horizontal beam was a small glass tube, terminated at the object end by a glass hook. The objects to be submitted to the magnetic force, were either cylinders of glass, with a filament drawn out from each, so as to make a long stiff hook for suspension from the beam, or cylindrical bulbs of glass, of like size, but larger size, formed out of glass tube; or other matters. The fine tubular extremities of the bulbs being opened, the way through was free from end to end; the bulbs could then be filled with any fluid or gas, and be re-submitted many times in succession to the magnetic force. The source of power employed was at first a large electro-magnet; but afterwards, in order to be certain of a constant power, and for the advantage of allowing any length of time for the observations, the great magnet, constructed by M. Logeman upon the principles developed by Dr. Elias, (and which, weighing about 100 lbs., could support 430 lb., according to the Report of the Great Exhibition Jury), was purchased by the Royal Institution and used in the inquiries. The magnet was so arranged that the axis of power was five inches below the level of the glass beam, the interval being traversed by the suspension filament or hook, spoken of above. When a body is submitted to the power of a magnet, it is affected as to the result, not merely by the magnet, but also by the medium surrounding it; and even if that medium be changed for a vacuum, the vacuum and the body still are in like relation to each other. In fact the result is always differential; any change in the medium changes the action on the object, and there are abundances of substances which when surrounded by air are repelled, and when by water, are attracted upon the approach of the magnet. When a certain small glass cylinder, weighing only 66 grains, was submitted on the torsion balance to the Logeman magnet surrounded by air, at the distance of 0·5 of an inch from the axial line, it required 15° of torsion to overcome the repulsive force and restore the object to its place. When a vessel of water was put into the magnetic field, and the experiment repeated, the cylinder being now in the water was attracted, and 54°·5 of torsion were required to overcome this attraction at the given distance of 0·5. If the vessel had contained a fluid exactly equal in diamagnetic power to the cylinder of glass, neither attraction nor repulsion would have been exerted on the latter, and therefore the torsion would have been 0°. Hence the three bodies, air, glass (the especial specimen), and water, have their relative force measured in relation to each other by the three experimental numbers 15°, 0° and 54°·5. If other fluids are taken, as oil, ether, &c., and employed as the media surrounding the *same glass cylinder*, then the degrees of torsion obtained with each of them respectively, shows its place in the magnetic series. One great object in the construction of an instrument delicate as that described, was the investigation of certain points in the philosophy of magnetism; and amongst them especially, that of the right application of the law of the inverse square of the distance as the universal law of magnetic action. Ordinary magnetic action may be divided into two kinds: that between magnets permanently magnetised and unchangeable in their condition, and that between bodies of which one is a permanent unchangeable magnet, and the other, having no magnetic state of its own, receives and retains its state only whilst in subjection to the first. The former kind of action appears in the most rigid and pure cases, to be subject to that law, but it would be premature to assume beforehand, and without abundant evidence, that the same law applies in the second set of cases also; for a hasty assumption might be in opposition to the truth of nature, and therefore injurious to the progress of science, by the creation of a preconceived conclusion. We know not whether such bodies as oxygen, copper, water, bismuth, &c., owe their respective paramagnetic and diamagnetic relation to a greater or less facility of conduction in regard to the lines of magnetic force, or to something like a polarity of their particles or masses, or to some as yet unsuspected state, and there is little hope of our developing the true condition, and therefore the cause of the magnetic action, if we assume beforehand the unproved law of action and reject the experiments that already bear upon it:—for Plucker has distinctly stated as the fact, that diamagnetic force increases more rapidly than magnetic force, when the power of the dominant magnet is increased; and such effect is contrary to the law above enumerated. The following are further results in relation to this point. When a body is submitted to the great unchanging Logeman magnet in air and in water, and the results are reduced to the centigrade scale, the relation of the three substances remain the same for the same distance, but not for *different* distances. The result of experiment proves that the greater the distance of the diamagnetic bodies from the magnet, the more diamagnetic is it in relation to water, taking the interval between water and air as the standard: and it would further appear, if an opinion may be formed from so few experiments that the more diamagnetic the body compared to air and water, the greater does this difference become. At first it was thought possible that the results might be due to some previous state induced upon the body, by its having been nearer to or further from the magnet, but it was found that whether the progress of the experiments was from small to large distances, or the reverse; or whether, at any given distance, the object was previous to the measurement held close up to the magnet or brought from a distance, the results were the same;—no evidence of a temporary induced state could in any of these ways be found. It does not follow from the experiments, if they should be sustained by future researches, that it is the glass or the bismuth only that changes in relation to the other two bodies. It may be the oxygen of the air that alters, or the water, or more probably all these bodies; for if the result be a true and natural result in these cases, it is probably common to all substances. The great point is that the three bodies concerned, air, water, and the subject of the experiment, alter in the degree of their magnetic relations to each other; at different given distances from the magnet the ratio of their magnetic power does not, according to the experiments, remain the same; and if that result be confirmed, then it cannot be included by a law of action which is inversely as the square of the distance. The cause of this variation in the ratio of the substances, one to another, if it be finally proved, has still to be searched out. It may depend in some manner upon the forms of the lines of magnetical force, which are different at different distances; or not upon the forms of the lines but the amount of power at the different distances; or not upon the mere amount, but on the circumstances that in every case the body submitted to the experiment has lines of different degrees of force passing through different parts of it, (for however different the magnetic or diamagnetic conditions of a body and the fluid surrounding it, they would not move at all in relation to each other, in a field of equal force:) but whatever be the cause, it will be a concomitant of magnetic actions; and therefore ought to be included in the results of any law by which it is supposed that these actions are governed. On the present occasion a passage was quoted from Newton which had since been discovered in his works, and which, showing that he was an unhesitating believer in physical lines of gravitating force, must from its nature, rank him amongst those who sustain the physical nature of the lines of magnetic and electrical force: it is as follows, in words written to Bentley:—"That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a *vacuum*, without mediation of anything else, by and through which their action and force may be conveyed from one to another, it is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers." Finally, reference was to be made to Sabine's remarkable observation, sustained as it has been by Wolf, Gautier, and others, of certain coincidences existing between the appearance of solar spots and the diurnal variation of the magnetism of the earth. Schwabe has been engaged in carefully observing the spots on the sun since the year 1826. He has found them gradually to increase in number and size from year to year, and then decrease, and so on in a regular period of about ten years. Lamont (Dec. 1851) was induced by recent researches in atmospheric magnetism, to examine the daily magnetic variation in declination, and found that, as a whole, it increased and diminished, and then increased again, having a regular variation of about ten years: the year 1844 was given as a minimum variation of 6'·61 and the year 1848 as presenting a maximum variation of 11'·15. Sabine (March 1852) in searching for periodical laws amongst the mean effects of the larger magnetic disturbances, found a simultaneous period of increase and decrease both at Hobarton and Toronto, on opposite sides of the globe; the minimum effect was in 1843, and the maximum effect in 1848, according therefore almost exactly with Lamont's observations at Munich. But, besides that, he pointed out the extraordinary circumstances that this similar variation of the daily magnetic declination is the same in length of period as that discovered by M. Schwabe for the solar spots, and still more that the maxima and the minima of these two most different phenomena coincide; for 1843 presents the least diurnal variation and the smallest number of solar spots, and 1848 the largest magnetic variation and the greatest number of solar observations. He has observed that the same period of increase and decrease exists with the same epochs in the diurnal variations of the magnetic inclination of the earth's magnetic force in both hemispheres. The phenomenon is general both as regards all the magnetic elements, and in parts of the globe most distant from each other. Gautier appears to have been struck with the same coincidence; but did not publish his idea until July 1852. Wolf, of Berne, who has sought far into the history of the sun spots, had the same thought, publishing it first at the end of July or beginning of August, 1852. He endeavours to trace the general condition of the spots from the year 1600, and concludes that the true length of the period is 11·11 years. As it is impossible to conceive such a coincidence in the length of the period and the time of the maxima and minima of these two greatly differing phenomena, without believing in some relation of them to a common cause; so, the observation of such a coincidence at this moment ought to urge us more than ever into an earnest and vigorous investigation of the true and intimate nature of magnetism; by means of which we now have hopes of touching in a new direction not merely this remarkable force of the earth, but even the like powers of the sun itself.