the Greenland coast, and a foot and a half along its opposite margin, and in consequence of this slope proceeds several degrees into the Strait. But as Baffin's Bay and Davis Strait, as has been said before, are traversed by a polar current descending towards the south-east, it ought to have an inclination in that direction; and it is on this account that the current from the east coast of Greenland, after advancing for some time into Davis Strait, is forced to run westwards towards the coast of Labrador, along which it then flows southwards after joining the current from Baffin's Bay. The two united polar currents, whose delivery may be estimated at 1,200,000,000 cubic feet per second, have a breadth of fifty miles, a speed of $\frac{5}{6}$ of a foot per second, and a depth of about 250 fathoms. They flow to the south-east, under the influence of the earth's rotation, which raises them towards the coasts of Labrador and Newfoundland, and continue their course along the latter towards the Gulf Stream until they have doubled Cape Race, when they bend westward and make for Florida.

If now we return to the warm current which, from the Gulf Stream, curves round the south of Iceland, and then spreads itself gradually over the cold waters of the Atlantic, we see that on its arrival at the south point of Greenland, it rises from left to right, from the Gulf Stream to Cape Farewell, about 2¼ feet, which shows clearly that its course is really to the south. Moreover, this elevation from left to right enables us to give a more satisfactory account of the conditions of currents. In short, the western margin of the warm current accompanying the polar current, ought, along the latter, to have a depth of 1,000 feet and a speed of $\frac{3}{4}$ of a foot; and as the speed of the current diminishes regularly in approaching the Gulf Stream, and as all the parts of the current follow, as far as Cape Farewell, a direction nearly parallel, it follows that the speed along the Gulf Stream ought to be at the rate of about ½ a foot per second. But if the returning branch of the Gulf Stream proceeds to the south-west with a fall of ½ a foot on its west border, it follows that the depth of the current ought to be 76 feet. By determining in the same way the depth for a certain number of points of a transverse section, and by calculating according to these data the total delivery of the current, we find that it is raised to 410,000,000 cubic feet per second, which perfectly accords with the result which we ought to obtain. If next we inquire how the various parts of the warm surface current move under the united action of the slope and the earth's rotation, we ascertain that this current ought to follow the course of the polar current which gradually absorbs the waters that penetrate underneath, the water of the current being more dense than that of the polar current, and we find at the same time that in thus flowing towards the polar current the water ought to spread itself all over the Atlantic as far as Newfoundland.

After having thus shown that the preceding theory accounts in a tolerably complete manner for all the movements of the ocean currents, I shall add, in conclusion, that it is very possible, considering our imperfect knowledge of the progress of currents, that many details may be very different from those which have been expounded above; but, so far as the main question is concerned, I believe I am entitled to say with confidence that the laws of ocean currents are pretty much those which I have attempted to establish.

That these laws are equally applicable to the atmospheric currents is evident, and it is scarcely necessary to repeat, that in periods when the differences of temperature on the surface of the globe were greater than at present, all these currents were much stronger, and of a nature otherwise very energetic.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for October, 1871. "The origin and distribution of Microzymes (Bacteria) in water, and the circumstances which determine their existence in the tissues and liquids of the living body," by Dr. Burdon Sanderson, F.R.S. This paper is occupied chiefly by details of experiments to determine the conditions which are fatal or favourable to the existence of microzymes in the liquid or gaseous fluids by which we are surrounded, in order to approach one degree nearer to an understanding of their influence on the processes which go on in the living body. After a definition of "microzymes" the author proceeds to their chemical composition and their relation to the media in which they grow. This portion is brief and incomplete. The remainder of the paper is occupied with the experiments, which are grouped under these three sections. (1) Experimental determination of the conditions which govern the development of microzymes in certain organic liquids to be used as tests. Having found in a number of cases that either contact with surfaces which had not been superheated, or the admixture of water which had not been boiled, was the exclusive cause of the growth of microzymes in the experimental liquid, it was inferred that water is the primary source from whence the germinal particles of bacteria are derived whenever they seem to originate spontaneously in organic solutions. A number of experiments were made with different varieties of water in ordinary use, in order to confirm the observations already made, and to ascertain if all waters possess the properties in question in a like degree. These experiments are detailed under the second section (2) Distribution of the Germal Matter of Microzymes in ordinary Water. The results under this head were not deemed satisfactory. (3) Circumstances which determine the existence of microzymes in organic liquids and tissues, that is, whether the tissues and liquids of the living body participate in the zymotic property which exists in water and moist substances. The conclusion drawn from the facts is, that "it has appeared certain that there is no developmental connection between microzymes and torula cells, and that their apparent association is one of mere juxtaposition. Thus fungi are not developed, notwithstanding the presence of microzymes in the same liquid in which, microzymes being absent, but air having access, they appear with the greatest readiness." Finally, the writer is certain that, although air is the main source of what he calls fungus impregnation, as distinguished from impregnation with microzymes, yet the two acts may take place at the same moment, germs of torula being often contained in the same liquid media as the germ particles of microzymes. — "On the Colouring Matter of some Aphides," by H. C. Sorby, F.R.S. — "Observations and Experiments on the Red Blood Corpuscles, chiefly with regard to the Action of Gases and Vapours," by E. Ray Lankester. — "On Undulina, the type of a new group of Infusoria," by E. Ray Lankester. — "On the Circulation in the wings of *Blatta Orientalis* and other Insects, and on a new method of injecting the vessels of insects," by H. N. Moseley. After describing the method adopted for preparing and fixing the wings of insects for examination of the circulation, the writer proceeds to his experiences with the cockroach. The corpuscles in *Blatta* are so large that the circulation may readily be seen with a high power of a simple dissecting microscope. If an insect be carefully tied, the circulation may be observed in action for as long as twelve hours. Abundance of parasites were found in the blood vessels of *Blatta* and coleopterous insects. The method recommended for the injection of the circulatory system of insects is through the largest artery on the front border of the wing, and the injecting fluid is indigo carmine. — "On the production of Spores in the Radiolaria," by Prof. L. Cienkowski; translated from vol. vii., part 4, of the "Archiv. für Mikroskop. Anatomie." The observations on which this paper is based were mainly made upon Collosphæra and Collozoum. The capsule is the source of the zoospores. In the mature capsule the contents break up into a quantity of little spheroids. — "On the Peripheral Distribution of non-medullated Nerve-fibres," by E. Klein. The writer purposes treating of the nerves of the cornea, those of the nictitating membrane of the frog, of the canal in the tail of the rabbit, and of the mesentery. The present communication is confined to the nerves of the cornea, the remaining subjects are to be embodied in a second paper.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Nov. 22. — The Rev. Thomas Wiltshire, M.A., in the chair. Mr. Samuel Baillie Coxon was elected a Fellow of the Society. The following communications were read:—1. "Notes on some Fossils from the Devonian Rocks of the Witzenberg Flats, Cape Colony." By Prof. T. Rupert Jones, F.G.S. In this paper the author noticed some Devonian fossils like those of the Bokkeveld, found on Mr. Louw's farm on the Witzenberg Flats, Tulbagh. *Orthoceras vittatum*, Sandberger, was added to the South African list of fossils. The fossils under notice were stated by the author to help to substantiate the late Dr. Rubidge's view, that the old schists termed "Silurian" by Bain are of Devonian age, and continuous across the colony. Their presence in the Witzenberg Flats was also

shown to be conclusive against the idea of coal-measures being found there. Mr. Godwin-Austen remarked that the presumed Devonian species of South Africa appeared not to have been completely identified with those of European origin. Although, judging from the range of European marine mollusca, some of which were found of precisely the same species both in Europe and at the Cape, there was nothing surprising in the extension of any old deposit, yet it seemed unreasonable to suppose that the whole district over which the wide-spread Devonian rocks extend could have been submerged at the same time. He traced the original foundation of the Devonian system to the late Mr. Lonsdale, who, in the fossils found in the deposits of Devonshire, thought he traced sufficient grounds for a marked discrimination between those beds and those of Carboniferous age. Mr. Austen had, however, always regarded the Devonian system as merely an older member of the Carboniferous, holding much the same relation to it as the Neocomian to the Cretaceous; and he would be glad to see it recognised, not as an independent system, but merely as the introduction of that far more important system, the Carboniferous, during the deposit of which the globe was subject to the same physiographical conditions. Mr. Etheridge did not agree with Mr. Austen as to the suppression of the name of Devonian system, and commented on its wide-spread distribution, and on the peculiar facies of its fossils, and their importance as a group. He was rather doubtful as to specific determinations arrived at from casts. Though the species of many fossils of Queensland procured by Mr. Daintree did not correspond with those of European areas, yet some of the corals were identical with those of South and North Devon, as were also the lithological characters of the containing beds. Mr. Seeley objected to any attempt to supersede the arrangements of the South African rocks in accordance with the local phenomena, by correlating them too closely with any European series. The recognition of the correspondence in forms seemed to him more to prove a similarity of conditions of life than any absolute synchronism. As to the connection between the Devonian and Carboniferous systems, he agreed with Mr. Austen in regarding the one as merely constituting the natural base of the other. 2. "On the Geology of Fernando Noronha (S. lat. 3° 50′, W. long. 32° 50′)." By Alexander Rattray, M.D. (Edin.), Surgeon R.N. Communicated by Prof. Huxley, F.R.S. The author described the general geological structure of Fernando Noronha and the smaller islands which form a group with it. The surface-rock was described as a coarse conglomerate, composed of rounded basaltic boulders and pebbles, in a hard, dark red, clayey matrix. This overlies a hard, dark, fine-grained basalt, which forms the most striking of the bluffs, cliffs, and outlying rocks. The highest peaks in the group consist of a fine-grained, light grey granite. The author remarked upon the possible relation of the geology of these islands to that of the neighbouring continent of South America, and stated that there is evidence of the islands having been elevated to some extent at a comparatively recent period. 3. "Note on some Ichthyosaurian Remains from Kimmeridge Bay, Dorset." By Mr. J. W. Hulke, F.R.S. The author noticed some teeth found, with a portion of an Ichthyosaurian skull, in the Kimmeridge clay of Dorsetshire. The fragments of the snout were said to indicate that it was about three feet long and proportionally stout. The author indicated the character by which these teeth were distinguishable from those of various known species of *Ichthyosaurus*, and stated that they approached most closely to those of the Cretaceous *I. campylodon*. Mr. Seeley did not consider that, in the main, the teeth of Reptilia afforded any criteria for specific determination. In the Cambridge Greensand, though there were five species of *Ichthyosaurus*, possibly including a second genus, the teeth found were so closely similar that it would have been impossible, from them only, to identify more than one species. Mr. Boyd Dawkins recognised in the specimens exhibited by Mr. Hulke a form of tooth he had found in the Kimmeridge beds of Shotover, near Oxford, but which he had been hitherto unable to attribute to any recognised species. He could not fully agree with Mr. Seeley as to the absence of specific criteria in the teeth of Saurians, as, from his own experience, he was inclined to attribute some importance to their external sculpturing. 4. "Appendix to a 'Note on a New and Undescribed Wealden Vertebra,' read 9th February, 1870, and published in the Quarterly Journal for August in that year." By Mr. J. W. Hulke, F.R.S. The author generically identified this vertebra with *Ornithopsis*, Seeley, *Streptospondylus*, Owen, and *Cetiosaurus*, Owen, taking the last to be typified by the large species in the Oxford Museum. He remarked that if this be the type of *Cetiosaurus*, *C. brevis*, Owen, can hardly belong to it, as the trunk vertebræ are described as being of a totally different structure. Mr. Boyd Dawkins, who had recently visited Oxford, stated that he had there examined the remains referred to. There was, however, no tooth found with them of a character to show the nature of the food on which the animal subsisted. But one of his students had lately found in the same pit that had afforded the remains, a tooth corresponding in its principal characters with those of *Iguanodon*, with which, therefore, the *Cetiosaurus* seemed to be allied, so that it was probably a vegetable feeder. Mr. J. Parker had lately procured from the Kimmeridge clay a number of Saurian remains, and among them were some vertebræ of *Megalosaurus*, to which were articulated others presenting distinctly the characters of *Streptospondylus*. He thought that probably many of the supposed Streptospondylian vertebræ might prove to belong to the cervical region of Dinosaurians. Mr. Seeley disputed the attribution to *Cetiosaurus* of the vertebræ described, and questioned whether the remains at Oxford might not be assigned to *Streptospondylus* or *Ornithopsis*. The depressions in the vertebræ, which might be connected with the extension of the air-cells of the lungs, did not exist in *Cetiosaurus*, but were to be found in *Megalosaurus*. As to the premaxillary tooth mentioned by Mr. Dawkins, he was uncertain whether it should be referred to what he considered as *Cetiosaurus* proper, or to the Oxford reptile. Mr. Hulke replied, pointing out that, since the determination of the Oxford reptile as *Cetiosaurus*, numerous other remains of the same species had been discovered, which had added materially to the basis of classification.—The following specimens were exhibited to the meeting:—Devonian fossils from the Witzenberg; exhibited by Professor T. R. Jones, F.G.S., in illustration of his paper. Specimens of Silver Ores from South America; exhibited by Professor Tennant, F.G.S. Fragment of the Wolf Rock, near the Land's End, and section under polarised light; exhibited by Mr. Frank Clarkson, F.G.S.

Royal Geographical Society, November 27.—Major-Gen. Sir H. C. Rawlinson, K.C.B., president, in the chair.—The President read a letter from Dr. Kirk, of Zanzibar, to the late Sir Roderick Murchison, giving news of a serious outbreak in Unyanyembe, the country lying on the main route to Lake Tanganyika, which is likely to prevent communication with Dr. Livingstone for some time to come. The letter was dated September 25th, and stated that a native chief, having been attacked by a force of Arabs settled in Unyanyembe, had waited his assailants in ambush when returning with their plunder, and had killed many of the principal men. Mr. Stanley, an American gentleman, who was travelling to Lake Tanganyika, and who had charge of letters and stores for Dr. Livingstone, was in the fray, and had been deserted by the Arabs. He had also been ill of fever, and his future plans were uncertain. A report, to which Dr. Kirk attached little credence, had spread in Zanzibar, to the effect that Livingstone and the Arab Mohammed bin Gharib, with whom he had been living, were returning round the south end of Tanganyika, and out of the region of disturbances. Captain R. F. Burton, in commenting upon this letter, informed the meeting that similar affrays between Arab trading parties and the natives had occurred before, and that this unsettled state might continue for two or three years. He thought that Livingstone would find no difficulty in returning by the south of the lake, and that a fearless man like him, speaking the native languages, would be able to pass through the disturbed districts. He had not the slightest misgiving with regard to him.—Captain Burton then read a paper "On the Volcanic Region east of Damascus and the Cave of Umm Nirán." This was a narrative of a hazardous journey of fifteen days, which he had performed in May and June 1871, in company with Mr. C. F. Tyrwhitt Drake, through the Safá Region, the Oriental *Trachon* of the Greek geographers, a wide extent of ancient lava-fields, the hills of which, like little pyramids, dot the eastern horizon, as viewed from Damascus. The danger and difficulty of visiting the many interesting places in this district arose simply from certain petty tribes of Bedouin, descendants of the refractory robbers of the Trachonitis, who dwell in the highlands of the Hauran, under the patronage of the Druses. The worst are the Ghiyás and the Shtáyá, who although they have given hostages, were allowed, during the author's stay at Damascus, to ride the country within three hours of the walls, and to plunder the villages. During one of his excursions a skirmishing party of Ghiyás attacked his party, severely wounding one of his companions. During his journey 120 inscriptions were collected, including three in the Palmyrene dialect. The volcanic outbreak to which the district

owes its singular character the author was inclined to attribute to the epoch when the Eastern Desert, a flat stoneless tract, extending from the Trachonitis to the Euphrates, was a mighty inlet of the Indian Ocean, having its northern limit in the range of limestones and sandstones, the furthest outliers of the Anti-Libanus, upon whose southern and eastern feet Palmyra is built, and which runs eastward to the actual valley of the great river. Mr. Drake took a continuous set of compass bearings during the journey, which had enabled him to draw an excellent map of the region. Mr. W. Giffard Palgrave spoke on the subject of the paper, stating that Captain Burton was the only European who had properly explored El Safá. He had himself explored about two-thirds of the distance, without, however, reaching the cavern of Umm Nirán. His own visit terminated at the southern part of the *El Leja*, the great volcanic district celebrated for the destruction of the Egyptian army in the time of Ibrahim Pacha, when they attacked the Druses in the basaltic labyrinth.—A second paper was read, "On the Geography of Southern Arabia," by the Baron Von Maltzan, which contained interesting elucidations of the physical configuration and tribal distribution of the region north of Aden, compiled by systematic interrogation of Arabs at Aden.

EDINBURGH

Naturalists' Field Club.—The annual business meeting of this club was held on Wednesday, the 29th ult., when Mr. Skerving was elected President and Mr. John Brown Honorary Secretary and Treasurer. A vote of thanks was accorded to Mr. Taylor, the retiring secretary. The club now numbers 87 members; and 13 excursions have been made to places of local interest during the summer months.

PARIS

Academy of Sciences, November 27.—M. Chasles presented a theorem concerning the harmonic axes of the geometrical curves, in which there are two series of points corresponding anharmonically on a unicursal curve.—M. P. A. Favre communicated the continuation of his thermic investigations upon electrolysis, in which he gave the results of experiments made especially with the voltameter with plates of copper immersed in sulphate of copper.—M. de Fonvielle presented a note on musical sounds produced at the opening of the valve in balloon ascents.—M. des Cloiseaux communicated some optical and crystallographical observations upon montebrasite and the amblygonite of Montebras, the former a new fluophosphate of alumina, soda, and lithia.—A letter was read from M. Moison describing the use of sea-water for making bread in the environs of Cancale.—M. H. Sainte-Claire Deville presented a note by M. T. Schlœsing on the separation of potash and soda. The author's process is founded upon that proposed by Serullas, in which perchloric acid is employed. He uses, instead of this acid, pure perchlorate of ammonia, treated with weak nitro-muriatic acid. The preparation of the perchlorate is described by the author.—M. Chabrier presented some further observations on the alternate predominance of nitrous and nitric acids in rain-water. The author finds that in calm weather nitrous acid is present in excess in rain-water, whilst nitric acid predominates in stormy weather.—M. Chevreul communicated a letter from M. Sacc on the properties of drying oils, with regard to which M. Thenard also made some observations.—A note by MM. Dusant and C. Bardy on the phenoles was presented by M. Cahours.—M. C. Bernard communicated a note by M. E. Faivre on the movements of the sap through the bark. The author describes a series of experiments made upon mulberry trees, and demonstrates that it is in the bark, and particularly in its liber, that the ascending and descending movements of the sap take place.—M. Joseph-Lafosse presented some observations on the germination of seeds submerged in 1870-71 during the inundation of the neighbourhood of Carenton for the defence of Cherbourg. He stated that after the retirement of the water many plants sprang up in unusual abundance and vigour, and suggested that experiments should be made upon the effects of long soaking upon the germination of the seeds of useful plants.—A letter from M. A. de la Rive on M. Marey's recent communications relating to the electrical discharge of the torpedo was read. The author considered the action of the nerves in causing muscular contraction to be electrical, and that the electrical effect produced by the apparatus of the torpedo was caused by the accumulation in it of the energy of the immense multitude of nervous filaments with which it is supplied.—M. C. Bernard presented a note by M. L. Reverdin on epidermic grafting, describing and discussing the phenomena produced by the transfer of portions of skin from one living animal to another. The author maintains that the adherence of these grafts is produced principally by the epidermis, the dermis having only a secondary action.—M. S. Meunier, in a note on meteoric metamorphism, described the transformation of aumalite into chantonnite by exposure for a quarter of an hour to a red heat, which confirms his conclusion that the latter is the eruptive form of the former.

BOOKS RECEIVED

ENGLISH.—The Young Collector's Handybook of Botany: Rev. H. N Dunster (Reeve and Co.).—Journal of the Iron and Steel Institute. Vol. II., No. 4.—Astronomical Phenomena in 1872: W. F. Denning (Wyman and Son).

AMERICAN AND COLONIAL.—The Fossil Plants of the Devonian and Upper Silurian Formations of Canada, 21 plates: Principal Dawson.—Elements of Chemistry, Vol. II.: G. Hinrichs.

FOREIGN.—Zeitschrift für Ethnologie; Supplement Band: Bastian and Hartmann. (Through Williams and Norgate.)—Die Sonne, von P. A Secchi, autorisirte Ausgabe von Dr. H. Schellen, 1te Abtheilung.—Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin, 1870.—Die ältesten Spuren Menschen in Europa: A. Müller.

DIARY

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 8.30.—On the Fossil Mammals of Australia. Part VI. Genus Phascolomys: Prof. Owen, F.R.S.—On the Solvent Power of Liquid Cyanogen. On Fluoride of Silver. Part III.: G Gore, F.R.S.
SOCIETY OF ANTIQUARIES, at 8.30.—Exhibition of Stone Implements.
LINNEAN SOCIETY, at 8.—Botany of the Grant and Speke Expedition: Lieut.-Col. Grant, C.B., C.S.I.—On a hybrid *Vaccinium* between the Bilberry and Crowberry: R. Garner, F.L.S.—On the Formation of British Pearls, and their possible improvement: R. Garner, F.L.S.
CHEMICAL SOCIETY, at 8.

FRIDAY, DECEMBER 8.

ASTRONOMICAL SOCIETY, at 8.
QUEKETT MICROSCOPICAL CLUB, at 8.

SUNDAY, DECEMBER 10.

SUNDAY LECTURE SOCIETY, at 4.—On the Optical Construction of the Eye: Dr. R. E. Dudgeon.

MONDAY, DECEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, DECEMBER 12.

PHOTOGRAPHIC SOCIETY, at 8.

WEDNESDAY, DECEMBER 13.

SOCIETY OF ATS, at 8.—Observations on the Esparto Plant: Robert Johnston
ARCHÆOLOGICAL INSTITUTE, at 8.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
MATHEMATICAL SOCIETY, at 8.—On the Celebrated Theorem that any Arithmetical Progression, two of whose Terms have no Common Factor, contains an Infinitude of Prime Numbers: J. J. Sylvester, F.R.S.

CONTENTS

	PAGE
THE CHAIRS OF SCIENCE IN THE SCOTTISH UNIVERSITIES	97
JUKES'S LETTERS	98
OUR BOOK SHELF	99
LETTERS TO THE EDITOR:—	
The Planet Venus.—WILLIAM F. DENNING, F.R.A.S.	100
The Flight of Butterflies.	101
The Origin of Insects.—B. T. LOWNE, M.B.	101
Aspect.—Prof. J. M. PEIRCE	102
Cause of Low Barometric Pressure.—A. WCJEIKOFER	102
Symbols of Acceleration.—THOMAS MUIR	102
Occurrence of the Eagle Ray.—W. S. M. D'URBAN	103
Deep Sea Dredging.—T. H. HENNAH	103
The Solar Halo.—GEO. C. THOMPSON	103
ON THE ZIPHIOID WHALES. By Prof. W. H. FLOWER, F.R.S.	103
CONTINUITY OF THE FLUID AND GASEOUS STATES OF MATTER. By Prof. JAMES THOMSON, LL.D. (*With diagram.*)	106
ALTERNATION OF GENERATIONS IN FUNGI. By M. C. COOKE	108
THE SCIENCE AND ART DEPARTMENT	109
ARCTIC EXPLORATIONS. By Dr. JOHN RAE, F.R.G.S.	110
NOTES	110
COLDING ON THE LAWS OF CURRENTS IN ORDINARY CONDUITS AND IN THE SEA. III.	112
SCIENTIFIC SERIALS	114
SOCIETIES AND ACADEMIES	114
BOOKS RECEIVED	116
DIARY	116

ERRATA.—Vol. v., p. 82, col. 2, line 9, for "150°" read "15°."—Vol. v. p. 95, col. 2, line 22 from bottom, for "inverse direction" read "inverse ratio."