Martin Folkes (1690–1754), president of the Royal Society for eleven years; John Freind (1675–1728), who while imprisoned in the Tower began his "History of Physic," and whose release was a condition laid down by Mead when prescribing for Sir Robert Walpole; Thomas Sprat (1635–1713), Bishop of Rochester and first historian of the Royal Society, who concluded his dedication to the King: "Your Majesty will certainly obtain immortal fame for having established a perpetual succession of inventors"; and William Buckland (1784–1856), the well-known Dean of Westminster and twice president of the Geological Society. In the early days of Buckland at Westminster his son, Frank, the discoverer of Hunter's coffin, climbed the roof of the nave and by means of a long pendulum suspended from it repeated Foucault's experiment for showing the rotation of the earth.

Besides the graves of Moray and Barrow already referred to, the south transept contains a monument to Stephen Hales (1677–1761), "pious, modest, indefatigable, and born for the discovery of truth," known to-day for his work on animal and vegetable physiology; and another to Sir John Pringle (1707–82), reformer of military medicine and the predecessor of Banks as president of the Royal Society. It was he who, when the world of science was torn asunder by the controversy over the pointed ends (Franklin's) and the blunted ends (Wilson's) of lightning conductors, made the reply to George III.: "Sire, I cannot reverse the laws and operations of Nature." Buried here is also Sir William Spottiswoode (1825–82), who died while president of the Royal Society.

Only a few more memorials remain to be noticed. Among these, however, is that of Watt. Of all the monuments within the Abbey none has called forth more criticism than Chantrey's great work which dominates the little chapel of St. Paul. "Well might the standard-bearer of Agincourt," wrote Stanley, "and the worthies of the Courts of Elizabeth and James have started from their graves in St. Paul's Chapel if they could have seen this colossal champion of a new plebeian art enter their aristocratic resting-place and take up his position in the centre of the little sanctuary, regardless of all proportion or style in all the surrounding objects. Yet when we consider what the vast figure represents, what class of interest before unknown, what revolutions in the whole actual framework of modern Society, equal to any that the Abbey walls have yet commemorated, there is surely a fitness in its very incongruity." Of Brougham's inscription Stanley said: "It is not unworthy of the omnigenous knowledge of him who wrote it or of the powerful intellect and vast discovery which it is intended to describe."

Watt's great contemporary, Telford, is commemorated by a statue in St. Andrew's Chapel, and here are also to be found the memorials to Matthew Baillie (1761–1823), pupil and successor of William Hunter, physician to George III., and president of the Royal College of Physicians; Sir Humphry Davy (1778–1829), discoverer of potassium and sodium, and inventor of the miner's safety lamp; Thomas Young (1773–1829), founder of physiological optics, and called by Rankine "the most clear-thinking and far-seeing mechanical philosopher" of his time; and lastly that to Sir James Young Simpson (1811–70), the great Edinburgh surgeon, by whose efforts "the fierce extremity of suffering has been steeped in the waters of forgetfulness." It is here, between the statues of Telford and of Mrs. Siddons, and above the memorials to Baillie and Davy, that the tablet to Lord Rayleigh has been placed. The chapel itself forms part of the aisle of the north transept, to which entrance is gained through the gates of the Ambulatory. Sir John Franklin, Admiral McClintock, who discovered the relics of the Franklin expedition, and Admiral Kempenfelt, all have their monuments here, while across the transept can be seen the window erected to the memory of the officers and men who were drowned in the Bay of Biscay through the capsizing of H.M.S. *Captain*, an eloquent reminder of the necessity of making adequate scientific research before embarking upon a great practical experiment.

The Nitrogen Problem.[1]

THE results of a detailed examination of the problem of nitrogen fixation were given in the comprehensive Final Report of the Nitrogen Products Committee of the Ministry of Munitions, published in 1920, and already noticed in these columns (vol. 104, pp. 533 and 569; vol. 105, p. 201). As the Ministry of Munitions is no longer in existence, the Department of Scientific and Industrial Research has arranged for the publication of the additional statistical information which has been accumulated since that time. This Supplementary Report has been drawn up by Dr. J. A. Harker, the director of the Nitrogen Research Laboratory under the Ministry of Munitions. It deals with the statistical aspect of the Chile nitrate industry, the saltpetre industry, the nitric acid industry, the ammonium sulphate industry, the synthetic ammonia industry, the Norwegian fixation industry, the cyanamide industry, the ammonia oxidation industry, and the fertiliser industry. It includes, in addition, a variety of miscellaneous statistics relating to the world's production of fixed nitrogen, national internal sources of fixed nitrogen, the world's fixation plants and power requirements, and the prices of nitrogen fertilisers in England and Germany. The whole concludes with a reference to the present position of nitrogen fixation in this country.

One of the most remarkable of post-war experi-

[1] Statistical Supplement to the Final Report of the Nitrogen Products Committee of the Ministry of Munitions. Department of Scientific and Industrial Research. (Published by H.M. Stationery Office, 1921.) 1s. net.

ences is to be seen in the widespread demand for fixed nitrogen products, especially in the form of fertilisers. In certain countries it is found that although the potential output has been greatly increased by the provision of large fixation plants during the period of the war, yet the total demand for fixed nitrogen is growing at an even greater rate. The same phenomenon is seen in the United Kingdom, which mainly relies upon imported Chile nitrate and home-made sulphate of ammonia. The consumption of nitrogenous fertilisers in 1919 was nearly two and a half times that in an average year before the war. The world's resources in nitrogen products have doubled during the last eight years. It is, however, to be remarked that while the percentage of the whole output contributed by the Chile nitrate industry decreased to one-half, the proportion contributed by the fixation industries has increased from 4½ per cent. of the whole in 1912 to 43 per cent. in 1920 —*i.e.* an increase in percentage of tenfold. The fixation industries are, in fact, now the largest contributors to the nitrogen requirements of the world. Cyanamide plant was largely extended during the war, and its present potential output is larger than that of any other fixation process.

The Supplement contains a series of tables dealing with the world's consumption of Chile nitrate during the war period, the total shipments and the British consumption during the same period, and the amount used for fertilisers and that allocated for war purposes. The figures, as might be expected, show violent fluctuations, due to a variety of causes, such as labour difficulties in Chile, shortage of coal, difficulties of transport, excessive freight charges, liquidation of war stocks, etc. The statistics are interesting, but as they are wholly abnormal it would serve no useful purpose to analyse them in detail.

As regards the saltpetre industry, it is noteworthy that whilst of the imports into the United Kingdom about two-thirds came from Germany, this during the war period was more than replaced by the growth of the Indian industry, which in 1916 attained more than six times its pre-war extent. In 1919 the supply from this source had declined to about one-third its maximum amount.

It need scarcely be said that the war had an enormous influence on the nitric acid industry. The annual pre-war production of nitric acid in this country was estimated at 15,000 tons of 100 per cent. acid, mainly for the manufacture of dyestuffs and explosives. The output in 1917 reached 237,000 tons, of which only 12,000 tons were used for other purposes than explosives.

The available information relating to the production of by-product ammonium sulphate is admittedly incomplete. During the war the market price, of course, steadily rose, and in 1919 the average price in the home market was nearly double that in 1914; the export price was 26*l.* 12*s.* 8*d.* f.o.b. U.K. ports. Germany, which heads the list of consumption, uses at the present time nearly double the amount consumed in the United Kingdom. In fact, she utilises nearly one-third of the world's consumption, mainly, of course, as a fertiliser.

As regards the synthetic ammonia industry, which is practically confined at present to Germany, it is estimated that the combined maximum output of the works at Oppau, and Merseburg when completed, will be about 1050 metric tons of ammonia per diem.

The Norwegian fixation industry has steadily developed since 1913. It is concerned with the synthetic production of the nitrates of calcium, ammonium and sodium, sodium nitrite, calcium cyanamide, and, intermittently, of nitric acid.

It is interesting to note that the general impression, sedulously cultivated by a certain section of German manufacturers, that the cyanamide industry is doomed is not borne out by the facts. There was a rapid extension of it during the period of the war, the world's production in 1917 being about three times that of 1914. Nine new works were erected in France, and the U.S. Government established in Alabama what is now the largest cyanamide factory in the world, with a capacity of about 200,000 tons of 20 per cent. cyanamide annually. As has already been stated, the cyanamide process is still the largest contributor to the world's nitrogen supply by fixation methods.

The ammonia oxidation industry practically owes its development to the war, due to Germany's imperative need for nitric nitrogen when her external supplies were cut off. Plants were also erected in America, France, Italy, and other countries, but complete statistics of production are not available. Details are given in the Supplement of the total annual output of two plants in Germany and two in America, amounting in the aggregate to 450,000 tons of 100 per cent. nitric acid.

An instructive table is given of the world's output of nitrogenous fertilisers, in metric tons, over the period 1910–18, for which complete statistics are alone available. The figures for Chile nitrate and by-product ammonium sulphate fluctuate, but, on the other hand, the synthetic products show a rapid increase, especially in synthetic ammonium sulphate, which is now practically equal to the by-product salt.

Col. White contributes certain statistical tables to the Supplement, one of which affords an approximate measure of the degree of economic independence of the several countries referred to as regards their internal sources of fixed nitrogen. Judged by this standard, Germany has four times the degree of economic independence of this country or of France, and six times that of the United States. Germany need no longer fear that even the most rigorous blockade will interfere with her supply of nitric nitrogen for munition purposes.

Tables are also given of the price of nitrogen fertilisers in England and Germany, but as the economic conditions in the two countries were, and still are, wholly abnormal and scarcely comparable, it is not easy to determine their actual significance or to forecast their eventual importance.

In conclusion, reference is made to the attempts to develop nitrogen fixation in this country by Messrs. Brunner, Mond, and Co., who have taken over the projected Government factory at Billingham, and by Cumberland Coal Power and Chemicals, Ltd., who are to work the Claude process of synthetic ammonia.

The entire Report constitutes one of the most valuable lessons of the war, and deserves the most serious study. The subject of nitrogen fixation has not yet received the attention in this country which its great importance merits.

Obituary.

EMILE BOUTROUX.

THE death of Emile Boutroux at the age of seventy-six is the loss not only of one who has been for a generation a central figure in the circle of French philosophy, known everywhere in Europe and America, but also of one who by the charm of his personality seemed to embody all that is most attractive in the French genius. It will necessarily cast a gloom on the meeting of the Société Française de Philosophie which is to be held in Paris between Christmas and the New Year and to which English, American, and Italian philosophical societies are sending delegates, for he was to have been its président d'honneur. To those who have known him at former international philosophical congresses his loss will mean much more than his vacant chair.

The last years of Boutroux's life had been saddened by the loss of friends. He felt deeply the death of his brother-in-law, Henri Poincaré, in 1913 at the age of fifty-eight, cut off, as it seemed, in his full intellectual strength. In a conversation with the present writer a few years ago he remarked that his one dearest wish was to be able to show the fruitfulness of Poincaré's ideas in philosophy. In 1919 he lost his wife, who had been for many years his inseparable companion at home and in all his lecture tours in foreign countries. Yet with all the weight of sorrow and the increasing infirmities of old age (he suffered much from deafness and eye trouble) he retained to the end his extraordinary vivacity and charm of conversation and his power of sympathetic control when addressing a meeting.

Emile Boutroux represents a distinct and very important position in the history of contemporary philosophy, especially in relation to the modern scientific revolution. From his student days he devoted his attention to that conception of a universal determinism which, from the time of Descartes down to the great scientific development in the nineteenth century, had seemed to be the absolute and necessary basis of physical science. In 1874 he presented a thesis to the Sorbonne for his doctorate. It was entitled "De la Contingence des Lois de la Nature." For twenty years this book attracted little attention outside the circle of his students and philosophical colleagues. He was fully engaged in lecturing and teaching, and some of his lecture courses were published as studies in the history of philosophy. In 1895, however, at the urgent request of his friends, he republished his thesis in its original form, and since then it has gone through innumerable editions and has been translated into all the principal languages.

The main idea of the thesis Boutroux probably owed to his older contemporary, Lachelier, but the work itself is of striking originality. The argument is that nowhere, not even in the logical syllogism, do we get the type of necessity which is represented by the proposition of identity, A is A, and yet this and nothing short of this will satisfy the ideal of universal science. He went on to prove that the more we advance from the abstract to the concrete, from mathematics to physics, from physics to biology, from biology to psychology, the more we see the range of necessity being restricted and that of contingency growing larger. The suggestiveness of his theory rather than the systematic expression which he was able to give to it marks its importance. It places him in the direct line of that philosophical speculation which, starting with Maine de Biran in the beginning of the nineteenth century, may be traced through Ravaisson, Lachelier, and Boutroux himself to the present philosophers, Bergson, Le Roy, Blondel, and Laberthonière, all of whom were at one time his pupils.

H. W. C.

PROF. PETER THOMPSON.

PROF. PETER THOMPSON, whose untimely and deeply lamented death occurred at Penmaenmawr on November 16, early showed an unusual aptitude for human anatomy. He obtained a special mark of distinction in the subject when a student, and it gained him the gold medal on taking the M.D. (Victoria) from Owen's College, Manchester. He soon won a reputation as a brilliant and enthusiastic teacher after he was appointed senior demonstrator of anatomy at Owen's College. This reputation he fully maintained when he came to London, first as lecturer at the Middlesex Hospital, and later as professor of anatomy at King's College. In 1912 he was elected professor of anatomy and dean of the medical faculty of the University of Birmingham.

Prof. Thompson's contributions to the literature