and drainage areas for the Rhone, Po, Danube, and Uruguay are taken from a paper by John Murray in the *Scottish Geographical Magazine* for February, 1887. The drainage area of the Nile was measured by planimeter from the best maps obtainable.

Discharge and Sediment of Large Rivers.

River.	Drainage Area, square miles.	Mean Annual Discharge, second-feet.	Sediment.				Authority.
			Total Annual Tons.	Ratio by Weight.	Height column 1 square mile base, feet.	Depth over Drainage Area, inches.	
Potomac	11,(43	20,16	5,557,250	1:3575	4.0	.00433	
Mississippi [1]	1,214,000	610,000	406,250,000	1:1500	291 4	.00288	Humphreys and Abbot
Rio Grande [2]	30,000	1,700	3,830,000	1:291	2 8	.00110	U. S. Geological Survey
Uruguay	[3] 150,000	[3] 150,000	14,782,500	[5] 1:10,000	10.6	.00085	J J. Revy
Rhone	[3] 34,800	[3] 65,850	[4] 36,000,000	1:1775	31.1	.01071	J. Barois
Po	[3] 27,100	[3] 62,200	[4] 67,000,000	1:900	59.0	.01139	"
Danube	[3] 320,300	[3] 315,2 0	[4] 108,00 ,000	1:2880	93.2	.00354	"
Nile	1,100,000	[7] 113,000	[4] 54,000,000	1:2050	38.8	.00042	"
Irrawaddy [6]	125,000	475,000	291,430,000	1:1610	209.0	.02005	R. Gordon

GLACIATION IN PENNSYLVANIA.

BY EDWARD H. WILLIAMS, JR., LEHIGH UNIVERSITY, SO. BETHLEHEM, PA.

Owing to the difference of opinion regarding glaciation in this vicinity, I have taken the subject for the out-door work of the post-graduates in the mining course, during the past few months, as their geological survey, and I make now a preliminary statement of what has been found, without theorizing upon it in any way, as the work is to be continued and extended to adjoining regions.

The Lehigh University is situated on the north slope of what is called The South Mountain, or the Durham and Reading Hills, immediately back of South Bethlehem, Pa. The crest of the same varies from 325 to over 900 feet above tide, at the point mentioned. This is above the reach of glacial deposits by floating ice. To the north lies the great valley bounded by the Blue Ridge, and just north of this is a lower ridge of Oriskany sandstone in a vertical position. The nearest portion of this sandstone is therefore beyond the Blue Ridge. As the rocks of this ridge are mainly barren, while the Oriskany sandstone carries the usual fossils, this formation was taken as a test-rock, owing to the fact that the rock called Potsdam sandstone sometimes weathers so as to greatly resemble rocks of other formations.

Professor Salisbury stated that he had found glaciated stones 500 feet above the Lehigh River, on the mountain back of the University, and adduced that fact to refute the statement of Professor Wright, that the ice failed to come as far south as Bethlehem. The height of the point noted was proof that the specimen had not been brought by water, and that the ice-sheet had extended across the great valley. From this was deduced the idea that there had been two periods of glaciation, and that the one marked by the terminal moraine north of us, was the later of the two.

To the south of that part of the mountain back of the University, lies a land-locked valley, so that there was no drainage southward, except at high levels, during the time when the bowlder clay was deposited and therefore there would be no current to divert icebergs into that valley and cause a universal distribution of that clay, as there is to the north of the South Mountain.

The preliminary work shows that Oriskany pebbles and bowlders are found at all altitudes over this mountain, and the great majority of the smaller ones lie in a clay, which may be due to the decomposition of the gneiss of the mountain; but which exists on the top of the highest part of the ridge. These have been traced into the Saucon Valley to the south as far as a line running from Friedensville to the second railroad cut south of Bingen. South of that line we find the clays from the subjacent limestones generally free from foreign stones, as far south as Centre Valley, the southern part of the survey. North of that line we have found four lines of glaciated material. In the valleys these run across all the formations from gneiss to limestone, in lines generally parallel, and with a freedom of glaciated material except in the lowest parts, where ice may have been present. Oriskany bowlders are found of considerable size, and in some parts abundantly. Only one of these lines has been traced fully, and that runs from the north of Bingen and at an elevation of about 300 A. T., across the Saucon Creek and Valley, and, passing south of Seidersville, has been followed to the summit of a hill west of the latter place, and at an elevation of 720 A. T.

It is comparatively easy to trace these lines, as the farms are provided with wooden and wire fences, except where these lines exist, and there the fences are of stone heaps, and the soil is stony. Digging under these lines shows that they are resting on rock in some cases, and on soil in others.

It may be said that the ice went over the South Mountain. In this case there has since been a great disintegration of the gneiss, as the cuttings for the South Bethlehem reservoir show 25 feet of rotten rock in some places. It may be said that these are evidences of a older glaciation; but this older intrusion followed exactly the lines of the later one, as can be seen by running a line from the points in New Jersey noted by Professor Salisbury (Pattenburg, etc.) to Seidersville, Pa., so that the advocates of a single period can say that this was a sudden intrusion for a short period followed by rapid retreat for twenty miles.

This work is not sufficiently extended to furnish data for theorizing, and it will be extended in the future; but attention is called to the fact that here exists a good field for observation, as the rocks of the country (gneiss quartzite and limestone) cause intrusive rocks from the Blue Ridge to be very prominent.

INFLUENCE OF PARASITES ON OTHER INSECTS.

BY G. C. DAVIS, AGRICULTURAL COLLEGE, MICH.

From a philantrophic standpoint, it seems cruel to see one class of insects preying upon another. The eager female parasite is so vigilant in her search that one would think a subject of her search could not escape till it had reached maturity; yet strategy, mimicry, offensive odor, hairy and other coverings, and many other peculiar and interesting methods of protection help to shield and protect the invader from its insidious foe till out of danger. In watching the ups and downs of the two from year to year, about the only effect that is noticeable is that the parasite generally holds the balance of power, though usually the balance is well equipoised.

Viewed from an economic and practical side, the practice loses its cruel aspect and is encouraged and fostered in many ways, as it means an inexpensive control of many of our common pests. There is little doubt but parasites do much more good than we are wont to give them credit for. In a large share of the cases of parasitism, about so many individuals of a species are parasitized each season, and the number left remains too small to produce serious damage. On the other hand, if the species had no parasite to contend with, it would soon be numerous enough to be a dreaded pest.

Very often certain species do appear in greatly increased num-

[1] "Report upon the Physics and Hydraulics of the Mississippi River," by A. A. Humphreys and H. L. Abbot, Philadelphia, 1861, p. 149.

[2] "Eleventh Annual Report U. S. Geological Survey," Washington, 1891, Part II., p. 57.

[3] Scottish Geographical Magazine, February, 1887, p. 76.

[4] "Irrigation in Egypt," by J. Barois, translated by Major A. M. Miller, Washington, 1889, p. 18.

[5] "Hydraulics of Great Rivers," by J. J. Revy, New York, 1874, p. 135.

[6] "Report on the Irrawaddy River," by R. Gordon, Rangoon, 1880, Part III. p. 25.

[7] Special Consular Reports, House of Representatives, 51st Congress, 2d Session, Ex. Doc. 45, Part I., p. 259.

bers, and cause widespread consternation. No doubt climatic and other influences have much to do with these sudden up-risings, as we find species that are known to be parasitized but very little, which fluctuate in numbers greatly with different seasons. All the effect, then, cannot be attributed to parasites.

The difference between the work of parasites and other influences, is quite marked and distinct in certain channels, and can be easily traced. The tendency of parasites is to increase or decrease in numbers as the host is numerous or scarce. A few years ago the wheat aphis was so numerous over the wheat plants that it threatened to destroy the whole crop in this region. Presently certain of the aphis looked brown and swelled, which told plainly that the parasites were there too. The wheat grew and headed. Still the aphis increased by the thousands daily, and the parasites increased in numbers also. Then there came a time when the parasites were in the majority, and, before the wheat-heads had ripened, a live aphis was a scarce and hard thing to find. The next year the wheat aphis was not common, and what did appear were disposed of early by the parasites.

Sometimes the work of the parasites is not as prompt as the instance just cited. For illustration, the oak army worm, *Edema albifrons*, was never known to be numerous enough to greatly injure the oak till two years ago, when the species came in such numbers as to strip whole forests of their foliage. Of the several hundred caterpillars and pupæ collected, only one pupa was parasitized. Last year the trees were again stripped by countless numbers as the year before, but from the pupæ collected, about every one in ten was parasitized. Probably this year the caterpillars will be less numerous, and by next will be scarse, because of the work of parasites.

An ideal parasite is one that would keep its host in such camplete subjection that no outbreak would occur, and the numbers not great enough to do any harm. While the effect of parasitism is not ideal in every respect, it nevertheless is a boon to economic entomology, and has already been used to good advantage, by introducing many foreign parasites that are known to work on certain species. As we become still more familiar with these parasites and their hosts, much more good, through parasitic species will undoubtedly result.

EARTHQUAKES IN AUSTRALASIA.— II.

BY GEORGE HOGBEN, M.A., SECRETARY OF THE SEISMOLOGICAL COMMITTEE OF THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In my former communication I explained the nature of the work that the Seismological Committee of the A. A. A. S. proposes to do anent earthquakes. In the present contribution I shall endeavor to sketch briefly what has already been done for New Zealand earthquakes.

The committee has published two reports, 1891 and 1892. The former was drawn up by Sir James Hector, F.R.S., and deals with New Zealand earthquakes to the end of the year 1890. It contains a list of earthquakes (537) felt in New Zealand from the earliest settled times, and gives interesting details concerning the somewhat severe shocks of October, 1848, and January, 1855. The last-named is notable as being one of the few in any country in which movement of the land has been actually observed by skilled observers on the spot. Captain Drury, R.N., was engaged at the time on the nautical survey of the New Zealand coast, and, being in the neighborhood of the land raised, was able by actual re-measurement to confirm the general impression. "An area of 4,600 miles was estimated to have been raised from one foot to nine feet, the greatest elevation being on the west side of the Wairarapa Valley, the vicinity of Porroria Harbor not being affected, and the west side of Cloudy Bay, north of Blenheim, having actually been depressed to the extent of five feet." (Transactions, A. A. A. S., 1891, p. 522). The elevation has been permanent. The same report (1891) contained a map by Sir James Hector, showing the seismic areas, principal fault and earthquake-rents in the islands of New Zealand. The division into seismic areas is not, however, based upon the determination of the earthquake origins, and, in the opinion of the present writer, is on that account misleading. At the same meeting of the Australasian Association (Jan., 1891), I read a paper on New Zealand Earthquakes, which contained a somewhat larger list (775) than the report of the committee, together with two maps and a diagram showing curves of monthly seismic frequency, the New Zealand curve based upon the records of 745 shocks being compared with Mallet's curves for the Northern and Southern Hemispheres — 5,879 and 223 earthquakes, respectively — (See Milne on Earthquakes, p. 256). The record for New Zealand shows a maximum of frequency in September, with smaller maxima in January and March, and minima in April and October, November, December. The inclusion of these facts might modify Mallet's curve for the Southern Hemisphere, but it does not appear that they point to any connection between earthquake-frequency and the season of the year.

One of the maps exhibited showed, by shading, the earthquake-frequency of the shocks in various parts of New Zealand, the region most effected being a portion of Cook Strait, included in the triangle Wellington, Blenheim, Wanganui; the next shade of frequency includes Christchurch, the next, Nelson. There is an isolated district of local earthquakes round Rotorua and Tarawera. On my other map were marked the epicentra of 35 earthquakes for which the data were sufficient to ascertain them with any degree of probability, and I have since been able to determine more or less exactly the origins of a few of the earthquakes of 1891–1892. The two chief sources are situated —(1) 10 miles north of Lake Sumner, or about 80 miles north-northwest of Christchurch. Hence proceeded the shock which on the 1st of September, 1888, threw down the upper portion of the spire of Christchurch cathedral. To the same origin I am able definitely to assign 10 other shocks, and probably many more belong to it. (2) 45-50 miles north-northwest of Wellington, in Cook Strait. This and some other origins near it are accountable for most of the New Zealand shocks, the average intensity being very low, III.— IV., on the Rossi-Forel scale.

The method used for finding the origins has been, in general, founded on the observed times of the shock at the several places at which it was felt, with the help of the isoseismals, when the effects were sufficiently definite to assign the degree of intensity on the Rossi-Forel scale.

One somewhat striking point in connection with all the recent earthquakes in New Zealand, is the low velocity of propagation they possess (less, with one exception, than 20 miles a minute). At first this made me doubt the correctness of the calculations, but the large number of shocks for which the velocity can now be approximately ascertained renders the results tolerably certain. In the solitary exception (an earthquake of the present year, which I am still investigating) the velocity is probably between 45 and 55 miles per minute. The depth of the origin has not been found in many cases, but in those for which the solution of the equations is most satisfactory, the depth is in each case about 24 or 25 miles below the surface.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Some Recently Discovered Trilobites with Appendages.

THE past winter the Geological Department of Columbia College came into possession of some extremely interesting specimens of *Triarthrus Beckii*, which were discovered by Mr. W. S. Valiant, now of Rutgers College, in the Utica shales at Rome, N.Y. They were entrusted to W. D. Matthew, our fellow in geology, for complete description, and Mr. Matthew's paper, recently read before the New York Academy of Sciences, will appear in the Transactions of the Academy for May. Owing to the unavoidable delay in their issue, and because the subject is such an interesting one, this preliminary announcement is made. The Trilobites possess two undoubted antennæ that come out together