THE BRITISH ASSOCIATION

SECTIONAL PROCEEDINGS

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE

On the Temperature of the Air at four feet, twenty-two feet, and fifty feet high.—J. Glaisher, F.R.S. In his opening remarks, Mr. Glaisher spoke of the erroneous opinions which were entertained previous to his balloon ascents with regard to temperature at different heights; it was supposed that the temperature of the air always decreased from the earth upwards, and followed some constant law; this was, however, found not to be the case; and in the Report to the British Association at Nottingham, in 1866, the conclusions were, "that the law of decrease of temperature with increase of elevation was variable throughout the day, and also in different seasons of the year; that at about sunset the temperature was sensibly the same up to 2,000 feet; and that at night (conjectures from the results of the observations taken in the only two night ascents) the temperature of the air increased from the earth upwards." It was therefore evident that a very large number of ascents would have to be made to determine the real laws.

Fortunately, in the second year of the balloon experiments, he placed a dry and wet bulb thermometer at the height of 22 feet above the ground, readings of which have been taken four times daily, viz. at 9 P.M., noon, 3 A.M., and at 9 P.M. Although from these observations, and also from those made at the different ascents, it was known that sometimes readings at the higher point were above those at 4 feet from the ground, no particular attention was paid to the above readings until after the results of the observations made in M. Giffard's Captive balloon were known; these, however, were of such importance, proving that "the decrease of temperature with increase of elevation had a diurnal range, and was different at different hours of the day, the change being greatest at mid-day, and least at or about sunset (see Report to the B. A. for 1869 at Exeter), and that sensible changes occurred within 30 feet of the earth," that Mr. Glaisher caused the observations taken at the height of 22 feet to be reduced; collecting the observations recorded during the period 1867-1870, the differences between the readings of the two thermometers were taken, and affixing the sign *plus* (+) to the difference when the temperature at the higher elevation exceeded that at the lower, and the sign *minus* (−) when *vice versâ*.

On taking the monthly means of these differences, it was proved that the *mean temperature* of the air at 22 ft. high differs from that at 4 feet by:—

	9 A.M. deg.	Noon. deg.	3 P.M. deg.	9 P.M. deg.
In January	+ 0·5	+ 0·2	+ 0·4	+ 0·6
,, February	+ 0·2	0·0	+ 0·4	+ 0·5
,, March	— 0·3	— 0·2	0.0	+ 0·4
,, April	— 0·6	— 0·5	+ 0·2	+ 0·5
,, May	— 0·6	— 0·4	— 0·4	+ 0·5
,, June	— 0·8	— 0·9	— 0·6	+ 0·8
,, July	— 0·8	— 0·8	— 0·8	+ 0·7
,, August	— 1·0	— 0·5	— 0·1	+ 0·9
,, September	— 1·0	— 0·6	0·0	+ 0·7
,, October	— 2·2	— 0·1	+ 0·6	+ 1·0
,, November	+ 0·2	+ 0·1	+ 0·6	+ 0·8
,, December	+ 0·5	+ 0·3	+ 0·4	+ 0·4

Therefore the monthly mean temperature of the air at 22 feet was higher than at 4 feet, at all hours of the day and night, in January, February, November, and December; in the afternoon and during the night hours in the months of March, April, August, September, and October; in the evening hours and during the night, in the months of May, June, and July; and that the results in one year agreed very closely with those in the same months in other years.

By selecting the largest number with a + sign, and the largest with a — sign in each month, it was found that in the winter months the temperature at 22 feet high ranged from 2° to 4° above, and from 1° to 2° below that at 4 feet, and in the summer months from 4° to 5° above and from 4° to 5° below that at 4 feet high.

The ratio of — readings to + was, in January and February as 1 to 5 at all hours. In March, April, August, and September, during the day, one of equality. In May, June, and July, as 3 to 2 during the day hours. In October, as 1 to 4; in November, 1 to 7; and in December, as 1 to 10. At the hour of 9 P.M. throughout the year, it was as 1 to 7.

Thus the — sign preponderates, indicating lower temperature above, during the day hours, in the months of May, June, and July; the two signs are about equal in number in the months of March, April, August, and September, and the + sign preponderates, denoting higher temperature during the day and night, in January, February, October, November, and December, and during the night throughout the whole year.

A second thermometer, carefully protected from radiation, was placed in the middle of the year 1869 at the height of 50 feet, and since then its readings have been regularly taken.

The *mean monthly temperature* of the air at 50 feet high was found to differ from that on the ground as follows:—

1869	9 A.M. deg.	Noon. deg.	3 P.M. deg.	9 P.M. deg.
In October	+ 0·2	— 0·5	+ 0·7	+ 1·5
,, November	+ 0·6	+ 0·5	+ 0·8	+ 1·4
,, December	+ 0·9	+ 0·3	+ 0·5	+ 0·5
1870				
,, January	+ 1·1	+ 0·3	+ 0·7	+ 0·9
,, February	+ 0·1	— 0·3	+ 0·3	+ 0·5
,, March	— 0·3	— 1·8	— 0·7	+ 0·7
,, April	— 0·9	— 2·2	— 1·7	+ 1·4
,, May	— 2·4	— 3·6	— 2·8	+ 1·1
,, June	— 2·4	— 3·8	— 3·1	+ 1·1
,, July	— 1·8	— 2·9	— 2·8	+ 1·1
,, August	— 1·7	— 2·7	— 2·0	+ 1·7

Thus we have the unexpected results that the *mean monthly temperature* of the air at 22 feet and at 50 feet high is higher during the evening and night hours throughout the year than at the height of 4 feet, and also higher night and day during the winter months.

In conducting the above investigation, it was known that the clouds had great influence on the temperature; Mr. Glaisher therefore selected those days with a sky covered with dense clouds, and it was found that there was on such days no difference between the temperature at the heights of 4, 22, and 50 feet. At the height of 50 feet, in the summer months, the temperature during the day was frequently 6° or 7° lower, and at night 5° or 6° higher than at 4 feet.

SECTION B.—CHEMICAL SCIENCE

Experiments on the Preservation of Building Stones.—Prof. A. H. Church, M.A.

This paper gave a brief account of a process for preserving stone in which solution of monocalcic phosphate, barium hydrate, and dialysed silica are successively employed. Very numerous and extensive experiments have been made with this process upon public and private buildings. The New Midland Terminus, St. Pancras, has been treated with these solutions, and so have the Chapter House, Westminster, and portions of Canterbury Cathedral and the Houses of Parliament. The process is now the property of the Patent Concrete Stone Company.

Contributions to Mineralogical Chemistry.—By Prof. Church, M.A.

The author gives an account of his researches into the constitution of numerous mineral species. The paper gives a list of the nine species which he has discovered, including the rare cerium phosphate from Cornwall. The paper also contains the chief results which its author has obtained in the analyses performed by him during the last seven years with a view to the revision of the formulæ of the mineral phosphates and arseniates. References to the original memoirs are given under the description of each mineral. Prof. Church lays great stress, in the prefatory remarks to his paper, on the importance of ascertaining the hygroscopic water of minerals, and of obtaining the samples for analysis in a state of freedom from admixture by foreign and intruding bodies.

SECTION D.—BIOLOGY

Department of Zoology and Botany

Prof. Huxley, President of the Association, read a paper on the relations of *Penicillium*, *Torula*, and *Bacterium*, in which he showed the extreme probability, if not amounting to absolute demonstration, perhaps going as far towards it as the extreme difficulty of the investigation of the subject admitted, that these two latter forms were but stages of the first. Prof. Huxley gave an account of his experiments and researches, which were carried on with extreme care, and mentioned that he had become convinced that the movements of the minute germs so much alluded to by experimenters was to be accounted for by the explanation that it was the well-known Brownian movement. The bearing of this important paper seemed to be to account for the presence of Bacteria on more ordinary principles than those of spontaneous generation.

Mr. A. W. Bennett read a paper on the *Theory of Natural Selection, looked at from a Mathematical Point of View.**

Prof. Huxley paid a high compliment to the author of this paper, which he said was the first that he could recollect having heard read at Section D, which, taking up the side against Mr. Darwin, still did so in a proper and philosophic manner. He had often mentioned objections that had struck him to Mr. Darwin, who always, however, had ready a quiver full of facts which generally settled the question, and he thought it probable that when Mr. Darwin read Mr. Bennett's paper, he would have a few facts ready which might alter his view of the case.

Dr. Anton Döhrn read a paper on the *Foundation of Zoological Stations.* In this he insisted on the importance of there being zoological stations throughout the world, just as there now were meteorological and astronomical stations. The author mentioned that he had commenced at his own cost the establishment of one such station at Naples. In it he would have large and small aquaria, a constant flow of salt water, microscope rooms, and there would be a resident working zoologist, a library, and a series of bed-rooms for foreign naturalists. At this station, not only would collections of living marine animals be made for purposes of study and for supplying the aquaria of Florence, Berlin and Vienna, but a collection in spirits would also be kept to supply working zoologists at a distance with the means of research. The President of the Section, Professors Newton and E. Perceval Wright, spoke strongly in favour of the station to be established at Naples, and expressed the hope that perhaps at some future day others would be established at such outposts as Dingle in Ireland, Aden in the Red Sea, &c. &c.

Dr. J. Barker read a paper in which he described an interesting little Infusorium called *Pleuronema doliarium.*

Professor Dickson read notes *On the Embryo of the Date Palm.* The author criticised the descriptions given in the books where the slit of the cotyledon is represented sometimes as a transverse fissure near the upper part of the cotyledon (Schnizlein's Iconographia), or as a vertical one near the upper part (Le Maôut and Decaisne). Dr. Dickson described the slit as a vertical one, situated near the base of the cotyledon, and called attention to the fact that there was here no fixed relation between the medial plane of the cotyledon and that of the seed, an exception to the general rule for monocotyledons, as laid down by Hofmeister, to the effect that in vertical seeds (erect or pendulous) the medial plane of the cotyledon coincides with that of the seed, while in horizontal seeds the plane of the cotyledon is at right angles to it.

Mr. Tyerman exhibited drawings of a young healthy plant of the double cocoa-nut (*Lodoicea sechellarum*), which he had succeeded in growing at the Botanical Gardens, Liverpool. He mentioned that he had some difficulty in keeping the strangely elongated basal portion of the cotyledon from penetrating too deeply into the ground, but after it had grown to a distance of some two feet, the germ developed a single sheathing leaf, and then shortly afterwards two of the ordinary characteristic leaves of the plant made their appearance.

Profs. Balfour and Wright congratulated Liverpool on having such an interesting collection of plants as that they had seen at their Botanical Gardens, and on having so able and intelligent a curator as Mr. Tyerman, and hoped that when next they visited Liverpool they would find at the gardens a range of glass worthy of the gardens and of the most interesting collection of plants at present preserved in a few tumble-down houses.

On the Staperaythr Whale of the Icelanders.—Mr. Bird.

On the Affinities of the Sponges to the Corals.—Mr. W. S. Kent. The author criticised the views of Haeckel.

On the Effects of the Pollution of Rivers on the Supply of Fish.—Sir James Alexander. This paper gave rise to a lengthened discussion.

Mr. Moore, director of the Liverpool Museum, exhibited some of Captain Mortimer's Sea Aquaria, by means of which he had been enabled to transport from the tropics many delicate marine fishes, crustacea, and sea anemones. He also exhibited a young Lamatin and the jaw of a fish, the rami of the mandible of which, instead of being united by a ligamentous union and forming a bony symphysis, were most compactly hinged together, admitting of a considerable amount of lateral motion. Mr. Moore also exhibited a stuffed skin of that most wonderful shark from the Seychelles, called *Rhinodon typicus.* This was the only perfect specimen known in any museum. This shark, which grows to the length of 50 feet and upwards, was known to Mr. Swinburne Ward, late Civil Commissioner of the Seychelles, as common off those Islands. But it was not known to be described until identified by Prof. E. Perceval Wright as the *R. typicus* of Smith.

A Statement in Reply to two Objections of Prof. Huxley relative to certain Experiments.—Dr. Bastian.

Department of Anatomy and Physiology

On Some of the more Important Facts of Succession in Relation to any Theory of Continuity.—Dr. Cobbold. This paper—which by permission had been transferred from the Department of Zoology and Botany—Dr. Cobbold stated, was generally of an elementary character. He said that for several years past the Biological Section of the Association had permitted, if it had not actually encouraged, the reading and discussion of papers having for their object the popularising (or it might be the unpopularising) of the theory of natural selection. To many besides himself the separate papers and remarks which followed were eminently unsatisfactory, perhaps arising not so much from any want of ability on the part of the authors as from the unscientific method adopted by them. The discussion which followed the reading of the Rev. F. O. Morris's paper at Norwich, "On the Difficulties of Darwinism," was lamentable in the extreme; for, so far as could be gathered, not one of those who sympathised with the reverend gentleman's position had the courage to advance a single fact in favour of the view which his "difficulties" were intended to support. At Exeter Mr. Morris renewed his exposition, but a much more vigorous effort in the same direction was made by the Rev. A. Freeman. The severity of the criticism which followed these final literary efforts in aid of anti-evolutionism could only be understood by those who were present; but the general conclusion of scientific authorities was significantly expressed in the statement made more than once to the effect that "neither of the papers ought to have been read." For his part, he thought the utmost freedom should be allowed to all desirous of opposing this or that theory; yet it should be thoroughly well understood that the sectional committee deprecated the employment of quotations from the Scriptures calculated to excite religious prejudice. A purely scientific question could only be satisfactorily discussed on a scientific basis—unless, indeed, it was insisted that theological speculations were inseparable from the domain of science. He then went on to say that to the mass of so-called educated men the acceptance of the views set forth by Mr. Darwin in his work "On the Origin of Species" must naturally present a variety of difficulties, and it appeared to him (Dr. Cobbold) that the best and truest way of showing an intelligent sympathy with those who were so situated, was to select and present some natural group of observed facts in such a clear and, if possible, attractive light, that common sense alone might be trusted to recognise the reasonableness or otherwise of honestly asserted deductions. The facts he had selected for exposition were such as represented what might be termed the apparent chronology of the organic series, or, in other words, the ascertained times of the coming and flourishing of the larger animal groups. A true conception of what was or ought to be understood by the expression "equivalences"—botanical, zoological, or geological—lay at the very basis of a correct appreciation of the significance of the records of animal, vegetable, or sedimentary rock distribution throughout all time. Further, he ventured to assert that the grandeur of the formative scheme of nature, whether testifying to an evolutionary method of production or to a series of creative acts, few or many in number, could only be adequately realised by the naturalist whose powers of allocation and grouping enabled him to grasp the magnitude and infinite import of those relations. Dr. Cobbold said he had insisted upon equivalency for years past. He then proceeded to deal with the facts of succession, and said the earliest organism as regarded time which geology had revealed was the fossil called Eozoon, which belonged to the lowermost division of the animal series. Dr. Cobbold then described the succession of the various known groups, and, glancing at the times of origin and suc-

* This paper will be found in full at p. 30.

cession of the placental mammals, said the first thing that the record suggested was the rapidity with which the most divergent groups made their appearance. Of course, there was no real basis for an assumption of a coeval creation, so to speak. It might be fairly held, on zoological grounds, that we ought not to separate man and monkeys, but retain them as one of the twelve groups under the ordinary title of primates. He adopted the division of the placental into twelve groups, not from any rigid belief as to their separate equivalences, but because they were not only sufficiently distinctive for all practical purposes, and also formed on the whole perhaps the finest expression of grouping which science could at present afford. After dwelling at great length upon the succession of the various groups, he stated that as regarded the highest of all, the placental series, he would only say that, as he understood the doctrine, the strictest demand of the development theory did not require, as was too commonly supposed, a lineal descent as between bimana and quadrumana; but it was certainly held that either of these groups, as we now knew them, might have been separately evolved from more generalised primatal types, the intermediary terms being possibly connected by a long antecedent and far more generalised common progenitor. In that connection the most advanced evolutionist must candidly own that the assumedly missing tertiary primatals constituted a great and very natural bar to the complete and popular acceptance of the theory of descent by natural selection. On the other hand, the scientific naturalist, whilst admitting these serious deficiencies, threw into the opposite scale a multitude of considerations, the collective value of which seemed to him to outweigh all the data thrown into the anti-continuity side of the balance. For himself, in conclusion, he said that his necessarily limited application of those data was amply sufficient to enforce upon him the provisional acceptance of any theory of continuity. To his mind, its clear application irresistibly implied that nature, to use an old phrase, was but a series of harmonies—wheel within wheel, there being probably but one wheel differing only from all the wheels of whose limits it was not possible for them to conceive. However, in the contemplation of the phenomena presented to them within that wheel—or that realm of "orderly mystery," as the president had called it—there was ample room and verge for the display of the highest physiological attributes with which man was endowed.

Department of Ethnology and Anthropology

The report *On the Heat Generated in the Blood in the Process of Arterialisation*, by Dr. Arthur Gamgee, was taken as read.

New Physiological Researches on the Effects of Carbonic Acid.—Dr. B. W. Richardson. The author explained that the observations he had made were new in that they related to the direct action of carbonic acid on animal and vegetable fluids, and they were interesting, equally to the zoologist and botanist as to the anatomist. The author first demonstrated the result of subjecting a vegetable alkaline infusion to the action of carbonic acid under pressure. The result was a thick fluid substance which resembled the fluid which exudes as gums from some trees. When the fluid was gently dried it became a semi-solid substance, which yielded elastic fibres. This observation had led the author to study the effect of carbonic acid on albumen, serum of blood, blood itself, bronchial secretion, and other organic fluids. When the serum of blood was thus treated with carbonic acid under pressure and general warmth, 96° F., the collodial part was separated; but when the blood, with the fibre removed from it, was treated, there was no direct separation, the blood corpuscles seeming for a time to engage the gas by condensation of it. But blood containing fibrine, and held fluid by tribasic phosphate of soda, was at once coagulated by the acid. The bronchial secretion is thickened by carbonic acid, and a tenacious fluid is obtained, resembling the secretion which occurs in asthma and bronchitis, while secretions on serous surfaces are thickened and rendered adhesive. After details of many other facts, Dr. Richardson concluded by showing what bearing this subject had of a practical kind. In the first place, the research had relation to the question of elasticity of organic substances; and, secondly, on the direct action of carbonic acid in the production of vegetable juices. But the greatest interest concentrated on the relation of the research to some of the diseases of the animal body. Thus in instances where the temperature of the body is raised and the production of carbonic acid is excessive, the blood on the right side of the heart has its fibrine often precipitated, and in many other cases fibrinous or albuminous exuded fluids are solidified, as is the case in croup. The author, in the course of his paper, explained how rapidly blood charged with carbonic acid absorbed oxygen when exposed to that gas, and he held that carbonic acid in the venous blood was as essential to the process of respiration as was the oxygen in the pulmonary organs.

SCIENTIFIC SERIALS

Journal of the Chemical Society, October, 1870.—The first paper in this number is by Dr. Divers, "On the Precipitation of Solutions of Ammonium Carbonate, Sodium Carbonate, and Ammonium Carbamate by Calcium Chloride." These results obtained by Dr. Divers are the following:—Calcic carbamate is soluble, and the presence of ammonia retards its transformation into carbonate. When carbonic anhydride is passed into an ammoniacal solution of calcic chloride, the carbamate is first formed, and is gradua ly precipitated as carbamate. This paper is followed by nearly two pages of Addenda et Corrigenda to the author's previous memoir.—"On the Manipulation of Gold and Silver Bullion," by Charles Tookey, Assayer in the Japanese Imperial Mint, formerly in the Royal Mint, Hong Kong. In this paper the author gives descriptions of two of the processes that he has adopted. Instead of boiling the cornets in separate parting flasks, he uses a series of perforated platinum tubes, supported in a porcelain plate. A number of cornets are, by this means, simultaneously submitted to the action of the nitric acid. Secondly, in order to clean the buttons, they are placed with the lower side uppermost on a platinum plate with depressed perforated cavities, which is plunged into hot dilute hydrochloric acid, afterwards into hot water acidulated with hydrochloric acid, and lastly into pure water. The plate is then drained by placing it on porous paper and dried over a g s flame.—"On some new Bromine Derivatives of Coumarin," by W. H. Perkin, F.R.S. On adding coumarin to bromine in the presence of carbonic disulphide, allowing the solution to evaporate, and crystallising the residue from alcohol, dibromide of coumarin $C_9H_6O_2Br_2$ is obtained. When coumarin and bromine in carbonic disulphide are digested at 140°, bromo-coumarine $C_9H_5BrO_2$ and dibromo-coumarin $C_9H_4BrO_2$ are produced, and are separated by crystallisation from alcohol, in which the latter is the less soluble. Dibromo-coumarin fuses at 174°, and distils nearly unchanged. It crystallises from alcohol in small needles. Bromo-coumarin fuses at 110°, and crystallises from alcohol in transparent prisms, often beautifully curved. When heated with solution of potassic hydrate both the bromo-compounds dissolve, producing crystalline salts, probably containing the bromo-coumaric acids.—"On Organic Matter in Water," by Mr. C. Heisch. The author has observed that certain waters which are known to be contaminated with sewage matters, give rise to the formation of a microscopical fungus when a small quantity of sugar has been added, and the mixture exposed to light for a few days at the temperature of 60°-70° F. Six drops of sewage from which the solid matter had settled, were mixed with 10,000 grains of West Middlesex and New River water; to 6 oz. of the mixture 10 grains of pure sugar were added, and 10 grains were also added to 6 oz. of the water without sewage; these solutions, and some of the mixture of water and sewage, were placed at a window. The water containing the sewage and sugar became turbid in 24 hours, the other liquids remaining clear. On examining the turbid water with an $\frac{1}{8}$ inch object glass, it was found to be filled with small spherical cells, with, in most cases, a very bright nucleus, which group themselves in bunches like grapes; they then spread into strings, with walls surrounding and connecting the cells; the original cell walls afterwards break, leaving tubular threads branched together. After several days, an odour of butyric acid is perceived. One drop of fresh urine in 10,000 grains of water produced similar effects; though without the addition of the sugar, the water might be kept for weeks without becoming turbid. Filtration through Swedish paper, or boiling for half an hour, does not prevent the growth of the fungus. The water no longer exhibits this property, however, after passage through a good bed of animal charcoal, that is, if the charcoal is frequently exposed to the air. If the filtration is continuous, the filtrate soon becomes as bad as the original water.—"On the Methods for the Determination of Carbon in Steel," by Mr. W. D. Herman. The author has obtained very concordant results by burning the iron or steel in a current of oxygen, the iron is converted into ferric oxide and the carbonic anhydride collected in