that they have left, but which they never regain. The migratory individuals proceed hopelessly on to a certain death." Sooner or later all the wanderers meet their death—thousands are drowned in rivers or fjords, thousands are attacked by beasts and birds of prey, and thousands perish from the effects of cold and damp; but the greater number die from the effects of a peculiar epidemic which attacks them in the lowlands. It is pointed out by the writer that the wandering instinct developed during migratory years is probably of distinct service to the species in reducing the surplus population.

THE AUSTRALASIAN ASSOCIATION.

WE gave, a fortnight ago, the presidential address delivered by the Hon. A. C. Gregory to the Australasian Association for the Advancement of Science at this year's meeting in Brisbane. Full reports of the proceedings in the different Sections have reached us, from the General Secretary, Mr. J. Shirley, but limits of space prevents us from printing more than a brief summary of them.

The public proceedings of the meeting were opened by a popular lecture on "Star Depths," by Mr. H. C. Russell. Mr. Russell traced the growth of knowledge concerning the distance of the stars, and the structure of the stellar universe, and illustrated his description by a selection from the excellent photographs of celestial scenery taken at Sydney Observatory.

We give a synopsis of the work of the various sections.

ASTRONOMY, MATHEMATICS, AND PHYSICS.

Mr. Alexander M'Aulay, as President of Section A, delivered an address "On Some Popular Misconceptions on the Nature of Mathematical Thought."

Mr. P. Baracchi, contributed a paper on "the most probable value and error of Australian longitudes, including that of the boundary lines of South Australia with Victoria and New South Wales." Dr. Ralph Copeland sent "Some Notes on the New Royal Observatory, Edinburgh," and Mr. H. C. Russell read a paper "On a Photographic Transit Instrument."

CHEMISTRY.

Mr. J. H. Maiden delivered the presidential address in this Section, entitled, "The Chemistry of the Australian Indigenous Vegetation." Mr. E. A. Weinberg contributed a paper on the refractory gold ores of Queensland: their sources and treatment. Prof. A. Liversidge, F.R.S., read a paper on "Variations in amount of Ammonia in Water on keeping." He also described the internal structure of some Australian nuggets, of different sizes, which had been closely examined and photographed. The etching was conducted according to the following plan:—A clean section was made and highly polished, and acted upon by chlorine water or bromine water, tincture of iodine or potassium cyanide, or sodium chloride mixed with nitric acid. The crystals less readily soluble stand up in relief and resemble the well-known figures seen in metallic meteorites when etched. One curious fact observed was that when the nuggets were subjected to heat, bubbles or blebs were formed on the surface, which burst with a sharp report, probably due to water included in the nugget being converted into high-pressure steam. Several beautiful photographs showing the crystalline nature of the nuggets were exhibited. Other papers read were: "On the Corrosion of Aluminium," and "Contributions to the Bibliography of Gold," by Prof. Liversidge; "Pharmacy as a Science and its Future," by Dr. W. Finselbach; "Notes and Analyses of some of the Artesian Waters of New South Wales," by John C. H. Mingaye; "On the Economic Treatment of Gold Ores," by Geo. H. Irvine; "Queensland Native Astringent Medicines," by Dr. Joseph Lauterer; "Portland Cement after Fifty Years," by W. M. Doherty; "Some Remarks on the Teaching of Elementary Chemistry," by A. J. Sach; "Analysis of Eucalyptus Gums," by Dr. Wilton Love; "The Ointments of the British Pharmacopœia," by F. W. Simmonds; "Notes on the Poisonous Constituents of Stephania Hernandiiafolia," by Prof. Edward H. Rennie; "Preliminary Notes on the Bark of Carissa Ovata, *R. Br.* v. Stolonifera, *Bail*," by H. G. Smith; "On a Method of Shortening certain Chemical Calculations," by W. A. Hargreaves.

GEOLOGY AND MINERALOGY.

Prof. T. W. Edgeworth David, in his address to this Section, reviewed briefly some recent geological discoveries of special interest. A paper by Mr. E. F. Pittman, Assoc. R.S.M., entitled "Notes on the Cretaceous Rocks in the North-western Portion of New South Wales," gave the results of a recent geological journey by him over 1150 miles of country. The geological examination was made chiefly with the object of determining approximately the area and boundaries of the artesian water formation.

Among other papers read before this Section were:—"Anticlines and Synclines and their Relation to Mining," by Ernest Lidgey; "On the Nomenclature of Crystals," by Prof. A. Liversidge, F.R.S.; "The Development and Progress of Mining and Geology in Queensland," by William Fryar; "On the Present State of our Knowledge of the Older Tertiaries of Southern Australia," by G. B. Pritchard; "The Antiquity of Man in Victoria," by W. H. Ferguson; "The Glacial Deposits of Victoria," by G. Officer, L. Balfour, and E. G. Hogg; "Notes on Tin Mining at Herberton," by John Munday.

BIOLOGY.

Prof. A. Dendy took for the subject of his presidential address, "The Cryptozoic Fauna of Australasia." Mr. F. M. Bailey read a paper on peculiarities of the Phanerogamic Flora of Queensland. The paper chiefly contained descriptions of indigenous fruits recommended for cultivation. Mr. D. Le Souëf furnished a paper on the Tree Kangaroo (*Dendrolagus Bennettianus*), describing its mode of climbing, its food, and the way it is captured by the natives. In a paper on the eating of earth by the larger Macropodidæ, by J. Douglas Ogilby, evidence was given of the eating of earth by kangaroos in the Bourke district, New South Wales. This habit does not appear to have been previously recorded, though in the district under notice it plays no unimportant part in the economy of the larger marsupials.

Dr. M. C. Cook sent a paper entitled "Pestiferous Fungi and their Modes of Attack." Dr. Charles Chilton gave a general account of history, occurrence, distribution and habits of the blind Amphipoda and Isopoda found in the underground waters of the Canterbury Plains in New Zealand. Miss Lodder furnished a revised list of the Marine Mollusca of Tasmania. Some plants peculiar to the Burnett Basin were described by James Keys. In a paper entitled "Notes and Observations on the Genus Nephila," W. J. Rainbow dealt with—(1) the localities in which spiders of the genus Nephila abound; (2) the strength and elasticity of their webs, in the sticky meshes of which certain birds of weak wing-power are caught; (3) the question as to whether the Nephilæ eat birds thus captured; (4) the mode by which silk may be obtained from these spiders by artifical means, and the experiments made by certain naturalists with a view to ascertaining the amount that could be obtained from individuals of this genus in a season, the object of which was to endeavour to prove that the product might be used for economic purposes.

Dr. J. Müller, of Geneva, Switzerland, contributed a paper on the Pyrenocarpeæ of the Lichen family. Mr. A. J. Campbell described the nests and eggs of Australian Hawks. Mr. A. G. Hamilton, in a paper entitled "The Fertilisation of some Australian Plants," gave many of his own observations as to the mode by which fertilisation is effected. Mr. W. M. Maskell gave a synoptical list of the Coccidæ reported from Australasia and the Pacific Islands up to December 1894.

Mrs. W. Martin gave the life-history of the vegetable growth known as Native Bread (*Mylitta Australis*). Australian mosses were enumerated by Richard A. Bastow, and some notes on the poisonous constituents of *Stephania hernandiæfolia* were read by E. H. Rennie and E. F. Turner. Picrotoxine and an alkaloid possessing strongly poisonous properties and marked chemical characteristics have been isolated from an extract from the plant.

"Economic Entomology" was the title of a paper by the Rev. E. H. Thompson, who pointed out the great benefit resulting to a country from a properly conducted Government Entomological Department, and urged, in order to increase its usefulness: (1) the formation of a federal entomological department with a head staff and field observers in each of the colonies; (2) a federal agricultural and scientific journal for all the colonies, subsidised by all; (3) elementary entomology to be taught in the State schools, special reference being given to the insect pests peculiar to each district or colony; and (4) the

formation of school museums and prizes given for the best collections.

Mr. G. B. Barton gave a concise historical account of the first discovery of the Eucalyptus, including the names and nationalities of those to whom the honour has been ascribed by various writers.

A paper by Dr. J. Lauterer contained physiological and microchemical researches on the Eucalyptus, and contributed some new items with regard to the life-history of those trees connected with the origin of the gum exuded by their bark.

GEOGRAPHY.

The President of the Section, Baron von Mueller, was absent, but his address, on "The Commerce of Australia with Neighbouring Countries in Relation to Geography," was read.

Mr. C. L. Wragge gave an account of his investigations of ocean currents by means of bottles thrown into the sea. He was of opinion from the results obtained that many of the bottles had been influenced more by winds than by ocean currents; but if this were not the case, the bottles cast adrift in the Australian Bight distinctly indicated that a strong current sets from the neighbourhood of Kangaroo Island towards the head of the Bight and Israelite Bay. The most interesting of the bottle papers is one that was cast adrift near the Cocos Islands, in the north-eastern portion of the Indian Ocean, and which was found a few months afterwards on the shores of German East Africa. Papers cast adrift by Mr. Wragge during a voyage to England, in the neighbourhood of the Sargasso Sea, were picked up at Hayti, on the Alabama coast, and on the Louisiana coast. Others thrown overboard with a view to testing Rennel's current, which sets towards the coast of Ireland, from the neighbourhood of Cape Finisterre, were certainly influenced by the strong west-south-west winds which were experienced on that occasion between the Western Islands and the English Channel. None of these appear to have followed the current, but went straight across it, some being found on the west coast of France, and near the islands of Sein, while one was picked up at Brighton. It appears to be highly desirable, judging from the results obtained, that the bottles should be weighted with sand or other material, with a view to more completely sinking them in the water, and thus minimising the influence of the winds.

Among other papers contributed to this Section were—"The Southern Alps of New Zealand," by Mr. A. P. Harper; "The Bissagos Islands," by M. Max Astrie; and "Physiography of the Victorian Gold Fields," by James Stirling.

ETHNOLOGY AND ANTHROPOLOGY.

Mr. Thomas Worsnop, President of the Section of Ethnology and Anthropology, delivered an address upon the prehistoric arts of the Australian Aborigines. Messrs. W. J. Enright and R. H. Matthews described the aboriginal drawings in the Wollombi Caves, New South Wales. A paper was contributed by Mr. Thomas Petrie, on the habits and customs of the wild tribes as he saw them in 1837, from Brisbane to Maroochy. "Foods of North-west Aboriginals" was the title of a paper by J. Coghlan. Mr. John F. Small contributed a paper on customs and traditions of the Clarence River aboriginals. The paper dealt with the traditions, funeral ceremonies, marriage laws, and the Bora ceremony. Mr. E. Thorne read a paper entitled "Curious Aboriginal Marriage Custom." The paper was the result of investigations made by the author in the Laguna Bay.

The other papers communicated to this Section included: "'Boomerang' and 'Woomera,' Evolution, Varieties, and Distribution," by Mr. A. Weston; "The Ancient Government of Samoa," by Rev. S. Ella; "Notes on Tokelau, Gillbert, and Ellice Islands," by Rev. J. E. Newell; "A Comparative View of some Samoan Customs," by Rev. J. B. Stairs; "Early Samoan Voyages and Settlements," by Rev. J. B. Stairs; and "Gaelic Contributions to Folk Lore," by Rev. A. C. Sutherland.

AGRICULTURE.

In a paper on the teaching of agricultural botany, Mr. C. T. Musson said that the object to be aimed at by instructors in agricultural botany should be to impart such information to the prospective cultivator as would make him acquainted with plant structure and the more important useful plants. Practice alone would not make a good farmer, but practice, when based upon a knowledge of the animate and inanimate objects he was dealing with, and their surroundings, would make the man of resources best fitted for his work. Mr. T. B. Guthrie contributed a paper on examinations of different varieties of wheat grown in New South Wales. He also read a paper on "soil analysis," in which the value of soil analysis to the farmer was discussed, and different methods for the determination of the available plant food in soils were reviewed. The paper embodied a suggestion for a scheme of soil analysis, the results of which should be of practical use to the farmer, based upon the determination of those conditions which conduce to fertility rather than to the chemical constitution of the soil. Of the remaining papers read before this section, the following were of more than technical interest:—

"Climatic Influences on Contagious Diseases of Live Stock," by P. R. Gordon; "How to Grow Fruit," by Albert H. Benson; "Floods and Forests," by Philip MacMahon; "Semi-Tropical Horticulture," by Leslie G. Corrie; "Forage Plants and Grasses of Australia," by Fred. Turner; "The Agricultural Chemistry of the Sugar Cane," by Joseph Fletcher.

ENGINEERING AND ARCHITECTURE.

Mr. James Fincham, President of this Section, delivered his presidential address on "Architecture and Engineering."

Prof. W. C. Kernot contributed a paper on wind pressure. The paper was a continuation of one read at the Adelaide meeting. It dealt with the relation between velocity and pressure, and detailed series of experiments leading to the formula $P = \cdot 0033V^2$, which approximates very closely to the rule given by Dines, and disagrees with the rules given by Smeaton and Crosby. The pressure of wind upon roofs was also dealt with, and experiments were quoted to show that the ordinary method of computing the pressure is fairly accurate when the roof is supported on thin columns, so that the wind can pass freely below, but is altogether wrong when the roof is supported on walls. In this latter case the pressure is greatly reduced, and when the walls terminate in parapets is often rendered negative, the roof having a distinct tendency to lift.

Other papers communicated to this section were:—"Experiments on the Waterproofing of Bricks and Sandstones with Oils," and "Experiments on the Porosity of Plasters and Cements," by Prof. A. Liversidge, M.A., F.R.S.; "On Teredo-Resisting River Structures," by Thomas Parker; "Earthquakes in Relation to Building Construction," by Thos. Turnbull.

SANITARY SCIENCE AND HYGIENE.

The President of the Section of Sanitary Science and Hygiene, Dr. J. W. Springthorpe, read an address on "The Teaching of Science in Matters of Health."

Among the papers read were:—"The Promise of 'Serum Therapeutics' in regard to Tuberculosis," by Dr. J. Sidney Hunt; "Contagiousness of Tuberculosis," by F. H. Vivian Voss; "The Prevalence and Intercommunicability of Human and Animal Tuberculosis," by S. S. Cameron; "Leprosy," by Dr. C. E. Dumbleton, and also by A. Francis; and "Etiological Views of the Maintenance of Leprosy," by Dr. J. A. Thompson.

MENTAL SCIENCE AND EDUCATION.

Prof. F. Anderson, the President of this Section, delivered his address on "Education in Politics."

Dr. Henry Belcher contributed a paper on the use and abuse of examinations. The advantages of the examination system were shortly stated as follows:—It enables the teacher to stimulate the intelligence and test the progress of the pupil, and to fill up flaws and gaps due to imperfect apprehension, carelessness, or defective memory; it is a power almost indispensable to the teacher's efficiency, and is thus a potent factor in general education; it had an alterative and prophylactic effect upon private adventure schools, raising their tone both intellectually and morally. The author doubted whether it was wise to entrust the examination of pupils to persons other than their teachers. The disadvantages of the examination system were that the best part of a teacher's work escapes analysis; methods of higher teaching rise in quality and character, while methods of examination lie behind; by the selection of set books, and the publication of manuals thereon, an intolerable yoke and shackle is placed upon elementary scholarship; examinations appeal to the lower side of human nature—what will pay becomes the pupil's ruling thought. Certain subjects of great importance are neglected because they do not largely count for prizes and honours; and research is altogether neglected.

Among the remaining papers read were:—"Science as a Subject in Girls' Schools," by Miss F. E. Hunt; "The Curriculum of Secondary Education," by D. H. Hollidge; 'The Technical Element in a State System of Education," by Antony St. Ledger; "A Contribution towards the Study of the Relation of Ethics and Science," by the Rev. J. S. Pollock; "The Importance of Mental Science as a Guide in Primary Education," by James Rule.

The business of the Association concluded with a meeting of the General Council, at which the following recommendations, among others, were adopted:—

(1) That the committee for the investigation of the thermodynamics of the voltaic cell be reappointed without grant.

(2) That the report of the Seismological Committee be printed, and that the committee be reappointed and allowed a grant of £10 towards the cost of the erection of the instruments presented by Dr. Von Rebeur-Paschwitz at Timaru.

(3) That the following be a committee—namely, Messrs. F. M. Bailey, R. L. Jack, A. Gibb Maitland, A. Meston, C. W. De Vis, and H. Tryon—to investigate the geology, land flora, and natural resources generally of the islands and islets of the Great Barrier Reef.

(4) That the New Zealand Government be asked to set apart Stephen's Island, Cook Strait, as a reserve for the Tuatara Lizard.

(5) That the committee for the investigation of glacial deposits in Australasia be Messrs. Hutton, R. L. Jack, R. Tate, R. M. Johnston, F. W. E. David (secretary), G. Sweet, J. Shirley, W. Houchins, E. G. Hogg, E. J. Dunn, A. Montgomery, and E. F. Pittman.

(6) That a committee—consisting of Messrs. H. C. Stanley, A. B. Brady, Thomas Parker, Prof. Warren, Prof. Kernot, Henry Moncrieff, and James Fincham—be appointed to inquire into the habits of the teredo, and the best means of preserving timber or structures subject to the action of tidal waters.

(7) That the committee on psycho-physical research be appointed without a grant.

The next meeting of the Association will be held at Sydney in 1897, under the presidency of Prof. Liversidge, and the following meeting will take place at Melbourne.

*ELECTRIFICATION OF AIR, AND THERMAL CONDUCTIVITY OF ROCK AT DIFFERENT TEMPERATURES.**

(1.) "ON THE ELECTRIFICATION OF AIR."

§ 1. CONTINUOUS observation of natural atmospheric electricity has given ample proof that cloudless air at moderate heights above the earth's surface, in all weathers, is electrified with very far from homogeneous distribution of electric density. Observing, at many times from May till September, 1859, with my portable electrometer on a flat open sea-beach of Brodick Bay in the Island of Arran, in ordinary fair weather at all hours of the day, I found the difference of potentials, between the earth and an insulated burning match at a height of 9 feet above it (2 feet from the uninsulated metal case of the instrument, held over the head of the observer), to vary from 200 to 400 Daniell's elements, or as we may now say volts, and often during light breezes from the east and north-east, it went up to 3000 or 4000 volts. In that place, and in fair weather, I never found the potential other than positive (never negative, never even down to zero), if for brevity we call the earth's potential at the place zero. In perfectly clear weather under a sky sometimes cloudless, more generally somewhat clouded, I often observed the potential at the 9 feet height to vary from about 300 volts gradually to three or four times that amount, and gradually back again to nearly the same lower value in the course of about two minutes.† I inferred that these gradual variations must have been produced by electrified masses of air moving past the place of observation. I did not remark then, but I now see, that the electricity in these moving masses of air must, in all probability have been chiefly positive to cause the variations which I observed, as I shall explain to you a little later.

§ 2. Soon after that time a recording atmospheric electrometer* which I devised, to show by a photographic curve the continuous variation of electric potential at a fixed point, was established at the Kew Meteorological Observatory, and has been kept in regular action from the commencement of the year 1861 till the present time. It showed incessant variations quite of the same character, though not often as large, as those which I had observed on the sea-beach of Arran.

Through the kindness of the Astronomer Royal, I am able to place before you this evening the photographic curves for the year 1893, produced by a similar recording electrometer which has been in action for many years at the Royal Observatory, Greenwich. They show, as you see, not infrequently, during several hours of the day or night, negative potential and rapid transitions from large positive to large negative. Those were certainly times of broken weather, with at least showers of rain, or snow, or hail. But throughout a very large proportion of the whole time the curve quite answers to the description of what I observed on the Arran sea-beach thirty-six years ago, except that the variations which it shows are not often of so large amount in proportion to the mean or to the minimums.

§ 3. Thinking over the subject now, we see that the gradual variations, minute after minute through so wide a range as the 3 or 4 to 1, which I frequently observed, and not infrequently rising to twenty times the ordinary minimum, must have been due to *positively* electrified masses of air, within a few hundred feet of the place of observation, wafted along with the gentle winds of 5 or 10 or 15 feet per second which were blowing at the time. If any comparably large quantities of negatively electrified air had been similarly carried past, it is quite certain that the minimum observed potential, instead of being in every case positive, would have been frequently large negative.

§ 4. Two fundamental questions in respect to the atmospheric electricity of fair weather force themselves on our attention:—(1) What is the cause of the prevalent positive potential in the air near the earth, the earth's potential being called zero? (2) How comes the lower air to be electrified to different electric densities whether positive ornegative in different parts? Observations and laboratory experiments made within the last six or eight years, and particularly two remarkable discoveries made by Lenard, which I am going to describe to you, have contributed largely to answering the second of these questions.

§ 5. In an article "On the Electrification of Air by a Water-jet," by Magnus Maclean and Makita Goto,† experiments were described showing air to be negatively electrified by a jet of water shot vertically down through it from a fine nozzle into a basin of water about 60 centimetres below it. It seemed natural to suppose that the observed electrification was produced by the rush of the fine drops through the air; but Lenard conclusively proved, by elaborate and searching experiments, that it was in reality due chiefly, if not wholly, to the violent commotions of the drops impinging on the water surface of the receiving basin, and he found that the negative electrification of the air was greater when they were allowed to fall on a hard slab of any material thoroughly wetted by water, than when they fell on a yielding surface of water several centimetres deep. He had been engaged in studying the great negative potential which had been found in air in the neighbourhood of waterfalls, and which had generally been attributed to the inductive action of the ordinary fine weather electric force, giving negative electricity to each drop of water-spray before it breaks away from conducting communication with the earth. Before he knew Maclean and Goto's paper, he had found strong reason for believing that that theory was not correct, and that the true explanation of the electrification of the air must be found in some physical action not hitherto discovered. A less thorough inquirer might have been satisfied with the simple explanation of the electricity of waterfalls naturally suggested by Maclean and Goto's result, and might have rested in the belief that it was due to an electrifying effect produced by the rush of the broken water through the air; but Lenard made an independent experimental investigation in the Physical Laboratories of Heidelberg and Bonn, by which he learned that the seat of the negative electrification of the air electrified is the lacerated water at the foot of the fall, or at any rocks against which the water impinges, and not the multitudinous interfaces between air and water falling freely in drops through it.

§ 6. It still seems worthy of searching inquiry to find

* Two communications to the Philosophical Society of Glasgow meeting, in the Natural Philosophy Lecture-room of the University of Glasgow, March 27, "On the Electrification of Air": "On the Thermal Conductivity of Rock at different temperatures."

† "Electrostatics and Magnetism" (S i William Thomson), xvi. §§ 281, 282.

* "Electrostatics and Magnetism" xvi. §§ 271, 292.

† *Philosophical Magazine*, 1890, second half-year.