raine (the immediate 'fringe' in the western part of the state excepted) was made because of certain statements to the contrary quite recently made by a distinguished authority. It was made only after a thorough investigation of every locality supposed to be glaciated.

In conclusion, I may be permitted to say that while, owing to the necessarily limited length of a public lecture, the rocks of Philadelphia could not be so fully treated of as the superficial formations, this latter — and in this region more debatable — subject will form the topic of future lectures, which may perhaps be worthy of further comment by my friendly critic. HENRY CARVILL LEWIS.

Philadelphia, Sept. 7, 1883.

The pre-Cambrian rocks of Wales.

Those who are interested in the questions raised by Dr. Henry Hicks in his criticism of Professor Geikie in SCIENCE for Aug. 10, may find it to their advantage to consult my paper entitled 'History of some pre-Cambrian rocks in Europe and America,' which appeared in the *American journal of science* for April, 1880 (vol. xix. p. 268–283). I had the good fortune, in 1878, to spend several days with Dr. Hicks, in going over the typical localities previously studied by him, not only at and near St. Davids in South Wales, but also those of Carnarvon, Dinorwic, and Anglesea, Messrs. Tosell and Tawney being our companions, in North Wales. As a result of these studies, I am satisfied that the views of Messrs. Hicks and Hughes are correct, and their criticisms of Professor Geikie well founded.

The Dimetian, alike in North and South Wales and in Anglesea, has both the lithogical characters and the stratigraphical relations of the Laurentian of North America. The Arvonian corresponds in like manner to the great series of *hälleflintas* or petrosilex rocks, jaspery and porphyritic, whose distribution on the coast of Massachusetts and of New Brunswick, in the Blue Ridge of Pennsylvania, in Missouri, and on Lake Superior, I have studied and elsewhere discussed (*Second geol. surv. Penn.*, rep. E, p. 189–195). Similar rocks have also been described by Irving in the Baraboo river in central Wisconsin, a locality which I have lately had an opportunity of examining. The conglomerates of Arvonian pebbles, which form the basal beds of the Cambrian near Snowdon, are indistinguishable from those found at Marblehead and elsewhere on our eastern coast, lying on or near the Arvonian.

The Pebidian of Hicks is our typical Huronian, as seen in eastern Canada and around the lakes Huron and Superior. Professor Bonney, who has lately received a collection of these, is struck with their complete resemblance to the Welsh Pebidian which I had seen and called Huronian thirteen years since. The succeeding gneisses and mica-schists (upper Pebidian or Grampian of Hicks, and Caledonian of Callaway), which are our Montalban series, are not met with in Wales, but appear not only in Scotland, but, as I have pointed out, across the channel, in the Dublin and Wicklow hills in Ireland.

The similar succession in the Alps, I have described in a late paper, of which an abstract appeared in SCIENCE for Sept. 7 (p. 322). The student who compares the succession of stratified crystalline rocks alike in North America, in the British Islands, and in southern Europe, can scarcely fail to recognize, in their constant stratigraphical and lithological relations, something like a 'universal law.'

T. STERRY HUNT.

Montreal, Sept. 11, 1883.

SERGEANT FINLEY'S TORNADO STUDIES.

Report on the character of six hundred tornadoes. Professional papers of the signal service, No. vii. By J. P. FINLEY, Washington, *Signal service*, 1882. 19 p., 3 maps, 4°.

Tornadoes: Their special characteristics and dangers. By J. P. FINLEY. Kansas City, 1882. 30 p.

So striking a phenomenon as a tornado, and one so destructive in its effects, would naturally receive much attention; yet, curiously enough, the competent treatment which these storms have received is remarkably inadequate. Those omniscient gentlemen, the reporters of the newspapers, have written much about tornadoes, and many columns of our summer dailies are filled with accounts of them; but, aside from the books of Peltier and Reye, the scientific literature is fragmentary. Half a century ago, at the time of the battle between Reid, Redfield, Piddington, Espy, Hare, and others, over the rotatory theory of storms, the tornado-literature took a considerable development; but it soon fell to small dimensions, and here it has remained until quite recently. The present activity in this field is largely due to the signal service, and Sergeant Finley's contributions form an important part of the current literature.

Mr. Finley's specialty is the collection of facts concerning tornadoes. He has accounts of individual tornadoes in many of the annual reports of the chief signal officer. They represent the facts collected by him on the field of destruction itself. They are evidently gotten together with great care; measurements are made when practicable, and explanatory maps and sketches are numerous. His evident object is to put before the reader the accurate representation of what he saw, encumbered as little as possible by explanatory theories. The result is that his reports are interesting reading, and afford a mine of wealth for the future Kepler of tornadoes.

Not quite so important, perhaps, from a scientific point of view, but of far more general interest, is his report. Its principal feature is the tabulation of the tornadoes discussed, with headings for time, dimensions, velocity, clouds, and other meteorological features. These are summed up, and from the results are drawn various interesting conclusions concerning maxima, minima, and averages.

Mr. Finley's search for accounts of tornadoes has been extensive; but as he has unfortunately given no references, we cannot tell how extensive it may have been. Evidently he has not gone through the Proceedings of the Amer-

ican association for the advancement of science, or he would have found the tornado of Aug. 9, 1851, in Connecticut, recorded, and that of May 3, 1868, at Shanghai, Ill. Nor has he searched through the state agricultural reports, where he would have found that of June 3, 1860, in Illinois, and doubtless others. Again, Niles's American register gives one at Keene, N.H., on July 25, 1807, and at Knoxville, Tenn., on May 25, 1808. The Philosophical transactions would have yielded him one in New England, July 10, 1760; and several others could have been picked up in Blodgett, Piddington, and in the *American journal of science*. Even that of May 22, 1873, in Illinois and Iowa, reported in the publications of his service for 1873, seems to have escaped his attention.

As average results like those deduced by Mr. Finley depend for their value on the number of individual cases taken into consideration, would it not have been wise for him to have collated those occurring in other countries, so far as they were accessible without difficulty? Peltier would have yielded him quite a crop, some of which, by the way, come curiously near home. Other text-books would have given other European ones; and Chinese and African ones have been described, the latter frequently. Tornadoes are by no means exclusively American; and by a comparison with those in the other countries their essential features could be more easily sifted out, and the incidental ones given their proper prominence.

In the pamphlet, 'Tornadoes, their special characteristics and dangers,' the author classifies the rotatory storms. It was in the pursuit of a classification of storms, that he first had his attention called to the insufficiency of our knowledge of this species. Tornadoes are here described in some detail, and numerous directions given for the protection of life and property on their occurrence. It is the best description of the storm known to the writer.

Mr. Finley considers the tornado a much better-defined species than is likely to be acknowledged by meteorologists generally. Right names are extremely useful, but we must not permit them to conceal any underlying unity. By his anxiety to get a clear species, the author shuts out the light which he might get from the study of storms of so similar character that one is compelled to believe that their differences are due only to difference in surroundings. Thus water-spouts are only tornadoes on the water, with circumstances remarkably favorable for observation. They occur not infrequently on the Great Lakes, and the change from tornado to water-spout has been observed more than once. Judging from the only description known to me of the riband storms of British North America (*Cosmos*, 2d series, iii. 274, 275), they are also somewhat modified tornadoes. And while the name cloudburst refers rather to a single feature of subordinate meteorological importance, the phenomenon is probably often of tornado character. Indeed, leaving out of account eddies, which it is not, the tornado differs only quantitatively from the other members of that list of storms which begins with the formation of a cumulus cloud, passes on to thunderstorms and hailstorms, and culminates in the 'low-centre,' the hurricane, and the typhoon. They all find their origin in the transformations of water; and to overlook the relations they have to each other, is to refuse assistance in a problem well-nigh insoluble with that assistance.

It is expressly stated (see p. 4 of the last-mentioned pamphlet), that the gyratory motion is always from right to left. The writer would point out the exceeding difficulties which surround the determination of this point. Some of the early observers saw only indications of a radial inpour, and in the descriptions of tornadoes one frequently finds dextral whirls mentioned. In so small a storm, the earth's rotation would surely have no appreciable disturbing effect; and that, in a difference of latitude of only a few rods, it should originate velocities of a hundred or more miles an hour, is so unlikely that it need hardly be considered. Furthermore on p. 7 the author admits variations in the gyration of the tornado's other self, — the water-spout. So, while unwilling to differ from so experienced an observer on such a point, both the records and general considerations lead the writer to think that the direction of gyration may be indifferently dextral or sinistral.

There is one possible feature of tornadoes which has not yet been definitely proven, but of which we ought now to be able to ascertain the truth or falseness by an investigation like that just discussed; viz., Are tornadoes disposed to return on the same path? The writer spent his childhood in northern Illinois, where heavy hail and other tornado-like storms are not rare. He remembers several instances of their following the exact path of their predecessors. Professor Whitfield (*Amer. journ. sc.*, 3d series, ii. 99) says in regard to southern tornadoes, "It is not an established fact, but it is commonly believed, and with some reason, that the tornado does, in the course of years, return along its beaten path, and that

it is unsafe to build where one has ever passed. The house in Pickens county stood on a hill from which a log-cabin had been blown away some thirty years before. I witnessed the last of three, which have passed along the same track. Near Hernando, Miss., three have followed an unvarying line." He suggests that some places are more favorable than others for the production of these storms, which would make them of a more local character than Mr. Finley would be willing to admit.

While Mr. Finley's work, like that of all others, is capable of improvement, the writer believes he has done great service to this branch of science, and deserves the sincere gratitude of both the student of science and the resident in tornado districts. In enabling him to pursue his investigations, the signal service deserves the commendation of the scientific and general public.

ZIEGLER'S PATHOLOGICAL ANATOMY.

A text-book of pathological anatomy and pathogenesis. By ERNST ZIEGLER; translated by Donald McAlister. London, *Macmillan*, 1883. 360 p. 8°.

THIS book is a translation, from the German, of a portion of Professor Ziegler's work on pathological anatomy, which appeared two years ago. The work is not as yet completed in German, nor does the translation contain all that has yet been published, covering only the ground of general pathological anatomy.

Professor Ziegler is a young man who has already gained distinction in Germany by his original investigations in connection with tuberculosis and certain of the processes involved in inflammation.

The scope of the present work is to afford to students and physicians a text-book which shall give a short and concise statement of what is known upon the subjects treated, including the results of the most recent investigations.

The book opens with a section of three chapters on malformations. This is condensed and dry; and further, as there are no plates to illustrate the monstrosities, the student wishing to acquire a knowledge of this difficult subject will do better to fall back upon the earlier monographs of I. G. St. Hilaire, Foerster, and Ahlfeld.

Then follow four chapters on the pathology of the blood and lymph, which, though short, are very good, containing essentially what is known upon the subject. Very little space is devoted to thrombosis and embolism; but this is not a neglect on Ziegler's part, as he treats of it in detail in that portion of the book which has not yet been translated.

The succeeding chapters on the retrograde disturbances of nutrition are worthy of much praise, giving as they do a very clear, though concise, account of these changes, including also the results of the latest work on coagulation-necrosis.

The chapter on cysts, consisting of but a single page, is incomplete, and does not treat with sufficient fulness this important subject.

The three chapters devoted to hyperplasia, regeneration, and metaplasia of tissues, give a good account of the somewhat meagre knowledge on these points.

In treating of inflammation, the author gives a short historical sketch of the ideas held at various times upon the conditions present in this process, and then devotes considerable space to the ideas now in vogue, as expressed by Cohnheim, Samuel, and others; the exudation from the vessels, due to presumable changes in the vessel-wall, now forming the anatomical basis. The parenchymatous inflammations of Virchow find no place in the category, nor will Ziegler allow that the connective-tissue corpuscles take any part in the process, as advanced by Virchow, and still maintained by von Recklinghausen.

The secondary changes occurring in the products of an inflammation are well treated; a point in regard to which Ziegler has himself contributed some original work.

The infective granulomata are removed from the category of tumors, and are classed with the inflammations. Under this head are considered tubercle, syphilis, leprosy, glanders, lupus, and actinomycosis.

The anatomy of tubercle and its development are fully and well treated, and the relation of the Bacillus tuberculosis to the disease detailed so far as the present knowledge permits.

Virchow's classification of tumors is adopted, with the exception, as already stated, of the omission of the granulation-tumors. In reference to the aetiology of tumors, the author does not regard Cohnheim's embryonic-foci theory as sufficient to explain all cases, though undoubtedly applicable to many.

Of the increasing importance of the subject of parasites in relation to disease, no better proof is to be found than in the greater number of pages devoted to this point in the newer books; and among the parasites the Schizomycetes claim the lion's share of attention.

The author gives Cohn's classification of the latter, together with a description of their gen-