

"original cow." Just below or on the line ( $\beta$ ), vertically above the *first cow*, and, like it, erect, would be a *second cow*, a repetition of the first. And often, above this again, below or on the line ( $\gamma$ ), would be a third cow, also erect.

Sometimes there were confused images hanging from the *second cow* and joining other confused images piled on the *first cow*; sometimes the first cow was clear of images, while they hung down from the second cow; sometimes the second cow was clear, and there were images piled on the first. Often the *third cow* was missing (see Fig. 1). As the original cow moved, these images changed their disposition or vanished, and the third cow appeared or vanished. But in all these changes it seemed to me that the *first cow*, *second cow*, and (when visible) the *third cow*, were the permanent images. These, it appeared, were always erect.

(3) After the sun had risen, all continued *in statu quo* for a short time. But soon, at various parts of the horizon, the land just above the edges ( $\alpha$ ), ( $\beta$ ), and ( $\gamma$ ) paled away, and finally melted into the appearance of "sky" or "water." There were left, in the later stages of the mirage, first, the plain itself, with an extension, the limits of which were not sharp, beyond the normal horizon; secondly, above this a strip of land, apparently suspended in the air; thirdly, in some parts of the horizon another strip of land suspended in the air above this again. The interval between ( $\alpha$ ) and ( $\beta$ ) was in all stages greater than that between ( $\beta$ ) and ( $\gamma$ ). One of the appearances in the later stages is indicated in Fig. 2.

Other changes crept in, too. Very often the original objects were wholly or partly sunk out of sight; the images were less defined; and the confused images hanging from the *second cow*, e.g., or piled on the *first cow*, were now seen in the watery layers, sometimes bridging it over.

(4) As time went on, the watery layers widened. The images, too, became still vaguer, and the original objects were usually out of sight or only just indicated above the line ( $\alpha$ ). Moreover, the aerial images, with their confused trails of images hanging from them, began to assume more the appearance of "inverted images suspended over objects hidden below the horizon."

(5) In these later stages, no doubt, anyone would have guessed that the aerial images were indeed very vaguely defined *inverted* images. But to me, as I followed the phenomenon from the beginning, it seemed that they were not so. It seemed to me that each aerial image was really topped by an *erect* image, which, with the trails hanging from it, seemed like an inverted image. At least I can say that, so long as the images were well defined at all, I never made out a clear case of the *main*, or permanent, aerial images being inverted. Thus, as the *first cow* moved, it was the erect *second* (and sometimes *third*) *cows* that remained clear.

(6) In these later stages it was only trees and houses that could be seen in the mirage, and these were ill-defined.

(7) The mirage lasted until about an hour and a quarter after sunrise. The last traces of aerial images of land appeared just under the sun, and in that part of the horizon that lay just opposite to it. Whether the abnormal extension of the horizon entirely ceased at the same time, I cannot say; but there did not remain any noticeable extension.

(8) As with the summer mirage, I found I could alter appearances by altering my level above the earth. But the change in level had to be more considerable. I have no good notes on this matter; but I believe that usually I could recover a past stage of the mirage by a sufficient descent down a ladder from my post of observation.

*General Conclusions as to Winter Mirage:—*

(1) It is due to the earth, and the air near it, being considerably chilled below the temperature of the rest of the atmosphere.

(2) The phenomena of extended horizon and multiple images are to be observed.

(3) The "drawn up" appearance of objects is really due to a number of images piled upon one another, only to be separated by the use of a telescope.

(4) No case of a terrestrial object having above it a single inverted image, or images of which the uppermost was inverted, came under my notice.

W. LARDEN.

### SCIENTIFIC SERIALS.

*American Journal of Mathematics*, vol. xii. No. 1, and index to vols. i.-x. (Baltimore, 1889).—This volume opens with

an instalment of sixty pages of a memoir by A. R. Forsyth, F.R.S., on "Systems of Ternariants that are Algebraically Complete." In this the writer has found it convenient to use "ternariant" as a generic term for concomitants of ternary quatics, instead of giving it the signification which Prof. Sylvester proposed (*Amer. J. of Math.*, vol. v. p. 81) to give to it, viz. the leading coefficients of those concomitants." The memoir is divided into three parts, and deals with the theory of the algebraically independent concomitants of ternary quatics, taking as the starting-point the six linear partial differential equations of the first order satisfied by them. References are supplied to numerous memoirs on the subject.—Captain (now Major) P. A. Macmahon continues (pp. 61-102) his investigations (vol. xi. No. 1) in a "Second Memoir on a New Theory of Symmetric Functions." Herein he is engaged with functions which are not necessarily integral, but require partitions, with positive, zero, and negative parts for their symbolical expression. The author thus summarizes his results: (1) a simple proof of a generalized Vandermonde-Waring power law which presents itself in the guise of an invariant property of a transcendental transformation; (2) the law of "groups of separations"; (3) the fundamental law of algebraic reciprocity; (4) the fundamental law of algebraic expressibility which asserts that certain indicated symmetric functions can be exhibited as linear functions of the separations of any given partition; (5) the existence is established of a pair of symmetrical tables in association with every partition into positive, zero, and negative parts, of every number, positive, zero, or negative.—The closing portion of the number (pp. 103-114) is taken up with an article entitled "De l'Homographie en Mécanique," by P. Appell.—A likeness of M. Poincaré faces p. 1.—The index is of a twofold description—of authors and of subjects. From the forewords we learn that papers have been published from eighty-nine contributors; these comprise "most of the leading mathematicians of the world."

### SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, November 11.—M. Hermite in the chair.—Presentation of Report of Proceedings of the permanent International Committee for preparing a photographic chart of the heavens, by M. E. Mouchez. Fifteen Observatories will be ready by the middle of next year; and five others before the end. The zones are indicated.—Note of M. Daubrée with descriptive catalogue of the meteorites of Mexico prepared by M. Antonio del Castillo. Meteorites are abundant in Mexico. A remarkably wide area of dispersion is indicated by three portions of one mass, found at the angles of a triangle, whose two longer sides were 90 km. and 60 km. In one of these places two plates were found 250 m. apart; and they seem to have formed one huge plate over 24,000 kgm. weight, which broke near the ground.—On the incineration of vegetable matters, by M. G. Lechartier. Trying various methods, he finds, that in the carbonization and incineration of a plant, there is considerable loss of sulphur, volatilized in various combinations; and special precautions are necessary in determining this constituent. Under the same conditions, and care being taken to prevent loss of solid matter carried away mechanically with the issuing gas, there is no sensible loss of phosphorus.—M. Picard was elected member in Geometry, in place of the late M. Halphen.—On a rotating magnetic field formed with two Ruhmkorff coils, by M. W. De Fonvielle. A current from accumulators is sent through the primary of one coil, the secondary of which is connected with that of the other coil, which is in a line with the first, and the primary of which may be open or closed.—On certain ellipsoidal areas, by M. G. Humbert.—On a new calculating machine, by M. L. Bollée. While in previous machines, multiplications, e.g., are done by successive additions, this one has a multiplying apparatus which determines immediately, in one function, the product of a number by each figure of the multiplier.—On the solubility of the chlorides of potassium and of sodium in the same solution, by M. Étard. The results of experiment are shown in graphic form; the curves of solubility of each salt separately being compared with those of the mixed salts, &c. The sum of the dissolved salts is represented by a continuous straight line. The curves for the mixed salts cross at temperature 97°; that for NaCl falling while the other rises.—On an application of thermo-chemistry, by M. A.

Colson. The formation of nicotine monohydrochloride liberates about twice as much heat as that of the dihydrochloride under like conditions; hence a probable difference in constitution of the two nitrogen groups of nicotine. The action of nicotine on coloured reagents shows at once a difference in the two basicities.—On the myelocytes of fishes, by M. J. Chatin. In fishes, as in other zoological groups, the nervous elements termed myelocytes, are not to be referred to a special histic type, but to the nerve cell; which is simply modified, chiefly by enlargement of the nucleus, and corresponding reduction of the somatic part.—On the continuity of the pigmented epithelium of the retina with the external segments of the cones and rods, and the morphological value of this arrangement in vertebrates, by MM. R. Dubois and J. Renault. This new fact makes it probable (according to the authors) that in the retina of vertebrates a similar process occurs to that in the light-sensitive apparatus of Mollusks like *Pholas*; by mechanism of impression and transformation of luminous movement into contractile, then sensorial.—On strabismus, by M. H. Parinaud. The immediate cause of the deviation (in squinting) is a disorder of innervation, excess in convergence, defect in divergence, caused generally by the accommodative effort in one case (hypermetropia), and the little use made of accommodation in the other (myopia). The deviation, when sufficiently fixed and prolonged, induces anatomical changes both in the brain-connections and the tissues of the eye (in the latter case, not only shortening of muscles, but retraction of all relaxed fibrous parts, especially Tenon's capsule). This has important bearings on treatment.—On the morphology and the biology of the fungus *Oidium albicans* (Robin), by MM. G. Linossier and G. Roux. Besides the yeast form, and the *globulofilamentous*, he finds a third, similar to *chlamydozoores*, and probably needing some new natural habitat for full development. This fact, with the absence of *ascospores*, &c., suggests removal of the organism from the genus *Saccharomyces*. Again, it is found, that in culture of the fungus, the complication of form increases with the molecular weight of the aliment; there is a growing tendency to form long thin filaments. This tendency is also favoured by high temperature, excess of oxygen, a trace of nitrates, and antiseptics.—Comparative activity of various digitalines, by M. Bardet. He compares crystallized and amorphous digitaline, prepared according to the French codex, German *digitoxine*, French *digitaleine*, and German *digitaline* (the power of the two last is much less than those of the others).

## DIARY OF SOCIETIES.

## LONDON.

## THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—(1) Further Discussion of the Sun-spot Observations at South Kensington; (2) on the Cause of Variability in Condensing Swarms of Meteorites: J. Norman Lockyer, F.R.S.—On the Local Paralysis of Peripheral Ganglia, and on the Connection of Different Classes of Nerve Fibres with them: J. N. Langley, F.R.S., and W. Lee Dickinson.—On the Tubercles on the Roots of Leguminous Plants, with Special Reference to the Pea and the Bean (Preliminary Paper): Prof. H. M. Ward, F.R.S.

LINNEAN SOCIETY, at 8.—External Anatomical Characters indicating Sex in Chrysalids, and Development of the Azygos Oviduct and its Accessory Organs in Vanessa Io: Prof. W. Hatchett Jackson.—Anatomy of Lepidoptera: E. B. Poulton.—Lepidoptera of Ichang, North China: John H. Leech.

CHEMICAL SOCIETY, at 8.—The Law of the Freezing-points of Solutions: S. U. Pickering.

## MONDAY, NOVEMBER 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Bahrein Islands, Persian Gulf: J. Theodore Bent.

SOCIETY OF ARTS, at 8.—Modern Developments of Bread-making: William Jago.

## TUESDAY, NOVEMBER 26.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Ethnology of the Western Tribe of Torres Straits: Prof. A. C. Haddon.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Water-Tube Steam-Boilers for Marine Engines: John I. Thornycroft. (Discussion.)

UNIVERSITY COLLEGE BIOLOGICAL SOCIETY, at 5.15.—A New Genus of Polychæt Worm: Florence Buchanan.

## WEDNESDAY, NOVEMBER 27.

SOCIETY OF ARTS, at 8.—Scientific and Technical Instruction in Elementary Schools: Dr. J. Hall Gladstone, F.R.S.

## THURSDAY, NOVEMBER 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Engineering in America: G. L. Addenbrooke.

## FRIDAY, NOVEMBER 29.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—Principles of Iron Foundry Practice: G. H. Sheffield.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Publicazioni del Real Osservatorio di Palermo, vol. iv. (Palermo).—Obeah; Witchcraft in the West Indies: H. J. Bell (Low).—Through Atolls and Islands in the Great South Sea: F. J. Moss (Low).—The Lesser Antilles: O. T. Bulkeley (Low).—Humanitism: W. A. Macdonald (Trübner).—Memoirs and Proceedings of the Manchester Literary and Philo sophical Society, vol. ii., 4th series (Manchester).—Report on the Mining Industry of New Zealand, 1889 (Wellington).—Reports on Mining Machinery and Treatment of Ores in Australian Colonies and America (Wellington).—Die Labyrinthodonten der schwäbischen Trias: E. Fraas (Stuttgart, E. Schweizerbart'sche).—The Butterfly; its History, &c.: J. Sturtard (Unwin).—A Glossary of Biological, Anatomical, and Physiological Terms: T. Dunman and V. H. W. Wingrave (Griffith, Farran).—An Introduction to the Study of Shakespeare: Dr. H. Corson (Boston, Heath).—On the Animal Alkaloids: Sir W. Aitken, 2nd edition (Lewis).—Matebele Land and the Victoria Falls, 2nd edition; F. Oates, edited by C. G. Oates (K. Paul).—Euclid's Elements of Geometry, books i. and ii.: H. M. Taylor (Cambridge University Press).—Travels in India by Jean Baptiste Tavernier, 2 vols.: V. Ball (Macmillan).—Results of Meteorological Observations made in New South Wales during 1887: H. C. Russell (Sydney, Potter).—Etnographische Beiträge zur Kenntniss des Karolinen Archipels: J. S. Kubary (Leiden, Trap).—Les Animaux et les Végétaux Lumineux: H. Gadeau de Kerville (Paris, Baillière).—Bibliographie Générale de l'Astronomie, tome premier, 2de partie: J. C. Houzeau and A. Lancaester (Bruxelles, Hayez).—The Evolution of Sex, Prof. P. Geddes and J. A. Thomson (Scott).—Synthèse Scientifique et Philosophique: A. H. Simonin (Paris, E. Leroux).—The State: W. Wilson (Boston, Heath).—Notes on Sport and Ornithology: late Crown Prince Rudolf of Austria; translated by C. G. Danford (Gurney and Jackson).—Blackie's Geographical Manuals; No. 2, the British Empire; Part 1, The Home Countries: W. G. Baker (Blackie).—Gold-Fields of Victoria; Reports of the Mining Registrars for the Quarter ended June 30, 1889 (Melbourne).—Victoria; Annual Report on the Working of the Registration and Inspection of Mines and Mining Machinery Act during the Year 1888 (Melbourne).—Magnetism and Electricity, Advanced and Honours Questions: A. Jamieson (Griffin).—Electrical Engineering, Ordinary and Honours Questions: A. Jamieson (Griffin).—Results of Rain, River, and Evaporation Observations made in New South Wales during 1888: H. C. Russell (Sydney, Potter).—Astronomical and Meteorological Workers in New South Wales, 1778-1860: H. C. Russell (Sydney, Potter).—The Thunderstorm of October 26, 1888: H. C. Russell.—On a Self-recording Thermometer: H. C. Russell.—President's Address by H. C. Russell at the First Meeting of the Australian Association.—The Source of the Underground Water in the Western Districts: H. C. Russell.

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