influence it. The discovery of this distinction overthrew all the old ideas dating from antiquity, and which continued up to the end of the last century. According to the ideas which were current when Lavoisier started his work, there were four elements—earth, air, fire and water—from which all substances existing in nature were said to be built up. By associating these elements in different proportions and by different methods, it ought to be possible to produce all bodies and transform any one into any other. As a matter of fact, the prolonged researches of serious workers had never succeeded in establishing this transformation, nor has this been accomplished since. But preformed ideas are tenacious, especially when supported by mysticism.

An equally grave mistake was committed in supposing that bodies submitted to the influence of heat alone could vary in weight, a variation apparently proved by innumerable observations with the balance in chemistry. It is, in fact, a most singular error, although one frequently held, that the use of the balance in chemistry dates only from the end of the last century. In reality its use is sixteen centuries old. The balance was used both in chemistry and in trade; it may be seen represented on the monuments of ancient Egypt. Bodies such as coal, oils and organic substances under the action of heat were known to lose their weight, hence was drawn the conclusion that matter may be transformed into heat and disappear; whilst heat, on the other hand, under inverse conditions, could be fixed, becoming visible ponderable matter. These opinions gave way to the views of Stahl, according to whom combustible bodies were rich in phlogiston, or fixed heat. Such was the state of science about 1772, when Lavoisier appeared on the scene. Ten years were sufficient for him to effect a complete transformation. He established, by the most precise experiments, a fundamental distinction, previously unknown, between the nature of bodies which we know, and heat and other agents capable of modifying these; it is the distinction between ponderable bodies and the imponderable heat, light, electricity, the intervention of which causes no change of weight in ponderable matter.

It could hardly have been expected that one man alone should make all the researches establishing the properties of gases, the composition of air and of hot water, and in this respect there can be no doubt that Lavoisier profited by the partial work of his predecessors and of contemporary workers; but to him alone belongs the merit of demonstrating the connecting links, and of giving the facts their true interpretation.

Two fundamental problems were first attacked by Lavoisier, the gain in weight of metals on calcination, and the apparent loss of weight of carbon, sulphur and oils on combustion. His first discovery was to put these phenomena upon a proper experimental basis. He demonstrated that in all such cases a weighable substance contained in the air takes part in the change, the addition of which explains the increase of weight of the calcined metals, an increase equal to the loss of weight sustained by the air. The same ponderable element in the air was shown to take part in the burning of carbon, sulphur and oils, forming gaseous compounds, the weight of which was also determined by Lavoisier. It was thus established, what had never been done before, that the materials of bodies possessing weight kept this weight constant throughout a series of chemical changes, heat and other agents of the same order having no effect either in increasing or decreasing the weight of the original bodies. This fundamental distinction between ponderable matter and imponderable agents is one of the greatest discoveries that has ever been made; it lies at the base of physical, chemical and mechanical science. Lavoisier, however, went farther than this, and attempted to penetrate the constitution of ponderable matter itself. He recognised that in all known experiments it presents itself as constituted by a certain number of undecomposable elements or simple bodies, which, combining amongst themselves, form all known compounds.

The two fundamental laws of nature once established—the distinction between matter and imponderable agents, and the invariability of the nature and weight of the simple bodies—Lavoisier went on to draw important conclusions on the composition of the acids and metallic oxides, the composition of air, water and organic substances, on the *rôle* of heat in chemistry, on animal heat and on the nature of respiration in physiology.

What share ought to be now attributed to Lavoisier in the classical discovery of the compound nature of air and water, a discovery in which he competed with Priestley and Cavendish? The matter would take too long to give here in detail. Suffice it to say that he alone swept from the composition of air and water the erroneous notion of phlogiston maintained by his contemporaries.

All these discoveries, accumulated in the course of only a dozen years, and carried out with wonderful ardour and energy, were not simple proofs of isolated facts; on the contrary, they were the consequences logically deduced and experimentally demonstrated of the two fundamental laws due to the genius of Lavoisier. The physiological questions relating to respiration were also answered completely and successfully; given a correct knowledge of the elementary composition of carbonic acid, of food materials and of air, respiration was then obviously a slow combustion of food by the oxygen of the air, a combustion producing carbonic acid and developing at the same time sufficient heat to maintain the human body at a nearly constant temperature.

A complete account of the after effect of Lavoisier's work would require almost a history of physical science during the nineteenth century; but an attempt will be made to recapitulate the more immediate consequences upon existing knowledge. The notion of the invariability of the weights of the simple bodies dominates the whole of chemistry at the present time; it is the scientific basis of all our chemical equations of composition and constitution, the origin of the new and singular algebra which, from its origin in the works of Lavoisier, so struck the mathematicians of his time. It is also the solid foundation of all our analyses, and is a certain starting-point in industries the most diverse, the manufacture of acids, alkalis, colouring matters, scents, drugs, in metallurgy and in agriculture.

And here a necessary reflection occurs. It cannot be pretended that Lavoisier was the direct and personal author of the vast array of discoveries here enumerated; but it is certain that it is he who has established the solid base upon which the modern chemical edifice is constructed, and without which these discoveries could not have been made; it is he who has raised the flaming torch of truth which we daily invoke, and for that reason it is just and equitable to give to him a part of the glory of the inventions of science and modern industry.

NILE FLOODS AND MONSOON RAINS.

THE practice or science of weather forecasting will evidently proceed on two very different lines—according to the relative importance of local or seasonal changes in the general meteorological conditions, and whether the prediction has reference to a long or a short period. The machinery employed in cases where the forecast aims at great minuteness over a small area consists mainly of the synoptical chart, based on information supplied by rapid telegraphic communication, and in the hands of experts this means probably proves sufficient, and furnishes a fair percentage of accurate predictions. But in the more difficult, as certainly the more important, problem of predicting the weather some time in advance, and over a considerable area, a problem which regularly recurs in the monsoon forecast for India, one must evidently depend on the more general physical conditions that are produced by the motions of the earth and the distribution of land and water on its surface. These causes, it is true, are always operative, and to a certain extent meteorological phenomena, broadly considered, must be periodic in their main features. The causes of deviation from periodicity, and the extent of the area affected by such abnormal conditions, are problems which the professional meteorologist has to encounter, and it is to be feared with insufficient means. But it seems not unlikely that, in proportion as the problem becomes more general, by bringing wider areas within the scope of the discussion, the prospects of greater success will become more assured; and it cannot but be considered a most significant feature that indications are not wanting that in the two considerable areas, India and Egypt, the respective climates betray peculiarities which may either react upon each other, or the origin of which must be sought in a common source.

From two independent investigations come attempts to trace a connection between the amount of the Nile floods and the abundance or deficiency of the south-west monsoon rainfall in India. Mr. Willcocks broached this subject in a paper read before the meteorological congress at the World's Exposition in Chicago, and there suggested that famine years in India are generally years of low flood in Egypt, and that when the summer supply of the Nile had been deficient and late, a high flood might well follow, since the drought in the valley of the White Nile must create a powerful draught from the Indian Ocean or the Arabian Sea, a district in which is to be sought the origin of the massive current of the south-west monsoon. Unfortunately, any exact data to establish this interesting connection are not forthcoming, and can hardly be expected, since the Nile is supplied from two distinct sources, and it is impossible to separate and trace the effect of either contribution. Of the great lakes of Central East Africa which constitute a reservoir for the Nile waters, little is known as to the variation in their relative height due to the rainfall in their vicinity, which lasts from March to December. At Port Alice, on the Victoria Nyanza, and at some other stations, observations, more or less regular, are made of the variation in the heights of the water, but in the absence of any common datum level these heights are referred to that of the mean lake. Much surveying work and long-continued observations will have to be made before these scanty statistics can be turned to full account. Of the second source of supply to the Nile, viz. the flood waters in the Atbara, the Blue Nile and other rivers, fed during the rainy season from June to November, we know practically nothing as to their amount. But it is this seasonal supply which is probably the greatest factor in causing variations in the Nile floods, and where a connection with the causes of the Indian rains is closest. Whatever influences the flow of the monsoon current from the equator northwards over the Indian seas towards the heated regions of India and the Malay Peninsula must have a proportional effect on East Africa and South Arabia. With heavy monsoon rains, therefore, it is not unlikely that the contributing rivers add materially to the volume of the Nile waters, but it is not altogether a trustworthy guide to gauge the amount of water that enters the Nile by measuring the quantity that passes a particular station. Much water enters the Nile that never contributes to the irrigation of Egyptian lands. Of the amount lost by evaporation no account can be taken, but a source of greater error arises from the peculiar flatness of the ground about Shambé, which forms the apex of the swamp delta. Here the Nile can spread its waters over a large area, and practically lose itself as a river among the beds of reeds and rushes, which form a veritable swamp. Engineering works, already projected or actually begun, aim at clearing some or other of the feeding streams, such as the Bahr el Gebel or the Bahr el Zarab, and the effect must be, when completed, to break the continuity of such observations as have been made. Other sources of error are to be found in the varying quantity and character of the "sudd" which may interrupt the flow or diminish the amount of evaporation; but without insisting on too much accuracy, there exists a certain amount of evidence that the two great agricultural countries of Egypt and India are likely to be prosperous together or to suffer in common.

Mr. Eliot, the meteorological reporter to the Government of India, in his recent forecast of the probable character of the south-west monsoon rains of 1900, not only fully endorses Mr. Willcocks' statement, but adds some statistics which render a connection highly probable. Omitting a few local particulars from Mr. Eliot's statistical summary, the broad features are shown below.

Year.	Variation of mean rainfall of year from normal.	Character of Nile flood.
	Inches	
1876	− 4·49	Good high flood.
1877	− 4·28	Poor flood.
1891	− 3·54	Late flood.
1896	− 4·83	Low Nile.
1899	− 11·14	Very low flood: lowest of century.

The years of excess of Indian rainfall tell a similar tale, even more distinctly.

Year.	Rainfall variation in inches.	Character of Nile flood.
1878	+ 6·34	Very severe flood: banks of river carried away in October.
1886	+ 3·02	High flood.
1892	+ 5·09	Very high and late flood.
1893	+ 9·07	High flood.
1894	+ 6·47	High flood.

Having mentioned some of the causes which prevent a rigorous comparison between the Nile floods and the Indian rainfall, one is not unprepared to find some discrepancies; but Mr. Eliot certainly does not overstate his case when he contends that these tables indicate that in at least four out of five seasons in which there was a partial failure of the rains in India there was a low Nile, and that generally the two countries are similarly affected by the meteorological conditions and the variations of those conditions. The causes of these variations are obscure, and at present very imperfectly recognised, for a complete solution, as Mr. Eliot points out, demands a much more intimate knowledge of the atmospheric conditions that prevail over a large area. The meteorology of Australia and the Indian Ocean, and perhaps also of the Antarctic Ocean, must be linked on to that of the Indian monsoon area "before it will be possible to ascertain the missing factors necessary to complete the explanations of the relations between the chief features of the monsoon currents and rainfall of India and the antecedent and concurrent conditions in the Indian area and the regions to the south." To trace and anticipate the effect of weather conditions over the area that embraces both India and Egypt, in which our interests are so largely involved, should stimulate further inquiry, with the result of placing at the command of science additional means for dealing with so grave a problem.

THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION AT BRADFORD.

IN the last article on the subject of the forthcoming meeting of the British Association an account was given of the handbook that is to be published in connection with the visit, and some information was furnished in regard to hotel and lodging accommodation. In the present article it is proposed to give a description of the excursions arranged by the local committee.

Following the custom of former years, it has been arranged that half-day excursions only shall take place on the Saturday, and that the whole-day excursions shall be reserved until the Thursday, when the serious work of the Association will be completed. The only exceptions to this are that the Mayor and Corporation are inviting a small party of engineers to visit their waterworks at Gowthwaite, in the Nidd Valley, and that a party exclusively for geologists will travel to Pateley Bridge by the