

On metamorphosis and metagenesis / Professor Owen.

Contributors

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23.

WEEKLY EVENING MEETING,

Friday, February 7, 1851.

THE DUKE OF NORTHUMBERLAND, President, in the Chair.

PROFESSOR OWEN

On Metamorphosis and Metagenesis.

THE Lecturer commenced by passing under review the Linnæan characters of Minerals, Vegetables, and Animals, and the subsequent distinctions which had been proposed for the discrimination of the two latter kingdoms of nature. After discussing those founded on motion, the stomach, the respiratory products, the composition of the tissues, and the sources of nourishment, it was shown that none of these singly, define absolutely the boundaries between plants and animals; it requires that a certain proportion of the supposed characteristics should be combined for that purpose.

The individuals in which such characters are combined are specially defined members of one great family of organized beings, and the supposed peculiarly animal and vegetable characters taken singly, interdigitate, as it were, and cross that debatable ground and low department of the common organic world from which the specialized plants and animals rise; and there are numerous living beings with the common organic characters that have not the distinctive combined superadditions of either group.

Between the organic and inorganic worlds the line of demarcation may be more definitely drawn. The term 'growth' cannot be used in the same sense to signify the increase of a mineral and of an organism. The mode of increase is different: there is a definite limit to it in the organic kingdom, and something more than mere growth takes place in the progress of an organism from its commencement to maturity. This was exemplified by reference to the human subject, to the lion which acquires its mane, to the stag which gets its horns, and to the change of plumage in birds during the course of growth. The changes of form and character are still more remarkable in the kangaroo; and in the frog they are such as to have received the name of '*metamorphosis*.'

The development of the frog was traced to its exclusion from the egg in the form of a fish, with external gills, a long caudal fin, and without legs.

The internal skeleton, like the external shape, is adapted for aquatic life.

Only those parts are ossified which are to be retained in the mature state. The vertebræ are at first biconcave, as in fishes, with intervening spherical elastic balls filled with fluid: they are converted into ball and socket joints by the ossification of the sphere, and its ankylosis to the back part of the vertebræ. The pelvis and hind legs are progressively developed; and, whilst this change is proceeding, the tail is undergoing proportional absorption. The chief change in the skull of the larva is operated in the lower or hæmal arches and their appendages. The maxillary arch is widened and provided with teeth, and the horny mandibles are shed. The mandibular arch retrogrades as well as expands. The hyoidean undergoes a remarkable change of size and shape, and the branchial arches are absorbed, excepting a small portion which is converted into the hinder 'horns' of the hyoid for supporting the larynx.

The scapular arch, which at first was connected with the occiput, whilst supporting the branchial heart — its primary function, begins as soon as the fore-legs bud out, to retrograde, and the sternum is developed to complete the 'point d'appui' for the fore limbs.

The food of the larva is chiefly the soft decaying parts of aquatic plants; it has a horny beak, a long alimentary canal disposed in a series of double spiral coils: but, as its frame undergoes the changes adapting it for life on land, and a purely animal diet, the mandibles are converted into jaws and teeth, and the long spiral intestine into a short and slightly convoluted one.

Soon after the external gills have reached their full development they begin to shrink and finally disappear; but the branchial circulation is maintained some time longer upon internal gills: by anastomoses between the principal branchial vessels these are converted into the aortic arches, carotids and subclavians; the internal gills with the cartilaginous hoops supporting them are absorbed, and lungs and glottis for breathing the air directly are developed.

Thus an animal formed for moving in water is changed into one adapted for moving and leaping on land; a water-breather is converted into an air-breather; a vegetable feeder into a carnivorous animal: yet the series of transmutations are limited to the nature of the species and produce no other. The frogs that croak in our marshes are as strictly batrachian as those that leapt in Pharaoh's chamber; their metamorphoses have led to nothing higher than their original condition, as far as history gives us any knowledge of it. With each successive generation the series of changes recommences from the old point, and ends in a condition of the animal adapted to set the same series again on foot.

Having traced the principal stages in the metamorphosis of an animal from a swimmer to a leaper; the Lecturer next took an instance

where one begins life as a burrower or a crawler, and is converted into an animal of rapid and powerful flight.

Most insects quit the egg in the form of a worm, which masking, as it were, a different and higher form, is called the 'larva;' it is active and voracious — but usually falls into a kind of torpor, during which the changes take place which issue in the flying insect; during the passive stage of metamorphosis it is called a 'pupa;' the last volant stage is the 'imago.'

The chief steps in the metamorphosis were traced as they affect the outward form, the digestive organs, the circulatory, and respiratory, and nervous systems.

The main differences in the metamorphoses of insects relate to the place where, and the time during which they are undergone. The young cockroach and the little aphis, which were first acephalous and apodal, and then had thirteen equal segments, with soft unjointed legs, proceed to acquire a distinct head with antennæ, a thorax with three pairs of long jointed legs, and an abdomen, before they quit the egg; they thus enter upon active life under the guise of a crab, instead of a worm. With regard to the *Aphis*, that insect, instead of proceeding to perfect its individual development, may at once begin the great business of its existence by parthenogenetic procreation. Bonnet's experiments, which first brought to light this marvellous fact, have received uniform confirmation from all subsequent enquirers, and no natural phenomenon is now better determined.

From seven to eleven successive generations have been traced before the individual has finally metamorphosed itself into the winged male or winged oviparous female.

In Autumn, when the nights grow chilly and long, the oviparous imago completes her duty by depositing the eggs in the axils of the leaves of the plant, where they are protected from the winter frost, and ready to be hatched at the return of Spring. Then recommences the cycle of change, which being carried through a succession of individuals and not completed in a single life-time, is a 'metagenesis' rather than a 'metamorphosis.'

This phenomenon which, until very recently was deemed an exception, and a most marvellous one, in Nature, now proves to be an example of a condition of procreation to which the greater part of organised Nature is subject.

The Lecturer was inevitably limited in his choice of illustrations: and proceeded to an instance of metagenesis from the radiated sub-kingdom of animals.

The stages of this metagenesis have been best and most completely traced in the *Medusa aurita*, by Siebold, Dalyell, Sars, and others.

The first step was made by Siebold who, in 1839, traced the development of the *Medusa aurita* from the egg to a stage resembling

a ciliated monad, then to a lobed rotifer, and next to a long-armed polype.

This polype stage of the *Medusa* had been previously recognised in 1788, but without a suspicion of its true nature, by O. F. Müller, who called it *Hydra gelatinosa*.

It was next observed, and its habits more fully described, by Sir John Dalyell, in 1834, as *Hydra tuba*: and in 1836 he made known its singular metamorphoses into forms which Sars had previously described as *Scyphistoma* and *Strobila*; and Dalyell saw the spontaneous division of the latter into a pile or series of small *Medusæ*. All the stages of the metagenesis were independently noted by Sars who described them in 1841.

The difficulty of accounting for the presence of Entozoa in the interior parts of animal bodies is rapidly disappearing as the knowledge of their course of development advances.

The principal stages of this development were described in a small worm (*Menostoma mutabile*), parasitic in the air-cells, intestines, and peritoneal cavity of many water-fowl.

The ovum is converted into a ciliated monadiform embryo, which escapes from the bird, and swims about freely in the water. A clear mass may be discerned in the interior which exhibits independent movements. This body is liberated, grows rapidly, and generates in its interior a number of independent organisms provided with a cephalic speculum and a caudal appendage, referable by their form to the genus *Cercaria*. They are very active and insinuating, could even bore through the skin by the sharp needle-like armature of the head, and somehow or other do, under the guise of the *Cercaria*, again get access to the interior of the water-fowl; fall into a state of torpor; become circular flattened pupæ; and are finally metamorphosed into monastomes — a sluggish pendant parasite utterly deprived of the power of existing in water, or of gaining access, as a monostome, to the interior of any animal.

Steenstrup, who has the merit of having first grouped together and pointed out the analogies of the different stages in the animals that undergo these successive changes, generalizes the facts under the phrase of 'Alternate Generation,' and he calls the procreant larvæ 'Amme,' or Nurses, and 'Gross-amme,' or Grand-nurses. There is no particular objection to these names; but we naturally desire to know on what power the metageneses depend.

Professor Owen thought the key to the power was afforded by the process which the germinal part of every egg undergoes before the embryo begins to be formed.

A principle, answering to the pollen, that fertilizes the seed of plants, is the efficient cause of these changes: its mode of operating is best seen in the transparent eggs of some minute worms; the principle manifests itself as a transparent, highly refractive globule

in the centre of the egg : it then divides ; and each division, attracting the vitelline matter of the egg about it, divides that matter into two parts. This division is repeated with the same result, until the principle has diffused itself by indefinite multiplication through the whole yelk which then constitutes the 'germ-mass.'

The next stage is the formation of the embryo : certain of the minute subdivisions, called 'nuclei' or nucleated cells, combine and coalesce to constitute the tissues of the embryos : they are afterwards incapable of generating. If all be so metamorphosed the organism cannot procreate of itself ; but if a part only of the germ-mass be metamorphosed into tissues, the unchanged remnant may, if nutrition, heat, and other stimuli are present, repeat the same actions as those that formed the first germ-mass, and lay the foundation of future embryos.

In proportion to the amount of the substance of an organism which retains the primitive condition of cells, is the power of producing new individuals without receiving a fresh supply of the pollen-principle.

Thus in a plant, when the seed has received the matter of the pollen-filament, analogous changes take place to those that have been described in the animal egg, and the embryo plant appears in the form of the cotyledonal leaf with its radicle or rootlet. From this shoots forth another leaf with its stem : and the cellular substance of the pith with its share of the pollen-principle goes on developing fresh leaves and leaf-stalks ; until a provision for developing fresh pollen is made by transforming certain individual leaves into a higher form of the 'phyton' or elemental plant. Thus a generation or 'whorl' of leaves assumes the character of sepals, another that of petals, a third that of stamens, a fourth that of pistils : and in the two latter forms we recognize the analogues of the perfect male and female of the animal.

The development of the compound polype follows very closely the stages of the compound plant, which we call shrub or tree : the ovum, like the seed, having received the pollen-principle, is converted into countless cells and nuclei of cells by the process for diffusing that principle through, or of assimilating it with, the matter of the egg. Then certain germ-cells are metamorphosed into a ciliated integument, and the larva starts forth in a state answering to the cotyledonal leaf of the plant : the ciliated larva settles, subsides, and shoots up a stem from which a digestive polype is developed, answering to the leaf : but the pollen-force not being exhausted, a second branch and polype are developed, and so on until a preparation is made for a fresh supply of pollen-force, by metamorphosing the polype into a higher form of individual ; and this, in many compound polypes, is set free in the shape of a minute medusa.

The true nature and relation of the individual polype to the compound whole is well illustrated by the propagations of the Aphides.

By comparing with the diagrams of the metagenesis of the plant and polype, that of the *Aphis*, in which was represented the corresponding stages intervening between the ovum and the perfect male and female individuals of the *Aphis*, the analogy between these stages in the plant, the polype, and the insect, was shown to be both true and close. The microscopic fertilizing filament of the male *Aphis* answers to the microscopic pollen-filament of the male leaf or 'stamen.' The ovum of the female *Aphis* to the ovule of the female leaf or pistil: by their combination the fertile ovum results. The same processes of cell-formation ensue, and the embryo *Aphis* is formed by the combination and metamorphoses of certain of these secondary germ-cells; but it retains the rest unchanged in its interior, which may be compared with the cells of the pith of the plant, and with the cells in the corresponding more fluid part of the pith of the polype. Under favourable circumstances of nutriment and warmth, certain of these cells repeat the process of embryonic formation, and a larval individual like that from the ovum is thus reproduced; which is only not retained in connection with its parent, because the integument is not coextended with it.

The generation of a larval *Aphis* may be repeated from seven to eleven times without any more accession to the primary pollen-force of the retained cells than in the case of the zoophyte or plant; one might call the generation, one by 'internal gemmation;' but this phrase would not explain the conditions essential to the process, unless we previously knew those conditions in regard to ordinary or external gemmation.

At length, however, the last apterous or larval *Aphis*, so developed, proceeds to be 'metamorphosed' into a winged individual, in which either only the fertilizing filaments are formed, as in the case of the stamens of the plant, or only the ovules, as in the case of the pistil. We have, in fact, at length 'male and female individuals,' preceded by procreative individuals of a lower or arrested grade of organization, analogues to the gemmiparous polypes of the zoophyte and to the leaves of the plant.

The process was described for its better intelligibility in the Aphides as one of a simple succession of single individuals, but it is much more marvellous in nature. The first-formed larva of early spring procreates not one but eight larvæ like itself in successive broods, and each of these larvæ repeats the process; and it may be again repeated in the same geometrical ratio until a number which figures only can indicate and language almost fails to express, is the result. The Aphides produced by this internal gemmation, are as countless as the leaves of a tree, to which they are so closely analogous.

It generally happens that the metamorphosis which has been described as occurring after the seventh or eleventh generation takes place much earlier in the case of some of the thousands of individuals so propagated: just as a leaf-bud near the root may develop a leaf-stem and a flower with much fewer antecedent generations of leaves from buds than have preceded the formation of the flower at the summit of the plant; or just as one of the lower and earlier formed digestive polypes may push out a bud to be transformed into a procreative and locomotive polype. The same analogy is closely maintained throughout.

The wingless larval Aphides are not very locomotive; they might have been attached to one another by continuity of integument, and each have been fixed to suck the juices from the part of the plant where it was brought forth. The stem of the rose might have been incrustated with a chain of such connected larvæ as we see the stem of a fucus incrustated with a chain of connected polypes, and only the last developed winged males and oviparous females might have been set free. The connecting medium might even have permitted a common current of nutriment contributed to by each individual to circulate through the whole compound body. But how little of anything essential to the animal would be affected by cutting through this hypothetical connecting and vascular integument and setting each individual free! If we perform this operation on the compound zoophyte, the detached polype may live and continue its gemmiparous reproduction. This is more certainly and constantly the result in detaching one of the monadiform individuals which assists in composing the seeming individual whole called 'Volvox globator;' and so likewise with the leaf-bud. And this liberation Nature has actually performed for us in the case of the Aphis, and she thereby plainly teaches us the true value or signification in morphology of the connecting links that remain to attach together the different gemmiparous individuals of the volvox, the zoophyte, and the plant.

The analogy between the procreating larvæ of the *Aphis*, the *Medusa*, and the *Coralline* is so true and so close, that if the larval Aphis be a distinct individual and not a part, so must be the strobila, the planula, and the gemmiparous leaf: if the succession of larval Aphides be truly described, as a succession of generations, so must that succession of planula, polype, and strobila which leads to the oviparous Medusa; and that succession of planulæ and nutritive polypes which precede the detachment of the free procreative medusoid polypes in the Coryne; and the like with the plant-generations preceding the flower.

It would have been easy, if time permitted, to multiply the illustrations of the essential condition of these phenomena. That condition is, the retention of certain of the progeny of the primary fertilized germ-cell, or in other words, of the germ-mass, unchanged

in the body of the first individual developed from that germ-mass, with so much of the pollen-force inherited by the retained germ-cells from the parent-cell or germ-vesicle as suffices to set on foot and maintain the same series of formative actions as those which constituted the individual containing them.

How the retained pollen force operates in the formation of a new germ-mass from a secondary, tertiary, or quaternary derivative germ-cell, the Lecturer did not profess to explain; neither was it known how it operates in developing the primary germ-mass.

The botanist and physiologist congratulates himself with justice when he has been able to pass from cause to cause, until he arrives at the union of the pollen-filament with the ovule as the essential condition of development—a cause ready to operate when necessary circumstances concur, and without which those circumstances would have no effect.

The chief aim of the present discourse was to point out the circumstances which bring about the presence of the same essential cause in the cases of the development of the successive generations completing the metagenetic cycle of the Aphis, the Medusa, the Polype and the Entozoon. The cause is the same in kind though not in degree, and every successive generation, or series of spontaneous fissions, of the primary germ-cell must weaken the pollen-force transmitted to such successive generations of cells.

The force is exhausted in proportion to the complexity and living powers of the organism developed from the primary germ-cell and germ-mass. It is consequently longest retained and furthest transmitted in the vegetable kingdom; the zoophytes manifest it in the next degree of force; and the power of retained germ-cells to develop a germ-mass and embryo by the remnant of the pollen-force which they inherited, is finally lost, according to present knowledge, in the class of Insecta and in the lower Mollusca.

Among the objects exhibited in the Library, were—Edwards' Atmopyre or Gas Stove [by D. O. Edwards, Esq., M.R.I.]—Sketch of Coldham-hall, near Bury St. Edmunds, reproduced as a Photograph, coated with a solution of Gun-Cotton; and several other Photographs from Etchings &c.—and a group of Garnets in Mica Schist from the Rocky Mountains, North America [by Dr. A. S. Taylor, M.R.I.]—Specimens of Sugar of Milk [by T. N. R. Morson, Esq., M. R. I.]—Model of the Nineveh Column in the British Museum, in Hall's Derbyshire black marble [by J. Tennant, Esq.] &c. &c.

Royal Institution of Great Britain.

1851.

GENERAL MONTHLY MEETING,

Monday, July 7.

GEORGE DODD, Esq., M.P., F.S.A., in the Chair.

Frank Bradshaw, Esq.

Thomas Rogers, Esq.

John Deacon, jun. Esq.

Alexander Stewart, Esq.

were duly *elected* Members of the Royal Institution.

William Henry Blaauw, Esq., F. S. A. was unanimously elected a **MANAGER** of the Royal Institution in the room of General Sir William Morison, K.C.B. deceased.

The following **PRESENTS** were announced, and the thanks of the Members returned for the same :—

FROM

Anonymous—A Plea on behalf of Publicans against Drunkards, by B. D. 12mo. 1851.

The Whole Doctrine of the Sabbath, as set forth in the Holy Scriptures, &c. by J. W. 12mo. 1851.

Asiatic Society of Bengal—Journal, No. 217, 218. 8vo. 1850-1.

Bell, Jacob, Esq. (the Editor)—The Pharmaceutical Journal, July, 1851. 8vo. 1851.

Bleekrode, Prof. S. (the Author)—Jaarboekje van Wetenschappen en Kunsten ; vierde Jaargang. 12mo. Gorinchem, 1850.

British and Foreign Bible Society—The HOLY BIBLE, in 25 Languages.

The OLD TESTAMENT in German and Hebrew.

The NEW TESTAMENT, in 42 Languages.

Other Parts of the Bible, in 15 Languages.

Reports, Vol. V.—XV. 1818.—1848. 8vo.

British Association for the Advancement of Science—Report of the Twentieth Meeting held at Edinburgh, 1850. 8vo. 1851.

Carpenter, William B., M.D., F.R.S. (the Author)—Principles of Physiology, General and Comparative. Third edition. 8vo. 1851.

Council of Education of Bengal—General Report of Public Instruction in the Lower Provinces of the Bengal Presidency, 1849, 1850. 8vo. Calcutta, 1851.

Editor—The Architectural Quarterly Review, Vol. I. No. 1. 8vo. 1851.

The Athenæum for June, 1851.

Faraday, M. Esq.—Kaiserlichen Akademie der Wissenschaften, Wien.

Denkschriften :—

Philosophisch-Historische Classe, Band I. und II. Abtheilung I. Wien, 1850.

Mathematisch-Naturwissenschaftliche Classe, Band I. Wien, 1850. 2te.

Band, 1ste und 2te Lieferung. 4to. Wien, 1850.

Sitzungsberichte : —

- Math.-Nat. Classe, Oct.—Dec. 1850. Phil.-Hist. Classe, Oct.—Dec. 1850. 8vo. Wien, 1851.
- Fontes Rerum Austriacarum, Band III. Abtheilung 2. 8vo. Wien, 1851.
- Die Antiken Cameen des K. K. Münz und Antiken Cabinettes in Wien : beschrieben von Joseph Arneth. Fol. Wien, 1849.
- Die Antiken Gold und Silber Monumente des K. K. Münz und Antiken Cabinettes in Wien : beschrieben von Joseph Arneth. Fol. Wien, 1850.
- Monatsberichte der Königl. Preuss. Akademie der Wissenschaften zu Berlin, März und April, 1851. 8vo.
- Jahresbericht des Physikalischen Vereins zu Frankfort-am-Main, 1849-50. 8vo.
- Atte dell' Academia Pontificia de' Nuovi Lincei, Anno IV. Sessione 1-3. 4to. Roma, 1851.
- Franklin Institute*—Journal, 3rd Series. Vol. XX. 8vo. Philadelphia, 1850.
- Jones, T. Wharton, F. R. S. (the Author)*—The Wisdom and Beneficence of the Almighty as displayed in the sense of Vision. (The Actonian Prize Essay for 1851.) 16mo. 1851.
- Linnean Society of London*—Transactions. Vol. XX. Part 3. 4to. 1851. Proceedings, No. 44. 8vo. 1851.
- Lovell, E. B. Esq. M. R. I. (the Editor)*—The Monthly Digest, June, 1851. 8vo.
- Nicol, W., Esq. M. R. I.*—Fac-simile in all but colour of the Remains of a Portrait on Panel of William Shakspeare, by Richard Burbage his fellow Player and Partner, 1597. — 1851.
- Royal Astronomical Society*—Proceedings, Vol. XI. No. 5, 6, 7. 8vo. 1851.
- Royal Institute of British Architects*—Lists of Members, Report of Council, &c. 4to. 1851. Proceedings for June, 1851. 4to.
- Royal Society of London*—Proceedings, Vol. VI. No. 78, sheet 3. 8vo. 1851. Philosophical Transactions for 1851. Part I. 4to. 1851.
- Savage, Miss A.*—A Dictionary of the Art of Printing by W. Savage. 8vo. 1841.
- Statistical Society*—Journal, Vol. XIV. Part 2. 8vo. 1851.
- Taylor, A. S., M. D., F. R. S., M. R. I.*—Report on the Water of the West Middlesex Water-works Company, by A. S. Taylor, M. D. and A. Aikin, F. L. S. 8vo. 1851.
- Vereins zur Beförderung des Gewerbfleisses in Preussen*—Verhandlungen, January zu April, 1851. 4to.
- Weale, John, Esq.*—Rudimentary Treatise on Ship-building, by James Peake, N.A. Parts II & III. 12mo. 1851. Examples and Solutions in the Differential Calculus, by James Haddon, M.A. 12mo. 1851.
- Webster, John, M.D., F.R.S., M.R.I., &c.* St. Luke's Hospital for Lunatics—Physicians' Report for 1850. 8vo. 1851. On the Health of London during the Six Months terminating March 29, 1851. 8vo. 1851.

GENERAL MONTHLY MEETING,

Monday, November 3.

SIR CHARLES FELLOWS, in the Chair.

Thomas Rogers, Esq. was *admitted* a Member of the Royal Institution.

Warren De la Rue, Esq. F.R.S. Robert Hanbury, jun. Esq.
Samuel Gaskell, Esq. Walter Spencer Stanhope, Esq.
were duly *elected* Members of the Royal Institution.

The Managers reported, that they had appointed THOMAS WHARTON JONES, Esq., F.R.S. to fill the vacant office of Fullerian Professor of Physiology.

The following PRESENTS were announced, and the thanks of the Members returned for the same :—

- FROM
Académie Impériale des Sciences de St. Petersbourg—Mémoires, 6^e Série. 4to. 1850-1. Sciences Mathématiques, &c. Tome IV. Livraisons 3 & 4. Mémoires par des Savans Etrangers. Tome VI. Livraisons 5 & 6. 4to. 1851.
Admiralty, Board of—Contributions to Astronomy and Geodesy: by T. Maclear, Esq. 4to. 1851.
Airy, G. B., Esq., F.R.S., Astronomer Royal—Reports of the Astronomer Royal on Greenwich Observatory, 1836 to 1851. 4to.
American Philosophical Society—Proceedings, No. 46. 8vo. 1851.
Asiatic Society of Bengal—Journal, No. 203, 219, 221. 8vo. 1849-1851.
Ayrton, W. S., Esq. (the Author)—Suggestions referred to those interested in the Reform of the Law. 8vo. 1851.
Barlow, Rev. John, M.A., F.R.S., Sec. R.I.—Report of the History, and Recent Collation of the English Versions of the Bible; adopted by the American Bible Society. 8vo. 1851.
Bell, Jacob, Esq., M.P., M.R.I., (the Editor)—The Pharmaceutical Journal for August to November. 8vo. 1851.
Bigsby, John J., M.D., M.R.I., &c. (the Author)—The Shoe and Canoe; or Pictures of Travel in the Canadas, &c., with Plates and Maps. 2 vol. 16mo. 1850.
Chemical Society—Journal, No. 14, 15. 8vo. 1851.
Council of Education, Calcutta—Annual Report of the Medical College of Bengal, 1850-1. 8vo. 1851.
D.C.L. (the Author)—Letters on Church Matters, Vol. II. 8vo. 1851.
Duprez, M. F. (the Author)—Mémoire sur un Cas particulier de l'Equilibre des Liquides. 1^{re} Partie. 4to.
Editor—The Athenæum for July to October 1851. 4to.

- Faraday, M., Esq., F.R.S., &c.*—Monatsberichte der Königl. Preuss. Akademie der Wissenschaften zu Berlin; Mai, Juni, Juli und August, 1851. 8vo. 1851.
- Verhandlungen der Königl. Akademie der Wissenschaften zu Berlin, 1849. 4to. Berlin, 1851.
- Lieutenant Maury's Investigations of the Winds and Currents of the Sea with Charts. 4to. Washington, 1851.
- Researches in Magnetism, Electricity, &c. by Karl Baron von Reichenbach; translated and edited by W. Gregory, M.D. Parts 1 and 2. 8vo. 1850.
- Die totale Sonnenfinsterniss am 28 Juli, 1851—Vortrag von Professor S. Stampfer. 8vo. Wien, 1851.
- Tijdschrift voor de Wisen Natuurkundige Wetenschappen uitgegeven door de Eerste Klasse van het Koninklijk Nederlandsche Instituut van Wetenschappen, &c. Derde Reeks, Vierde Deel. Amsterdam, 4to. 1851.
- Franklin Institute*—Journal, Vol. XXII. No 1. 8vo. 1851.
- Geological Society*—Quarterly Journal, No. 27. 8vo. 1851.
- Glover, J. H. Esq.* (Librarian to Her Majesty)—Bibliothecæ Regiæ Catalogus, 5 vol. Fol. 1820-1829.
- Grant, James Gregor, Esq. (the Author)*—Madonna Pia, and other Poems. 2 vol. 16mo. 1848.
- Hennen, J., M.D. M.R.I.*—St. Gervais-les-Bains et le Mont Blanc—Aperçus topographiques, pittoresques et scientifiques. 18mo. Paris. [1851.]
- Her Majesty's Government (by Col. E. Sabine)*—Observations made at the Magnetical and Meteorological Observatory at the Cape of Good Hope, Vol. I. Magnetical Observations, 1841-6, 4to. 1851.
- Horticultural Society of London*—Journal, Vol. VI. Nos. 3, 4. 8vo. 1851. List of Members, 1851.
- Liverpool Literary and Philosophical Society*—List of Communications, 1812-21. 12mo. 1821.
- Proceedings. No. 1—6. 8vo. 1845-51.
- Laws, 8vo. 1848.
- Lovell, E. B. Esq. M.R.I. (the Editor)*—The Monthly Digest of Equity, Common Law, &c. for July, August, September, and October. 8vo. 1851.
- Northumberland, Duke of*—Report of the Committee appointed to examine the Life-Boat Models submitted to compete for the premium offered by his Grace the Duke of Northumberland; with Maps and Plans. Folio. 1851.
- Radcliffe Trustees, Oxford*—Astronomical Observatory, Oxford, in 1849. Vol. X. 8vo. 1851.
- Raumer, Friedrich von, Hon. Mem. R. I. &c. (the Author)*—Geschichte Frankreichs und der Französischen Revolution, 1740—1795. 8vo. Leipzig, 1850.
- Real Academia de Ciencias de Madrid*—Memorias, Tomo I. Tercere Serie, Ciencias Naturales: Tomo I. Parte I. 4to. Madrid, 1850.
- Resumen de las Actas en el año academico de 1849 á 1850, por el secretario perpetuo Dr. Dom M. Lorente. 4to. Madrid. 1850.
- Rennie, James, Esq. F.R.S. M.R.I.*—Mathematical Tracts, by G. B. Airy. 3rd edition. 8vo. 1842.
- Royal Agricultural Society of England*—Journal, Vol. XII. Part I. 8vo. 1851.
- Royal Astronomical Society*—Monthly Notices, Vol. XI. No. 8. 8vo. 1851. Memoirs, Vol. XIX. 4to. 1851.—Proceedings, Vol. X. 8vo. 1850.
- Royal College of Surgeons of England*—List of Fellows and Members, 8vo. 1851.
- Royal Cornwall Polytechnic Society*—Eighteenth Annual Report. 8vo. 1850.
- Royal Society of Van Diemen's Land*—Papers and Proceedings, Vol. I. Part 3. 8vo. Tasmania, 1851.
- Royal Society of Edinburgh*—Transactions, Vol. XX. Part 2. 4to. 1851. Proceedings, Nos. 40, 41, and Title, Contents, &c. to Vol. II. 8vo. 1851.
- Smyth, Capt. W. H., R. N., (the Author)*—Address at the Anniversary Meeting of the Royal Geographical Society, May 26, 1851. 8vo. 1851.

- Quire, Peter, Esq., M.R.I. (the Author)*—The New London Pharmacopœia, translated and arranged in a Tabular Form with the Edinburgh and Dublin Pharmacopœias. 8vo. 1851.
- Statistical Society*—Journal, Vol. XIV. Part 3. 8vo. 1851.
- Vereins zur Beförderung des Gewerbfleisses in Preussen*—Verhandlungen, Mai und Juni, 1851. 4to. Berlin.
- Weale, John, Esq.*—Rudimentary Treatise on Mensuration, by T. Baker, C. E. 12mo. 1850.
- Manual of the Mollusca, or Rudimentary Treatise on Shells Recent and Fossil; by S. P. Woodward. 12mo. 1851.
- Webster, John, M.D., F.R.S., M.R.I.*—Homœopathy. Report of the Speeches on Irregular Practice delivered at the 19th Meeting of the Provincial Medical and Surgical Association. 8vo. 1851.
- Wrontchenko, M. le Comte, &c.*—Annales de l'Observatoire Physique Central de Russie, par A. T. Kupffer, Année 1847. 4to. St. Petersburg, 1850.

GENERAL MONTHLY MEETING,

Monday, December 1.

PROFESSOR CHARLES WHEATSTONE, F.R.S., Vice President,
in the Chair.

Warren De la Rue, Esq. F.R.S. was *admitted* a Member of the Royal Institution.

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| Bernard Edw. Brodhurst, Esq. | John George Dodson, Esq. |
| John William Digby, Esq. | Edward Dolman Scott, Esq. |

were duly *elected* Members of the Royal Institution.

Col. Julius G. Griffith was unanimously elected a VISITOR of the Royal Institution in room of C. B. Mansfield, Esq., resigned.

The Secretary reported, that the following Arrangements had been made for the Lectures before Easter, 1852 :

Six Lectures on Attractive Forces (adapted to a Juvenile Auditory,)—by Professor FARADAY.

Twelve Lectures on Animal Physiology—by T. WHARTON JONES, Esq., F. R. S., Fullerian Professor of Physiology, R. I.

Eleven Lectures on the Physical Principles of the Steam Engine—by the Rev. JOHN BARLOW, M. A., F. R. S., Sec. R. I.

Eleven Lectures on some of the Arts connected with Organic Chemistry—by Professor BRANDE.

(Laboratory Lectures.) Twenty-five Lectures on the Chemistry of the Metals—by CHARLES BLACHFORD MANSFIELD, Esq.

The following PRESENTS were announced, and the thanks of the Members returned for the same ; —

FROM

- Asiatic Society of Bengal*—Journal, Nos. 108-110. 8vo. 1850.
Astronomical Society (Royal)—Monthly Notices, No. 9. 8vo. 1851.
Bache, Dr. A. D., Superintendent of the United States Coasts Survey—Charts of the Survey, 31 sheets.
Babbage, Charles, Esq. (the Author)—The Exposition of 1851, &c. Second Edition. 8vo. 1851.
Bell, Jacob, Esq. M.P. M.R.I. (the Editor)—Pharmaceutical Journal for December, 1851, 8vo.
Editor—Athenæum for November 1851. 4to.
Faraday, Prof.—Papers relating to the University of Sydney, New South Wales. 8vo. 1851.
 Bulletin de la Classe Physico-Mathématique de l'Académie Impériale de St. Pétersbourg. Tome IX. No. 209-216. 4to. 1851.
 Rapporte Generale della Pubblica Esposizione dei Prodotti Naturale e Industriale della Toscana, fatta in Firenze nel Novembre, 1850. 2 vol. 8vo. Firenze, 1851.
 Memoria della Struttura Geologica delle Alpi degli Apennini e dei Carpazi, di Sir R. I. Murchison : traduzione dall' Inglese ed Appendice sulla Toscana dei Professori Cav. P. Savi e G. Meneghini. 8vo. Firenze, 1851.
Geological Society—Quarterly Journal, No. 28. 8vo. 1851.
Institution of Civil Engineers—Proceedings for Nov. 1851.
Lovell, E. B. Esq., M. R. I., (the Editor)—The Monthly Digest, Nov. 1851. 8vo.
Morgan, J. M. Esq., M. R. I., (the Editor)—The Triumph, or the Coming Age of Christianity, &c. 12mo. 1851.
 Richard Baxter and other Divines on Christian Society. 18mo. 1851.
Morell, Rev. Deacon, M. A. Life Subscriber R. I.—The Scripture Doctrine of the Trinity, &c. by S. Clarke, D. D. 8vo. 1851.
Royal Irish Academy—Proceedings for 1850-1. 8vo.
Royal Society of London—Proceedings, Nos. 4, 5, 6, of Vol. VI. 8vo. 1851.
Smithsonian Institution, Washington, U.S.—Smithsonian Contribution to Knowledge, Vol. II. and Appendix to Vol. III. 4to. 1851.
 Fourth Annual Report. 8vo. 1850.
 Portrait of J. Smithson and View of Smithsonian Institution.
 Reports on Planet Neptune and Public Libraries. 8vo. 1851.
 Proceedings of the American Association for the Advancement of Science, 4th Meeting. 8vo. 1850.
Vereins zur Beförderung des Gewerbfleisses in Preussen—Verhandlungen, Juli und August, 1851. 4to.
Wood, W., M.D., (the Author)—Remarks on the Plea of Insanity and on the Management of Criminal Lunatics. 8vo. 1851.
Yates, James, Esq. F.R.S., M.R.I. (the Author)—Additional Observations on the Bulla worn by Roman Boys, &c. 8vo. 1851.