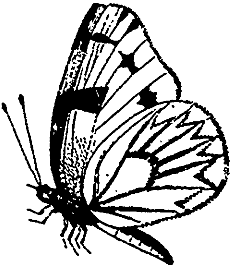

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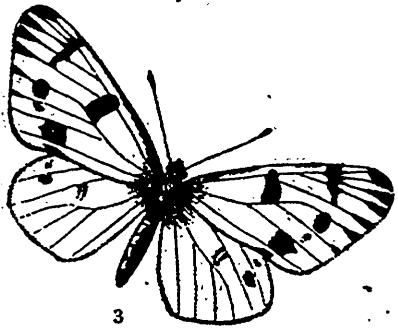

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THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOLUME II. NOVEMBER, 1857. NUMBER 5.

ART. XXVIII.—*On Ozone* BY CHARLES SMALLWOOD, M.D., L.L.D., Professor of Meteorology in the University of McGill College, Montreal, Canada.*

Mr. Chairman,

It would be unbecoming in me as forming a part of the deputation to Albany last year, for the purpose of inviting the Association to meet at this place, were I not to take advantage of the present moment, to greet you, gentlemen Members of the American Association, with a cordial and hearty welcome, and I need scarcely add, that the like sentiment inspires the whole of the inhabitants of this city.

Until the present time, these Annual Meetings have been confined to the United States alone, (although not exclusively American,) and separated only by an imaginary boundary, which has now been removed, for we here meet, united as one family, having one common object in view,—"the Advancement of Science,"

* This and the following paper were read at the Annual Meeting of the American Association for the Advancement of Science, Montreal, August, 1857.

we are treading the same peaceful path of knowledge, we are assembled under the broad, the vast canopy of the American firmament, the gentle breeze that wafts the red cross banner of St. George and Merry England, alike unfurls, the stars and stripes, the emblem of your land of freedom. Long may these two flags entwine in peace, in kindred folds, and may that master-piece of scientific genius, the electric cable, which is at this moment being laid beneath the Atlantic sea, whose waves science has measured with a mighty span, be the peaceful band, that will cement more firmly the destinies of the two great nations of the earth, under the benign and able guidance of your worthy President, and our beloved Queen, and may science, which knows no country, no nation, no language, be rendered more subservient to the happiness and welfare of the whole human family.

A year has now passed since the deputation from this place enjoyed the hospitalities of one of your large cities, the familiar and friendly faces of many we met there, and now present, calls to mind many pleasant recollections, but like all things mundane, we have some cause for sadness, for in the few fleeting moons that have waned since last we met, death has taken from our midst a Redfield, a Bailey, and a Mitchel, each pre-eminent in his department of scientific research, and to science and us, an irreparable loss, and the Association has done itself honor in paying a tribute to their memories; but the midnight lamp of the man of science must grow dim, the experimentalist must for ever quit the busy scenes of his laboratory, the eye of the astronomer must be closed, for the life of the philosopher is but mortal.

It is my intention to lay before the section the results of observations made on the amount of ozone present in the atmosphere. The place of observation is at St. Martin's, about 9 miles due west of Montreal, and is 118 feet above the mean level of the sea; it is situated in the centre nearly of the Isle Jesus, an island surrounded by the branches of the Ottawa, the place of observation is a little more than 3 miles from the river, thus being sufficiently inland, to be removed from any transient vapour or fog, which is often present in the proximity of rivers; it is a flat island, and the whole of the neighborhood is under cultivation.

It is not my purpose to enter into a lengthy detail of the chemical composition of ozone, enough for our present purpose to define it to be, a compound of oxygen, analogous to the per-oxide of hydrogen, or that it is oxygen in an allotropic state, that is with the capability of immediate and ready action impressed upon it. To Schonbien is awarded the discovery, who, in 1840, applied the term ozone to the peculiar smell which is perceptible during the action of the electrical machine, and also during the decomposition of water by the galvanic apparatus. It was subsequently ascertained that a similar smell is developed by the influence of Phosphorus on moist air, and also by a great many chemical changes, and for some time its existence was recognized by its smell, or odour, alone; but in April, 1848, Schonbien became possessed of another of its characters, viz: its oxidizing principle, and it is this property which it possesses more particularly, when we direct our attention to its presence in the atmosphere, although these oxidizing properties may be common to some other bodies, as nitrous acid, which is said to be generated in the atmosphere by atmospheric electricity.

When largely diffused in the atmosphere, it causes like chlorine (to which it is somewhat allied) very unpleasant sensations, such as difficult respiration, and it acts powerfully on the mucous membrane, it kills small animals very quickly; it is insoluble in water, and oxydizes very quickly all metallic bodies, and it has the power in a large degree, of destroying *miasma* arising from the decomposition of animal and vegetable substances, and Schonbien came to the conclusion, that its formation depended upon the action or formation of atmospheric electricity, and he referred the beneficial effects of thunder storms, to the action of the ozone formed, neutralizing the miasma arising from the decomposition of animal and may be vegetable substances, and it possesses in a powerful degree bleaching properties, and in this it is again analogous to chlorine.

Since Schonbien brought its properties before the scientific world, it has received more or less attention both from the physician and the meteorologist.

It has been advanced, that during the presence of cholera and other epidemic disease, its absence was remarked, while on the other hand, when the atmosphere has indicated a great amount present, diseases of the lungs and mucous membrane have been more prevalent, it has been still further stated that its action on the vegetable kingdom is similar in its effects as in the animal economy; the potatoe disease or rot especially, and other diseases in vegetables has, it is said, been caused by either its absence or presence, in too large quantities.

It would far exceed the limits of time alloted to me to enter fully into the progressive steps of the investigation or history of ozone, for it has engaged the attention of physicians in England, and on the continent of Europe, and I am happy to say, that some members of the American Association have devoted considerable attention to it, and I have deemed it of sufficient import, to lay before the section the result of some eight years of investigation, or nearly 6,000 observations. This includes observations during the visitation of the cholera in 1854, and I heartily trust that the Association may, by its influence, extend these observations through the whole of the United States territory, and, as far as practical, throw some light on its action in the animal and vegetable kingdom, and I am sure a subject of so much importance, and which must (if we are to believe the report of some investigators) exert an influence on both the health of animals and of plants, will be at once a sufficient ground for extending such observations, which should be as uniform as possible.

The method of estimating and detecting the amount of ozone, is by what is called the *Ozoneometer*, which is nothing more than slips of paper, wetted with the solution of starch and iodide of potassium; these became blue on exposure, owing to the oxidization of the potassium by the ozone, and the setting free of the iodine, the formula I use, and the one generally adopted is ʒ i of starch boiled in ℥ i of distilled water, and when cold 10 grains of the iodide of potassium is mixed with it, it is quickly spread on paper and dried in the dark, and must be kept in a dry place, and free from light until required; when they are placed in a situation shaded from the sun and rain, these strips are one-half an inch wide, and from three to four inches long. Dr. Moffatt, an eminent English physician, and who has paid much attention to the subject, places his slips of paper in a box, without a bottom, so as to be *excluded* from the light; but so far as my observations go, I have found so little difference in the two methods, that I have continued that of Schonbien's, as I have before stated, and expose the slips of paper to light, but *excluded from the sun and rain.* The amount of ozone present is estimated, in 10ths the deep shade or saturation, being 10, and diminishing in depth of shade to 0.

It has also been asserted that slips of paper placed at high elevations, has exhibited a deeper shade. To test this fact, I exposed slips of prepared paper at an altitude of 80 feet, on the top of a pole or mast, which is used for collecting atmospheric electricity and as far as my observations go, I could detect no appreciable difference from those exposed 5 feet from the ground, and if I might be permitted to suggest, that to insure uniformity, the elevation of 5 feet might be considered the standard height, and which is at once convenient and far enough removed from the effects of terrestrial radiation or deposit of dew, leaving it o course to observers to adopt at the same time, any other method which might suggest itself, during the observations on this phenomena.

So far I have, as concise as the subject would permit, traced its history, properties and method of observations, and the propriety of so doing may indeed be questionable, before so learned a body; but I have felt that the subject might be new to some present, and with a wish that uniform observations should be made, I deemed it well to state very briefly its prominent character, and in so doing I have thrown myself on your indulgence. I may just state that the colour of the test paper may be brought more fully out, by moistening it with water.

I shall now proceed to give the *section* the results of observations made by these means.

The questions for our investigation, and which naturally arise are these :—What is the effect of the presence of ozone on the meteorological conditions of the atmosphere, as indicated by the instruments most in use ?

And, secondly, what influence does its presence or absence exert on the health of animals or vegetables ? or does its presence or absence give rise to disease ?

1st. What are the *barometric* indications ?

The presence of ozone in the atmosphere is accompanied by a low reading of the barometer, which generally continues while the *ozonic* period lasts; this period is accompanied or terminated almost invariably by precipitation in the shape of rain or snow.

Therometer. I have observed the presence of ozone at all temperatures, when the therometer has indicated 20°, (below zero,) and as high as 80°, and in all the intermediate temperatures, and it is generally in larger quantities during a fall of snow than of rain. The *psychometer* is a certain indication of the presence of ozone, for it would appear that a moist state of the atmosphere was necessary for its production or development, for when the difference between the *dry* and *wet* bulb therometer is little, the presence of ozone in considerable quantity is invariably present but when the difference between the two therometers is considerable, no ozone is appreciable by the *ozoneometer.* This fact and the only one which (as far as my observations here go) is in connexion with the presence or absence of ozone, has led me to compare the presence of ozone with the presence of precipitation in the shape of snow or rain, which gives a remarkable co-incidence. For in and during the past seven years there were 918 days on which rain or snow fell, (this is regardless of the amount or duration,) and during the like period there were 816 days on which ozone was present in a quantity of five-tenths, any amount below that quantity in this estimation is not taken into consideration in the discussion. In the year

1850	there were	106	days of precipitation,	and	110	days	of ozone.
1851	"	123	"	"	135	"	"
1852	"	136	"	"	152	"	"
1853	"	136	"	"	114	"	"
1854	"	133	"	"	73	"	"
1855	"	140	"	"	110	"	"
1856	"	144	"	"	126	"	"

The small amount of ozone in 1854, which was the year of the last visitation of cholera, would tend to favour the opinion that there was a deficiency of ozone in the atmosphere during the prevalence of that epidemic. A deficiency was, however, observed in almost every month of that year, although the number of days on which snow or rain fell were almost equal with the other years, which see the following table, which shews the amount for each year, and for each respective month :—

YEARS.	1851.		1852.		1853.		1854.		1855.		1856.	
	DAYS OF		DAYS OF		DAYS OF		DAYS OF		DAYS OF		DAYS OF	
MONTHS.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.
January,	10	5	14	7	9	11	14	6	12	6	12	14
February,	6	7	11	8	11	9	16	6	8	9	9	16
March,	11	6	17	11	9	21	17	7	9	6	10	17
April,	12	8	10	11	7	12	10	6	14	8	11	20
May,	16	14	9	8	16	12	8.	7	6	9	13	20
June,	12	12	17	18	15	11	10	8	15	12	10	17
July,	13	16	11	17	9	4	5	4	7	11	12	18
August,	8	15	9	16	13	7	7	3	11	12	15	11
September,	11	15	10	16	11	9	11	3	12	11	14	12
October,	12	11	17	18	14	5	11	8	18	11	10	8
November,	10	13	10	12	14	11	13	11	14	9	15	8
December,	11	13	18	14	8	8	12	7	14	6	11	5
Total.	123	135	136	152	136	110	133	73	140	110	144	126

Southerly and easterly *winds* being the point from which our rain or snow generally comes, are for the most part present, during the indications of ozone, while on the contrary northerly or westerly winds, very rarely accompany its development.

In reviewing these observations, there is no condition of the atmosphere appreciable by our instruments, that indicates the presence of ozone except the presence of vapour or humidity.

Schonbien has asserted that a high electrical state of the atmosphere was always present when ozone was developed, and that the amount depended essentially on the amount of atmospheric electricity. From the comparison of nearly 6,000 observations on the electrical state of the atmosphere, and the amount of ozone taken at the same hour, at this place, and carefully compared; I have not found that opinion sustained, neither have I found its amount or presence influenced by the appearance of the *aurora borealis* which has also been said to be the case.

From these observations it would appear that a moist and humid atmosphere was necessary for the development of ozone, and this may account in some measure for its more constant presence and its greater quantity, in proximity to the sea. So far as its effects on the production of disease in plants, especially the potatoe. and to which it has been more especially referred; it is almost certain that one of two causes must have given rise to the lamentable failure in this useful vegetable, either that the soil must have furnished the medium of disease, or the action of the atmosphere upon the leaves and stem of the plant,—the causes which act upon the stem and leaves, involve the action alone of Atmospheric Influences, while those that act through the medium of the soil are more numerous.

In this neighbourhood the disease showed itself after rain followed by a hot Sun, the atmosphere being loaded with moisture or vapour—just the condition essentially proper for indicating the presence of Ozone—the disease was much more extensive on wet and clayey soils than on sandy or dry ones.

It cannot be doubted that an agent so active as ozone, if really present, must exert a great influence on the health of individuals as well as animals and plants, the manner of its production, whether by chemical action or electricity, or magnetism, demands from us further investigation, and these investigations should be carried out with uniformity for the sake of careful comparison—one point should not be overlooked, that is, to mark carefully the amount of vapour present in the atmosphere, as the intimate connexion between them is too prominent to escape observation.

I have, as you will perceive, offered no theoretical deductions, if, as our continental brethren assert, that it does possess such powerful and wonderful properties, it must be evident that the American Association should at once take up the subject, in a way that we may arrive at important conclusions. I should not be justified in expressing a doubt on the labours of others in this Department of Physical Science, neither do I think it fair to offer any conclusions until our observations are more extended, and it is with this intention that I have brought it before the Association, hoping that between now and our next meeting, we may be able to investigate and compare observations so as to give it a proper place in this department of physical investigation.

ART. XXIX.—*On the Meteorology of the Vicinity of Montreal,* being reduced from Observations taken at St. Martin, Isle Jesus, Canada East, by CHARLES SMALLWOOD, M. D., L.L.D. Professor of Meteorology in the University of McGill College.

Being well aware that many of you are here for the first time in this, our Northern city, and have scanned, and I have no doubt, admired the numerous edifices—those artificial structures erected by the human hand, guided by human skill, and well suited to our wants. I am also aware that many among you have bent your investigations beneath our alluvial and fruitful soil, to contemplate the geology of our rocky formations, and the deposits of bygone ages, the work of that Divine Architect at whose command those bright and countless orbs that spangle in our firmament were brought into existence, and which forms to the astronomer so many objects for his study ;—and I felt it might be interesting to you to know something of our climatology, and it is for this purpose I intend laying before the section some remarks in illustration, reduced from observations taken at St. Martins, nine miles due west of this place, and I shall for this purpose confine my observations to the means reduced from the last septennial period, although the observations on record extend over a much longer period of time.

The geographical co-ordinates of the place are 45° 32' north latitude, and 73° 36' longitude west of Greenwich. The cisterns of the barometers are placed at 118 feet above the level of the sea. The instruments used are standard instruments; the barometric observations are all reduced to the freezing point, (32° F.) and the temperatures are all in Farenheit's scale. The hygrometric observations are reduced by the tables and formula adopted at the Greenwich observatory in England. The receiver of the rain guage is placed 20 feet above the soil. The direction and velocity of the wind is ascertained by a self-registering instrument which indicates its velocity by dots on a paper register in miles linear. The electrical apparatus is provided with a collecting lanthorn which is elevated 80 feet from the ground. The solar and terrestrial radiators are also read in terms of Farenheit's scale. The ozonometer is of Schonbien's construction. The whole of the means are reduced from three daily observations, taken at 6 a.m., 2 p.m., and 10 p.m.; extra hours are also set apart for any unusual phenomena.

Barometer.—The mean heighth of the barometer for this period (7 years) was 29.676 inches, the mean reading for the same septennial period in January was 29.744 inches, February 29,744 inches, March 29,492 inches, April 29,679 inches, May 29,604 inches, June 29,718 inches, July 29,715, inches, August 29,754 inches, September 29,722 inches, October 29,619 inches, November 29,769 inches, December 29.565 inches. The highest reading observed and on record here was on the 8th January 1855, and at 4 p.m. it attained the unusual height of 30.876 inch.; the lowest reading on record was in December also in 1855, and was 28,689 inches, giving an absolute range of 2,187 inches. The mean yearly range for the 7 years was 1,032 inches, and for the months as follows:

	inches.		inches.		inches.
January,........	1,550	May,............	0,800	September,.....	0,815
February,......	1,131	June,...........	0,752	October,........	0,951
March,..........	1,145	July,...........	0,616	November,.....	1,295
April,..........	1,090	August,........	0,701	December,......	1,538

There are two maxima and two minima variations occurring in the barometer in the 24 hours; the maxima variation occurs at between 9 and 10 o'clock a.m., and between 9 and 10 p.m., the minima variations occur at 3 a.m., and 3 p.m.

Thermometer.—The temperature of the air for the same period (7 years) exhibits a yearly mean of 41° 56'. The mean temperature of January was 13° 26', February 13° 31', March 25° 44', A 'l 40° 12', May 55° 70', June 62° 11', July 74° 78', August 61° 21', September 58° 12', October 46° 04', November 31° 49', December 13° 80', the absolute mean range for the same period has been from 90° 9' + to 27° 4' — (below zero) the absolute monthly range was, in

January + 40° 7 to 25° 1—	July + 97° 1 to 47° 8+
February + 41° 1 to 25° 2—	August + 96° 7 to 40° 6+
March + 56° 0 to 6° 7—	September + 91° 2 to 30° 4+
April + 75° 6 to 10° 1+	October + 75° 7 to 23° 8+
May + 86° 6 to 25° 7—	November + 60° 4 to 5° 7+
June + 94° 5 to 40° 5+	December + 42° 1 to 26° 3—

The highest temperature in the shade on record here was 100° 1, and the lowest range was 36° 2′ below zero, giving a climatic range of 136° 3′ degrees; the hottest month is July, and the coldest month is February; the warmest part of the day in summer is at 3 p.m., and in the winter season at 2 p.m.; the coldest part of the day in winter is at a little before sunrise.

The mean yearly temperature of the *dew point* reduced for the same period was 35° 6, and for the different months as follows:—

January	9° 6	July,	65° 0
February	7° 4	August,	53° 1
March,	20° 2	September,	52° 2
April,	34° 6	October,	40° 8
May,	47° 2	November,	26° 1
June,	54° 1	December,	8° 1

The relative degree of humidity for that period saturation being 1·000 was 814, and for the months:—

January,	·869	July,	·744
February,	·808	August,	·765
March,	·835	September,	·809
April,	·812	October,	·821
May,	·774	November,	·824
June,	·770	December,	·832

The *Electric force of Vapour* exhibits a daily maximum at 3 a.m., and a minimum at between 3 and 4 p.m. The summer quarter, which embraces June, July and August, is the dryest quarter; next is the Spring quarter which embraces March, April and May, the Autumnal and Winter Quarters are the most humid. Complete saturation does not often occur, it has nevertheless taken place about four or five times in each year.

The mean number of days on which *rain* fell for the same period is 73 per year, and the number of days on which *snow* fell is 43, making a sum of 116 days on which precipitation took place, leaving 249 fair days as a yearly mean for the 7 years,—there is on an average of about 110 nights suitable for astronomical purposes in each year.

The yearly mean amount of rain for the same period was 43. 004 inches in depth on the surface, and the depth of snow also on the surface, shows a yearly mean of 95.76 inches. The monthly mean for snow and rain are as follows:—

	Inches of Rain.	Inches of Snow.		Inches of Rain.	Inches of Snow.
January,	0·600	22·38	July,	3·003	......
February,	0·167	25·00	August,	5·908	......
March,	0·380	18·79	September,	5·831	......
April,	4·624	2·46	October,	6·063	1·80
May,	4·386	.....	November,	5·055	4·34
June,	6·013	.....	December,	0·940	17·71

This gives a mean of 52,380 inches of rain and melted snow, this is reduced by the Smithsonian formula, which does not hold good or correct for low temperatures, and I think 1 to 8 would be more accurate. The greatest amount of rain which fell in 24 hours, on record here, was in September 1853, and amounted to 5,142 inches, but this is unusual ; you will perceive that we are little more than five months without snow.

The difficulty in this climate of measuring the amount of evaporation from the surface of water, except for 7 months of the year, owing to frosty nights, has induced me to undertake the registration of the amount of evaporation from the surface of ice during the remainder of the year, (5 months) so as to compensate in some measure for the defect in the observations on the amount of evaporation from the watery surface. These combined observations give a mean of more than 30 inches as the amount of water evaporated. The evaporator is shaded from the sun and rain, but is exposed to the currents of wind, so is also the icy surface in winter.

I am led to believe this amount is tolerably correct. The mean amount of evaporation from the surface of water alone for the 7 months is nearly 21 inches, the remaining amount being furnished by the evaporation which takes place from the surface of ice during the remaining 5 months.

Winds.—The most prevailing wind of the year is the Westerly, and the mean direction for the 7 years in the different months is as follows :—

January,	N.E. by E.	July,	S.W. by W.
February,	W.S.W	August,	W.N.W.
March,	W.	September,	W.N.W.
April,	N.E. by E.	October,	W. by W.
May,	N.W. by N.	November,	W.N.W.
June,	S.W. by W.	December,	N.E. by E.

The greatest velocity on record here exceeds somewhat 60 miles per hour linear,—there seems a disposition for a change both in the direction and velocity, at 3 p.m. and at 3 a.m., which corresponds precisely with the diurnal barometric fluctuations. The whole amount of miles linear of wind during the past year (1856) was 53061,63 miles, which being resolved into the four cardinal points, gave, N. 6969,80 miles ; S. 5298,89 miles ; E. 10776,40 miles, and W. 30016,56 miles. The maximum velocity during the past year was 44,40 miles per hour. There were 2220 hours 15 minutes calm, and 6546 hours during which the atmosphere was in motion. Below is a table of the anemometric observation during the year 1856, showing the direction and amount of miles from each quarter of the compass, and also the amount of miles run in each month, also the amount of calm in hours for each month :—

Course.	Velocity in Miles.	Course.	Velocity in Miles.	Course.	Velocity in Miles.
N.	310,50	S.E. by E.	403,00	W.S.W.	4679,66
N. by E.	211,50	S.E.	297,00	W. by S.	4542,50
N.N.E.	412,00	S.E. by S.	690,20	W.	3111,80
N.E. by W.	661,70	S.S.E.	374,00	W. by N.	3103,00
N.E.	1325,00	S. by E.	578,50	W.N.W.	4790,00
N.E. by E.	8092,60	S.	714,70	N.W. by W.	2112,80
E.N.E.	892,70	S. by W.	238,30	N.W.	2728,00
E. by N.	237,10	S.S.W.	497,57	N.W. by N.	1269,00
E.	86,30	S.W. by S.	608,10	N.N.W.	687,00
E. by S.	156,00	S.W.	2375,70	N. by W.	77,00
E.S.E.	240,00	S.W. by W.	3845,60	....	....

RESOLVED INTO THE FOUR CARDINAL POINTS.

Months.	Miles North.	Miles South.	Miles West.	Miles East.	Total Miles.	Hours and Min. calm
Jany.	395·40	95·77	4115·66	1744·10	6351·23	143·00
Feby.	71·90	280·00	4854·80	277·20	5463·90	166·00
March.	674·80	917·30	3706·60	567·70	5866·40	177·00
April.	234·00	116·00	1644·00	2585·10	4579·10	247·00
May.	1415·00	484·00	1323·00	1321·00	4540·00	179·10
June.	350·00	768·00	1450·00	582·00	3130·00	168·40
July.	776·00	345·00	1652·20	111·00	2884·00	174·20
August.	621·00	242·30	1018·20	569·30	2450·00	269·20
Sept.	471·00	589·50	1249·00	490·00	2799·50	243·14
Oct.	843·00	371·00	2270·00	248·00	3752·10	226·45
Nov.	653·00	650·00	2386·00	975·00	4644·00	149·00
Dec.	464·70	458·00	4387·00	1310·00	6628·20	78·30

The yearly mean intensity of the sun's rays for the same septennial period, is 102° 6, and for the months as follows:—

January,	79° 4	July,	121° 4
February,	87° 5	August,	118° 4
March,	119° 4	September,	103° 9
April,	107° 1	October,	99° 4
May,	110° 5	November,	89° 7
June,	110° 2	December,	84° 9

The yearly (septennial) mean of Terrestrial Radiation was 11° 6, and for the months as follows:—

January,	20° 9	July,	46° 7
February,	22° 6	August,	38° 1
March,	18° 2	September,	34° 2
April,	8° 0	October,	18° 9
May,	29° 6	November,	11° 6
June,	39° 1	December,	25° 1

The amount of dew is very variable, but bears a proportion to the degree of terrestrial radiation.

The mean of cloudless days were 57 days perfectly cloudless—the prevailing clouds are the Cumuli Stratus and Cirri Stratus.

The song Sparrow—(*Fringilla Melodia*)—The harbinger of the Canadian spring generally makes its first appearance the first week of April. Frogs, *Rana*, are first heard about the 23rd of April. Shad, *Alosa*, are caught the last week in May. Fire-flies, *Lampyrus corusca*, are first seen about the 24th of June, and the Snow-bird, *Plectrophanes nivalis*, generally makes its first appearance about the 20th of November; Swallows, *Hirudo rufa*, about the 18th of April. Our winter generally sets in about the latter week of November or the first week in December, and is ushered in by a fall of snow from the N.E. by E., and this is the point from which our winter storms come. Rain generally comes accompanied with a wind from the S. S.W. or S.E., and also from the N.E. by E.

We have generally a few days of that poetic season, the Indian Summer in November.

> "The years last lovliest smile,
> That comes to fill with hope the human heart;
> And strengthen it to bear the storms awhile,
> Till winter's days depart."

Our snow storms of winter are from the N.E. by E., and for some hours before they form, the Eastern horizon becomes gradually covered with heavy *strata* clouds of a deep leaden hue, the upper strata of clouds are generally a mixture of *Cirri Cumulus* and *Stratus*, moving from the South, but the surface wind is from the point I have stated N.E. by E., the wind during these storms often attain a velocity of some 30 or 40 miles per hour, the barometer is falling and the thermometer somewhere about zero, the Psychometer indicates an increasing amount of moisture, the Electrometers indicate a very high tension of *Negative* Electricity, often an amount of 300 deg. in terms of Volta's No 1. Electrometer, and sparks are constantly passing between the receiver and discharger for hours.

Minute but perfect crystalline forms of snow commence to fall, and may continue for some 48 hours, and I have seen some 12 or more inches of snow fall during this time. Precipitation then ceases; the wind veers *always* by the N. to the W., or W. N.W., with a velocity of some 30 miles per hour, (this is our cold term); and the wind carries the loose finely crystallized snow in clouds before it, this is in Canadian parlance a "Poudrerie." The wind is intensely cold; the thermometer during this period attains a minimum of some 30° below zero. The sky is partly covered by *cumuli* clouds, with a few *strati*—the electrometers still indicate a high tension, but of an opposite or *Positive* character, this Westerly wind may last some 48 hours or more, and lulls down at sunset; may be of the second day into a calm. The blue tint of the sky is very deep, and the rays of the setting sun throws a red or orange shade on the snowy scene, and the atmosphere attains a greater dryness, the electrical action gradually ceases with the wind.

Our thunder storms of summer, which give a yearly mean of 14 (for the same period of 7 years) are of short duration, forming generally in the W. or N.W., and the electricity varies in kind.

The months of April, May and June bring returning summer; the nights of July and part of August are generally oppressive, the temperature often remains at 70° during the night: but the Canadian autumn is very pleasant. The woods with its leaves of a thousand varied tints, and the blue and cloudless sky, with frosty nights, reminds us that the good times of the merry sleigh bells are near.

Notwithstanding these vicissitudes and extremes of temperature, the soil is very productive and vegetation prolific and rapid; and it has again pleased an all-wise Providence, during the present year, to crown the labours of the Canadian husbandman with a bountiful and abundant harvest.

ART. XXX.—*Introductory Lecture to the Course on Botany*, delivered before the Students of Arts and Medicine, McGill College, Session, 1857. By JAMES BARNSTON, M. D., Edin. Professor of Botany, University of McGill College, Montreal.

GENTLEMEN,—The course of Lectures on Botany upon which we are about to enter, is authorised to be delivered in connexion with the Lectures on general Natural History, under the auspices of the Principal of this University. Being called upon to perform the responsible office of instructing you in this department of Science, there are considerations that prompt me to offer one or two suggestions for approval, which will serve to ameliorate the austerity of the circumstances under which we meet. You can readily conceive the difficulties under which a teacher usually labours, who is brought for the first time in presence of a class of intelligent Students—the unpleasant tax upon his nervous modesty, the severe trial of his mental and physical energies accompanied by an inward consciousness of his possible inability to perform satisfactorily the duties before him.

The consciousness of such difficulties generally implants a desire in the teacher to meet faithfully the requirements of his office employing both time and labour in their fulfilment. The sincere and candid acknowledgment of them may, therefore, be received as a direct apology for such inefficiencies as may become apparent. Under such circumstances, it is becoming in the hearer to overlook the infirmity and extend the indulgence required. It is not for me to demand of you more than necessity requires. That necessity, however, is great, and will compel me throughout the course to draw largely upon your indulgence and patient attention, which I now crave at your hands.

Relying then upon your generous forbearance, it will be my endeavour to fulfil, to the best of my ability, the purposes for which these lectures are intended, namely, to bring prominently before you the beauties and perfection of nature, as exhibited in that portion of God's creation—the vegetable kingdom—to sketch out to you the philosophy of the plant in its structural and physiological aspects, to systematise the varied productions of the earth's surface upon principles derived from an actual study of nature's laws and manifestations, and to adapt the knowledge which botanical science imparts to the true interests of man. In pursuance of these objects, it will be my duty to enter into the minute details of plants, in reference to their structures, functions, chemical composition and natural relations, and show you the value of such scientific knowledge in its application to medicine, horticulture and agriculture.

In a youthful and growing country like this, there is usually a tendency to undervalue a science which apparently cannot promise results of a practical and useful character. The advantages to be derived from a cultivation of scientific knowledge are scarcely recognised in comparison to the supposed greater benefits of an early acquaintance with the grand material object of man's temporal existence. We are all aware that it has been through no ordinary difficulties that we have attained the position we now hold; first, as a community desirous of supporting literary and scientific institutions, and secondly, as a University, whose great aim is the thorough education of the student in matters which will best serve his interests, as an accomplished and useful member of Society. If such have been the difficulties of the past, how much greater now should be the vigour—how much stronger the animus—prompting us to maintain the value and importance of the University in which we labour, as students and professors, to study with spirit and assiduity while within its sacred walls, in order to attain that knowledge which will refine the mind, enrich the intelligence, and entitle us to honor and preferment.

It is difficult at first to estimate the value of a science like Zoology, Geology or Botany and how far the study of the one or the other may bear upon intellectual improvement or general success in life. It is this primary difficulty that forms the great drawback to the more general acquisition of scientific knowledge. It is moreover too often considered that the study of science is an arduous task—one that burdens the head with hard and inexplicable names as well as many useless and may be questionable theories and dogmas. It is much to be regretted that an error of this kind should prevail so universally, since it places science in a false position and prevents the student from attempting what he believes to be a laborious undertaking, and one of little utility, even were he to prosecute his studies and researches successfully. There is but one method of relieving the doubts and difficulties that here harass the youthful mind—it is, to search and receive the testimony of those who have been in their day active and diligent students of nature, acute observers of its laws and manifestations and faithful interpreters of its great truths. The history of such men furnishes ample evidence that there is in science an influence for good, a power within it to improve the quality of the mind and in some measure to regulate human action. In its study there are brought into play, in an eminent degree, such powers and qualities as those of observation, comparison and judgment, which may be at first feeble, but they are gradually increased in vigour and acuteness and at length perfected under the beneficial influence of a well regulated and methodical training. The development of such qualities gives precision and force to the thoughts and actions, and their application to the ordinary pursuits of life renders one more capable of meeting its necessities and overcoming its difficulties. When we observe the advantages of a well-regulated mind, we cannot ignore the importance of those studies, whose tendency is to perfect the qualifications necessary for the successful prosecution of an active business or profession. The most marked facilities are now given in this University for the attainment of scientific knowledge, because it is felt that such a course will raise the standard of general education, open up a new field for the active operations of the youthful mind and give to those of the community, who value their own mental improvement, such instructive information as will tend to elevate their tastes, refine their qualities of mind, and extend the range of their sympathies beyond the contracted limits of a business life. It is within the reach of all, to partake of these advantages and derive benefit from those efforts which have successfully terminated in the institution of special courses of instruction on the most important departments of Natural History.

To the student who is undergoing a regular course of collegiate education, the sciences of Natural History possess interest of considerable value. They form, as it were, a sister-alliance with his strictly professional studies and, as an adjunct to the latter, contribute materially to the health of his mind. We admit, it is of paramount importance that professional students should be thoroughly educated in the science and literature of their respective professions, a perfect knowledge of which is essential to their callings. But while granting this, we would not hesitate to employ means for the occasional diversion of the mind, by turning the thoughts into channels, giving a wider range for the occupation, improvement and gratification of the senses, the feelings and the imagination. *It would thus be in our power to counteract* the tendency of an education purely professional, a tendency too apparent, but rarely acknowledged ere it be too late to remedy. And what is this tendency? "To limit the range of mental vision," is the expressive language of one who stood pre-eminent in science, the late Professor Forbes, for, said he, "were the sciences so infused to be entirely professional, we should warp and contract the mind, the tonic would be too strong, would not invigorate but corrugate."

These remarks are applicable to students of all professions, but it is particularly to the student of medicine that the Natural History sciences prove of so much practical value. The necessity and importance of admixing them with his professional studies is an opinion now firmly established, and of the advantages there can be no question. To quote the words of the late Sir George Ballangall, "it is indispensable to any man who aspires to the elevated rank of a Physician." But I cannot do better here than give the testimony of the able authority, (Forbes) previously mentioned, who spoke thus;—"We can most beneficially counteract the natural tendency of purely professional studies, through the collateral sciences, which are sufficiently allied to the professional ones to prevent an undue dissipation of the students' thoughts, and at the same time are sufficiently different to give them a wider sphere of action. It is in this point of view, that we should regard the Natural History sciences as branches of medical education. For my own part, after much intercourse with medical men, who had studied at many seats of professional education, some collegiate, some exclusively professional, I have no hesitation in saying that, as a rule, the former had the intellectual advantage. There are noble and notable exceptions, old and young, but the rule is true in the main. The man who has studied in a seat of learning, a college or university, has a wider range of sympathies, a more philosophical tone of mind and a higher estimate of the objects of intellectual ambition, than his fellow-practitioner, who, from his youth upwards, had concentrated his thoughts upon the contractedly professional subjects of an hospital school. . . . There are not a few, too (medical men) who may some day find themselves isolated in distant and little-explored regions. Far away from friends and the conversation of intellectual companions, any pursuit that can engage and occupy the mind and above all satisfy its thirst for truth by draughts from the pure and refreshing fountains of nature—any such pursuit becomes a blessing and converts the desert into a paradise, one often filled with creatures yet to be named. How delightful does it then become to be able to recall the lessons of our student-days and casting away regret and languor, invigorate our minds by the practice of healthy intellectual exercise."

In conjunction with such testimony, it will suffice to add that every Medical University, particularly in Britain and on the Continent, that professes to furnish an extended education to its students, not only gives every encouragement and facility for the study of the collateral sciences, as they are called, but the curriculum in each demands imperatively a regular course of instruction in these sciences by qualified teachers or professors, and the subjection of candidates to examination in order to ascertain whether they possess a fair and competent knowledge of them, before receiving their Diplomas. Two courses, one upon Zoology, the other upon Botany, have been prescribed by this University to the student of medicine during his collegiate career, and from the remarks that have been already made in reference to the subject, you will at once discern the laudable motives that have actuated those in authority, in extending your curriculum of study. While it will be to the honor of the University, it is but simple justice to the student and graduate, who will thus find himself prepared, as occasion may require, to meet the demands of other Universities and of every Board of Examination, and ultimately to fulfil his obligations, whether in a civil or military capacity, with credit to himself and the *Alma Mater* from which he hails.

I have thus, gentlemen, laid before you the highest considerations in favor of the prosecution of scientific study, and confessedly with the desire of urging upon you the necessity of weighing them fully, now that you are about to enter upon a course of instruction in that special branch of Natural History, to which I shall have the honor of directing your attention. You will find that the more you are influenced by these considerations, the greater will be your zeal and assiduity, and the more successful will be your efforts to attain a sufficiency of knowledge to gratify the present and enable you to improve the future. Your interest will be excited, as the science of Botany becomes gradually developed, as the grand operations of nature are disclosed and the beautiful phenomena of vegetable life portrayed. The value of the science, in a practical point of view, will be properly estimated as you become acquainted with the economy of plants, their nutritious and medicinal properties, the conditions of soil and climate under which they grow, their capability of special improvement in quality and more especially their adaptation to human interests,—man's life, comfort and happiness.

It is usual, in an introductory lecture, to give a short sketch of the history of the subject that is to engage the attention of the student. I would be unwilling to adopt this course, were it not that the history of Botany furnishes ample evidence of its cultivation, even from an early period, as a practical science, and of the utility of its knowledge in the advancement of the arts, and particularly of Medicine, in the improvement of agricultural operations and the attainment of a more perfect system of gardening. As this evidence of the past will be probably more convincing than any arguments I can here adduce, I propose relating to you a few leading points of botanical history, that seem to me to be of value and importance for the present purpose.

Without entering into any speculations upon the probable amount of knowledge possessed by man, at the earliest period of the world's history, of the nutritious qualities and medicinal properties of plants and the various uses to which they may have been applied, a subject replete with interest, I will date my remarks from a period when we first observe Botany cultivated as a science.

We find the first evidences of botanical study and research among the philosophers of ancient Greece. They devoted themselves principally to the digging of roots and the finding of herbs, in order to advance the arts and particularly medicine. They were elegantly styled *Rhizomatæ,* (wood-cutters) and not unfrequently nick-named *Pharmacopolæ,* (barterers of medicine or druggists.) They were also called *Cultivators of Physics.* This latter title was somewhat appropriate, for it was not so much the naming and classifying of plants they studied, but their aim was an explanation of their phenomena and their employment as physical substances in arts and trades. The great philosopher Aristotle is reckoned with justice, the first cultivator of the natural science of Plants. He collected and described many medicinal plants, but his genuine works are supposed to have been lost. His favorite disciple, however, the eloquent Theophrastus imbibed the principles and improved upon the information of his great teacher. In his History of Plants, he exhibits deep reasoning and furnishes evidence of his constant and excellent observations of the phenomena of the vegetable world. Theophrastus was also the first who kept a garden for plants, and in his legacy he named some of his scholars as keepers of this property. Immediately after his time, the science of nature lapsed into comparative obscurity till the subjugation of Greece by the Romans, who, acting upon the knowledge imparted to them by the conquered, applied it to rural economy, horticulture and agriculture. It was in the middle of the first century of our era that flourished the most celebrated of writers on ancient Botany. This was Pedacius Dioscorides of Anazarbus in Silicia, a renowned physician who followed the Roman armies in their expeditions throughout the Empire. In his *Materia Medica,* he enumerates all the medicinal plants then known, describes their characters and properties, and gives proofs of their efficacy in diseases. This work held universal sway in the schools for more than 1500 years, as the only fountain of all knowledge relating to Natural History and particularly of botanical information. To him succeeded Caius Plinius Secundus, known as the elder Pliny, who left lasting memorials of his great learning in his "Summary of all Science, Knowledge and Arts." He also added to the list of known plants. A dark cloud again brooded over the science of Botany. Its study was for a long period forgotten or neglected by the Romans. It would seem that during the darkness of the middle ages up to the thirteenth century, the Arabians, who derived their knowledge entirely from Dioscorides through a distorted translation of his work, were the only nation who applied themselves diligently to the study of medicinal plants; and they were enabled to become acquainted with many remarkable oriental plants through the flourishing trade they carried on for centuries from Madeira to China. It was towards and during the 15th century that a new light dawned over free Italy. Science and Art received an impetus under the spirited influence of rivalry. Dioscorides and Pliny were then taken from the mouldy shelves and studied in the original as pure fountains of botanical knowledge. But it is to the German fathers, schoolmasters and professors of the 16th century, that we look for the first natural exposition of Botany. Among the most learned of these was Gesner, a physician and professor at Zurich, who died in 1564. Besides possessing the merit of being an extensive collector of plants, he described them, gave designs, wood-cuts, and copper-plates, especially of foreign plants, and was the first to draw attention to the important parts of fructification. Lobelius, also, of Flanders, who was afterwards superintendent of the garden of Queen Elizabeth of England, besides his many discoveries, made the first attempt to arrange plants according to a certain natural affinity. Great zeal and diligence were now displayed in the advancement of the arts and sciences, and Botany flourished in every country. It had its advocates in Germany, France, Italy, Portugal and Spain, and the discovery of America enlarged the field of research. Can it be wondered then, that under these circumstances, there was urgent necessity of becoming acquainted with the anatomy and structure of plants in order to their systematic arrangement and classification. These investigations were carried on under the auspices of the Society of London for the promotion of Science, which was liberally supported by Charles II. The discoveries of Grew, Secretary to the society, are recorded in the immortal work, the Anatomy of Plants, published in London in 1682, in which is found the doctrine of the two-fold sex of plants. The same Society published the excellent and peculiar investigations of Malpighi of Bologna. It was the influence of such investigations that gave birth to the classification jo plants according to a natural method. In the beginning of the 18th century, appeared the works of Morison, a Scotchman, and of the celebrated John Ray, an English clergyman, who travelled for many years through all Europe and published his *Methodus Plantarum Emendata*, which gives the principles whereby genera and species should be distinguished, and contains the elements of a natural system, based upon a study of all the parts of the plant.

He was followed by Herman and Boerhaave of Leyden, but there was also laid the foundation of the artificial system—one entirely opposed to the former, and which was soon to eclipse its rival. Rivinius, professor at Leipzic, constituted the corolla, the most important part for the division and classification of plants, and in the promulgation of this doctrine, he was materially assisted by the distinguished French botanist, Joseph Pitton de Tournefort. It was at this time, the beginning of the 18th century, when botanical gardens flourished in Italy, Germany, France and England, (among which may be mentioned the celebrated gardens at Amsterdam in the Netherlands, and at Bologna in Italy, the Royal Garden in Paris, the Royal Garden at Hampton Court, near London,) when native Floras were objects of careful investigation, and when the knowledge of exotic plants of foreign climes was vastly extended by travellers and well-informed naturalists,—it was at this time that Sweden gave birth to one of the most remarkable men in the history of Natural Science, Charles Linnæus, who was born in 1707. To him is Natural History, in all its branches, especially indebted, as the founder of the historical part. He possessed a peculiar relish for Botany, and his writings and works give evidence of his unwearied labours and devotion to the cause of botanical science. He established an artificial nomenclature, gave specific characters to plants, arranged them into genera and formed a gigantic system of artificial classification, in which high value is put upon the stamens and pistil, and upon the corolla. Into the merits of this system we shall hereafter have occasion to enter. Let me merely observe here, that despite the declamations of the promoters of the natural method of classification, who either greatly undervalue or entirely reject the Linnæan system, it stands not merely the historical monument of past genius, but forms a simple key to the naming of plants, and an essential preliminary to the understanding of the intricacies of natural classification. During his own time, Linnæus met with much opposition both in Germany by Haller and the followers of Rivinius, and in France by the disciples of Tournefort, and by Bernhard Jussieu. Other theories and systems were also started and had their supporters. But their influence was merely temporary, and all gave way before the simple and fascinating system of Linnæus.

In process of time, while herbaria were enriched with numerous new plants and systematic works written in Linnæan order, the elementary structure and physiology of plants were more minutely studied, the organs of reproduction were better examined and due attention was paid to the essential products of vegetation—the fruit and seed. In consequence, the science made rapid advances and resulted in the construction of a natural method and arrangement of plants. France, Germany and Italy vied with each other in discoveries. The botanist of the present day is familiar with the names of Lorentzo Jussieu, Augustus Pyramus Decandolle, Mirbel, Rudolphi and Treviranus, whose works on structural botany and natural systems were published at the beginning of the present century. Since that period, botany has made rapid strides The natural systems of Jussieu and Decandolle have been materially improved by Endlicher, and more especially by Lindley in his elaborate work entitled "The Vegetable Kingdom." The various interesting researches of Gaudichaud, Schleiden, Mohl, Brown, Amici, Griffith, Schultz and others, have in a measure completed our knowledge of the structure and functions of the different parts and organs of plants and of their alliances and affinities; while the labours of Liebig, Mülder and Johnston on the chemistry of plants have tended to the application of botanical science to the interests of agriculture and horticulture, at the same time that others as Christison, Royle, Burnett and Lindley, have supplied valuable data in reference to their medicinal properties and diatetic uses. Not less important and interesting have been the researches and observations, both practical and speculative, made in reference to the geographical distribution of plants over the globe as well as regarding those plants which existed on the earth in its primæval state and which now lie as monuments of vanished forms of vegetable life, buried in the vast geological epochs that elapsed before the establishment of the present order of things.

And what has been the ultimate effect of this? Why, it has raised the standard of botany to the high rank it should hold—rivalling, if not excelling its sister sciences—and has established it within schools and universities as one of the most interesting, beautiful and useful of studies. It claims as its votaries a host of the most accomplished of minds and of the highest order of rank, and it now flourishes in all countries and in every clime. And why should Canada rest satisfied—now that she is interesting herself in the subject of schools and colleges—till she has established these as nurseries of science as well as of arts and literature—nurseries that will rear up youths of talent and ability, to be hereafter claimed as lasting monuments of honor and credit to the country.

You will perceive, from the short sketch just given you, that the tendency of scientific investigations, has been to reduce to practical and useful ends the knowledge acquired by research, and that the spirit of enquiry, however exclusively scientific, has generally subserved in some way one or more of the special interests of man. It will be my anxious desire, in the present course of lectures, to give you a faithful representation of botanical science in its present advanced state, and place prominently before you such important facts and considerations as bear specially on medicine, agriculture and horticulture. I have no doubt you will ere long become interested in the subject and it will give me pleasure to furnish you with such information as you may occasionally require, and such facilities for the prosecution of the study as may be within my power. The deeper your study of the operations and phenomena of nature, the more intimate your acquaintance with the structures and functions of the plant, the greater will be the pleasure and gratification you will experience and the more profound will be your admiration of this portion of God's creation. With a knowledge of botanical science, you cannot but take delight hereafter in the contemplation of those beautiful and varied objects of nature that will constantly meet your eye, and if you study them as living organizations as well as the manifestations of life they exhibit and the laws which govern them—if you study such phenomena in the true spirit of wisdom, they will subserve a better and higher purpose than the mere gratification of the mind. They will enrich it with pure and lofty thoughts and raise your souls in admiring contemplation of Him, at whose fiat, at the beginning, "the earth brought forth grass, the herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind," and can we ignore the beauty and perfection of the plant, when it is recorded in the same breath, that "God saw that it was good."

ARTICLE XXXI.—*Description of four species of Canadian Butterflies.*

(*Continued from page* 318.)

GENUS II., PIERIS. *Schrank.*

PONTIA, *Fabricius, &c.*

Palpi, short, cylindrical, moderately compressed, three jointed, the last joint as long or longer than the preceding; antennæ long and slender, terminated by a somewhat abrupt, compressed, obtuse club, consisting of seven or eight joints, and grooved on one side; wings opaque, and thickly clothed with scales; anterior pair nearly three-cornered, the apical angle not very acute; posterior pair rounded, partly embracing the abdomen, and the discoidal cell closed; legs long, slender, and alike in both sexes, the anterior pair being perfect; tarsi terminated by two equal sized hooklets much curved, each having a small tooth on its under side; between these hooklets is along fleshy cushion, and each is laterally defended by a long conical hirsute appendage; eyes naked; head rather small. Larvæ cylindric, elongated and fleshy, with numerous points or larger tubercles, which emit pale hairs, and are arranged in regular transverse series; the head small and rounded. Pupæ angulated, with a short process in front of the head, and with a projecting lateral appendage behind each of the wing cases, they are attached by a tuft of silk at the tail, and a loose girth round the middle of the body. They do not constantly place themselves in one position with the head upright, but undergo this state in various positions.

This genus is very extensive, the species being distributed over most parts of the globe, but especially in the intertropical parts of the old world, the western hemisphere being comparatively poor in species. The prevaling colour is white, more or less pure, with a black border to the anterior wings, variable in width but seldom wanting. Some of the exotic species are much more varied in their colouring, The underside of the posterior wings generally differs considerably from the upper, and is often very agreeably varied with brilliant colours. The sexual differences in certain species are very conspicuous but in others much less so, the females being distinguished from the males only by a somewhat broader band, or by having the upper wings more rounded at the apex. Such of the larvæ as are known feed almost exclusively on the *Cruciferæ*, especially the species of *Brassicæ*, as well as on the *Residaceæ Tropeoliæ* and *Capparideæ*. In some years certain of the common English species abound to an astonishing extent, and at such times the cabbages and other cruciferæ in gardens, almost disappear under their attacks. It is nearly the only genus of Diurnal Lepidoptera injurious to man and to keep them in check Providence has provided several small species of hymenopterous parasites, (*microgaster glomeratus, &c.,*) which live within the body of the caterpillar till the latter is about to assume the pupa state, when they issue from its body through a multitude of minute holes and spin their cocoons of yellowish silk in little heaps on each side of the now shrivelled skin of their victim which then falls lifeless to the ground.

Only three species are found in North America. They are *P. oleracea*, *protodice*, and *casta*. The two first of these occur in Canada, and the third which is very closely allied to *oleracea*, but differs in being less strongly marked, and in having no tinge of yellow on the underside, is described by Kirby in his "Northern Zoology" as inhabiting the Hudson's Bay territories. *P. cleomes* of Boisduval is an *aporia*.

Species 1.—Pieris Oleracea, the Grey-veined White.

Pontia oleracea (Harris), Emmons, Agri. N. Y. Ins., p. 204. All the wings above pure white, the base and tips slightly dusky, the nervures blackish brown, and strongly marked; underside also white, slightly tinged with yellowish green, the nervures on the posterior pair edged with dusky scales; antennæ with the club black, tipped with brownish white, the rest brown palest on the underside, and faintly annulated with white; palpi white, thorax and abdomen black, clothed with whitish hairs; legs black; expansion of the wings 2 inches.

Dr. Harris, who first named this species, states that the female lays her yellowish eggs upon the leaves of cabbages, radishes or turnips about the first of June; that they are hatched in about a week, and that the caterpillars attain their full size in three weeks; they measure an inch and a half in length, and are of a pale green colour, and feed indiscriminately upon every part of the leaf. They remain about eleven days in the pupa state.

This species is not mentioned by Boisduval. It appears in May, and continues up to September. It is common in the Northern States, Upper Canada, and the Eastern Townships. It also occurs about Montreal, St. Hilaire, and Quebec, but does not appear to be very numerous at either of these places, and we do not remember to have noticed it at Sorel.

Species 2.—Pieris Protodice.

Plate vi., fig. 3, male; 4, female; 5, female underside.

Pieris Protodice, Boisduval and Leconte, Ico., &c., des Lépidopterès, &c., de l'Amer. Sept. t. 1, p. 45, pl. xvii, fig. 1, 2, 3.

The anterior wings are white with a large, black, trapezoid spot placed in the middle before the margin, and an oblique, spotted black band, most defined at the anal angle. They have besides, along the margin near the tip, four or five triangular black spots placed upon the nervures. The posterior wings entirely white with sometimes a small group of blackish atoms near the costa. Underside of the anterior wings nearly the same as the upper but the black spots rather paler. The posterior wings slightly tinged with yellow and with a blackish spot upon the edge of the discoidal cell. They are also marked by a marginal mark formed of blackish atoms hardly distinguishable from the ground colour. Antennæ black, tipped with white; abdomen greenish black.

The female is distinguished from the male, which we have just described, by the following characters: the black on the anterior wings above, is more intense, and underneath, they are a little tinged with green at the tips; the posterior wings on the upper side are white a little tinged with greyish, and the hind margin blackish, and marked with five or six white trapezoid spots; their underside has the nervures greenish brown, and a marginal band of the same colour.

Boisduval says this pretty species is rather rare. It appears in the spring, and about the end of June, round New York. It is also found in Connecticut, and we have strong reasons to believe it occurs in the neighbourhood of Montreal. Having now described all the Canadian species of the first family of Diurnal Lépidoptera we reach the second the Heliconiidæ, which, however, is represented in this country by a single species only.

FAMILY 2. HELICONIIDÆ.

This family may be easily distinguished from the preceding, by having the anterior part of legs very small or rudimentary in both sexes, and folded up, not being fitted for walking. They thus appear to have but four legs and are termed *tetrapods* (four-footed.) The joints of the anterior tarsi are very indistinct, and very slightly dentated at the extremity. In some genera, however, the first part of legs, though small, has nearly the same structure as the others. The tarsal ungues or claws of the hind legs are simple, large, and very strong. The antennæ are long, and placed close together at the base, and in general have the club very gradually formed and elongated; in some species they are almost filiform, whilst in a few others the club is rather abruptly clubbed. The palpi are wide apart, slender, cylindrical, rather short, and densely clothed with hair-like scales; the terminal joint generally very small. The abdomen is elongated. The wings large, in some triangular, in others oblong and narrowed. The caterpillars are cylindric and elongated; they are very variously ornamented, some being glabrous, with several long fleshy prolongations, others are covered with slender spines and tufts of hairs, others again are entirely smooth, and some are clothed with long white hairs. The chrysalides are suspended by the tail, and never supported by a band in the middle. This very numerous family contains some of the most beautiful and remarkable amongst the Diurnal Lepidoptera. Some of the species, especially of the typical genus *Heliconia*, having the wings so scantily covered with minute scales, that these organs are completely transparent. This genus, (*Heliconia*,) is very extensive, but is exclusively confined to the new world, where its metropolis is in the West Indian Islands, and South America. One species is, however, met with in Georgia and Florida, and is common in Mexico.

The Heliconiidæ may be conveniently divided into two sub-families, viz., *Danaidi* and *Heliconiidi*, the former of which is alone represented in Canada.

SUB-FAMILY,—DANAIDI.

This contains some very large and handsome species. They are mostly inhabitants of the inter-tropical regions, of the old world where they appear to take the place of the *Heliconiidi* of the western hemisphere.

Palpi wide apart, and not rising above the top of the head, their second joint is a little longer than the preceding; club of the antennæ very gradually formed; the wings large, with the discoidal cell of the posterior pair closed; thorax strong and thick; abdomen rather long; anterior pair of legs not fitted for walking, their tarsi hardly distinguishable into five joints, but generally consisting of a single piece with several crowded spines at the extremity. The Larvæ are glabrous, cylindric, rather long, provided with two, four, six, eight or ten fleshy prolongations, which are long, flexible, almost filiform, and placed by pairs on the different segments. The pupæ are shortened, cylindric, without angulosities, and ornamented with brilliant golden spots.

One of the species which inhabits New Holland, it is said, sometimes appears in such vast numbers as to darken the air by the clouds of them.

It is divided into several genera, only one of which inhabits North America.

GENUS 1.—DANAIS, *Boisduval*, EUPLŒA, *Fabricius*.

Head a little smaller than the thorax; antennæ rather long, with a pretty thick, gradually formed, and slightly curved club; palpi widely separated, with the last joint minute, globular and ending in a point, the second long and thick, the radical one about one-third of its length, and all the joints straight, rather broad, and thickly clothed with hairs; abdomen somewhat thin and nearly as long as the posterior wings; wings large, with the margins a little sinuated, the upper pair triangular, the second pair have in the males towards the anal angle, sometimes a blackish pocket or hollow, and sometimes a very black spot divided by a greyish line in relief, placed at the extremity of the nervure; anterior tarsi slightly articulated, but very indistinct, and scarcely any projecting points in the room of the claws.

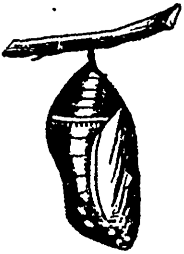
All the species have two marginal rows of spots. Some have the ground colour of the wings rufous with the border black, others are black, with the longitudinal lines and scattered spots of a greenish or bluish white, and sometimes of a greenish yellow. The head, prothorax, thorax and breast spotted with white. The Larvæ generally feed on *nerium*, *asclepias*, *synanchum*, and other plants of the same family. The Pupæ are short, smooth and round, and suspended by the tail.

Two species are found in North America, viz: *D. archippus* and *Berenice*; the first of these alone occurs in Canada. The true country of this genus is the Indian Archipelago, China, Bengal, &c. It also inhabits Africa, and accidentally the south of Europe.

SPECIES 1.—DANAIS ARCHIPPUS. The Storm Fritillary. pl. vi, fig. 1., male, 2, underside.

a.

b.



a, The Caterpillar, b, The Chrysalis.

Danais Archippus, Godart, Enc. Method, ix, p. 184, N. 28, 1821. Boisduval et Leconte, Ico., &c., des Lépridopterès, &c., de l'Amer, Sept., t. 1, p. 137, pl. 40, fig. 1-4, 1833. Gosse, Canadian Naturalist, p. 262, 1840.

Papilio Archippus, Fabricius, Ent. Syst., III, 1, p. 49, n. 151, 1794. Smith & Abbott, Lepid, of Georgia, vol. 1, tab. vi, 1798.

Papilio plexippus, Cramer, pl. 206, fig. E. F., 1779.

Danaus plexippus, Emmons, Agri. N. Y., Ins. p. 202, pl. 38, 1854.

Papilio megalippe, Hubner, Exot. Saml, 1806.

The four wings are a little sinuated, fulvous above, with a rather brilliant reflection, and the nervures dilated and black. The hind margin is also black, with two rows of white spots, in some individuals a portion of these spots are fulvous. The anterior wings have at the tips a large patch of black upon which are placed three oblong fulvous spots, preceded internally by eight or ten smaller white or yellowish spots, spreading themselves along the middle of the costa, which as well as the inner margin is also black. The underside of the wings is much like the upper, but the spots on the hind margin are larger, and all are white. The ground colour of the posterior wings is a bright nankin yellow, with the nervures very slightly bordered with whitish spots. The notches on the margins of all the wings are bordered with white. Expansion of the wings about 4½ inches. The caterpillar is white, transversely banded with black and yellow. It has two pairs of black fleshy prolongations, the first pair is placed on the second segment, and the other, which is much the longest, on the eleventh. It feeds on various species of *asclepias*, and probably in this country, principally on *A. syriaca* or milk-weed, the "cotonier" of the French Canadians, so well known for its large pods filled with elastic, silky filaments, and from the young shoots being eaten, in early spring, like asparagus. In July its large clusters of purple blossoms are a great resort for moths of various families, and the beautiful chrysomela *Labidomera trimaculata* feeds on its milky leaves.

The Chrysalis is of a delicate green, sprinkled anteriorly with golden dots and marked upon the back a little beyond the middle, with a semi-circle of the same colour, bordered underneath by a row of minute black spots, placed very closely together.

This is a common species throughout the middle States and the West Indies. It is more abundant in Upper than Lower Canada, but is by no means uncommon in the latter. It appears in July, and there is but one brood during the season. We remember it being named to us, in our early entomological days, as the Storm Fritillary. We have retained this name, although not strictly correct, for it does not belong to the same family as the Fritillaries. It is, however, a very appropriate appellation, as it appears to be most active when the atmosphere is charged with electricity, and often, in those death-like calms which precede a thunder-storm in this country, when not a breath of wind ruffles the glassy surface of the water, and the lurid clouds are hurrying up from the horizon, one of these splendid butterflies may be seen floating past on the sultry air, like a herald of the approaching storm. It generally flies in a slow and heavy manner near the ground, but occasionally soars to a great height in the air. Professor Emmons has repeated an old error in his work on the Insects of New York, by calling this species *plexippus*, and moreover misspells the name of the genus. He also, for some reason not obvious to us, places two species of Nymphalis, (*N. disippus* and *ursula*) with it in the family Helicomiidæ, which he inserts between Papilionidi and Pieridi! *N. disippus* is certainly very similar in colour and markings, but the neuration of the wings is totally different, and the discoidal cell of the posterior wings is open, instead of being closed as in the present species.

FAMILY 3.—NYMPHALIDÆ.

Palpi close together, very erect, densely clothed with hair-like scales, the front of the two first joints almost as broad as their sides, which are also broad; antennæ long, generally furnished with a more or less distinct club which is never hooked; anterior legs entirely rudimentary in both sexes, and quite unfitted for walking; the hind legs with only a single pair of spurs at the extremity of the tibia and the tarsal ungues strongly bifid; posterior wings strongly grooved and their inner margins almost meeting beneath the abdomen, which rests upon them, and their discoidal cell generally open. The caterpillars are cylindric, variable in structure, but generally clothed with numerous strong spines; others have the body smooth, with the head or tail forked. The chrysalides are naked, sometimes armed with small conical protuberances, generally ornamented with metallic colours, and suspended by the tail only.

The species of this family are very numerous and beautiful, and are found in every part of the world, and almost all our commonest butterflies belong to it. They are mostly of the middle size, and few rival the gigantic proportions of some of the Papilionidæ. It is divided into four sub-families, viz: *Argynnidi, Vanessidi, Nymphalidi* and *Satyridi*, all well represented in Canada. Generally, the sub-families are placed in an inverse order to that which we adopt, but for various reasons we adhere in this respect to the arrangement pursued in Humphreys and Westwood's British Butterflies.

In his work on the Butterflies of North America, M. Boisduval places the *Lycænidæ* between the *Papilionidæ* and the *Heliconiidæ*, on the ground that their pupæ agree with the first family in being supported by a girth round the middle. As, however, there appears to be a natural gradation from the *Papilionidæ* to the *Heliconiidæ* and *Nymphalidæ*, we have followed the arrangement adopted by most English authors.

SUB-FAMILY 1.—ARGYNNIDI.

Palpi long, ascending, closer together at the base than at the tips, second joint the largest, the third small and variable in shape; antennæ long, terminated by a suddenly formed, rounded, compressed, somewhat spoon-shaped club; head broad; anterior legs rudimental in both sexes; discoidal cell of the posterior wings open. The caterpillars very spinose. It is divided into several genera, of which three, viz: *Agraulis, Argynnis* and *Melitæa* inhabit North America, but the two last only are met with in Canada. They are termed Fritillaries, (derived from the Latin word *Fritillus*, a chess-board) in allusion to the underside of their posterior wings being generally chequered with silver spots, and various colours, something in the manner of a chess-board.

GENUS 1.—ARGYNNIS.

Head large, as broad as the thorax, which is thick and strong; eyes very large and naked; palpi very hairy, erect, rather wide apart, the terminal joint small, naked and terminating in a point; antennæ rather long, terminated by a very suddenly formed, broad, compressed, spoon-shaped club; abdomen shorter than the posterior wings; wings slightly sinuated; anterior legs rudimental in both sexes, but differing in the following particulars;—in the males they are not only much more hairy than in the females, but are entirely destitute of articulations, whilst in the females they are much less hairy, and distinctly composed of five joints, even without denuding them of scales, each of the joints having two short spines at the extremity on the inside.

The two genera *Melitæa* and *Argynnis* are so closely allied, it is difficult to give satisfactory characters by which to distinguish them, but the present may be known chiefly by the silver spots which ornament the underside of the wings, being large and conspicuous, and by the tessellated appearance of their upper side.

The larvæ are thickly clothed with spines, two on the first segment next the head being rather longer than the rest. They feed principally on plants of the genus *Viola.* The Pupæ are angular, ornamented with spots of gold or silver and marked with two rows of spots on the back.

The ground colour of the upper surface of the Argynnes is fulvous or reddish brown, marked with a row of sinuated black lines (somewhat resembling written figures) occupying the central cell of the anterior wings, and with several rows of black spots running parallel to the hind margin. It is, however, the beautiful silvery markings on the underside for which they are most remarkable, and which afford the best means of distinguishing the species from each other.

Boisduval describes nine species as being found in North America. We shall describe four as Canadian, of which two are doubtful natives, and of the rest three inhabit Labrador, and the other two the southern States. Very few of the caterpillars of the American species are known, and we are therefore unable to furnish figures of them.

SPECIES 1.—Argynnis Idalia.

Godart, Encyclop. Method ix., p. 263, No. 20.

Papilio Idalia, Fabricius, Ent., Syst. 111, 1, p. 145, No. 446.

Cramer, pl. xliv., D.E.F.G.

Drury, Ins. 1, tab. xiii, fig. 1, 2, 3.

Argynnis Idalia, Boisduval, Ico., p. 147, pl. 43, fig. 1, 2.

Argynnis Idealia, Emmons, Agri, N. Y. Ins., p. 212.

Anterior wings on the upper side fulvous, with fifteen black spots, the five first linear, and situated on the discoidal cell, the next forming a zig-zag tranverse band across the middle of the wing, the rest round, smaller, and disposed in a line parallel to the hind margin; the hind margin is covered by a large black band, dentated internally, divided in the male by a row of fulvous lunules, and in the female by a row of white spots; the latter has also some white spots opposite the tip, where the black border is considerably dilated. Underneath, these wings are nearly the same as on the upper side, except that the terminal band is less marked and the spots by which it is divided are arrow-shaped, and pearly white. The posterior wings are bluish-black, with the base reddish-brown, traversed, behind the central cell by two rows of large white spots, the outer of which are yellow in the male: underneath this pair of wings is very beautiful; the ground-colour is brown, marked with about 22 pearly white spots, arranged in four rows, parallel to the hind margin; the seven composing the marginal row are somewhat crescent-shaped, and those of the next row, which crosses the disk, wedge-shaped, each surrounded by a black line, the next near the base are of different shapes; the costa, and inner margin are bordered near the base by a streak of pearly-white; the notches of the wings are edged with white; abdomen blackish, the thorax covered with fulvous hairs.

It is found in the neighbourhood of New York and Philadelphia, and may possibly occur in the Eastern Townships and Upper Canada. It also inhabits Jamaica.

ARTICLE XXXII.—*Farther Gleanings from the Meeting of the American Association in Montreal.*

In our notice in last number, we were obliged to omit many topics of interest, partly from want of space and partly from the difficulty of obtaining in time the materials required. We propose in the present article to recur to some of these points.

One of the earliest subjects which engaged the attention of the Local Committee was the invitation of men of science from Europe; and large numbers of circulars, accompanied by all necessary information respecting routes of travel, were scattered over Great Britain and the Continent. Courteous replies were received from many of the institutions and gentlemen addressed, but few were found to be able to accept the invitation. Hopes were at one time entertained that Sir Roderick I. Murchison and Sir Wm. Hooker would have honoured the meeting with their presence. It proved impossible for either to come; but, instead of the former, we had the pleasure of welcoming his able assistant in the geological survey of Great Britain, Professor Ramsay; and to represent the botanists of England, and the Linnean Society of London, we had Mr. Seaman, one of the more eminent of the younger cultivators of botanical science. Both of these gentlemen made themselves very useful in the meetings of the sections. Prof. Ramsay, in particular, at once took his place as a leading mind in geological science; and by his union of bonhommie and ready utterance, with profound and extensive knowledge, took a firm hold both of the hearts and heads of the members. The mathematical and physical science of Great Britain had but one eminent representative—Prof. Kelland, of Edinburgh, whose presence in the physical section was warmly greeted by the American physicists; though his dislike of public display prevented him from taking a prominent part in the public meetings.

It is to be regretted that the efforts of the Committee were unable to secure the presence of any of the *savans* of France or Germany; but even the partial success which attended the invitations sent to Great Britain is a proper subject of congratulation; and, taken in connection with the number of American men of science who attended the late meeting of the British Association, gives reason to hope for a more cordial union of scientific men on the opposite sides of the Atlantic. A practical union of the American Association with its older and greater sister of Britain is much to be desired. Why may not Canada, as a middle ground, some day secure a joint meeting of both these bodies. As an initiatory foreshadowing of such a communication, we insert a few sentences from the address of the President of the Natural History Society:—

"We believe that Science knows no political limits. The great physical laws of the Universe are the same in all lands. Geological structure and animal and vegetable life are everywhere framed on one uniform type. We cannot attempt to nationalize science without losing its greatest results. But we are connected with our American scientific friends by still closer ties. We are one with them in language, institutions and origin. Descended with them from that great people that, alone of the nations of the world, has the vigor to beget children in its own likeness, and capable of maintaining an independent existence, we acknowledge their great nation as a brother. We regard it not as a prodigal that has left his father's house to waste his father's substance, but as an honorable adventurer who has departed from his paternal home to establish himself in honest independence; and we delight to welcome him as a visitor to our corner of the old homestead of John Bull. We of British America desire to think of the British people as one in all parts of the world; and not as one only in those Anglo-Saxon and Celtic elements which form its nucleus, but along with all the other peoples and races that have been united with it. Taking this large view of British national existence on both sides of the Atlantic, we cannot be accused of presumption in believing that this great aggregate of nations, spreading itself over the world, and standing with one foot on the land and the other on the sea, points more than any other people to the highest destinies of the human race, and to the final union of all nations, peoples and tongues in the brotherhood of mutual benefits. We love, too, to regard British America as an important connecting link between Britons of the old and the new world. Our country is rapidly rising to a position which may enable it to vie with the United States themselves; and retaining our connection with the maternal state, while we are united by the closest ties with our brethren of the South, we desire to cultivate that mutual good will which is so important to the welfare of the world. In what way can we better do this than through the amenities of science, and by inviting to mingle with us those minds that, more than any other, are building up the fabric of American greatness. Nor is our ambition in this direction limited by this meeting, great and successful though it may be. We hope that there may yet be held in this, the chief city of British America, another meeting of the American Association; and not of it alone, but of the British Association also, that we may thus unite these two great bodies, and gather around them delegates from every other Scientific Society."

The preparations made by the city of Montreal, in a pecuniary point of view, appear, from all that we can learn, to have been quite adequate to the occasion. The accommodation afforded to the sections was ample; and the amount of private hospitality, and the number and character of the public entertainments, were not inferior to those of previous meetings of the Association. The magnificent collection of the Geological Survey was an object of deserved admiration. The collection of the Natural History Society, arranged for the occasion, presented a most creditable appearance, and afforded a very good representation of several departments of the Zoology of Canada. The Botany of the environs of Montreal, and several points in its natural history, were well represented by the collections exhibited in McGill College. The great public works and interesting scenery of the city and its vicinity excited much interest. Last, though perhaps not least, the neat geological map and guide card given to the members was a happy thought, and highly appreciated. Some of these features of the meeting are thus noticed in Silliman's Journal:—

"The eleventh meeting of the American Association for the Advancement of Science opened at Montreal on Wednesday the 12th of August last. The president elect, Professor J. W. Bailey, having died during the year, the vice president, Professor Caswell of Brown University, was the acting President. The number of members in attendance was as large as at any previous meeting. Mr. Ramsay was received as delegate from the Geological Society of London, and Mr. B. Seeman, from the Linnæan Society of London. The departments of astronomy, physics, meteorology and geology, were well represented by papers, and especially the last, and there were also important communications in ethnology; while in zoology, botany, and chemistry, the communications were exceedingly few. A biographical memoir of Mr. William C. Redfield, the first president of the Association, was read by Professor D. Olmsted; and one of Professor Bailey, by Dr. A. A. Gould of Boston. The retiring President, Prof. James Hall, delivered an address on American Geology."

"Commodious accommodations for the meetings, were afforded the Association, at the Court House, by the government of Canada, and generous attentions by citizens of Montreal. Each member was furnished on arrival with a large folded card, containing, on one side, a plan of the Court House, a list of the officers of the Association, and an enumeration of the places of public interest in and about Montreal; and on the other, a map of the city of Montreal and of the St. Lawrence adjoining with its islands, and also a colored geological map of Canada for a circuit of fifty miles around Montreal, showing the outlines of the formations as laid down by Sir William E. Logan, under whom the geological survey is still in progress. One of the principal objects of attraction in the city was the Geological Museum, containing the collections made in the course of this survey. It was remarkable for the extent and variety of rock specimens, and the great number and beauty of the fossils; no geological survey on this or any other continent has been carried forward with greater energy or skill."

To have succeeded in collecting so large a concourse of scientific men from all parts of the United States and British America, and to have so successfully managed the local affairs of the meeting, is in the highest degree creditable to the Local Committee, and will be productive of great and lasting good. The men of science are not so prominently before the public as the leading politicians; but they have a large and deeply seated influence, both personally and through their connection with literature and institutions of learning. That this influence should be of a cosmopolitan, and not of a sectional character, is of the highest importance, and such a meeting as that which has just closed tends more strongly than any other agency in this direction. Nothing connected with literature or science can be more delightful than to see able and learned men from the South and the North, the East and the West, from Republican and British America, quietly and harmoniously discussing questions all of which bear more or less directly on the well-being, not only of America, but of man. Such a spectacle relieves science from any suspicion of being a trifling pursuit, stimulates the mind of the place in which it occurs, honours that place in the estimation of the world, and diffuses around a feeling of amity and mutual helpfulness, that must mitigate, if it cannot overcome, the jealousies of national and local rivalry.

In our present number will be found abstracts of two of the papers referred to in the former notice—that of Prof. Ramsay on the Geological Survey of Great Britain, and that of Dr. Rae on the Search for Sir J. Franklin.

ARTICLE XXXIII.—*Abstract of Professor Ramsay's Paper on the Geological Survey of Great Rritain.*

It has been thought by some of my friends here present that a description of the mode of conducting the Geological Survey of the United Kingdom of Great Britain and Ireland would be interesting in this country, when so many great and important geological surveys are now in progress in the United States and Canada, and, as I believe, will shortly be the case in Nova Scotia. The geological survey of Great Britain was commenced more than 20 years ago by the offer of Sir Henry de la Beche, who commenced a geological survey of England at his own expense. He commenced this survey, beginning in Cornwall, stretching east through Devonshire, this being the great metalliferous district of England. After some time he received a little assistance, namely, two of the civil officers attached to the ordnance survey, giving a portion of their time to tracing geological lines, entirely under the supervision of Sir Henry de la Beche. This was found to be insufficient; and when the geological survey had finished in Devon and Cornwall, it transplanted itself to South Wales, and commenced operations on the great coal fields of South Wales, where he received one or two assistant geologists, expecially those who might be supposed to have some skill in tracing coal beds. Before this time a certain grant had been made for the conduct of the survey, and there Sir Henry first made the acquaintance of Sir William Logan (then Mr. Logan), who was at the time living in Swansea, and had for six years been amusing his leisure in constructing a map of the Glamorganshire coal field, which was entirely surveyed by Sir William, and was constructed upon so admirable a system that ever since it has served as a model for all our work when we chance to be conducting operations in any coal field. Pointing to the one constructed by Sir William, Mr. Ramsay said there are no fewer than 25 or 30 beds of coal on this map, and their actual out crop on the ground is traced and engraved. Sir William Logan having done so much in that field, transferred the whole of his work as a present to the geological survey, and occasionally worked himself as an amateur on the survey for upwards of 12 months afterwards. This survey gradually increased. Sir Henry de la Beche was too wise to ask for a large sum of money at one time; but, as the importance of the survey attracted attention, he gradually asked for and obtained enlarged grants to increase the force till at length he had a large staff of geologists organized. His general rule was to seek out young men, not those who had always distinguished themselves in the science, but who were full of energy and love of the subject, and in whom he saw a strong appreciation of the science, He took them into the field with himself and having trained them in the field under his own care, appointed them an area, and sent them out to make operations by themselves, These operations he examined and corrected if necessary, and gave the young men any further assistance they required, until they became all as experienced as himself in tracing lines, faults, &c., &c., in conducting all field operations connected with geological maps. The grant we now have is £6000 sterling a year. In 1845 the survey was remodelled and divided into two portions. One for Great Britain and another for Ireland. Captain now Colonel James, was appointed Director for Ireland. I was appointed Director for Great Britain. Each of us had a staff of assistants, while Sir Henry de la Beche was then appointed Director general of the Survey. The Geological Museum attached to the survey originated nearly as follows: The Houses of Parliament having been burned down, a commission was appointed to examine into the best stones for re-constructing parliament building. Sir Henry was one of that commission, and while it was in operation, building stones squared and dressed to a six inch cube, were sent in from all parts of the country. The commission examined not only the stones, but what ancient buildings had been constructed with them in order to test their quality of endurance. In consequence of a previous collection of metalliferous mineral specimens and of this large collection having been sent in, it struck Sir Henry de la Beche that there ought to be some building to preserve them, and he merely asked for a small house belonging to Government to store them in. Then he asked for cases to put them in, that they might not only be preserved, but might be examined. By degrees he increased his demands, and Government perceived the importance of a National Geological museum. He asked for and obtained a special building in which to exhibit all the economic and scientific resources of the country connected with geology, and the large and spacious building in Jermyn Street, known as the Museum of Practical Geology, sprung up, with its varied rooms containing suites of all the fossils, building stones and mineral wealth of the country, and everything connected with Geology. The building itself was entirely constructed of British materials. The front of magnesian limestone, the back of brick, the pilasters of Aberdeen and other granites, of Derbyshire and Irish marbles, and of Cornish and Irish serpentines. People are amazed when they enter this building and see so many rich materials for architectural purposes displayed, all of them afforded by the British Islands. Having secured this building, it occurred to Sir Henry, partly in consequence of representation from the mining districts, that to establish a Mining College in connexion with this would be of the greatest advantage to all connected with mining. He proposed, therefore, that certain chairs should be founded in connection with this institution, and the consequence was that in the large and spacious theatre connected with the building, lectures are given on Geology by myself, on Natural History by Professor Hauxley, on Demonstrations in Palæontology by Mr. Salter, on Mining and Mineralogy by Professor Smythe, on Chemistry by Prof. Hofman, on Physics by Prof. Stokes, on Mechanics by Prof. Willis, and Metallurgy by Dr. Percy. Plan and machine drawing, &c., are also taught. As a necessary result of these operations we have turned out from this school a number of young men who, in geology whether practical or scientific, are beginning to distinguish themselves. Those who get the best certificate are appointed to the Geological Survey, whenever there is a vacancy, if they wish to follow geology as a profession. This year three new assistants were in this manner sent into the field to be trained for conducting field operations. As Director for Great Britain I have thirteen assistants, three of them are senior Geologists. They have served a number of years to get up to that rank on the Survey, perhaps from eight to sixteen years. I have eight assistant-Geologists, younger men who have come on the staff and are struggling to attain some standing in their profession. There are two others whose chief duty is to collect fossils under my direction or that of any of the officers in the staff, under whose charge I may chance to place them. When a young man comes in I place him on the secondary strata—the tertiary strata being too obscure—and after they have laboured on these comparatively horizontal strata, in which the lines are comparatively easily traced, they are transferred to the palœozic districts. In Ireland the same system with an independent staff is pursued under the direction of Mr. Jukes. These are all the field officers employed on the Survey, but in addition to that we have two palæontologists in Jermyn Street, whose duty is to receive all the fossils, examine them, label them, describe and figure them, and if necessary to go into the field and give advice in regard to critical points in palæontology. The maps we work upon are the Ordnance maps. These maps we apply for, and every surveyor takes one or two copies of the district he is in charge of, and traces the geological lines upon it. In this map (pointing to a small quarter sheet map) there are no fewer than eighty geological lines traced. The mountains in this map, are most of them over 2,000 feet high, some of them more than 3000 feet in height. In this map the geological lines of all the different formations are traced. On the maps heretofore published, no fewer than 125 formations, or modifications of them, are indexed by the colors employed, and each of these formations, &c., is traced foot by foot on the ground with many ramifications. The maps used heretofore in England are all on a scale of one inch to a mile. The tract having been surveyed, the next duty is to construct horizontal sections for its illustration. All the sections published by the survey are on a true vertical and horizontal scale of six inches to a mile. The whole country is levelled across with the level or the Theodolite, as the case may be. By this means, the true form of the ground is obtained, and it is then easy to delineate the actual thicknesses of the various strata. The angles of some of these hills are so steep that it requires bold men to climb them. In rare cases some of the chainmen have refused to do so. After this is done for one section the same is done for all parts of the country in an elaborate manner. Professor Ramsay here explained the construction of the maps which were hung up. He then stated that having completed these horizontal sections, the next step is to construct vertical sections chiefly of the coal measures, and rarely of the other ground. These are made on the scale of forty feet to an inch, and give the precise thickness of the beds of coal in any coal field, and the nature and thickness of the strata which contain them. Underneath each bed of coal we have always fire clay—as I have no doubt it is the case with you—filled with stigmaria. This, then, is the general mode of procedure. But in the north of England, in Ireland and in Scotland, a new scale of Ordnance survey has been adopted. The whole of Ireland is surveyed upon a scale of six inches to a mile, and Scotland and the north of England are being surveyed upon the same scale. This large scale gives immense facilities for accuracy of delineation, especially in the mining districts. These six inch maps are sometimes contoured, the result of which will be that when we come to construct a geological section across the country, it will be much more easily done and will, therefore, be a great saving of money and labour. In regard to the Geological Survey, I cannot say that we trained and sent out Sir William Logan, for he was a trained Geologist before he ever saw the survey, but others have been sent to other Provinces, who are conducting important Geological surveys. The Director of the Geological surveys of India, Professor Oldham, and all his assistants, have either sprung from our Survey or the School of Mines in Jermyn Street. The Director of the Survey of Australia, the Colony of Victoria, Mr. Selwyn, and Mr. Wylie of the Cape of Good Hope, also Mr. Hall, directing the Geological survey of Trinidad, were sent out from the Survey or the School of Mines. A short time before coming here I was asked, in reference to a survey of Nova Scotia. I recommended the gentleman to come and consult Sir William Logan, as no man was better acquainted with the necessities of a Colonial Survey than he. I firmly believe that the time will come when the authorities not only of Canada and the United States but of every civilized country, will find it to be of the greatest benefit to have not only topographical maps of every part of the country, with all their features delineated in the most accurate manner, but also upon these to have every Geological feature surveyed to the most minute detail, and published at the expense of Government. Our Government is so completely aware of this, and the people of Great Britain are so confident of its advantages that it would never occur to any one to think of stopping the survey of Great Britain from any motive whatever. You will have an idea of the value set upon our labours by the public when I tell you that 5000 sheets of these expensive maps and sections are annually sold in Great Britain. They are published bythe StationaryOffice, and are sold through Longman & Co. The profit, if there is any, goes to the Stationary Office, but their object is to sell them as cheap as possible, without any reference to money returns. Coloured maps such as these (pointing to those hanging up) are sold from 2s 6d to 8s. according to the amount of work in them; the sectional sheets are 5s each. We are now well aware in Britain that the importance of our country in the scale of nations depends upon its mineral wealth. Government, therefore, freely grants whatever is considered essential to the Survey. We have as many men upon the Survey at present as we can use. But if we found it necessary to double the number and to ask for increased grants, I fully believe it would be freely given. We have published about 50 sheets of maps, embracing an extent of about 36,000 square miles. About 50 horizontal sections of the country illustrate these maps, and about 20 sheets of vertical sections of the coal measures are already given, and we intend to proceed in the same way with the rest of the country, I ought to have mentioned thattwoyears ago Sir Henry de la Beche worn out in body and mind gradually sank and died, regretted by all his friends, men of science, and especially by those to whom he had long endeared himself, who were connected with him in an official capacity. He was succeeded by Sir Roderick Murchison, a gentleman whose previous geological labors and great skill in the field fitted him more thoroughly than any other person to succeed Sir Henry delaBeche, whose monument it is to have established this Survey, Museum and School of Mines, a monument which will remain so long as geology is known on the other side of the Atlantic, and I am sure will be equally appreciated here.

ARTICLE XXXIV.—*Abstract of Dr. Rae's Account of the Expedition in Search of Sir J. Franklin.*

Dr. RAE, at the request of the Chairman, then addressed the section. He said that previously to the expedition in which he discovered these relics, he had been engaged in four boat expeditions to the Arctic regions, and had traced some 2000 to 3000 miles of coast. This last expedition of his was undertaken more for the purposes of geographical information than to search for Sir John Franklin—that having been a secondary consideration, as he had hardly expected to find any traces of Franklin's party. But in the course of his travels he fell in with an Esquimaux, who had seen a party of whites the winter before, who were dead. They were in possession of several watches, spoons, &c., with crests upon them, which proved to be those of persons belonging to Franklin's Expedition, including the decoration of Sir John's order of Knighthood. He bought these from the Esquimaux for saws, daggers and other weapons. Doubts have been expressed in several quarters as to the honesty of the Esquimaux, and it was suggested that they might have murdered Franklin's party and robbed their bodies. He had always found them honest and trustworthy, and much more cleanly in their habits than those Dr. Kane met with. He found them extremely accurate in their remembrance and description of what they had seen. He wintered among them in 1847. They described to him the visit of Parry and others twenty years before, with such minuteness, that he recognised their visitor as Parry, who had subsequently confirmed to him (Dr. Rae) the circumstances concerning his visit which they related. All the time he was among them they never stole an article. He went away on a distant expedition, leaving three men behind him with stores. They were never molested in any way, and nothing was taken from them, though the Esquimaux would have made much more by murdering and robbing them, than by the destruction of Franklin's party. In the eastern part of the continent there was no instance of that bloodthirsty disposition towards the whites or other Indians, that they showed on the western side of the continent. On this latter side they were constantly at war with the neighboring Indian tribes, and as these latter were furnished with fire-arms in exchange for peltries by the white men, the whites were regarded as the allies of their enemies. The Esquimaux, among whom he had resided, were very exemplary in their domestic relations. When you went among them the men brought out their wives and children and introduced them to you, and were proud of any notice you took of them. The women were not, as among many other Indian tribes, made slaves and worked like beasts of burden. They had only charge of the snow house and the affairs of the household. In fact, they were extremely kind to their wives, and children were prized as a great blessing. In return, these children always took great care of their parents when they grew too old to labor and provide for their families. So much was this the case, that if children were left orphans there was always a scramble among their neighbors and friends to adopt them. They are very grateful, too. He had had occasion once to do them a kindness. They ran short of food, and he supplied them from his stores. Afterwards, whenever he wanted seal fat for his men to eat with their other provisions, it was left for them at the doors of their houses, the Esquimaux positively refusing all compensation, because, they said, he had fed them when they were in want. They were frank and friendly in their intercourse. He had never had a quarrel with any of them but one, and that man was esteemed so bad a character among themselves, that they begged him to shoot the fellow, and rid them of him, and afterwards tried to get poison wherewith to destroy him. He had no doubt himself about Franklin's course and his fate. He had been heard to say that, if ice came in his way, he should not shrink from running his ships into it. After wintering at Beechy Island, he had tried to get to Cape Walker, and make thence for Behring's Straits. His provisions had failed in the fifth year, and he had tried to get up Back's River, and perished in the attempt. Capt. McClintock had gone out to endeavour to examine the place where the ships had been abandoned, which they knew pretty well, and to determine, if possible, the position of the Magnetic Pole, to discover if there was any shifting which would account for the variations of the needle. He would endeavor also to make the North-West Passage in his vessel, which Captain McClure had only succeeded in doing by walking a portion of the distance. If any man could do all this it was Captain McClintock. He was admirably fitted for his task, his vessel well adapted for the voyage, and well provided. He only took thirty men with him, and if his own provisions gave out, there were provisions deposited there by previous expeditions sufficient for 100 men for two years. They desired to recover, also, any books or journals which Franklin's party might have left behind them. When he asked the Esquimaux about them they had said they had had several, but not knowing they were of value they had given them to their children, who had played with them and torn them up. He only succeeded in obtaining two leaves of a religious book which an Esquimaux woman had in her work-bag, and which, with the rest of the relics, save those he had with him, he had deposited by order of the government in Greenwich Hospital. The Esquimaux he found most correct in their geographical notions and descriptions. He had only to point out to them on the chart certain places he knew in common with them, and they would give him most accurately the relative situation of another. Thus he ascertained the place where the party had perished, and when parties from his description subsequently went there, they found the remains of a boat, and near it a piece of wood on which the word "Terror" had been stamped. They found also kettles and other utensils belonging to the expedition. They also found a piece of a snow-shoe frame with the name of Mr. Stanley, one of the surgeons of the expedition, carved upon it. He had traced it back to the maker and the man in London from whom Mr. Stanley had bought it. No remains of the bodies had been found; and this was principally owing to the nature of the site where the party perished. They had been seen ere the ice had decayed, in the spring time, on a low beach, which, at times, was doubtless covered with water. The bodies were left to lie there; the other articles moved to a safer place. The former were washed away and lost, foxes and wolves, perchance, aiding in their destruction. Capt. Penny had told him that whales and walruses, which he had left in similar places, had similarly disappeared. Dr. Rae here showed the relics of which he had retained possession. They consisted of portions of the cases of watches, pocket chronometers, gold chain, an anchor badge worn on the shoulder of a ship's petty officer, and a fork with Sir John Franklin's crest upon it. We also had a very nicely made Esquimaux needle. The thread was made from deer's hide. In fact the reindeer furnished them with food;

clothing, and beds. The Esquimaux were very expert in killing deer. They drove them into the water in the autumn in herds, and sometimes killed 30 or 40 at a time. In winter they drove them into pit-falls ingeniously contrived in the snow. These were so prepared that when the deer got in, their haunches were imprisoned and they could not leap out. His men never could manage it. They managed to kill seals too with their spears, when his men could not manage it with rifles. Instead of going head-foremost toward the seal, they wriggled themselves towards them on their sides, presenting a broadside to the seal; and whenever they seemed startled, the Esquimaux would imitate a peculiar noise or cry they made from their throats. When they got near enough they speared and held on to them. Dr. Rae's party never managed to shoot them so entirely dead that they would not tumble into their holes and so be lost. With very large ones, the Esquimaux would, while imitating the flipping of the seal's fin, dig a hole in the ice and fasten their line in that, and so hold them. Had they attempted to hold them by their own strength, they ran the risk of being drawn into the water themselves. The Esquimaux he met were much more cleanly than those Dr. Kane described. In winter he was ashamed of his own men in comparison with them. In order to preserve their furs, they cleaned them of all filth or moisture before entering their huts at night; they stripped themselves of all their clothing, each night, and got in between their fur blankets. They washed themselves with snow from time to time, and so kept their bodies clean. His party had tried washing with water, but found they could never dry themselves, as they had no furs. Their snow huts were very warm and clean. They used stone lamps with moss wicks, such as described by Dr. Kane, but they managed so to arrange them that they gave out no smoke, and the ceilings of their huts were pure white and polished, after being heated, with the breath of the dwellers, and the lamps were brazen again like glass. He was satisfied that Kane, who deserved all the credit he had obtained, or more, for the courageous manner in which, with a constitution so weakened, he had endured so much—had made a great mistake when he had used tents, instead of conforming to the habits of the Esquimaux and building snow-huts. His party had slept comfortably in these huts with a deer-skin beneath them on the snow, and one blanket above them. The weight of this bedding for four of them was but 24 lbs. for each man. It required some skill to build a snow-hut properly, but it was soon learned. The doctor here exhibited a rough diagram, and described the process. In answer to a question, he said the Esquimaux would attack a white bear, and did not consider him a peculiarly dangerous animal. A musk ox, when wounded, was much more so. He had killed several. The robes were of the finest kind, and the under fur he had had manufactured into shawls as fine as cashmere. These skins were not brought into market, the Esquimaux reserving them for their own use.

ART. XXXV.—*Thoughts on Species;* by JAMES D. DANA.

Read before the American Association at Montreal, August 13th, 1857.*

WHILE direct investigation of individual objects in nature is the true method of ascertaining the laws and limits of species, we have another source of suggestion and authority in the comprehensive principles that pervade the universe. The scource of doubt in this synthetic mode of reaching truth consists in our imperfect appreciation of universal law. But science has already searched deeply enough into the different departments of nature to harmonize many of the thoughts that are coming in from her wide limits; and it is well, as we go on in research, to compare the results of observations with these utterings of her universality.

I propose to present some thoughts on species from the latter point of view, reasoning from central principles to the circumferential, and, if I mistake not, we shall find the light from this direction sufficiently clear to illumine a subject which is yet involved in doubts and difficulties.

The questions before us at this time are—

1. What is a species?
2. Are species permanent?
3. What is the basis of variations in species?

1. *What is a species?*

It is common to define a species as a *group* comprising such individuals as are alike in *fundamental* qualities; and then by way of elucidation, to explain what is meant by fundamental qualities. But the idea of a group is not essential; and moreover it tends to confuse the mind by bringing before it, in the

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* From Silliman's Journal.

outset, the endless diversities in individuals, and suggesting numberless questions that vary in answer for each kingdom, class or subordinate group. It is better to approach the subject from a profounder point of view, search for the true idea of distinction among species, and then proceed onward to a consideration of the systems of variables.

Let us look first to *inorganic* nature. From the study of the inorganic world, we learn that each element is represented by a specific amount or law of force; and we even set down in numbers the precise value of this force as regards one of the deepest of its qualities, chemical attraction. Taking the lightest element as a unit to measure others by, as to their weights in combination, oxygen stands in our books as 8; and it is precisely of this numerical value in its compounds: each molecule is an 8 in its chemical force or law, or some simple multiple of it. In the same way there is a specific number at the basis of other qualities. Whenever then the oxygen amount and kind of force was concentered in a molecule, in the act of creation, the species oxygen commenced to exist. And the making of many such molecules instead of one, was only a repetition in each molecule, of the idea of oxygen.

In combination of the elements, as of oxygen and hydrogen, the resultant molecule is still equivalent to a fixed amount, condition, or law, of chemical force; and this law, which we express in numbers, is at the basis of our notion of the new species. It is not necessarily a different amount of force; for it may be simply a different state of concentration or different rate or law of action. This should be kept in mind in connection with what follows.*

The essential idea of a species, thence deduced is this: a *species* corresponds to *a specific amount or condition of concentered force, defined in the act or law of creation.*

* When we have in view, oxygen and the elements, we are apt to think of their molecules as distinguished by a different *amount* and *kind* of force. But when we consider the manydifferent compounds that may be made of the same elements (as carbon and hydrogen), in the very *same* proportions, we are led to conceive of these as differing molecularly in a different *law* of the same force or forces. When, again, we see the same element under conditions as diverse as any two compounds, as in cases of allotropism, we are still better satisfied with adopting, for the present, the most general expression—a different law of action or condition of molecular force.

Turn now to the organic world. The individual is involved in the germ-cell from which it proceeds. That cell possesses certain inherent qualities or powers, bearing a definite relation to external nature, so that, when having its appropriate nidus or surrounding conditions, it will grow, and develop out each organ and member to the completed result, and this, both as to all chemical changes, and the evolution of the structure which belongs to it as a subordinate to some kingdom, class, order, genus and species in nature. The germ-cell of an organic being developes a specific result; and like the molecule of oxygen, it must correspond to a measured quota or specific law of force. We cannot apply the measure, as in the inorganic kingdom, for we have learned no method or unit of comparison. But it must nevertheless be true, that a specific predetermined amount, or condition, or law of force, is an equivalent of every germ-cell in the kingdoms of life. I do not mean to say that there is but one kind of force; but that whatever the kind or kinds, it has a numerical value or law, although human arithmetic may never give it expression.

A species among living beings, then, as well as inorganic, is based on *a specefic amount or condition of concentered force defined in the act or law of creation.*

Any one species has its specific value, or law of force; another, its value; and so for all: and we perceive the fundamental notion of the distinction between species when we view them from this potential stand-point. The species, in any particular case, began its existence when the first germ-cell or individual was created; and if several germ-cells of equivalent force were created, or several individuals, each was but a repetition of the other; the species is in the potential nature of the individual, whether one or many individuals exist.

Now in organic beings,—unlike the inorganic,—there is a cycle of progress involving growth and decline. The oxygen molecule may be eternal as far as any thing in its nature goes. But the germ cell is but an incipient state in a cycle of changes, and is not the same for two successive instants; and this cycle is such that it includes in its flow, a reproduction, after an interval, of a precise equivalent of the parent germ-cell. Thus an indefinite perpetuation of the germ-cell is in fact effected; yet it is not mere endless being, but like evolving like in an unlimited round. Hence, when individuals multiply from generation to generation, it is but a repetition of the primordial type-idea; and the true notion of the species is not in the resulting group but in the idea or potential element which is at the basis of every individual of the group; that is, the specific law of force, alike in all, upon which the power of each as an existence and agent in nature depends. Dr. Morton presented nearly the same idea when he described a species as *a primordial organic form.*

Having reached this idea as the starting point in our notion of a species, we must still, in order to complete and perfect our view, consider what is the true expression of this potentiality. For this purpose, we should have again in mind, that a living cell, unlike an inorganic molecule, has only a historical existence. The species is not the adult resultant of growth, nor the initial germ-cell, nor its condition at any other point; it comprises the whole history of the development. Each species has its own special mode of development as well as ultimate form or result, its serial unfolding, inworking and outflowing; so that the precise nature of the potentiality in each is expressed by the line of historical progress from the germ to the full expansion of its powers, and the realization of the end of its being. We comprehend the type-idea only when we understand the cycle of evolution through all its laws of progress, both as regards the living structure under development within, and its successive relations to the external world.

2. *Permanence of species.*

What now may we infer with regard to the permanence or fixedness of species from a general survey of nature?

Let us turn again to the inorganic world. Do we there find oxygen blending by indefinite shadings with hydrogen or with any other element? Is its combining number, its potential equivalent, a varying number,—usually 8, but at times 8 and a fraction, 9, and so on? Far from this the number is as fixed as the universe. There are no indefinite blendings of elements. There are combinations by multiples or submultiples, but these prove the dominance and fixedness of the combining numbers.

But further than this, even numbers, definite in value and defiant of all destroying powers, are well known to characterize nature from its basement to its top-stone. We find them in combinations by volume as well as weight, that is in all the relations of chemical attraction; in the mathematical forms of crystals and the simple ratios in their modifications,—evidence of a numerical basis to a cohesive attraction; in the laws of light heat, and sound. Indeed the whole constitution of inorganic nature, and of our minds with reference to nature, as Professor Pierce has well illustrated, involves fixed numbers; and the universe is not only based on mathematics, but on finite determinate numbers in the very natures of all its elemental forces. Thus the temple of nature is made, we may say, of hewn and measured stones, so that, although reaching to the heavens, we may measure and thus use the finite to rise toward the infinite.

This being true for inorganic nature, it is necessarily the law for all nature, for the ideas that pervade the universe are not ideas of contrariety but of unity and universality beneath and through diversity.

The units of the inorganic world, are the weighed elements and their definite compounds or their molecules. The units of the organic are *species* which exhibit themselves in their simplest condition in their germ-cell state. The kingdoms of life in all their magnificent proportions are made from these units. Were these units capable of blending with one another indefinitely, they would no longer be units, and species could not be recognized. The system of life would be a maze of complexities; and whatever its grandeur to a being that could comprehend the infinite, it would be unintelligible chaos to man. The very beauties that might charm the soul would tend to engender hopeless despair in the thoughtful mind, instead of supplying his aspirations with eternal and ever-expanding truth. It would be to man the temple of nature fused over its whole surface and through its structure, without a line the mind could measure or comprehend.

Looking to facts in nature, we see accordingly every where, that the purity of species has been guarded with great precision. It strikes us naturally with wonder, that even in senseless plants, without the emotional repugnance of instinct, and with reproductive organs that are all outside, the free winds being often the means of transmission there should be rigid law sustained against intermixture. The supposed cases of perpetuated fertile hybridity are so exceedingly few as almost to condemn themselves, as no true examples of an abnormity so abhorrent to the system. They violate a principle so essential to the integrity of the plant-kingdom, and so opposed to nature's whole plan, that we rightly demand long and careful study before admitting the exception.

A few words will explain what is meant by perpetuated fertile hybridity. The following are the supposeable grades of results from intermixture between two species:—

1. No issue whatever—the usual case in nature.

2. Mules (naming thus the issue) that are wholly infertile whether among themselves or in case of connection with the pure or original stock.

3. Mules that are wholly infertile among themselves, but may have issue for a generation or two by connection with one of the original stock.

4. Mules that are wholly infertile among themselves, but may have issue through indefinite generations by connection for each with an individual of the original stock.

5. Mules that are fertile among themselves through one or two generations.

6. Mules that are fertile among themselves through an indefinite number of generations,

The cases 1 to 5 are known to be established facts in nature; and each bears its testimony to the grand law of purity and permanence. The examples under the heads 2 to 5 become severally less and less numerous, and art must generally use an unnatural play of forces or arrangements to bring them about.

Again, in the animal kingdom, there is the same aversion in nature to intermixture, and it is emotional as well as physical. The supposed cases of fertile hybridity are fewer than among plants.

Moreover, in both kingdoms, if hybridity be begun, nature commences at once to purify herself as of an ulcer on the system. It is treated like a disease, and the energies of the species combine to throw it off. The short run of hybridity between the horse and the ass, species very closely related, reaching its end *in one single generation*, instead of favoring the idea that perpetuated fertile hybridity is possible, is a speaking protest against a principle that would ruin the system if allowed free scope.

The finiteness of nature in all her proportions, and in the necessity of finiteness and fixedness for the very existence of a kingdom of life, or of human science its impress on finite mind, are hence strong arguments for the belief that hybridity cannot seriously trifle with the true units of nature and at the best can only make temporary variations.

It is fair to make the supposition that in case of a very close proximity of species, there might be a degree of fertile hybridity allowed; and that a closer and a closer affinity *might* give a longer and a longer range of fertility. But the case just now alluded to seems to cut the hypothesis short; and moreover it is not reasonable to attribute such indefiniteness to nature's outlines, for it is at variance with the spirit of her system.

Were such a case demonstrated by well established facts, it would necessarily be admitted; and I would add, that investigations directed to this point are the most important that modern science can undertake. But until proved by arguments better than those drawn from domesticated animals, we may plead the general principle against the *possibilities* on the other side. If there is a law to be discovered, it is a wide and comprehensive law, for such are all nature's principles. Nature will teach it not in one corner of her system only, but more or less in every part. We have therefore a right to ask for well defined facts, taken from the study of successive generations of the interbreeding of species known to be distinct.

Least of all should we expect that a law, which is so rigid among plants and the lower animals, should have its main exceptions in the highest class of the animal kingdom, and its most extravagant violations in the genus Homo; for if there are more than one species of Man, they have become in the main indefinite by intermixture. The very crown of the kingdom has been despoiled; for a kingdom in nature is perfect only as it retains all its original parts in their full symetry, undefaced and unblurred. Man, by receiving a plastic body, in accordance with a law that species most capable of domestication should necessarily be most pliant, was fitted to take the whole earth as his dominion, and live under every zone. And surely it would have been a very clumsy method of accomplishing the same result, to have made him of many species, all admitting of indefinite or nearly indefinite hibridization, in direct opposition to a grand principle elsewhere recognized in the organic kingdoms. It would have been using a process that produces impotence or nothing among animals for the perpetuation and progress of the human race.

There are other ways of accounting for the limited productiveness of the mulatto, without appealing to a distinction of species. There are causes, independent of mixture, which are making the Indian to melt away before the white man, the Sandwich Islander and all savage people to sink into the ground before the power and energy of higher intelligence. They disappear like plants beneath those of stronger root and growth, being depressed morally, intellectually and physically, contaminated by new vices, tainted variously by foreign disease, and dwindled in all their hopes and aims and means of progress, through an overshadowing race.

We have therefore reason to believe from man's fertile intermixture, that he is one in species; and that all organic species are divine appointments which cannot be obliterated, unless by annihilating the individuals representing the species.

It may be said, that different species in the inorganic world combine so as to form new units, and why may they not in the organic? It is true they combine, but not by indefinite blendings. There is a definite law of multiples, and this is the central idea in the system of inorganic nature. In organic nature, such a law of multiples, if existing, would be general, as in the inorganic; it would be an essential part of the system and should be easily verified, while, in fact, observation lends it no support, not even enough to have suggested the hypothesis.

In one kingdom, the *inorganic*, there is multiplication of kinds of units by combination, according to the law of multiples, and no reproduction; while in the *organic*, there is reproduction of like from like and no multiplication of kinds by combination. And thus the two departments of living and dead nature widely diverge.

Neither does the possibility of mere mixture among inorganic subtances afford any analogy to sustain the idea of possible hybrid mixture indefinitely perpetuated, among living beings. The mechanical aggregation of units that make up ordinary mixture, is one thing; and the combination that would alter a germ, one of the units in organic species, even to its fundamental nature, is quite another. This last is not aggregation. It is as different from mere mixture as his chemical combination and stands somewhat in the same relation, so that the analogy has no bearing on the question.

3. *Variations of species.*

But there are variations in species, and this is our next topic. The principles already considered teach, as we believe, that each species has its specific value as a unit, which is essentially permanent or indestructible by any natural source of change? and we have, therefore, to admit in the outset, if these principles are true, that variations have their limits, and cannot extend to the obliteration of the fundamental characteristics of a species.

To understand these variations, we may again appeal to general truths.

Variation is a characteristic of all things finite; and is involved in the very conditions of existence. No substance or body can be wholly independent of every or any other body in the universe. The most comprehensive and influential law in nature most fundamental in all change, composition or decomposition, growth, or decay, is the law of mutual sympathy, or tendency to equilibrium in force through universal action and reaction.

The planets have their orbits modified by other bodies in space through their changing relations to those bodies. A substance, as oxygen or iron, varies in temperature and state of expansion from the presence of a body of different temperature; in chemical tendencies from the presence of a luminous body like the sun; in magnetic or electrical attraction from surrounding magnetic or electrical influences. There is thus unceasing flow and unceasing change through the universe. All the natural forces are closely related as if a common family or group, and are in constant mutual interplay.

The degree or kind of variation has its specific law for each element; and in this law the specific nature of the element is in a degree expressed. There is to each body or species, the normal or fundamental force in which its very nature consists; and in addition, the relation of this force to other bodies, or kinds, amounts or conditions of force, upon which its variations depend. One great end of inorganic science is to study out the law of variables for each element or species. For this law is as much a part of an idea of the species, as the fundamental potentiality; indeed the one is a measure of the other.

So again, a species in the *organic* kingdoms is subject to variations, and upon the same principle. Its very development depends on the appropriation of material around it, and on attending physical forces or conditions, all of which are variable through the whole of its history. Every chemical or molecular law in the universe is concerned in the growth,—the laws of heat, light, electricity, cohesion, etc.; and the progress of the developing germ, whatever its primal potentiality, is unavoidably subject to variation, from the diversified influences to which it may be exposed. The new germ, moreover, takes peculiarities from the parent, or from the circumstances to which its ancestry had been exposed during one or more preceding generations.

There is then a fixed normal condition or value, and around it librations take place. There is a central or intrinsic law which prevents a species from being drawn off to its destruction by any external agency, while subject to greater or less variations under extrinsic forces.

Liability to variation is hence part of the law of a species; and we cannot be said to comprehend in any case the complete idea of the type until the relations to external forces are also known. The law of variables is as much an expression of the fundamental equalities of the species in organic as in inorganic nature; and it should be the great aim of science to investigate it for every species. It is a source of knowledge which will yet give us a deep insight into the fundamental laws of life. Variations are not to be arranged under the head of *accidents:* for there is nothing accidental in nature; what we so call, are expressions really of profound law, and often betray truth and law which we should otherwise never suspect.

This process of variation, is the external revealing the internal, through their sympathetic relations; it is the law of universal nature reacting on the law of a special nature, and compelling the latter to exhibit its qualities; it is a centre of force manifesting its potentiality, not in its own inner working, but in its outgoings among the equibrating forces around, and thus offering us, through the known and physical, some measure of the vital within the germ. It is therefore one of the richest sources of truth open to our search.

The limits of variation, it may be difficult to define among species that have close relations. But being sure that there are limits—that science, in looking for law and order written out in legible characters, is not in fruitless search, we need not despair of discovering them. The zoologist, gathering shells or mollusks from the coast of eastern America and that of Japan, after careful study, makes out his lists of idential species, with the full assurance that species are definite and stable existences; and he is even surprised with the identity of characters between the individuals of a species gathered from so remote localities. And as he sees zoological geography rising into one of the grandest of the sciences, his faith in species becomes identified with his faith in nature and all physical truth.

If then we may trust this argument from general truths to special,—general *truths* I say, for general principles as far as established are truths—we should conceive of a species from the potential point of view, and regard it as—

a. A concentered unit of force, an ineffaceable component of the system of nature; but

b. Subject to greater or less librations according to the universal law of mutual reaction or sympathy among forces.

And, in addition, in the *organic* kingdom,

c. Exhibiting its potentiality not simply or wholly in any existing condition or action, but through a cycle of growth from the primal germ to maturity, when the new germ comes forth as a repetition of the first to go another round in the cycle and perpetuate the original unit; and, therefore, as follows from a necessary perpetuity of the cycle—

d. Exhibiting identity of species among individuals by perpetuated fertile intermixture in all normal conditions, and non-identity by the impossibility of such intermixture, the rare cases of continuation from one or two generations, attesting to the stability of the law, by proving the effort of nature to rid herself of the abnormity, and her success in the effort.

e. The many like individuals that are conspecific do not properly constitute the species, but each is an expression of the species in its potentiality under some one phase of its variables; and to understand a species, we must know its law through all its cycle of growth, and its complete series of librations.

We should therfore conceive of the system of nature as involving, in its idea, a system of units, finite constituents at the basis of all things, each fixed in law; these units in organic nature as adding to their kinds by combinations in definite propositions; and those in organic nature adding to their numbers of representative individuals, but *not* kinds, by self-reproduction; and all adding to their varieties by mutual reaction or sympathy. Thus from the law within and the law without, under the Being above as the Author and sustainer of all law, the world has its diversity, the cosmos its fullness of beauty.

I would remark again that we must consider this mode of reaching truth, by reasoning from the general to the special, as requiring also its complement, direct observation, to give unwavering confidence to the mind; and we should therefore encourage research with a willingness to receive whatever results come from nature. We should give a high place in our estimate to all investigation tending to elucidate the variation or permanence of species, their mutability or immutability; and at the same time, in order that appearances may not deceive us, we should glance towards other departments of nature, remembering that all truth is harmonious, and comprehensive law the end of science.

A word further upon our conceptions of species as realities. In acquiring the first idea of species, we pass, by induction, as in other cases of generalization, from the special details displayed among individuals to a general notion of a unity of type; and this general notion, when written out in words, we may take as an approximate formula of the species. One system of philosophy thence argues that this result of induction is nothing but a notion of the mind, and that species are but an imaginary product of logic; or at least, that since, as they say, (we do not now discuss this point), genera are groupings without definite limits which may be laid off variously by different minds, so species are undefined, and individuals are the only realities—the supposed limits to species being regarded as proof of partial study, or a consequence of a partial development of the kingdoms of nature. Another system infers, on the contrary, that species are realities, and the general or type idea has, in some sense, a real existence. A third admits that species are essentially realities in nature, but claims that the general idea exists only as a result of logical induction.

The discussion in the preceding pages sustains most nearly the last view, that species are realities in the system of nature while manifest to us only in individuals; that is, they are so far real, that the idea for each is definite, even of mathematical strictness, (although not thus precise in our limited view,) it proceeding from the mathematical and infinite basis of nature. They are the units fixed in the plan of creation; and individuals are the material expressions of those ideal units.

At the same time, we learn, that while species are realities in a most important and fundamental sense, no comprehensive type-idea of a species can be represented in any material or immaterial existence. For while a species has its constants, it has also its variables, each variable becoming a constant so far only as its law and limits of variation are fixed; and in the organic kingdoms, moreover, each individual has its historic phases, from the germ through the cycle of growth. The general idea sought out by induction, therefore, is not made up of invariables. Limited to these, it represents no object, class of objects, or law, in nature. The variables are a necessary complement to the invariables; and the complete species-idea is present to the mind, only when the image in view is seen to be ever changing along the lines of variables and development. Whatever indidualized conception is entertained, it is evidently a conception of the species in one of its phases,—that is, under some one specific condition as to size, form, color, constitution, &c., as regards each part in the structure, from among the many variations in all these respects that are possible: mind can picture to itself individuals only and not species, and one phase at a time in the life of an organic individual, not the whole cycle.

We may attempt to reach what is called the typical form of a species, in order to make this the subject of a conception. But even within the closest range of what may be taken as typical characters, there are still variables; and, moreover, we repeat it no one form, typical though we consider it, can be a full expression of the species, as long as variables are such an essential part of its idea as constants. The advantage of fixing upon some one variety as the typical form of a species is this,—that the mind may have an initial term for the laws embraced under the idea of the species, or an assumed centre of radiation for its variant series, so as more easily to comprehend those laws.

Again, abrupt transitions and not indefinite shadings have been shown to be the law of nature. In proceeding from special characters to a general species-idea, nature gives us help through her stepping stones and barriers. In former times, man looked at iron and other metals from the outside only, and searching out their differences of sensible characters, gradually eliminated the general notion of each, by the ordinary logical method of generalization. But science now brings the element to the line and plummet, and reaches a fixed *number* for iron and other elements as to chemical combination, etc. By this means, the studying out of the idea of a species seems almost to have escaped from the domain of logic into that of direct trial by weights and measures. It is no longer the undefined progress of simple reason, with a mere notion at the end, but an appeal to definite measurable values, with stable numbers at bottom, fixed in the very foundations of the universe. So, in the organic kingdoms, where there is, to our limited minds, still greater indefiniteness in most characters, the barrier against hybridity appears to stand as a physical test of species. We are thus enabled in searching into the nature of a species, to strike from the outside detail to the foundation law.

The type-idea, as it presents itself to the mind, is no more a subject of defined conception than any mathematical expression. Could we put in mathetical terms the precise law, in all its comprehensiveness, which is at the basis of the species iron, as we can for one of its qualities, that of chemical attraction, this mathematical expression would stand as a representative of the species; and we might use it in calculations, precisely as we can use any mathematical term. So also, if we could write out in numbers the potential nature of an organic species, or of its germ, including the laws of its variables, this expression would be like any other term in the hands of a mathematician; the mind would receive the formula as an expression for the species, *and might compare it with the formulas of other species.* But, after all, we have here a mere mathematical abstraction, a symbol for amount or law of force, which can be turned into conceptions, only by imagining (supposing this possible) the force in the course of its evolution of concrete realities, according to the law of development and laws of variations embraced within it.

Miscellanies.

The following is an extract from a letter lately received from Dr. Gibb, of London, by a friend of his in Montreal, in which reference is made to the chalk cliffs on the south-east coast of England:—

"In the month of August I spent a few weeks at Brighton, and made a *pedestrian tour along the south-east coast, walking from* Brighton to Hastings, a distance of about 48 miles with the indentations, but shorter by railway. I do not recollect in the whole course of my wanderings—I must except Niagara Falls—experiencing such pleasure, information, and satisfaction, as on this occasion, for an opportunity was afforded me of studying some of the grandest objects of nature, in the truly magnificent chalk cliffs along this coast. The distance from London to Brighton is 50½ miles, directly south from London, and the journey is easily done within a couple of hours, thus giving an opportunity of studying the lines of section through the different strata, especially of the Wealden and the Chalk. There are four tunnels, two of them pretty long, and each time on passing through them, the rattling rumbling noise has reminded me of the Falls of Niagara, resembling the roar of the falls to some extent, but not so loud, nor yet so awful. The recollection is, however, always pleasing. After being some days at Brighton, thoroughly invigorating both mind and body, I started one morning lightly clad, with a little black bag hanging from an umbrella over my shoulder, for Hastings, on foot. The weather was a little cloudy, but very warm, so much so that I dispensed with a superfluity of vesture, but I never felt in better health in the whole course of my life. I walked along the cliffs to Rottingdean, 4 miles from Brighton, and examined the elephant bed described by Dr. Mantell, and Sir Roderick Murchison, recognising the divisions so well described by the former. This bed, I traced for some distance to the east of Kemptown, being lost in the pure chalk, and re-appearing in the low cliffs at Rottingdean; I had previously gone over the same ground and did not procure any fossils. I saw a very nice lot of good fossils from the chalk in a lapidary's shop at this place, but did not like to encumber myself with any at this period of my journey. On leaving Rottingdean I walked over a series of high chalk hills, or more properly hillocks, as there were hollows between them, frequently stopping to examine the perpendicular faces of the cliffs, which were in many places 200 feet high. Added to the majestic grandeur of these cliffs were the views of many fine farms scattered over the neighbouring downs, and here and there immense flocks of sheep were to be seen browsing the scanty herbage, and after a truly delightful and not fatiguing walk I reached the top of Castle Hill, near the little seaport town of Newhaven, and saw a regular sea-beach of oyster shells, many feet in thickness, forming the summit of the chalk cliffs, which were here 150 feet above the level of the sea. On descending this hill I stopped at the "Hope Inn," where I refreshed the inner man, a little after two o'clock with some biscuit, cheese and ale. Not a particle of meat was to be had for love or money, and the walk of 9 miles had most certainly sharpened my appetite. I crossed the mouth of the harbour in a boat, and landed on a beach of shingle on my way to Seaford. On the banks of a small canal or stream which I skirted for short distance, I found a raised recent clay deposit recently dug, in which were hundreds of bivalve shells with their mouths open, and in some the remains of the animals dried; these were the *Lutricola compressa*, and I preserved a few. I walked along the beach a part of the way, and then turned inland a slight distance, and reached the pretty little village of Seaford, laying in a sort of hollow behind an elevated beach of loose shingle. This part of the country is so quiet and retired, that a party of ladies were bathing in the sea, past Newhaven, in a state of nudity, and a general scramble ensued with a rush towards their clothes until I passed. I made up my mind to stop at Seaford for the night, and took the opportunity of examining the vertical face of a fine chalk cliff to the eastward, the strata of which dipped to the west, thus permitting me to clamber up in various directions, and to pick out with my hammer and chisel a few choice fossils. To the eastward of Seaford the chalk rises to a considerable height, and forms a majestic line of cliffs which extend to the Cuckmere River, and finally terminate in the magnificent promontory of Beachy Head, nearly 600 feet above the level of the sea. After a good night's rest, and a dinner which was served up capitally at this place, I arose refreshed and not fatigued from my walk of yesterday. It had poured torrents of rain during the night, with a tremendous storm, and the weather was a little cool, the day promising to be most lovely. It was about half-past 8 o'clock when I commenced ascending the cliffs, and reached the top without once halting, my walk was then continued along the summit of the cliffs, through hollow and elevation, until I came to the Cuckmere River, but before reaching this stream I counted very distinctly, in the distance, the summits of seven hills, known as the seven sisters, which presented an even serrated appearance. I crossed the Cuckmere River, very shallow and narrow, and paid the coast guard man who rowed me over in advice about his sore eyes. I staid nearly half an hour examining the base of the chalk cliff to the east of the gap at Cuckmere, and then came the most interesting part of my journey. The first hill, which was pretty high, was quietly mounted, the first of the seven sisters, all of which were very tall and high. I sat down on the summit of the second sister and surveyed the prospect seawards, and after traversing the remainder of the sisters, reached a place called Birling-Gap, to the south of East-Dean. I was undecided whether to go along by the coast round Beachy Head, or along the summit of the cliffs, my mind was made up to adopt the former, and by good luck the son of an intelligent coast guard man accompanied me. It was after eleven o'clock when we started, I knew what I had to encounter, and most dearly paid for it,—for the fatigue and torture of walking along the shingle was absolutely dreadful, enlivened and relieved only by my anxiety to examine the masses of chalk which had fallen along the base of the cliffs, from among which we picked up a few fossils. We entered several caves, made to serve ship-wrecked mariners, one called the Parson's Hole, was most extensive, with several passages, and must be pretty old, as I saw dates cut in the chalk of 1778, 1794, &c. The cliffs varied in height, but were very high in some places, from 300 to 450, and, finally, near Beachy Head 600 feet; and to stand underneath some of them, on top of immense masses which had fallen, with towering masses above threatening to fall, it naturally made one feel more or less nervous. We were exposed to two dangers along this piece of coast, one of being washed into the sea when passing these fallen masses of chalk,—the other of being crushed to death by some enormous mass of chalk rock. After a weary and really toilsome tramp in the heavy shingle, we at last got to the Cows Gap, just beyond Beachy Head, and ascended this steep hill for 600 feet. Being quite exhausted I had to stop several times for breath and rest, until the top was reached at half-past 2 o'clock; when, lo! I had of all things on earth the greatest luxury it was possible to wish for at this time, a glass of rain water. My mouth was parched from my walk on the loose shingle in the broiling sun, my tongue was dry and clove to the roof of my mouth, I did not dare touch the sea-water, and when my lips tasted pure rain water, it was perfect ecstasy and happiness; I drank two tumblers of it, and was thoroughly refreshed and relieved, so that I was now enabled to descend the hill in a northerly direction with a coast guard man of the name of Blackman to the village of Meads, which I reached at twenty minutes past 3 o'clock, and where I dined on a rasher of bacon and eggs. The longest day of my life, I shall never forget this fatiguing walk along the heavy shingley coast round Beachy Head; the cliffs were so stupendous and their whiteness so dazzling, it made one dizzy to look upwards from their base in the burning sun.

I may here remark that there are few places in England in which the chalk can be studied with greater advantage, as the venerable Dr. Fitton has observed before me, than along the range of cliffs, beginning at Brighton and terminating to the eastward of the precipices of Beachy Head; all the sub-divisions of the chalk, however, are to be seen between the gap at Cuckmere and a place called Sea-Houses, a short distance beyond Beachy Head. At Beachy Head the upper division of the chalk is to be seen in the form of projecting turret-like masses called "The Charleses," not less than 550 feet above the sea. At the bottom of these cliffs we come upon the dark marley beds, known as the chalk marl, of a bluish grey colour, which were well seen at the end of my walk around Beachy Head. From the top of Beachy Head the view was beautiful and grand, to the right Brighton could be seen as the day was clear, and to the left Folkestone in the distance. The ships and vessels in the offing seemed to be at our feet. A peep over the precipices at this place is rather dangerous, as there is nothing to hold on by; when coming around the coast, I hopped frequently from one mass of chalk to the other, and had my foot slipped I would either have been dashed to pieces or drowned in the sea. Although left till rather late, a bed could not be had in the village of Meads if a hundred pounds had been offered for it, it was my lot therefore to walk on some miles further in the pelting rain and pitch dark, until I came among some Christian people at Eastbourne, where I was accommodated at the Anchor Hotel. Next day I pushed on to Pevensey Castle, 5 miles from Eastbourne, went all through it, sat upon one of the towers musing upon its construction, attributed to the Romans. The towers are six in number, and pretty large, and the outer walls are still in some parts surrounded by an immense fosse. It is an example of a regular old fortress with all its curious appurtenances, of keep, drawbridge, &c., and my curiosity was amply repaid by a visit to it. My course was now pursued uninterruptedly till I arrived at the quiet village of Bexhill, seven miles from Pevensey, with its pretty little Church, built about the year 1100. The desire could not be resisted of passing the night here. A few miles further in the morning completed my journey to Hastings, six miles by road and four by rail. I had a good view of the town from the summit of the east cliff, and afterwards went through the remains of Hastings Castle, situated on the west cliff, the town being principally built in the great valley between these cliffs. I shall not dwell longer upon the many interesting features incident to Hastings and its vicinity, but will merely observe that the Wealden rocks are of some importance here; the rare good fortune attended me of procuring a number of bones, such as a vertebra, a rib imbedded in the solid rock, bones of the feet, and portions of the great thigh bone of the Iguanodon, one of these gigantic crocodile-lizards of the dry land, so well known through the writings of Dr. Mantell. These bones with others were obtained from the weald clay at low tides on the sea shore, and fell into my possession with a number of other choice fossils. My collection had now so accumulated that I returned to Brighton the same evening by railway. In conclusion, I may state that the collections which accrue during my occasional wanderings are becoming very valuable; they are all destined some day to be placed in the museums of Canada."

G.

Notes on Microscopic Literature.

No part of the field of science has within the last few years awakened more interest, or been more fully studied, than those departments of Natural History which require the aid of the Microscope for their full elucidation.

Soirées, Conversationes, and Lectures public and private, having for their subject-matter the "Microscope and its revelations," have become every-day occurrences; and long articles in the Reviews, Magazines, and Newspapers on the same topic, all go to prove how popular the investigation has become.

The instrument itself, both in its mechanical and optical parts, has engaged the attention of able *savans* on both sides of the Atlantic, and in the hands of such workmen as Powell and Ross in London, Spencer and Grunow in America, and Nachet in France, it would appear to be rapidly approaching its limit of perfection.

The beginners' requirements have had special attention. Learned Societies have offered premiums for the best instruments suitable to the wants of students and saleable at a low price. Prize medals have been liberally awarded to preparers of microscopic objects, who now have the rank of a distinct profession accorded to them; and some even confine themselves to one department of the art—that of preparing injections of animal tissues. And a new feature, supplying a manifest want, has lately been perfected in London, as will appear from the following advertisements which we clip from recent British publications:

"Smith & Beck have now completed and opened *The London Microscopical Subscription Room.* Prospectuses to be had on application at No. 6, Coleman-street, London."

"M. Pillischer's *Microscopical Subscription Room*, 88, New Bond-street, opened May 1st, 1856."

"A room has been fitted up with every care for the comfort and convenience of Subscribers, especially as regards light."

"It contains eight Compound Microscopes of various construction, with their respective powers and apparatus; Dissecting Microscopes and Instruments; as well as all the appliances necessary for the examination and preservation of objects, and a Cabinet of upwards of a Thousand Standard Objects, illustrating most of the branches of Microscopic Research, are maintained in perfect order for general reference, as well as the Periodicals and Books of Reference on Microscopical Subjects."

"The Terms of Subscription are Half-a-Guinea per annum, payable in advance, and entitling a Subscriber to introduce a friend."

The Room is open daily from 12 to 6 P.M.; and till 8 P.M. on Tuesdays and Thursdays.

We commend the idea to our only progressive public body—the McGill College—in the hope that its Governors may ere long announce that a "Montreal Microscopical Subscription Room" is opened with an efficient supply of instruments.

Here is another idea worthy of consideration:

"A Course of Evening Demonstrations on Microscopes and Aquaria, by Samuel Higeley, F.G.S., F.C.S., &c. More especially arranged for those about to visit the sea-side or country, and desirous of establishing Marine or Fresh-water Aquaria. The Course also includes MICRO-PHOTOGRAPHY, and will commence on Tuesday, July 8th, at 8 P.M. Fee One Guinea. Prospectuses and Tickets may be had at 43, Piccadilly."

We shall have something to say on Aquaria in an early number.

It is quite impossible for us to give notes on, or even titles of, all the works bearing on this subject which have lately appeared. The following are some of the more important:

Quekett's Lectures on Histology. Delivered at the Royal College of Surgeons of England. Vol. I. Elementary Tissues of Plants and Animals, 8vo., 159 Woodcuts, $1 75. Vol. II. Structure of the Skeletons of Plants and Invertebrate Animals, 8vo., 364 Woodcuts, $4. H. Balliere, New York and London.

A Microscopic Examination of the Water Supplied to the Inhabitants of London and the Suburban Districts. By Arthur Hill Hassall, M.B., F.L.S. 8vo., Coloured Plates. 2s. 6d. Lond.

The Microscopic Anatomy of the Human Body. By A. H. Hassall. The United States Edition, edited with additions and notes by Henry Vanarsdale, M.D. In 2 vols., 8vo. Vol. I., pp. 560, text. Vol. II., pp. 168, text and 79 Coloured Plates. New York: Pratt, Woodford & Co.

This is a most valuable and able work, the only complete one in the English language with which we are acquainted. This American edition is as good as the English, and has ten additional plates. Dr. Hassall has also written two works on the Adulteration of Food, and the Methods by which such may be detected, among which methods—as may be supposed—the microscope occupies an important place.

Principles of the Anatomy and Physiology of the Vegetable Cell. By Hugo Von Mohl. Translated (with the author's permission) by Arthur Henfrey, F.R.S.; with an Illustrative Plate and numerous Woodcuts; pp. 158, 8vo. London: Van Voorst.

This work deserves especial commendation. It should be in the hands of every student of Physiology.

Microscopic Objects, Animal, Vegetable, and Mineral; with Instructions for Preparing and Viewing them. By Andrew Pritchard. 5s.

A History of Infusorial Animalcules, Living and Fossil. Illustrated by magnified representations, by Andrew Pritchard. A new edition enlarged. 1 vol., 8vo, pp. 704, with 14 Plates; some coloured.

This volume contains a vast amount of information on the Infusoria, but is disfigured and injured by its slovenly arrangement. We notice that the author has lately (1857) announced a new edition in preparation.

Hannover on the Microscope. Translated from the Danish. With Introduction. By John Goodsir, Professor of Anatomy, University of Edinburgh. Edinburgh: Sutherland & Knox.

Gould's Companion to the Microscope. Sixteenth edition, revised and improved. 8vo., plates. 1s. 6d. By H. Gould, Optician. London: Samuel Highley.

The Microscope, in its Special Application to Animal Anatomy and Physiology. By T. H. Huxley, F.R.S., &c., Lecturer on Natural History at the Department of Practical Science.

The Microscope: its History, Construction, and Applications. Illustrated by 500 Drawings of Objects. By James Hogg, M.R.C.S. pp. 440. London: H. Ingram & Co.

The Microscope: its Applications to Clinical Medicine. By Dr. Lionel Beale, Professor of Physiology and Anatomy in King's College, London. 282 Illustrations, and One Chromo-Lithograph. Price 10s. 6d. London: Samuel Highley.

The Microscope in its Special Application to Vegetable Anatomy and Physiology. By Dr. Hermann Schacht. Edited, with the co-operation of the Author, by Frederick Currey, M.A. Second Edition, considerably enlarged. Numerous Woodcuts. Price 6s. London: Samuel Highley.

This author has also written a useful little book entitled "*How to work with the Microscope.*"

The Microscope and its Revelations. By W. B. Carpenter, M.D., F.R.S. With 345 Engravings on Wood; foolscap 8vo., cloth, 12s. 6d. London: John Churchill.

Without giving the author credit for any originality, we are free to state that this work is perhaps the most useful and cheap compilation, which the tyro in Microscopic observation can procure. We however consider, that in view of previous publications, the large space which he has devoted to the history, mechanical construction and accessories of the microscope uncalled for. The American edition, published by Blanchard & Lea, is, we think, superior to the English.

Practical Treatise on the Use of the Microscope: Including the Methods of Preparing and Examining Animal, Vegetable, and Mineral Structures. By John Quekett. Third edition, with 11 Steel and 306 Wood Engravings. 8vo. Price $5. London and New York: H. Balliere.

This work is usually considered a standard. The third edition is enlarged and improved.

The Micrographic Dictionary; A Guide to the Examination and Investigation of the Structure of Microscopic Objects. By J. W. Griffith, M.D., F.L.S., and Arthur Henfrey, F.R.S., F.L.S., &c. Illustrated by 41 Plates and 816 Engravings on Wood. 1 vol., 8vo., pp. 696; or, in 12 Half-Crown Parts. London: John Van Voorst.

This is without doubt the most elaborate and extensive work on general microscopic investigation which has appeared in our language.

A copious introduction (pages x to LX) treats:

I. Of the use of the microscope and the examination of objects.

II. Of the methods of determining structure from—*a*, the *microscopic analysis* of the surface, including—1. the form; 2. the colour; 3. the structure; and 4, the internal structure: *b*, the *histological analysis*: *c*, the *qualitative chemical composition*: and *d*, *the measurement*. The body of the work is arranged alphabetically and each article has numerous Bibliographical citations in which the student is referred to the best and latest works, treating on the specific subject. The authors have given a larger space to Microscopic Botany than to any of the other departments of the science. The plates are tolerably good, and the wood engravings profuse and excellent. We cordially recommend the work as a valuable vade-mecum to the general naturalist, who has not access to an extensive scientific library.

Drops of Water; their marvellous and beautiful Inhabitants displayed by the Microscope, (6 coloured plates; square 16mo; price 7s 6d.; London: Lovell Reeve,) is the title of an elegant and fascinating little volume by Miss Agnes Catlow, well adapted to young folks. Her plates are copied without acknowledgement by a United States writer, a Rev. Joseph Wythes, M.D., in a book entitled "Curiosities of the Microscope." Any one claiming to be a member of both learned professions ought to know better than to act so dishonorable a part.

The British Desmidieæ. By John Ralfs, M.R.C.S.; the Drawings by Edward Tenner, A.L.S. 1 Vol., 8vo.; Pp. 226; with 35 Colored Plates. London: Lovell Reeve.

A Synopsis of the British Diatomaceæ; with Remarks on their structure, functions and distribution; and instructions for collecting and preserving specimens. By Rev. Wm. Smith, F.L.S.; the Plates by Tuffin West. In two volumes, 8vo. Vol. 1, Pp. 89, with 31 plates, some colored, 1853—21s.; Vol. 2, Pp. 107, with 36 plates, some colored, 1856—30s. London: John Van Voorst.

We cordially recommend these two admirable Monographs to the students of Microscopic Botany in Canada. They enter fully into the Habits, Nature, Structure, Reproduction, Classification, Determination and Uses of the Families of which they respectively treat; and are written, descriptions and all, in the English language.

We purpose, from time to time, keeping our readers informed on any new and valuable works which may hereafter be published, and also of such instruments and accessories as may be helpful to microscopic observation. We invite communications from those of them who are original observers, and will be happy to afford such information, advice, or assistance as may at any time be in our power.

SCIENCE AND THE INDUSTRIAL ARTS.

Manufacture of Iron in Great Britain. Little more than one hundred years ago, the quantity of iron made in the kingdom of Great Britain was about twenty-five thousand tons, and at the beginning of this century one hundred and seventy thousand tons. Fifteen years ago this quantity had increased to one and a half millions of tons, and at present the production reaches, or exceeds two and a half millions of tons.

Propeller Shaft Bearings.—An English engineer has originated a novel plan for the construction of plummer blocks, or bearings for shafts, particularly under circumstances where high velocities are required, such as screw propeller shafts. The plan consists in surrounding the journals of the shaft with brass casings. The inner surface of the bearings is grooved, to receive fillets of wood which project beyond the inner surface, like cogs to a wheel, so as to prevent the shaft coming in contact with the metal. Through the spaces formed between the fillets water is allowed to flow freely between the shafts and the bearings, keeping the whole cool, and acting as a lubricator.—Another modification of the invention is to fix the wooden fillets on the shaft, which then rotate with it in the brass bearings. The wood prepared for the purpose is lignumvitæ, which is found so well to withstand friction in machinery.

Lightning Rods Attracting Lightning.—Sir Snow Harris has made a valuable scientific report to Parliament, in which he refutes the fallacy of the unphilosophical assumption that lightning rods "attract" the lightning, and so act as efficient safeguards. It is proved by an extensive induction of facts, and a large generalization in the application of metallic conductors, that metallic substances have not exclusively in themselves any more attractive influence for the agency of lightning than other kinds of common matter; but that, on the contrary, by confining and restraining the electrical discharge within a very narrow limit, the application of a small rod or wire of metal to a given portion of a building is in reality highly objectionable.

Rotary Pump.—A new description of rotary pump has been invented. The machine consists of a cylinder, around the axis of which work four vanes, connected with the axis by rings, after the manner of a compass or rule joint, and having their edges completely in contact with the internal surface of the cylinder. Their middle points are connected by links to four pins or bosses, symmetrically situated on the inner surface of a disc, working in an eccentric recess in the top of a cylinder. The dimensions of the parts being properly adjusted, the effect of this arrangement is to cause the space between any of the vanes to be maximum when they are on that side of the cylinder farthest from the centre of the recess, and minimum when they are on the other side.

Effect of Metals on the Hair.—M. Stanislas Martin has published, in the "Bulletin de Therapeutique," the curious case of a worker in metals, who has wrought in copper only five months, and whose hair, which was lately white, is now of so decided a green that the man cannot appear in the street without immediately becoming the object of general curiosity.—He is perfectly well, his hair alone being affected by the copper, notwithstanding the precautions taken by him to protect it from the action of the metal. Chemical analysis shows that his hair contains a notable quantity of acetate of copper, and that it is to this circumstance it owes its beautiful green color, which is most singular and remarkable.

The Discoverer of Gutta Percha.—The discoverer of this inspissated sap of an Indian tree—now so extensively used in the arts and sciences—was Dr. Montgomerie, of the Indian medical service, and this only in the year 1845, although many of the countries producing the article have been in European occupation for above 300 years. The mode in which the discovery was made is worth mentioning. Dr. M. observing certain Malay knives and kris handles, inquired the nature of the material from which they were made, and from the crude native manufacture inferred at once the extensive uses to which the gutta percha might be put in the arts of Europe. He purchased a quantity of the raw material, sending from Singapore part of it to Bengal and part to

Europe, suggesting some of the uses to which he fancied it might be applied. The quantity sent to England secured to him at once, as the discoverer, the gold medal of the Society of Arts, his sole reward, until the President of the India Board, on no other ground whatever than this discovery, liberally bestowed his patronage on Dr. M's son.

The Comet of 1556, *being popular Replies to every day Questions.* By J. Russell Hind. (Parker & Son.)—We remembered reviewing Mr. Hind's first work on this subject, as long ago as when he had only discovered two planets, or in 1848. He then believed in the identity of the comets of 1264 and 1556, and believed that a third appearance might be expected speedily. Nine years have elapsed, which, considering the effect of perturbation, is no improbable margin for a conjecture to require. It is to be remembered that we have not those accurate accounts of the appearance of 1264, hardly even of 1556, which would enable the astronomer to use the theory of gravitation, as was done with Halley's comet both in the last century and the present. In the meanwhile, much attention has been paid by astronomers to the subject in the last nine years, and this oozing out to the wide world, the wide world made up its mind that it was to be burnt alive, and fixed a day. The day turned out rather cool for the season, and the world consented to live on. Mr. Hind discusses all the questions in a popular manner, gives his account of the preceding appearances, and of some new historical information of the methods of calculating, &c. It seems that the most recent materials and calculations make it probable that the comet will re-appear between 1857 and 1861. Then follow discussions about the possibilities and the effects of a *collision* of a comet with the earth! Why is the word used? Has the astronomer any reason to conclude that the thickest part of a comet bears as much comparison to our earth in solidity as a puff of smoke from a cigar bears to a granite rock? Are not all the presumptions, and those no weak ones, the other way? May not plenty of comets have already found their level in the higher strata of our atmosphere, and may they not be there still? To be afraid of a comet while we are living on an earth the interior of which we can only judge of by what we see at the crater of the volcano, is about as absurd as for the passengers to look at the possible collision of a donkey with the train, while they have a furnace which vomits hot cinders at their head. So far as we know, that is: for those who want fears of the unknown, the comets will do exceedingly well: but earthquakes, the possibility of new volcanoes, &c., should not be entirely neglected; and the theory of epidemics being caused by comet matter falling down from the higher air should be cherished. *Athenaeum.*

Basalt and Tufa.

There is reason to believe that much confusion in geology has resulted from want of careful attention to the distinction of truly molten rocks from consolidated volcanic ashes, which, as in the case of the Palagonites of modern volcanic regions, are often re-consolidated by aqueous infiltration into rocks even harder than those cooled from a state of fusion. An interesting experiment on this subject is quoted in the *Journal* of the Geological Society of London, No. 46. (Expt. by A. Bensch Lunt, and Berne Johr., 1855, p. 597). Basalt (sp. grav. 2.877) was ground in water to fine powder, and allowed to remain for some months in a glass cup. It became a hard stone; in the centre black and waxy, externally less dense and grey. Exposed for some time to air, it exhibited an appearance of carbonate of potash. The specific gravity of the nucleus was 2.1588; that of the external portion 2.423. It is probable that, in this case, hydrated silicates were formed out of the basalt; and it would be interesting to have similar trials made with igneous rocks of known composition, and to compare the results with the actual composition of trappean rocks. D.

Native Copper in Scotland.

The occurrence of native copper in Scotland was noticed in a paper, recently read before the Philosophical Society of Glasgow by J. Bryce, Jr., F. R. S.

"The metal occurs at Barrhead in a state of perfect purity, in the Boylestone quarry, about a quarter of a mile north-west of the railway station. The rock is a coarsely crystalline greenstone, a member of the trap series which forms the Fereneze hill ranges, erupted through, overlying and much altering the lower marine coal series which occurs in that district. Through this rock the metal is irregularly distributed in large thin plates, usually attached firmly to the rock, and also coating its surface in broad films, as if laid on by the electrotype process. It occurs also in large lumps, and in flattened dendritic masses. Its origin was ascribed by Mr. Bryce to the circulation of electric currents through the mass of rock, while passing to the solid state from that of igneous fusion."

The occurrence of the metal in crystalline greenstone is of much interest, especially if not associated with minerals of aqueous origin; and may possibly be a case of the actual igneous origin of native copper, though we should be inclined to suspect that the appearances may be deceptive, and that it may have been introduced after the cooling of the mass. Mr. Bryce quotes Prof. Dawson's Acadian Geology as describing a similar mode of occurrence at Cap D'Or, in Nova Scotia; but in these two cases, though the metal occurs in the crevices of burathe trap, the appearances are by no means conclusive as to its igneous origin. D.

Reptiles in Ireland.

In a notice, in the *Athenæum*, of the last volume of the "Natural History of Ireland," by the late William Thompson, we find the following on the popular belief of the absence of reptiles from the Emerald Isle:

"Of course, every one would expect that an Irishman should discourse on the alleged absence of Reptiles from his native isle. This is partly true; for although the sand lizard is "common in suitable localities," and the eft is "abundant in some localities," and the natterjack is found in Kerry, yet there is not the slightest doubt that where other common British reptiles, as the snake, the frog, and the toad, have been found, they have been introduced. The frog is common enough now, but Stuart, in his 'History of Armagh,' says: "The first frog that was ever seen in this country made its appearance in a pasture-field, near Waterford, about the year 1630. The grandmother of one of Mr. Thompson's friends used to tell "that, when a girl at school (1736), she was taken some distance to see a frog which was exhibited as a show." At one time, the Irish Frog was regarded as a distinct species, but Mr. Thompson, after a careful comparison with English specimens, regards them as identical. The toad appears never to have been introduced into Ireland. It is curious that its first cousin, the natterjack, or running toad, should be found in abundance in Kerry. The Irish people have always a ready explanation of these natural phenomena, and just as they ascribe the freedom of their island from reptiles to the prayers of St. Patrick, so they ascribe the presence of natterjacks in Kerry, as of potatoes, to their having escaped from a ship. Mr. Thompson, however, believes this story, and says, it "is borne out by the fact that it is the only part of Kerry that they are to be met in—a district extending from the sand-hills of Inch and Rosbegh, at the head of the Bay, to Carrignafery, about ten miles in length, of low marshy ground, and about the same number in breadth."

Snakes, vipers, and blind-worms are also absent from Ireland. Many attempts have been made to introduce the ringed snake (*Natrix torquata*), but although there are no evident climatic or terrestrial conditions to prevent their increase, they have from one cause or another speedily perished. The physical conditions of atmosphere and earth-surface that regulate the distribution of species are at present but imperfectly understood; there can, however, be no doubt that such agents have been at work in producing this difference between the fauna of Ireland and England. The flora of Ireland, on the other hand, supplies us with species of plants that flourish there, but have never reached so far north as the most southernmost points of Great Britain. It is one of the sources of value of such books as Mr. Thompson's, that facts like the absence of reptiles from Ireland, are thoroughly investigated, and their true significance ascertained.

D.

The New Metal.—Aluminium begins, it appears, to come into more general use, at least in France. The eagles which surmount the colours of the army, hitherto made of copper, gilt by galvanism, are now made in aluminium, thus lightening the weight of the flag by nearly 2¾ lbs. Aluminium is more sonorous than bronze, and is consequently brought into use for musical instruments. Spoons and forks, drinking cups, &c., have also been formed of it. The weight of the new metal is about one-fourth that of silver. Fine silver being worth 225f. the kilogramme, and aluminium 300f, a piece of the latter, equal in size to a kilogramme of silver, will only be worth 75f., instead of 225f. Thus, an article which in silver would cost 30f., would be only 16f. in aluminium.

The Sun forever in the Meridian.—Professor Sontag, Astronomer to the "Grinnell Expedition," in his narrative, says—"As the land adjacent to the Pole is all *terra incognita*, it is impossible to say what additions to the stores of natural science a visitor to those regions might be able to make. Certain it is however, that a new and wide field would be opened for his investigation

Everything there would be novel ; and that circumstance alone would be well calculated to stimulate his attentive faculties. The difficulties which would present themselves to the investigator may be appreciated at home ; but they would be greater or less, according to circumstances of which we know nothing. We know not, for example, whether the Pole is covered with open water, or icy sea, or dry land ; nor do we know which of these three conditions would be most favorable for investigation. It may be presumed, however, that an open sea would be, in several respects the most disadvantageous. In the first place, it would in all probability be so deep that the ship would be unable to anchor ; and the current might be too strong to permit her to keep stationary long enough to make accurate observations. In the second place, if she could not maintain her position steadily at one point, the commander would experience a new embarrassment, as the meridian must extend southwardly, he would be apt to lose that on which he approached the Pole—and consequently he would be at a loss how to shape his course homeward.

The occurrence of this strange difficulty will naturally present itself as one among many novel phenomena which will arrest the adventurer's attention, and the following observations would probably occur to him on the spot. The time of day (to use that phraseology for want of any other that would be more appropriate) would no longer be marked by any apparent change in the altitude of the sun above the horizon ; because to a spectator at the pole no such change would appear, except to the small amount of the daily change of declination. Thus, not only to the eye, but also for the practical purpose of obtaining the time by astronomical observations, the sun would appear throughout the twenty-four hours neither to rise nor fall, but to describe a circle round the heavens paralled with the horizon. Therefore, the usual mode of ascertaining the time would utterly fail ; and indeed, however startling may be the assertion, it is nevertheless true, that time, or the natural distinction of time, would be no more. This will appear from the consideration that the idea of apparent time refers only to the particular meridian on which an observer happens to be placed ; and is marked or determined only by the distance of the sun, or some other heavenly body, from that meridian. Now, as an observer at the pole is on no one meridian, but is stationed at a point where all meridians meet, it is evident that " apparent time " for him has no existence.

UNIVERSITY OF McGILL COLLEGE.

We are happy to learn that in the present session, the University of McGill College is beginning to realise in enlarged public patronage the results of its active and enlightened efforts in behalf of improved education. The model schools attached to the McGill Normal School, were filled with pupils on the day of opening, and a large number were unable to obtain admission, the ac comm odation afforded by the school being limited to 230 pupils. In the Normal School, there are sixty-two teachers in training, and we are informed that they are of a high grade in education and ability, and that most of them promise to be excellent teachers. The High School Department numbers 242 pupils, a large increase over the last session, and is giving even greater satisfaction to parents than in former years. The Faculty of Arts has raised its number of regular students to 30. In the Medical and Law Faculties, which opened last week, the classes are scarcely fully organised, but will probably reach to 100 students in both. In all about 650 pupils and students of various grades, will, during the present session, be receiving instruction from this institution, in addition to occasional students who may attend particular courses or popular lectures.

The class in Civil Engineering commenced last week. It gives in two sessions a thorough preparation for active work in that profession; and under an act passed in last session of the Legislature, students who have received the college diploma are exempted from two years of the apprenticeship required of provincial land surveyors. In addition to this advantage they attend lectures in Geology, also required by law as a qualification for land surveyors. No young man intending to enter on the engineering or surveying profession should neglect the educational and other advantages thus offered.

The University is constantly adding to its library, museum and apparatus. An electrical apparatus of the largest size has been procured and will be used in the lectures of this session. The important collection of insects formed by Mr. Couper, of Toronto, has been acquired for the museum, where it will form a worthy companion to those of Dr. Holmes in Mineralogy and Botany, and to the varied collection in other departments of natural history, constantly increasing under the care of the Principal. The collections of Dr. Holmes and Mr. Couper being of some historical interest in relation to natural science in Canada, it is intended to keep them distinct from other parts of the cabinet, under the names of their respective collectors. It is much to be desired that these treasures in natural science could be more securely lodged than in a building constantly in use for purposes of instruction. We would earnestly recommend to the consideration of any man of wealth desirous of erecting a monument to his own memory, and at the same time of aiding the progress of science, the erection of a fire-proof library and museum in connection with the University. As the University gives every reasonable facility of reference to its collections, such a building might be available for the secure keeping of other literary and scientific valuables beside those which are its property.—*Montreal Witness.*

MEETINGS OF THE NATURAL HISTORY SOCIETY.

It has been resolved that in the meetings of the present winter the business of the Society will be dispatched before 8 P.M., and that immediately after that hour the reading of scientific papers and discussions thereon will be commenced. The first paper of the series will be read by Principal Dawson at the Meeting of Monday November 30. At the following meetings on the last Monday of each month, papers are expected from Mr. Billings, Rev. Mr. Kemp, Professor Barnston, M.D., Sir W. E. Logan, Mr. D. Urbain, Professor Hunt, Professor Hall, M.D., and Mr. Poe. It is probable that several other papers will be read, and the meetings will assume an interesting and scientific character, and will be largely attended. A course of popular lectures is also being organised, and will be commenced in January.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF AUGUST, 1857.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29·569	29·533	29·655	62·7	66·0	60·6	·528	·516	·511	·93	·80	·93
2	614	620	798	60·0	76·7	65·6	·512	·692	·586	·93	·78	·93
3	734	700	898	62·2	81·0	68·8	·528	·739	·634	·93	·71	·90
4	754	712	698	66·1	87·7	70·6	·574	·814	·541	·89	·65	·74
5	643	700	726	63·2	87·9	62·5	·461	·801	·499	·29	·62	·89
6	812	835	949	59 6	86·0	59·0	·478	·648	·452	·90	·53	·89
7	967	915	999	56·5	88·1	68·0	·488	·692	·582	·89	·53	·85
8	848	749	891	64·4	83·0	64·0	·565	·715	·476	·93	·64	·79
9	980	970	846	55·6	72·5	58·0	·552	·498	·437	·79	·64	·89
10	685	552	491	58·0	79·2	64·2	·462	·659	·565	·90	·67	·63
11	857	468	596	62·0	70·3	62·6	·528	·541	·499	·93	·74	·89
12	696	700	724	48·1	78·0	64·0	·334	·607	·504	·93	·64	·84
13	676	612	446	63·0	70·0	63·0	·546	·659	·546	·94	·89	·94
14	417	524	551	67·0	84·0	67·3	·626	·854	·593	·93	·74	·89
15	641	714	830	65·0	76·0	58·0	·529	·659	·437	·85	·74	·89
16	858	778	30·005	55 0	71·0	57·2	·372	·559	·376	·84	·74	·76
17	811	746	29·688	48·7	68·0	49·6	·366	·552	·226	·92	·81	·88
18	813	741	764	47·0	72·0	54·7	·313	·578	·373	·92	·74	·87
19	800	714	817	47·0	74·1	57·1	·313	·648	·398	·93	·78	·84
20	806	672	856	67·4	73·0	58·9	·447	·692	·478	·94	·86	·92
21	917	915	954	61·0	76·6	60·6	·520	·597	·441	·96	·67	·84
22	817	720	666	55·6	72·1	61·0	·418	·578	·483	·93	·74	·89
23	517	358	404	57·4	71·6	61·0	·447	·681	·512	·93	·89	·96
24	527	511	783	53·2	63·5	51·1	·361	·546	·337	·87	·93	·87
25	928	868	992	55·0	78·7	65·0	·396	·670	·555	·89	·71	·89
26	925	900	883	37·0	79·7	65·5	·449	·692	·555	·94	·71	·89
27	880	786	614	64·0	86·0	70·1	·365	·910	·628	·93	·75	·86
28	377	344	485	65·0	79·9	68·0	·589	·692	·613	·93	·71	·89
29	504	521	624	66·0	68·0	60·0	·514	·590	·467	·89	·86	·89
30	681	679	746	48·2	66·6	60·7	·312	·440	·467	·86	·68	·89
31	817	883	30·052	60·1	73·6	50·6	·441	·568	·349	·84	·71	·92

	Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	S. W.	W. S. W.	S. W. by S.	7·22	2·96	1·11	0·540		Cirr. Str. 10.	Nimb. 10.	Cirr. St. 2. Thunder.
2	S. W. by W.	S. W. by W.	S. W. by W.	0·22	1·42	2·16	Inapp.		" 7.	C. C. Str. 6.	C. C. St. 2.
3	S. E.	S. by E.	S. E. by E.	0·12	0·18	0·40			Clear.	C. Str. 4.	C. Str. 3.
4	S. S. W.	S. S. W.	N. N. W.	0 00	0·35	0·30			"	" 2.	" 10.
5	N. by E.	N. by E.	N. W. by W.	6·57	3·06	4·65			C. Str. 10.	" 2.	Clear,
6	E. N. E.	E. by N.	S. E.	3·16	2·08	0·10			Clear.	Clear.	"
7	S. S. W.	S. W.	S. by E.	0·48	0·43	0·10			"	"	C. Str. 2.
8	S. by W.	W. S. W.	W. N. W.	0·66	7·21	8·77			C. C. Str. 10.	C. Str. 9.	Clear.
9	W.	N. E.	S. S. W.	9·75	4·87	0·21			Clear.	Clear.	Str. 2.
10	S. S. E.	S. by E.	S. W. by S.	0·00	1·90	1·16	Inapp.		C. C. Str. 6.	C. C. Str. 8.	Cum. St. 10. Dis. Thunder
11	W.	N. W.	N. by W.	1·30	6·31	3·90	0·274		C. Str. 10.	C. Str. 4.	" 6. "
12	W. by S.	S. S. W.	S. E.	0·36	6·40	2·60			Clear.	Clear.	" 2.
13	S. S. E.	N. E.	N. E.	3·71	1·40	1·42	1·079		C. Str. 10.	C. Str. 9.	" 10.
14	W. by S.	W. N. W.	W. N. W.	1·05	5·50	9·65			" 10.	" 6.	Clear.
15	N. by W.	W. N. W.	. W. by W.	0·21	5·63	8·27			" 6.	Clear.	"
16	W. by N.	W. by S.	W.	6·40	9·52	5·93			Clear.	Str. 2.	C. Str. 8.
17	N.	N. E. by E.	W. by N.	0·20	3·17	4·12			C. C. Str. 6.	Clear.	Cirr. Str. 4.
18	N. E. by E.	N. E.	N. E.	1·00	0·69	0·86			" 4.	C. C. Str. 8.	Clear.
19	S.	S.	S. by E.	1·32	1·15	1·25			C. Str. 2.	C. Str. 10.	Nimb. 10.
20	N. E.	S. W.	W. S. W.	2·11	0 37	1·40	1·200		Str. 10.	" 6.	C. Str. 2.
21	S. W. by S.	S. E.	S. by E.	0·13	0·17	0·86			C, Str. 8.	C. C. Str. 4.	Clear.
22	S. S. E.	S. by E.	S. E.	1·28	5·91	9·51	Inapp.		C. Str. 10.	Cirr. Str. 6.	C. Str. 10.
23	E. S. E.	S. by E.	S. S. W.	8·61	8·25	0·82	0·473		Cirr. 4.	4.	Clear.
24	W.	W. N. W.	S. W. by W.	7·78	10·55	9·43	Inapp.		C. Str. 6.	C. C. Str. 6.	"
25	W. by S.	S. W.	S. W.	6·05	3·27	3·70			Clear.	Clear.	"
26	S. S. W.	S. S. W.	S. S. W.	1·63	4·52	5·06			"	"	Clear. Aurora Borealis.
27	S. S. E.	S. S. E.	S. by E.	6·02	0·63	9·30			"	C. C. Str. 2.	C. St. 10.
28	S. by E.	S. W.	S. S. W.	22·25	7·10	8·66	1·023		C. Str. 10.	C. Str. 10.	" 4.
29	S. W. by S.	W.	N. W.	2·18	7·63	4·65	Inapp.		" 4.	" 8.	C. C. St. 8.
30	W. by S.	W. by S.	W. S. W.	1·96	9·81	7·07			" 10.	Clear.	C. St. 4.
31	W. by N.	S. S. E.	S. E.	11·75	3·70	·81			" 8.	C. Str. 4.	Clear.

REPORT FOR THE MONTH OF SEPTEMBER, 1857.

	Barometer			Temperature of the Air			Tension of Aqueous Vapour			Humidity of the Atmosphere		
	6 a. m.	2p. m.	10 p. m	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	30·061	30·019	30·090	46·9	85·7	68·2	·282	·763	·582	·86	·65	·85
2	049	29·974	093	62·0	88·4	70·0	·472	·801	·628	·84	·62	·86
3	099	30·076	083	60·7	88·6	62·5	·511	·801	·546	·93	·62	·92
4	081	076	003	63·5	91·4	68·2	·526	·814	·646	·89	·59	·93
5	29·861	29·701	29·691	69·8	81·2	65·7	·668	·704	·605	·92	·68	·93
6	987	935	30·031	51·2	63·3	46·6	·315	·307	·282	·81	·53	·86
7	30·160	30·135	179	48·4	66·3	48·0	·281	·440	·502	·80	·68	·86
8	158	035	29·959	54·0	69·1	60·9	·304	·437	·456	·89	·62	·84
9	29·961	29·883	905	58·2	69·0	62·4	·462	·570	·472	·92	·81	·84
10	857	671	598	60·4	81·6	73·0	·494	·739	·692	·91	·71	·86
11	451	806	925	7·00	58·0	54·6	·628	·437	·400	·86	·89	·92
12	912	814	766	48·0	58·7	52·0	·302	·389	·349	·86	·79	·87
13	764	609	745	48·1	84·8	69·0	·281	·854	·634	·80	·75	·90
14	747	712	604	65·7	77·9	66·1	·586	·787	·605	·92	·86	·92
15	680	722	900	59·5	67·5	52·9	·452	·490	·373	·89	·72	·92
16	952	885	946	46·2	67·9	53·0	·282	·563	·361	·86	·85	·87
17	599	453	531	41·5	56·7	52·7	·235	·432	·386	·85	·94	·93
18	635	975	981	45·4	35·5	33·1	·253	·203	·187	·80	·91	·90
19	968	908	892	34·2	58·1	42·0	·170	·367	·243	·79	·75	·85
20	694	715	901	44·0	50·9	41·7	·241	·326	·263	·79	·87	·92
21	980	970	999	37·7	57·8	42·9	·218	·422	·263	·91	·89	·92
22	847	704	581	44·7	50·5	49·2	·261	·349	·336	·85	·90	·93
23	500	494	604	40·2	51·4	44·9	·227	·255	·261	·85	·66	·85
24	686	712	810	44·1	67·3	5·66	·282	·534	·432	·92	·81	·94
25	852	819	835	48·0	80·5	59·0	·291	·751	·432	·84	·75	·89
26	861	992	954	57·1	72·5	5·41	·422	·450	·349	·89	·58	·81
27	897	762	718	51·2	76·6	63·2	·361	·692	·516	·92	·78	·89
28	574	580	583	57·0	51·7	48·0	·447	·315	·324	·94	·81	·92
29	754	759	852	39·0	47·0	36·0	·214	·271	·192	·84	·80	·83
30	868	840	857	34·0	52·0	38·2	·186	·274	·226	·87	·70	·90

	Direction of Wind			Mean Velocity in Miles per hour			Amo'nt of Rain in inches	Amo'nt of Snow in inches	Weather, Clouds, Remarks, &c.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2. p. m.	10 p. m.
1	S. W.	S. W.	S. W..	0·20	5·61	3·06			Clear.	Clear.	Clear.
2	S. W.	S. S. W.	S. by W.	1·46	1·72	0·30			"	"	Cirr. Str. 2.
3	S. by W.	S. by W.	S. by W.	0·46	0·17	0·35			Str. 2.	"	Clear. Aurora Borealis.
4	S. by W.	S. S. E.	S. S. E.	0·15	0·05	0·00			Clear.	"	Cirri. 2.
5	S.	S. W.	W. N. W.	0·00	6·16	10·11	1·001		"	C. Str. 9.	C. Str. 8. Thunder storm.
6	N. W.	N. W.	N. W.	10·15	17·77	8·30			Str. 1.	Str. 2.	Clear.
7	N. W.	S. W.	S.	1·26	0·63	0·73			Clear and Frost.	" 1.	"
8	W.	W. S. W.	S. W.	0·15	4·99	5·33			C. Str. 8.	C. Cirr. 4.	C. Str. 9. Thunder.
9	W. by S.	N. W.	E. S. E.	4·50	1·20	0·21	0·140		" 6.	C. Str. 10.	Clear, Lightning.
10	E. N. E.	W. by S.	W. S. W.	0·26	15·22	3·96	0·133		" 10.	Clear.	Clear, Aurora Borealis.
11	W. by S.	N. E. by E.	E. by N.	5·00	10·20	0·96	0·104		" 3.	Rain.	C. Str. 8.
12	N. E. by E.	N. E.	N. E.	6·78	8·12	12·05			" 9.	C. Str. 8.	" 10.
13	S. E. by E.	S. S. W.	S. E. by E.	1·62	0·12	0·82			Clear.	Clear.	C. C. Str. 4.
14	S. S. E.	S. S. E.	S. S. E.	0·10	1·21	4·08	0.330		C. Str. 8.	C. Str. 2.	C. Str. 8. Lightning.
15	W.	N. N. W.	N. W. by W	12·42	16·50	2·00			" 6.	" 2.	Clear.
16	N.	S. by W.	W. S. W.	10·96	1·61	2·67			Clear.	" 4.	C. C. Str. 4.
17	N. W.	W. S. W.	W. S. W,	0·22	0·10	0·35	0·140		"	Rain.	C. Str. 9.
18	S, by E.	N. W.	N. W.	0·92	18·77	3·77			C. Str. 10.	Clear.	Clear.
19	E.	E. S. E.	E.	6·57	0·47	0·08			Clear.	C. C. Str. 8.	"
20	E.	N.	S. W. by W.	1·97	6·15	1·70	0·210		Rain.	C. Str. 4.	"
21	S. S. E.	E. by W.	E. by S.	0·00	0·50	0·07			Clear.	" 2.	"
22	S. by E.	S. by E.	S. S. E.	0·86	2·27	10·32	0·720		C. Str. 7.	Nim. 10.	Rain.
23	W. by N.	W. by N.	W. S. W.	13·87	19·48	9·42	0·170		Clear.	C. Str. 2.	Clear. Aurora Borealis.
24	S. W.	W. by S.	S. W.	7·80	8·26	4·33			"	" 2.	"
25	S.	W. S. W.	S. by W.	0·98	5·89	1·22			"	Clear.	" " "
26	S. W.	W.	W. S. W.	1·52	6·90	3·71			"	"	"
27	S. by W.	[illegible] S.	S. by W.	0·35	3·82	7·00			"	"	" Lightning.
28	S. W. by S.	S. W.	S. W.	4·22	1·62	10·47	1·053		C. Str. 10.	Rain, Thunder.	C. Str. 9.
29	W. N. W.	W. by N.	W.	19·32	15·67	11·32			Clear.	C. Str. 6.	Clear.
30	W. N. W.	S. W.	S. W. by S.	1·90	4·80	2·71	0·170		"	" 8.	C. Str. 6.

REMARKS FOR AUGUST, 1857.

Barometer. Highest, the 31st day, 30·052 inches. Lowest, the 28th day, 29·344 ". Monthly Mean, 29·723 inches. Monthly Range, 0·608 ".

Thermometer. Highest, the 7th day, 90°4. Lowest, the 25th day, —45°2. Monthly Mean, 65°07. Monthly Range, 45°2.

Greatest intensity of the Sun's rays, 120°0.
Lowest point of Terrestrial radiation, —41°4.
Mean of Humidity, ·848.

Amount of Evaporation, 2·84 inches.
Rain fell on 11 days, amounting to 4·580 inches; it was raining 43 hours and 10 minutes, and was accompanied by Thunder on 3 days.
Most prevalent wind, S. W. Least prevalent wind, E. by N.
Most windy day, the 28th day; mean miles per hour, 12·45.
Least windy day, the 3rd day; miles per hour, 0·23.
The Electrical state of the Atmosphere has indicated rather feeble intensity.
Ozone was in large quantity.
Aurora Borealis visible on 1 night.

REMARKS FOR SEPTEMBER, 1857.

Barometer. Highest, the 7th day, 30·179 inches. Lowest, the 23rd day, 29·494 ". Monthly Mean, 29·842 inches. Monthly Range, 0·685 ".

Thermometer. Highest, the 4th day, 91°4. Lowest, the 19th day, 30°4. Monthly Mean, 57°47. Monthly Range, 61°0.

Greatest intensity of the Sun's rays, 121°2.
Lowest point of Terrestrial radiation, 29°8.
Mean of Humidity, 823.
Amount of Evaporation, 2·48 inches.

Rain fell on 11 days, amounting to 4·171 inches; it was raining 45 hours and 4 minutes, and was accompanied by Thunder on 3 days.
A few flakes of Snow fell on the 29th day, being the first this season.
Most prevalent wind, the W. S. W. Least prevalent wind, the N.
Most windy day, the 29th day; mean miles per hour, 15·43.
Least windy day, the 21st day; mean miles per hour, 0·19.
The Electrical state of the atmosphere has indicated rather high intensity.
Ozone was in moderate quantity.
Aurora Borealis visible on 5 nights.
First Frost on the 7th day.