

depth of working. It will, therefore, be for mining and mechanical engineers to bring all the resources of their science to bear upon this difficult problem of counteracting terrestrial heat, at depths where it approaches the limit of human endurance. The Commissioners adopting 4,000 ft. as the probable limit of practicable depth, came to the conclusion that there exists in this kingdom an aggregate quantity of about 146,480 millions of tons of available coal. If we assume that the future population of this country will remain constant, and that the consumption for domestic and manufacturing purposes, including exportation, will continue uniform at the present quantity, or merely vary from year to year without advancing, then our stock of coal would represent a consumption of 1,273 years. But if, on the other hand, we assume that population and consumption will go on increasing at the rate exhibited by the statistics of the last fifteen years, or, I might probably say, of the last fifty years, had accurate statistics been so long recorded, then the whole quantity of coal would, as shown by Mr. Jevons, be exhausted in the short space of 110 years. It will be generally admitted that the truth is likely to lie between these two extremes. The Commissioners refrained from expressing an opinion as to what the period of duration would actually be, but they presented certain alternative views of the question, resulting in periods varying from 276 to 360 years. But, all these estimates of duration have reference to the time required for absolute exhaustion of available coal, and leave untouched the important question of how long we are likely to go on before we become a coal-importing instead of a coal-exporting country. The computation of quantities made by the Commissioners, includes all coal seams exceeding 1 ft. in thickness, whatever the quality may be, and it is obvious that vast quantities of such coal can never be worked, except at a price which would render it more advantageous to purchase coal from abroad than to work it from such unfavourable beds. If, at the present time, while working our best and most available coal, our markets will barely exclude the coal of Belgium, what will be our position when driven to inferior coal more costly to work? If we look to cheaper labour for enabling us to work less valuable coal, I fear we shall look in vain; but there is one hope for a longer endurance of our prosperity as dependent on our coal, and that hope rests on the skill and perseverance of mining and mechanical engineers, who, even now, are called upon to lessen, by all the resources of mechanical science, the amount of human labour required in coal mines.

SCIENTIFIC SERIALS

THE *Monthly Microscopical Journal*.—The first paper is one of Mr. Parker's excellent studies, being on the osteology of the head of the sparrow-hawk. The first paragraph contains a generalisation which will surprise many ornithologists, for the *Cariama* is included among the raptorial birds; is this a result of the study of the skull? The accompanying drawings are excellent.—Dr. Royston-Piggott gives two articles, "On an Aërial Stage Micrometer," and "On the Spherules which compose the Ribs of the Scales of the Red Admiral Butterfly, and the *Lepissa Saccharina*."—An ingenious method of obtaining an equal illumination in both tubes of a binocular is contributed by Mr. W. R. Bridgman; and Mr. Stewart endeavours to prove that the hair follicles of the negro's scalp are curved instead of straight; he also describes clearly the framework of the sucking feet of the *Echinus*.—These papers are followed by abstracts of interest, including several from the American journal, the *Lens*.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Feb. 6.—"Memoir on the Osteology of *Hyopotamida*," by Dr. W. Kowalevsky. The paper is intended to fill a deficiency in our knowledge of the extinct creation by giving a complete osteology of one family of the Paridigitate Ungulate. It has been supposed that fossil representatives of this family would exhibit a less reduced skeleton and a more complete number of digits than recent genera; yet such is not the case. The genera *Anoplotherium* and *Liphodon* present in their feet the same degree of reduction as in recent Ruminants, save the confluence in a canon-bone. Notwithstanding this, they have been considered the progenitors of the Ruminantia, from a deficiency in other forms. The present paper introduces a new form, known

only by the teeth till now; these, the *Hyopotamida*, vary considerably in specific and generic form, ranging from the Lower Eocene up to the Lower Miocene period, and in size from a rabbit to a hippopotamus. The Eocene species, except one termed *diplopus*, have not lost the lateral digit, and are included in the genus *Hyopotamus*. The division of the Ungulata into *Paridigitata* and *Imparidigitata* must have occurred about the cretaceous period, as shown by the diversity exhibited by both groups from the lowest Eocene. The former, the *Paridigitata*, split very anciently, perhaps in the chalk, into those with tubercular, and others with crescentic teeth. These groups, once separate, kept entirely apart, but frequently followed parallel lines of descent. Following these two divergent lines of descent, both groups culminate at the present time in such forms as *Phacochærus* and *Dicotyles* for one group, and the *Bovide* for the other, links between these being absent. The *Paridigitata* with crescentic teeth will be termed *Par. selenodonta*, and those with tubercular *Par. bunodontata*. To the first group belong *Anoplotherium*, *Liphodon*, *Hyopotamus*, and others, together with the existing ruminants, whilst the second embraces the *Suina*, *Hippopotamina* and *Entelodon*. There is in some cases difficulty in deciding whether the teeth are tubercular or crescentic, the lobes being so thick.

It is important to find some osteological characters to confirm the above division, and the hand and foot from their variations suggested probable data. In tracing the *Paridigitata* in time, there is a marked tendency to the gradual reduction of the manus and pes, and an advantage to the individual apparently arises from the simplification. By comparison of all forms, a simple structure of the manus and pes may be obtained, such as was probably possessed by the common ancestor, and such a type is nearly retained by *Hippopotamus*, and was possessed by *Hyopotamus*. In none of these forms is the limb pentadactylate. Supposing the feet to be pentadactylate, the following is the disposition of the digits in the type:—The two outer digits (the fourth and fifth) are always supported by one bone, the unciform in the manus, and the cuboid in the pes; the three succeeding inner digits are supported each by a separated bone, the third, second and first cuneiform in the pes, and the os magnum, trapezoideum, and trapezium, in the manus. In the latter the third digit touches the unciform, and the second the magnum; the second digit of the pes touches the third cuneiform. The first digit being lost in all Ungulata, the trapezium and first cuneiform support the second digit.

Beginning with this type, which was probably exhibited by the progenitors of the *Paridigitata*, the reduction along both lines of descent may be followed, and in doing so a series of parallel modifications may be obtained, though it is found among the crescent-toothed line that the reduction is much more rapid than along the tubercular toothed. By reduction of the foot is meant that locomotion is carried on by the two middle toes instead of by the original four; and this seems to be an advantage to the organism, as it is exhibited by all descending lines of Ungulata. Going further into detail, it is found that both in *Selenodont* and *Bunodont Paridigitata*, a two-fold method of reduction of the manus and pes, a simple or *inadaptive*, and an elaborate or *adaptive* method is observed. In the first or *inadaptive* mode of reduction, the foot, whilst losing its lateral digits, acquires no better adaptation to altered circumstances of locomotion than is derived from the mere thickening of the remaining digits. The relation between the carpal and tarsal bones, and the remaining two metacarpal and metatarsals, remains unaltered, and the remaining digits do not enter into any modification by which they can receive more ample support from the carpal and tarsal bones, by taking the place formerly occupied by the reduced digits. *Anoplotherium*, *Liphodon*, and *Hyopotamus*, are examples of this method of reduction.

In the second or *adaptive* method of reduction, the middle digits grow larger and thicker than in the first mode; but while broadening transversely they do not adhere to the ancestral type, but tend to gain a support on all the bones of the carpus and tarsus, pushing the lateral digits to the side and thereby gaining a better and more complete support for the body. The lateral digits, being rendered useless, tend to disappear, and the remaining digits, being pressed from both sides by the carpal and tarsal bones, tend to coalesce to form the *canon* bone of recent ruminants, or of the hind foot of *Dicotyles*. In this, the *adaptive* method, modification keeps pace with inheritance, and examples of it may be seen in *Sus*, *Dicotyles*, *Hyemoschus*, and the Ruminants.

All extinct Paridigitata follow the first or *inadaptive* mode of reduction, whilst all living genera follow the second. Did the former not become extinct because of their incapacity to adapt themselves to altered circumstances, and the latter survive from being able to adapt themselves more fully to those circumstances? From an examination of fossil remains, it is found that the Paridigitata, of the genus *Hyopotamus*, were Selenodonta of the *inadaptive* line of descent, inheritance in them being stronger than modification. Among the Bunodonta following the *inadaptive* method, the old representatives are but little known, *Lisbriodon* and *Elotherium* being the most certain, and the latter apparently didactylate.

Following the adaptive method, among the Selenodonta are *Charotherium*, *Paleocharus*, and the Swine, and the culminating or most reduced stage is not yet reached among the *Suina*, but it is certainly the direction in which they tend. Among the Bunodonta there is great difficulty in tracing the line of descent whence originate the Ruminantia. From the existence of *Hyamoschus* we may predict that they were originally tetradactylate, and there are many other intermediate conditions, as *Tragulus* and *Gelocus*.

"Magnetic Survey of Belgium in 1871." By Rev. S. J. Perry.

The magnetic observations which furnished the results contained in this paper were made during the Autumn months of 1871.

The instruments used and the methods adopted were almost identical with those employed in previous magnetic surveys of France.

The dip was observed by Mr. W. Carlisle, magnetic assistant of Stonyhurst Observatory, and the rest of the observations were taken by the Rev. S. J. Perry.

This new series of determinations of the terrestrial magnetic elements was rendered the more necessary, as preceding observers had chosen very few stations in Belgium, and as the curvature of the isodynamics and isoclinals in Dr. Lamont's maps of Belgium, Holland, and North-west Germany, indicated a very considerable disturbing cause in the first-named country.

The values obtained in 1871 are a strong confirmation of the suspicions of irregularity, to which former observations had given rise. For although the lines of equal dip, declination, and horizontal force bear a sufficiently close resemblance to those of neighbouring countries, there is evidence of much disturbance; and when the values of the dip and horizontal force are combined, the isodynamics show clearly that the coal-measures, which stretch completely across the south east portion of Belgium, exercise a strong disturbing influence. This local magnetism might be incapable of producing more than a decided curvature of the isodynamics of an extended tract of country; but when all the stations of observation are situated within narrow limits, the perturbation completely masks the normal direction of the lines.

The following is a complete list of the magnetic elements observed at the different stations, and reduced to the common epoch of January 1, 1872.

Station.	Declination.	Dip.	Horizontal force.	Intensity.
Aix-la-Chapelle..	16°464	66°637	4°0064	10°1025
Alost	17°349	67°210	3°9518	10°2016
Antwerp	17°489	66°999	3°9296	10°0559
Arlon	16°398	65°907	4°1175	10°0857
Bruges	17°938	67°155	3°8950	10°0321
Brussels	17°959	66°975	3°9613	10°1271
Courtray	17°756	66°678	4°0028	10°1103
Ghent	17°823	67°221	3°9197	10°1232
Liège	16°233	66°464	4°0145	10°0522
Lierre	—	66°948	—	—
Louvain	16°824	66°898	3°9565	10°0828
Mechlin	—	66°714	—	—
Mons	17°216	66°573	4°0065	10°0767
Namur	17°541	66°538	3°9941	10°0311
Ostend	18°097	67°211	3°9152	10°1077
Spa	16°627	66°653	4°0239	10°1531
Tournay	17°691	66°632	3°9975	10°0776
Tronchiennes	17°867	67°361	3°9032	10°1397
Turnhout	17°025	66°113	3°9542	10°1665
Verviers	—	66°718	—	—
Secular variation	-0°1255	-0°0573	+0°00542	-0°01155

Zoological Society of London, February 4.—Professor Huxley, F.R.S., V.P., in the chair.—A letter was read from

Mr. Henry W. Piers, late acting curator of the South African Museum, Capetown, containing remarks on a specimen of the *Chimera australis*.—Mr. E. Blyth exhibited and made remarks on some Tiger Skins from India, Burma and Siberia.—A communication was read from Mr. R. Meldola, containing remarks on a certain class of cases of variable protective colouring in insects.—A communication was read from Mr. G. Gulliver, F.R.S., containing a series of measurements of the Red Blood Corpuscles of various Batrachians.—A paper was read by Dr. A. Günther, F.R.S., containing an account of certain species of Reptiles and Batrachians, obtained by Dr. A. B. Meyer in Celebes and the Philippine Islands.—A communication was read from Mr. A. G. Butler, containing a monographic revision of the genera *Zephronia* and *Sphaerotherium* of the sub-order Myriopoda, together with descriptions of some new species of these genera.—A communication was read from Mr. G. French Angus, containing descriptions of eight species of Land and Marine Shells from various localities.—Messrs. P. L. Sclater and Osbert Salvin read the sixth of a series of papers on Peruvian Birds, collected by Mr. H. Whately, in the Andes of Peru. The present communication contained an account of eighty species, collected principally at Cosnipetz, in the province of Cuzco.—A communication was read from Mr. H. Whately, containing notes on the Humming Birds collected and observed by him in the Andes of Peru.—A communication was read from Dr. J. E. Gray, F.R.S., on the genus *Ocadia*, which he considered should be referred to the family *Bataguridae*.

Chemical Society, February 6.—Dr. Williamson, F.R.S., vice-president, in the chair.—A communication was made by Dr. H. E. Armstrong "On the action of Sodium on Aniline."—A paper on "Anthrappurpurine," by Mr. W. H. Perkin, was then read by the author. Anthrappurpurine is a colouring matter which accompanies alizarine in the crude "artificial alizarine," now so largely manufactured and employed in dyeing instead of madder. Like alizarine it is capable of imparting brilliant and fast colours to cloth mordanted with alumina or iron.—A paper was also read by Dr. C. R. A. Wright on "Isomerism in the terpene family of hydrocarbons." In it he gives an account of his experiments with oil of nutmegs and oil of orange-peel.

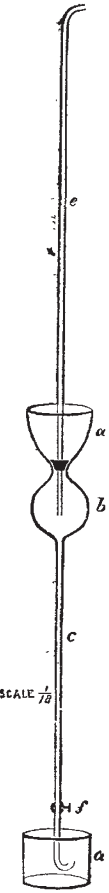
Anthropological Institute, Feb. 4.—Col. A. Lane Fox, vice-president, in the chair.—Mr. W. L. Distant read a paper on the inhabitants of Car Nicobar. "The people of Car Nicobar are taller than the average Malay, and darker in the colour of the skin. Their faith in a good spirit is slight, and in an evil spirit, which is invested with a personality, is strong. Their honesty is so well known that traders at once deliver their stores on the promise of these islanders to pay the necessary number of coconuts in return; and the promise is always fulfilled. They take but one wife, and adultery is severely punished.—A paper by Mr. J. E. Calder was read on the extirpation of the native tribes of Tasmania." The author who had had the advantage of above forty years' experience of the Tasmanians, entered very fully into their physical and mental characteristics, habits, customs, and modes of warfare, and the causes which led to the rapid extinction of all the tribes. They were intelligent, capable of considerable culture, and showed every disposition to become civilised; but the abundant supply of food induced indolence, which, together with the sudden and violent change of habit from savage to civilised life was one of the chief causes of extinction. The chairman announced the appointment of a Committee of Psychological Research.

Entomological Society, January 27, Annual Meeting.—Professor Westwood, president, in the chair. Statement of treasurer's account for 1872 read, and report of council.—Professor Westwood was re-elected as president for 1873, Messrs. S. S. Saunders, G. H. Verrall, C. O. Waterhouse and J. J. Weir, new members of council; Mr. McLachlan as treasurer; Messrs. F. Grut and G. H. Verrall, secretaries, and Mr. E. W. Janson as librarian.—he president delivered an address on the progress of entomology during the past year.

Geologists' Association, Feb. 7.—The Rev. T. Wiltshire, M.A., the retiring president, in the chair.—Henry Woodward, F.G.S., was elected president for 1873; and Robert Etheridge, F.R.S., Prof. Morris, F.G.S., James Thorne, F.S.A., and the Rev. T. Wiltshire, M.A., vice-presidents. Messrs. W. Hislop, J. L. Lobley, and A. Bott were re-elected treasurer, honorary secretary, and honorary librarian respectively. The report for the year 1872 shows the association to be in a flourishing state, and was unanimously adopted.

MANCHESTER

Literary and Philosophical Society, Dec. 24, 1872. —The president, Dr J. P. Joule, F.R.S., drew attention to the increasing number of cases of hydrophobia. There was every reason for believing that this dreadful disorder was communicated from one animal to another by a bite, and seldom, if ever, was spontaneously developed. Inasmuch therefore as the effects of a bite nearly always occurred within four months, it would only be necessary to isolate all dogs for that period in order to stamp out the disease. That was the opinion of Dr. Bardsley, whose elaborate paper will be found in the fourth volume of the Memoirs of the Society, and probably gave rise to the practice of confining dogs at certain periods of the year, which has unfortunately been rendered to a great extent nugatory in consequence of having been only partially adopted.



Jan. 7.—The president referred to the great loss which the Society had experienced by the death of one of its most distinguished honorary members, Dr. Rankine; called away in the prime of life, his loss is one of the most severe that could have befallen science.—Mr. William H. Johnson called attention to the action of sulphuric and hydrochloric acids on iron and steel. If after immersion for say ten minutes in either of these acids a piece of iron or steel be tested, its tensile strength and resistance to torsion will be found to have diminished. Exposure to the air for several days, or gentle heat will, however, completely restore its original strength. Prolonged immersion in acid has a tendency to produce a crystalline structure in even the best wrought iron.

Jan. 21.—The president explained a simple apparatus by means of which a very high degree of rarefaction of air could be produced with much facility, and which might in some circumstances be found preferable to the common air-pump or even the Sprengel. It consists of a glass funnel *a* surmounting a globe *b*, from the lower part of which a tube *c* descends to a jar of mercury *d*. The tube *c*, in connection with the receiver to be exhausted, is furnished with a vulcanised india-rubber plug which fits into the neck of the funnel. In using the apparatus the stopcock *f* is shut and the funnel filled with mercury. Then by lifting the tube *e* with its plug, the mercury fills the globe *b* and the pipe *c*. The tube *e* is then replaced, and the stop-cock being opened, the mercury descends in *c*, emptying the globe. By returning the mercury into the funnel by means of a pump, or more simply, by lifting the jar *d*, the process is repeated until the requisite degree of rarefaction is produced.

PARIS

Academy of Sciences, Jan. 27.—M. de Quatrefages, president, in the chair.—M. A. Trecul read the second part of his paper on the carpillary theory of the Papaveraceæ. This portion of the paper treats of *Glaucium* and *Eschscholtzia*.—M. Boussingault read a note on alimentary substances preserved by cold. The author exposed several articles of food to a temperature of -20° for several hours in closed flasks; this was in 1865. The substances are now perfectly sound and free from putrefaction.—M. Th. Lestiboudois read the continuation of his paper on the structure of the *Heterogena*.—M. Marès read a note on the vine sickness characterised by *Phylloxera*. The paper was referred to the commission on that subject.—A letter from M. I. Pierre on the determination of the boiling point of liquid sulphurous anhydride was then read. The method consists in introducing a thermometer, through a pierced cork, into a thin tube containing the anhydride. Another hole in the cork holds an exit tube; the apparatus is then suspended in the air, the SO_2 begins to boil, and the thermometer is then read.—M. Faye presented M. Heis's "Atlas cœlestis novus," and made some quotations from it on the number of stars visible to the naked eye; the author can see many stars put down by other astronomers as of the 7th or 8th magnitude.—M. L. d'Henry read a paper on the use of the mono-chromatic

sodium light in observing the tints of litmus in alcalimetry. The author finds that this reaction is much more easily seen by the yellow light.—M. Ch. Valsen sent a note on the modulus of refrigerating power in saline solutions.—MM. C. Friedel and R. D. Silva sent a note on a new tertiary alcohol, &c.; M. H. Joulie a note on the commercial estimation of nitrates; and M. M. Gayon one on the spontaneous alteration of eggs; the author finds the putrid eggs full of vibriones; he intends to seek for the origin of these bodies.—M. Gréyhant sent a note on the estimation of carbonic oxide combined with hæmoglobin.—M. F. Pisani sent a paper on the analysis of Jeffersonite from New Jersey, and on the analysis of Arite from Mount Ar (Basses Pyrenées).—M. S. Chautrain sent a paper on the reproduction of eyes in the crayfish. The author has cut out the eyes of the crustacean, and finds that they grow again in about eleven months.

DIARY

- THURSDAY, FEBRUARY 13.
 ROYAL SOCIETY, at 8.30.—On Curvature and Orthogonal Surfaces: Prof. Cayley—On a New Relation between Heat and Electricity: Prof. Guthrie
 SOCIETY OF ANTIQUARIES, at 8.30.—On a Brass Bowl of the 12th century: T. A. Gardiner—On Early Deeds and Charters: R. H. Wood.
 MATHEMATICAL SOCIETY, at 8.—On Systems of Linear Congruences: Prof. H. J. S. Smith.—Application of the Hodograph to the Solution of Problems on Projectiles: J. Macleod.
 FRIDAY, FEBRUARY 14.
 ASTRONOMICAL SOCIETY, at 8.—Anniversary.
 ROYAL INSTITUTION, at 9.—On Recent Progress in Weather Knowledge: R. H. Scott.
 QUEKETT CLUB, at 8.
 SATURDAY, FEBRUARY 15.
 ROYAL INSTITUTION, at 3.—Comparative Politics: Dr. E. A. Freeman.
 SUNDAY, FEBRUARY 16.
 SUNDAY LECTURE SOCIETY, at 4.—Pre-Historic Fortifications: Lawson Tait.
 MONDAY, FEBRUARY 17.
 LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.
 ENTOMOLOGICAL SOCIETY, at 7.
 ASIATIC SOCIETY, at 3.
 COLLEGE OF SURGEONS, at 4.—Osteology and Dentition of Extinct Mammalia, with their Geological and Geographical Distribution, &c.: Prof. Flower (Hunterian Lectures)
 TUESDAY, FEBRUARY 18.
 ANTHROPOLOGICAL INSTITUTE, at 8.—Note on the Macas Indians: Sir John Lubbock, Bart.—On the Relation of the Parish Boundaries in the South East of England to Great Physical Features: William Topley.
 ZOOLOGICAL SOCIETY, at 8.30.—Report on the Hydroïda collected during the Expeditions of H.M.S. Porcupine: Prof. G. J. Allman.—On (Egithoughous Birds: W. K. Parker.—Notes on the Anatomy of the Binturong (*Arctictis binturong*): A. H. Garrod.
 ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.
 WEDNESDAY, FEBRUARY 19.
 SOCIETY OF ARTS, at 8.
 METEOROLOGICAL SOCIETY, at 7.—Description of an Electrical Self-rectrating Anemometer and Rain-gauge: Fenwick W. Stow.—On the Madras Cyclone of May 2, 1872: Capt. H. Toynebee.—On the Character of the Storm of August 21-23, 1868, over the British Isles: Capt. T. O. Watson.—On some Results of Meteorological Telegraphy: Robert H. Scott.
 LONDON INSTITUTION, at 7.—Paper and Discussion.
 COLLEGE OF SURGEONS, at 4.—Hunterian Lectures.

BOOKS RECEIVED

- ENGLISH.—On the Miracle recorded in Joshua x.: Rev. E. Biley (Hatchard).—Lessons on Elementary Anatomy: St. G. Mivart (Macmillan).
 FOREIGN.—Annuaire de l'Académie Royale de Belgique, 1873.—Lehrbuch der Physik: 2nd part, 1873.—Fauna der Kieler Bucht, vol. ii.: H. A. Mayer and R. Robins (Englemann: Leipzig).

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ERRATUM.—No. 171, p. 275, 1st col., line 7 from bottom: for "boiled Bacteria" read "living Bacteria."