The above table showed that the rainfall and sun-spots were, with a single exception, both below or above their respective means in the same years, and it would be seen that as the one increased or decreased, so did the other.

The *separate* results for Europe, America, India, and the stations in the Southern Hemisphere were similar. Those for Europe, for example, derived from observations taken at ninety nine stations, were as follows:

Years of mean cycle.	Rain variation.	Spot variation.
	in.	
1	− 0·7	− 37·2
2	− 1·7	− 22·8
3	− 0·6	+ 4·4
4	+ 0·8	+ 33·0
5	+ 1·2	+ 43·8
6	+ 1·8	+ 32·9
7	+ 1·7	+ 14·3
8	+ 1·4	− 2·9
9	− 0·3	− 16·6
10	− 1·1	− 24·7
11	− 0·1	− 24·0

Similar results were obtained by taking the sun-spot cycles *separately*. Those for the cycle 1856–67, were as follows:—

Years of cycle.	Rain variation.	Spot variation.
	in.	
1	− 2·2	− 39·7
2	− 1·8	− 39·9
3	− 0·8	− 16·9
4	+ 0·9	+ 24·3
5	+ 1·9	+ 56·9
6	+ 2·5	+ 57·6
7	+ 2·0	+ 38·1
8	+ 0·6	+ 12·4
9	+ 1·0	− 13·9
10	− 1·5	− 34·1
11	− 0·4	− 45·0

The observations at many single stations, when treated by themselves, gave similar results. Those for Edinburgh and Bombay from 1824 to 1867, and for the Cape of Good Hope from 1843 to 1867, were as follows:—

Years of mean cycle.	Rain variation.			Spot variation.
	Edinburgh.	Bombay.	Cape.	
	inch.	inch.	inch.	
1	− 2·8	− 9·0	− 2·3	− 37·2
2	− 1·8	− 5·8	− 2·2	− 22·8
3	+ 0·7	+ 1·3	+ 0·4	+ 4·4
4	+ 2·4	+ 7·3	+ 3·1	+ 33·0
5	+ 3·3	+ 3·5	+ 2·6	+ 43·8
6	+ 2·8	+ 2·4	+ 3·2	+ 32·9
7	+ 0·5	+ 3·8	+ 4·3	+ 14·3
8	− 0·4	+ 0·7	+ 0·8	− 2·9
9	− 1·0	− 1·9	− 2·8	− 16·6
10	− 2·5	− 0·3	− 3·9	− 24·7
11	− 1·7	− 1·9	− 3·3	− 24·0

It had also been found that the levels of the principal rivers of Europe, and those of the great American lakes, had on the whole varied with the amount of sun-spots.

Such were a few of the results for the four sun-spot cycles from 1824 to 1867. Now it was important to remark that the evidence had increased as the rainfall observations had increased. Hence, with the large number of observing stations now spread over the world, it was inferred that a few more sun-spot cycles would settle the question of a corresponding rainfall cycle, if it was not settled already.

Another way of testing the matter in a comparatively short time was to compare, as far as possible, the daily, weekly, or monthly rainfall of the globe with the sun's-spotted area; for the amount of sun-spots varied much in the course of a year.

The results for the sun-spot cycle which commenced in 1867, and which probably was now closing, were not yet fully known, but there was reason to believe that they would be similar to those obtained for former cycles. It could already be stated that a mean of a large number of observations made in all parts of the world showed that the rainfall in the years 1870–72 had been greater than that in the years 1865–67, and judging from the severe droughts that had occurred in India, China, Japan, Australia, South Africa, South America, &c., since 1876, it was not improbable that the rainfall of the last three years had been less than that of the years 1870–72. In 1877 and 1878 the Nile, at Cairo, was lower than it had been for many years, showing that in the regions drained by it there had been a deficiency of rain. There had also of late years been a gradual decrease in the depth of water in the upper portions of the Amazon, so that navigation had sometimes been impeded, and this was supposed to be due to a general diminution of rainfall in the interior of South America. Moreover, various parts of the United States had lately been suffering from drought.

It would appear, then, that the circumstance that the rainfall of Paris had for a long period been greater in the years of maximum than of minimum sun-spots, was not a mere coincidence, but the result of a general law, and a similar remark applied to the rainfalls of many other public observatories.

There were, as might be expected in the case of so fickle an element as the rain, great local exceptions to the general law, though not greater or more frequent than exceptions to the general laws of other cycles; but, as far as had yet been ascertained, the rainfall of the globe varied directly as the sun-spots varied, the deficiency at some places in the maximum years being more than made up by the excess at others, and the excess in the minimum years reduced by a proportionately greater deficiency elsewhere.

Great fluctuations occurred near the epochs of maximum and minimum, but at a large majority of stations the rainfall in the three years of most sun-spots was almost invariably greater than that in the three years of fewest sun-spots.

The general rainfall cycle for the whole globe might be conceived to be made up of a number of local cycles differing more or less among themselves and from the general cycle, according to local conditions, and in some places the general cycle might be reversed.

From this point of view, it was possible that, although the recent rainy weather in Western Europe, at a time when there were few or no sun-spots, was a deviation from the general law, yet it was not an exception to the particular modification of it which prevailed in that part of the world. As a matter of fact, the rainfall of Western Europe was considerably above the average in 1844–45, 1845–55, and 1866–67, that is at intervals the mean length of which was eleven years, and at times when there were few sun-spots. But Western Europe was only a small part of the earth's surface; and from such a deviation, it could not be inferred that the rainfall, *generally*, was above the average in the minimum years.

In Mauritius there had been continuous observations only since 1852. Since that time the rainfall had on the whole been considerably less in the minimum than in the maximum years, but it would take some time to eliminate the effects of local causes.

SCIENTIFIC SERIALS

Zeitschrift für wissenschaftliche Zoologie, 33 Bd., 1 and 2 Heft, October 29, with seventeen plates.—F. E. Schulze, researches upon the structure and the development of the sponges; eighth notice.—On the genus Hircinia of Nardo, and on Oligoceras, a new genus, Plates 1 to 4. The genus of Nardo equals Stematumenia of Bowerbank; Sarcotragus, O. Schmidt; Filifera, Lieberkühn; and Polytherses of Duchassaing and Michelotti. The structure of the filaments—algæ of some authors—is fully discussed. The new genus Oligoceras is established for a new species (collective) from Lesina, which, though a fibrous sponge, is almost destitute of fibrous material—Prof. E. Selenka, on the germ lamellæ and the arrangement of the organs in the Echinidæ, Plates 5 and 7.—Prof. A. Weismann, Contributions to the natural history of the Daphnidæ, No. 6 and 7, with Plates 8 to 13.—Prof. P. Langerhans, on the worm fauna of Madeira, with Plates 14 to 17.

Gegenbaur's morphologisches Jahrbuch, 5 Bd., 4 Heft.—Reinhold Hensel, on the homologies and varieties of the teeth formulæ of some mammals—Carl Rabl, on the development of the embryo in Planorbis, with Plates 32 to 38, and woodcuts.—A. Rauber on the formation of form and the disturbance thereof during the development of the vertebrata, first section, introductory remarks, Plates 39 to 41.

Cosmos, November.—Prof. O. Caspari, Darwinism and philosophy, with respect to the homonymous writings of Gustav Teichmüller, of Dorpat.—Baron Dellingshausen, the metaphysical foundation for the mechanical theory of warmth.—Dr. Wernich, on dying and on being killed in the lower forms of life.—Dr. Speyer, protective resemblance in some native insects (end) with woodcuts, communicated by Dr. Fritz Müller.—On Christian Conrad Sprengel; being sketches by two of his pupils.—Smaller contributions literary and critical.

Revue Internationale des Sciences, November 15, contains:—M. Vulpian, introduction to the physiological study of poisons.—Prof. Donders, on science and the art of medicine, being the introductory address to the International Congress of Physicians held this year at Amsterdam; this admirable address will well repay perusal.—M. Villot, the experimental method and the positive limits of natural history.—F. Lataste and R. Blanchard, on the peritoneum in Seba's python.—M. Hallez, on the classification and on the phylogeny of the turbellarians.—Proceedings of the Anthropological Society of Paris.—Bibliographical Bulletin.

SOCIETIES AND ACADEMIES

London

Royal Society, November 27.—"On the Changes in Pepsin-forming Glands during Secretion," by J. N. Langley, M.A., Fellow of Trinity College, Cambridge, and H. Sewall, B.Sc., Fellow of the Johns Hopkins University, Baltimore, U.S.A. Communicated by Prof. Michael Foster, M.D., F.R.S.

The Œsophageal Glands of the Frog.—In a frog three to four days after food, the alveoli of the œsophageal glands are, in the living state, granular throughout. The outlines of the cells are not visible.

Shortly after food is given, the granules thin away at the peripheries of the alveoli, and thus render the alveolar outlines more obvious. This thinning proceeds so rapidly that in a few hours there is a well-marked clear zone in the outer part of each alveolus, the part nearest the basement membrane.

Later the clear zone becomes larger, the granular zone becoming smaller, but as the clear zone enlarges it ceases to form in section a ring, it dips down into the granular zone at intervals.

Nuclei are not seen either in the resting or the digesting gland.

The points mentioned above as observable in the fresh tissue, can also in the main be observed in glands treated with osmic acid; the border granules, however, stain more deeply and readily than the central granules. The mucous cells are fewer in the active than in the resting glands; it is only in the fresh state that they appear granular.

The granules we consider as stored up cell-products, which, on suffering molecular re-arrangement during the secretion, give rise amongst other substances to the proteid ferment.

We cannot agree with Nussbaum's view that the depth o staining with osmic acid is a trustworthy index of the amount of ferment present in the cells. On his view, it appears to us, the border, rather than the central, granules should be connected with the ferment.

The Gastric Glands of the Newt (*Triton tæniatus*).—In the newt, the glands were observed through the muscular coat of the stomach with a rapid capillary circulation still going on.

Twenty-four hours after feeding, the glands of the fundus are thickly granular throughout; about three hours after feeding, the maximal change takes place; it corresponds in the main to that already described for the œsophageal glands of the frog.

The glands recover their granular appearance comparatively quickly; in six hours after feeding, the granules have usually again crept up to the periphery; they then increase in number throughout the cells up to about the twenty-fourth hour. Later than this they diminish somewhat; in six days the peripheries of the glands have become more sparsely populated.

In *Triton cristatus* the digestive changes are of the same nature, but much less pronounced.

The Gastric Glands of Stickleback.—In the gastric glands of the hungry fish the granules thin away somewhat from the centre to the periphery; the lumina are inconspicuous. Three to five hours after feeding, the lumina are much larger, the granules are aggregated about it, leaving a peripheral clear rim, the glands are more unequal in size, some having lost more granules and diminished more in size than others.

The Gastric Glands of Mammals.—In the glands of the fundus of the stomach of all mammals investigated, viz., dog, cat, rat, and rabbit, the chief cells are, in rest, crowded with conspicuous granules; the border cells are either without conspicuous granules or are finely granular.

During digestion the granules in the chief cells diminish.

The stomach of the rabbit has certain structural peculiarities; the principal of these is that a large portion of the greater curvature contains glands, in which the chief cells are not coarsely granular. The glands of the greater curvature contain scarcely more pepsin than the glands of the smaller curvature and pylorus. But in the smaller curvature and pylorus there are few if any border cells, whilst there are many in the greater curvature.

Hence the border cells are not directly connected with the formation of pepsin.

The glands of the fundus contain a very much larger amount of pepsin than the glands of the greater curvature; that is, where there are coarsely granular chief cells there is a large amount of ferment.

Further, during digestion the fundus-glands contain less ferment than in hunger—a fact observed first by Grützner—and it is during digestion that the chief cells have fewest granules.

Hence the conspicuous granules in the chief cells are directly connected with the formation of ferment.

Since in passing from the fundus to the greater curvature we meet all stages of granularity in the chief cells, and since the chief cells of the greater curvature do not differ in any essential point from the pyloric gland cells, we conclude with Heidenhain that the pyloric gland cells and the chief-cells of the fundus are fundamentally the same. We consider, however, the chief cells of the fundus to be a highly differentiated form of the pyloric gland cells, a form more especially designed for the production of pepsin, and probably other solids of the gastric secretion.

December 11.—"Thermo-Electric Behaviour of Aqueous Solutions with Mercurial Electrodes," by G. Gore, LL.D., F.R.S.

In this research the author has examined, by means of a new form of apparatus, the thermo-electric properties of a number of liquids in relation to mercury. The liquids include those of acid, neutral, and alkaline reaction. The results obtained are arranged in a table or series, with the solution at the top, in which hot mercury was the most positive at 180° F., and that at the bottom, in which it was most negative, the amount of deflection of the galvanometer needle with each solution being stated.

Another table is also given, in which the solutions are arranged according to the relative degrees of electro-motive force of the currents obtained from them. This series was arrived at by employing two similar apparatus with different solutions in each and ascertaining the difference of strength of their currents by passing the two currents simultaneously in opposite directions through the coils of a differential galvanometer, the amount of difference of deflection produced by each two consecutive pairs being given.

The results obtained from this research have not revealed any very striking phenomena nor disclosed any relation to chemical action or property, but are reasonably explicable upon the hypothesis that the rise of temperature of the liquid is attended by a change of molecular arrangement of the solution, of such a kind as to enable a portion of heat to be converted into an electric current.

The most peculiar phenomenon observed was, that if a solution of a salt, made with distilled water freed from dissolved air, was divided into two equal parts, one of which had been heated and cooled without loss of water or other constituent, previous to making an experiment, the non-preheated portion gave a stronger current than the other, probably in consequence of a change of molecular arrangement of the solution produced by the heating. The method may therefore be employed for detecting molecular differences in conducting liquids having the same chemical composition.

In the class of cases in which the differences of molecular arrangement were the least and the currents the most feeble, the