prejudice, is the characteristic of American Naval Architecture and Nautical Practice. Disbelief in the power of prejudice and the virtue of routine is the principle which this example inculcates; and if it lead us to believe in science and our own judgment, and to emancipate ourselves from the trammels of prejudice grown old under unwise laws, and to cease from building ships by Acts of Parliament and Club laws, the recent victory of the America and the present victory of American Packet-ships will prove to have been benefits in disguise.

[J. S. R.]

In the Library, were exhibited :—

Model of the Yacht "America." [Exhibited by Mr. Scott Russell.]

Model of Apparatus for enabling a Ship's Company to take to the Boats simultaneously, and for the rapid disembarkation of Troops, by Julius Jeffreys, Esq. F.R.S., M.R.I., and Model of a Safety Boat Sling for a similar purpose, by Mr. Landells.

Model of a Brig with Revolving Masts, &c.—and Sculptured Windows from Akbar's Palace. [From United Service Institution.]

Models of Bones of Iguanodon, &c. and Impression of Labyrinthodon. [Exhibited by Mr. Tennant.]

Printing in Colours: L'Allegro, Il Penseroso, and View of Nottingham.—Portrait of a Child; and Walter and Jane, in Water Colours. —Portrait of Joseph Hume, Esq. M.P., in Crayons,—by Mr. C. B. Leighton.

Talbotype Portraits by Messrs. Henneman and Co.

Specimen of Pearl Enamelled Glass, and Jewelled Papier Maché. [Exhibited by Messrs. Allen.]

A Crozier, carved in wood, by Mr. W. Rogers.

Microscope by Mr. Varley.

WEEKLY EVENING MEETING,

Friday, February 13.

The Duke of Northumberland, F.R.S., President, in the Chair.

W. R. Grove, Esq., M.A., F.R.S.,

On the Heating Effects of Electricity and Magnetism.

n the early periods of philosophy when any unusual phenomenon ttracted the attention of thinking men it was frequently referred to preternatural or spiritual cause; thus with regard to the subject bout to be discussed, when the attraction of light substances by ubbed amber was first observed, Thales referred it to a soul or piritual power possessed by the amber.

Passing to the period antecedent to the time of more strict inductive philosophy, viz. the period of the Alchemists, we find many natural phenomena referred to spiritual causes. Paracelsus taught that the Archæus or stomach demon presided over, caused, and regulated the functions of digestion, assimilation, &c.

Van Helmont, who may be considered in many respects the turning point between Alchemy and true chemistry, adopted with some modification the Archæus of Paracelsus and many of the opinions of the Spiritualists, but shewed tendencies of a more correctly inductive character; the term 'Gas' which he introduced, gives evidence of the thought involved in it by its derivation from 'Geist' a ghost or spirit. By regarding it as intermediate between spirit and matter, by separating it from common air and by distinguishing or classifying different sorts of gas he paved the way for a more accurate chemical system.

Shortly after the time of Van Helmont lived Torricelli, who by his discovery of the weight of air was mainly instrumental in changing the character of thought and inducing philosophers to introduce, or at all events to develope the notion of fluids, as agents which effected the more mysterious phenomena of nature, such as light, heat, electricity, and magnetism.

Air being proved analogous in many of its characters to fluids as previously known, the idea of fluids or of an ether was carried on to other unknown agencies appearing to present effects remotely analogous to air or gases.

Sound was included by some in the same category with the other affections of matter, and as late as the close of the last century a paper was written by Lamarck to prove that sound was propagated by the undulations of an ether. Sound is now admitted to be an undulation or motion of ordinary matter, and Mr. Grove considered that what have been called the imponderables, or imponderable fluids, might be actions of a similar character, and might be viewed as motions of ordinary matter.

Heat was at an early period so viewed, and we find traces of this in the writings of Lord Bacon. Rumford and Davy gave the doctrine a greater development, and Mr. Grove in a communication made by him at an Evening Meeting of this Institution in 1847, shewed that what had hitherto been deemed stumblingblocks in the way of this theory of heat, viz. the phenomena presented by what have been called latent and specific heat, might be more simply explained by the dynamic theory.

In this evening's communication he brought forward some experiments and considerations in favour of the extension of this view to electricity and magnetism, an extension which he had for many years advocated, and which was, in his opinion, supported by many analogies.

The ordinary attractions and repulsions of electrified bodies present no more difficulties when regarded as being produced by a change in the state or relations of the matter affected, than did the attraction of the earth by the sun, or of a leaden ball by the earth; the hypothesis of a fluid is not considered necessary for the latter, and need not be so for the former class of phenomena.

In the cases of heating or ignition of a conjunctive wire or conducting body through which what is called Electricity is transmitted, we have many evidences that the matter itself is affected, and in some cases temporarily, in others, permanently changed; thus if a wire of lead is ignited to fusion by the voltaic battery, the fused lead being kept in a channel to prevent its dispersion, it gradually shortens, and the molecules seem impressed with a force acting transversely to the line of direction of the electricity; at length the lead gathers up in nodules which press on each other as do, to use a familiar illustration, a string of figs.

With Magnetism we have many instances of the molecular change which a ferreous or magnetic substance undergoes when magnetized. If the particles are free to move, as for instance iron filings, they arrange themselves symmetrically. An objection may be made arising from the peculiar form of the iron filings, but Mr. Grove in the year 1845, shewed that the supernatant liquid in which magnetic oxide had been formed, and which contains magnetic particles not mechanically but chemically divided, exhibits when magnetized a change in the arrangement of the molecules, as may be seen by its effect on transmitted light; — a molecular change is also evidenced by the note or sound produced by magnetism, and by other effects.

Assuming that the molecules of iron change their position *inter se* upon magnetization, then by repeated magnetization in opposite directions, something analogous to friction might be produced; and just as a piece of caoutchouc when elongated produces heat, (as it was on this occasion experimentally shewn to do) so a bar of soft iron might be expected when subjected to rapid changes in its magnetic state, to exhibit thermic effects.

With the aid of the large magnet of the Institution and of a commutator for changing the direction of the Electricity a bar of soft iron was alternately magnetized in opposite directions; and in a few minutes a thermometer placed in an aperture in the iron shewed a rise of temperature of 1, 5° Fahrenheit; the bar being separated from the magnet by flannel, and the magnet being at a notably lower temperature than the bar, this heat could in nowise be attributed to conduction.

The effect of Electricity in the disruptive discharge as in the Voltaic arc and the electric spark, would seem at first sight to offer greater difficulties of explanation on the dynamic theory. The brilliant phenomenal effects of the electric discharge, and the apparent absence of change in the matter affected by it, would at first lead the observer to believe that Electricity was a specific entity.

With ordinary flame or the apparent effects of combustion however, the idea has to a great extent been abandoned that such visual effects are due to specific matter, and it is regarded by many as an intense motion of the particles of the burning body. So with Electricity, if in regard to the disruptive discharge it can be shewn that the matter of the terminals or of the intervening medium is changed, the necessity for the assumption of a fluid or ether ceases, and, to say the least, a possibility of viewing Electricity as a motion or affection of ordinary matter is opened.

To make evident to the audience the relation of the electrical discharge to combustion and the fact that the terminals were themselves affected, the Voltaic arc was taken, first between silver and then between iron terminals; in the first case a brilliant green coloured flame was produced, and in the second a reddish scintillation or spur fire effect, just as in the ordinary combustion of the metals.

So with the discharge of Franklinic Electricity between the same two metals, a strip of silvered leather gave the bright green discharge, while a chain of iron gave the spur fire effect.

The known transport of particles of the terminals from one pole to the other,— the different effects of different intervening media on induction as shewn in Faraday's experiments,— the polar tension of such media, &c. were instances of the train of molecular changes consequent upon electrical action.

Hitherto the polarity of the gaseous medium existing between the metallic or conducting terminals of the electrical circuit was only known as a physical polarity and not shewn to have an analogous chemical character with that existing in electrolytes anterior to electrolysis; but Mr. Grove stated that in a recent communication to the Royal Society he had shewn that mixtures of gases having opposite electrical or chemical relations, such as oxygen and hydrogen, or compound gases such as carbonic oxide, were electro-chemically polarized or had their electro-negative and electro-positive elements thrown in opposite directions: thus if a silvered plate be made positive in such gases it is oxidized, if negative the dark spot of oxide is reduced; and an experiment was shewn in which such a plate was thus oxidized and the spot reduced in gaseous media.

Here, as in the other experiments, was an effect on the terminals and an effect of polarization of the intermedium. In the experiments hitherto shewn, solid terminals were used; it became important to examine what would be the effect of liquid terminals, for instance water; the spark or disruptive discharge of Franklinic Electricity was readily obtained from its surface, but hitherto no voltaic battery had been found to shew a discharge at any sensible distance from the surface of water.

Mr. Gassiot had procured to be constructed 500 cells of the nitric acid battery, the combination discovered in 1839 by Mr. Grove and first shewn at this Institution in the year 1840. The cells of this battery were all well insulated by glass stems, and as regards intensity of action it was probably far the most powerful ever seen. Mr. Gassiot had kindly lent this apparatus for the illustration of this evening's discourse, and by its aid Mr. Grove was able to shew an experiment which he had first made when experimenting with Mr. Gassiot some time ago, and which produced the effect he had long sought for, viz. a quantitative or voltaic discharge at a sensible distance from the surface of water. The experiment was made as follows: — a platinum plate forming the anode of the battery was immersed in a capsule of distilled water, the temperature of which was raised. A cathode or negative terminal of platinum wire was now made to touch for a moment the surface of the water and immediately withdrawn to a distance of about quarter of an inch; the discharge took place, the extremity of the platinum wire was fused and the molten platinum attached to the wire but kept up by the peculiar repulsive effect of the discharge was exhibited, as it were, suspended in mid-air, giving an intense light, throwing off scintillations in directions away from the water and only detaching itself from the wire when agitated.

Here water in the vaporous state must be transferred, for the immersed electrode gave off gas, without doubt oxygen, and the molecular action on the negative fused platinum resembled, if it were not identical in character with the currents observed on the surface of mercury when made negative in an electrolyte.

It may be objected to the theory proposed, that electrical effects are obtained in what is called a vacuum, where there is no inter-medium to be polarized; but this objection, though not applicable to the projection of the terminals, could hardly be discussed until experimentalists had gone much further than at present in the production of a vacuum; the experiments of Davy and others had shewn that we are far off from obtaining any thing like a vacuum where delicate investigations are concerned.

The view of the antient philosophers that Nature abhors a vacuum which had been much cavilled at, and was supposed to be exploded by the discovery of Torricelli, Mr. Grove thought had been unjustly censured: giving the expression some degree of metaphorical license, it afforded a fine evidence of the extent and accuracy of observation of those who were unacquainted with inductive philosophy as a system, but who necessarily pursued it in practice. Whether a vacuum was possible might be an open question, experimentally it was unknown.

Lastly, in answer to those who might ask, to what practical results do researches such as these lead? what accession of physical comfort or luxury do they bring? Mr. Grove took occasion to offer his humble protest against opinions now perhaps too generally prevalent, that science was to be viewed only or mainly in its utilitarian or practical bearings. Even regarding it in this aspect, were it not for the devotion which the love of knowledge, which the yearning anxiety to penetrate into the mysteries of our being and of surrounding existences induced; the practical results of science would not have been attained; the band of Martyrs to Science from Socrates to Galileo would not have thought and suffered without a higher incentive than the acquisition of utilitarian results: without disparaging these results, indeed regarding them as necessary consequences of any advance in scientific knowledge, he considered that the love of truth and knowledge for themselves was the great animating principle of those who rightly pursued science; that, based upon an enduring quality of our common nature, this feeling was rooted in far firmer foundations, that it led to greater and more self sacrificing exertions, than any capable of being induced by the hopes of augmenting social acquisitions, and was an attribute and an evidence of the non-transient part of our being.

[W. R. G.]

In the Library were exhibited : —

Native Salts from Tarapaca, Peru, presented by W. Bollaert, Esq.

Crystals of Meconic Acid, Morphia, &c. [Exhibited by T. N. R. Morson, Esq. M.R.I.]

Specimens of Harmotome, and Calc Spar Crystals. [Exhibited by Mr. Highley, jun.]

Spanish Terra Cottas; and a Drawing after Lucca di Robbia, by Mr. W. G. Rogers.

Porcelain Vessels for Chemical Purposes, from the South of France. [Exhibited by W. T. Copeland, Esq.]

Minié's Projectiles, used by the Chasseurs of Vincennes. [Exhibited by J. Prosser, Esq.]

Native Gold from California — Green Carbonate of Copper — Carbonate of Lime, &c. [Exhibited by Mr. Tennant.]

Microscope by Mr. Varley.

WEEKLY EVENING MEETING,

Friday, February 20.

THE DUKE OF NORTHUMBERLAND, F.R.S., &c. President, in the Chair.

MR. F. C. PENROSE,

On some Relations of Science to Architecture, considered as a Fine Art.

SCIENTIFIC considerations not only apply to the Constructive in Architecture, but also to its æsthetic element.

Science was defined by the Lecturer as "the knowledge which is derived in the first instance from the observation of natural phenomena aided by reflection upon the results of such observation," and he classed under the head of Science, so defined, all careful considerations of the analogy of Nature and Art.

In all the most perfect works of art the economic and æsthetic ends are answered together. Illustrations were drawn from the beauty of the tapering shaft of a Greek column, which with the same amount of material has more stability than if cylindrical; and from the graceful form of the Eddystone lighthouse, of which the contour was chosen chiefly with reference to the form of greatest resistance.

The perception of beauty is an innate idea implanted in man by his Creator, and the only really perfect examples are to be looked for in Nature; but the highest works of art may come so near perfection that we can propose no material change which would not more or less injure their beauty. The most important lesson which can be learnt from a careful examination of Nature is that no design is perfect until the utmost attainable utility is combined with the