planets may be much more effectively utilising this small energy gift from the sun than does the nearer group of planets, for their atmospheres, as their spectra show, are as blankets retaining energy of the longer heat-waves, and may let little or none pass out in the heat spectrum available to observers on the earth.

These studies further direct attention to that important break between the two groups of planets between Mars and Jupiter, and emphasise the need of its further study, and perhaps from theoretical grounds as well, for when we know what has happened to produce the asteroids and cause this vast change in the planetary bodies, we shall better understand the past of the solar system.

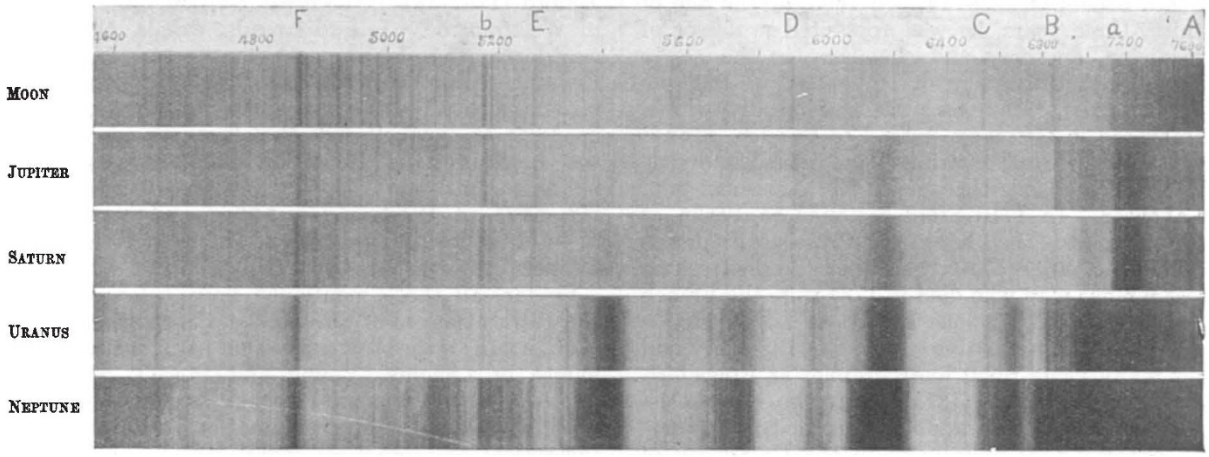

FIG. 4. Spectra of planets and the moon.

Scientific Centenaries in 1934

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THE records of the past year contain accounts of many commemorations of the centenaries of notable men such as Wren, Pepys, Priestley and Trevithick. In some instances the celebrations included the arrangement of interesting exhibitions, the delivery of lectures and the erection of memorials, but in every case they reminded the world of its benefactors and brought to light new information regarding the lives and work of those commemorated. If the sole value of the practice of commemorating centenaries were that it reminded us of great achievements it would be justified, for most men are like Emerson who said: "I cannot even hear of personal vigour of any kind, great power of performance, without fresh resolution." Then, too, we are all debtors of the dead, appropriating from their labours what is pure grain, rejecting what has proved to be chaff and utilising their discoveries and inventions for furthering our immediate ends.

In looking forward once again, it will be found that the centenaries falling within 1934 recall names worthy in every way to be placed beside those brought to mind during the past year. In their own time, and in their particular spheres of activity, few men held higher positions among their fellows than Mendeléeff, Langley, Weismann, and Haeckel, who were all born a century ago, or Jacquard and Telford, who died in 1834. But they only built on the work of their predecessors, and in commencing a short review of the scientific centenaries of 1934, it is of interest to go back to the revival of learning and the days of the Reformation. The outstanding figure in the science of those days was Copernicus (1473–1543), one of whose contemporaries was Otto Brunfels, who died on November 23, 1534, four centuries ago. The son of a German cooper, Brunfels was in turn a Carthusian monk, a Lutheran preacher, a schoolmaster at Strasbourg and a doctor in Berne. His study of herbs caused him to be called a reviver of botany and his name was afterwards given to a genus of plants by Plumier. The year of Brunfels's death saw the birth of another German botanist, Joachim Camerarius (1534–98), son of the learned scholar who reformed the University of Leipzig. The pupil of Melancthon, Camerarius received the degree of M.D. at Bologna in 1562, then settled in Nuremberg and there formed one of the earliest botanical gardens. A French botanist of a hundred years later was Denis Dodart (1634–1707), physician to Louis XIV, a member of the Paris Academy of Sciences and one of the compilers of the "Mémoires pour servir à l'histoire des plantes" published in 1676.

It was but natural that the early botanists should be recruited from the ranks of the

physicians, from which came also some of the early chemists. Among the medical men of the seventeenth and eighteenth century whose names are indelibly inscribed on the roll of scientific worthies is Georg Ernst Stahl, the bicentenary of whose death occurs on May 14. In 1693, at the age of thirty-three years, he was appointed professor of medicine, anatomy and chemistry in the newly established University of Halle and in 1698 he enunciated the famous phlogiston theory which, embraced in Germany, spread to Sweden, France and England and continued an orthodox article of faith until overthrown by the experiments of Lavoisier. In 1716 Stahl removed to Berlin as physician to the King of Prussia, Frederick William I (1688–1740), and there he died. Two less famous men who died in 1734 were the French mathematicians Thomas Fantet de Lagny (1660–1734), a foreign member of the Royal Society and for many years royal hydrographer at Rochefort, and Peter Poliniere (1671–1734), who it is stated was the first person appointed to deliver lectures on experimental philosophy in the University of Paris.

The year 1734 also saw the birth of many individuals who achieved distinction in science and engineering. These included Edward Waring (1734–98), F.R.S., for thirty-eight years Lucasian professor of mathematics at Cambridge, whose "profound researches were not," it was said, "adapted to any form of communication by lectures"; Wolfgang, Baron de Kempelen (1734–1804), the Hungarian statesman and mechanician, who devised an automatic chess player, which was exhibited in London, and a process of printing books for the blind in embossed type; the French agriculturist Francis Rozier (1734–1793), who in 1771 founded the *Journal de Physique et d'Histoire Naturelle*; Thomas Henry (1734–1816), F.R.S., the chemist, who was first secretary, and later on president of the Manchester Literary and Philosophical Society, and Robert Mylne (1734–1811) the engineer and architect who is buried in St. Paul's Cathedral close to Wren. Mylne designed the Gloucester and Berkeley Canal, the Eau Brink Cut at Lynn and the first Blackfriars Bridge, the third bridge to span the Thames at London. For a very long period Mylne was the surveyor of St. Paul's.

Turning to the deaths and births of just a hundred years ago, the list, without being exhaustive, contains many familiar names. In 1834 died Jean Nicholas Peter Hachette (1769–1834), a professor at the École Polytechnique, whose development of the descriptive geometry of his colleague, Monge, proved of great value to the constructors of machinery in France; the German astronomer Karl Ludwig Harding (1775–1834), who in 1804 discovered Juno, the third asteroid, and the Swiss physicist Charles Gaspard de la Rive (1770–1834), who like his son Auguste de la Rive was a friend of Faraday. On February 26, 1834, Alois Senefelder (1771–1834), the inventor of lithography, died in Munich; on August 7 Joseph Marie Jacquard (1752–1834), the inventor of the loom for figure weaving, died near Lyons; on August 19 General Henri Joseph Paixhans (1783–1834), a pioneer in the improvement of artillery, passed away at Metz, and on September 2, Thomas Telford (1757–1834), the great civil engineer, died in Westminster. Telford's roads, canals, bridges and docks are to be found in many parts of Great Britain. After the death of Rennie he was the recognised head of the engineering profession, and in 1820 he was elected the first president of the Institution of Civil Engineers, a position he held until his death. He was buried in the nave of Westminster Abbey and a statue of him is to be seen there in St. Andrew's Chapel.

So far, all those mentioned have belonged to the western nations of Europe, but of men of science born in 1834 the list may well begin with the names of Langley, Young and Powell, of the United States. Samuel Pierpont Langley (1834–1906) will always be remembered for his important theoretical and practical investigations on aeronautics, but he was also distinguished as a physicist and astronomer, and for many years was secretary of the Smithsonian Institution. His contemporary, Charles Augustus Young (1834–1908), of Princeton University, was also an eminent astronomer, while Major John Wesley Powell (1834–1902) was, from 1879 until 1902, Director of the United States Bureau of Ethnology and from 1881 until 1894 Director of the United States Geological Survey.

These three eminent men were born in the eastern States of America; the birth of the great Russian chemist, Dmitri Ivanowitsch Mendeléeff (1834–1907), carries us to the plains of Siberia, to Tobolsk, where his father was a schoolmaster. Mendeléeff was born on January 27 (O.S.) or February 8 (N.S.) and died in 1907 on January 20 (O.S.) or February 2 (N.S.). His life and work were the subject of a memorial lecture delivered to the Chemical Society in 1909 by Sir William Tilden. Two of Mendeléeff's contemporaries, born in Germany and famous as chemists, were Carl Schorlemmer (1834–92) and Hermann Johann Philipp Sprengel (1834–1906) both of whom, however, spent the greater part of their lives in England, Schorlemmer being the colleague of Roscoe at Owens College, Manchester. Sprengel was famous for his invention of the improved mercury air pump and for his work on explosives. Another German man of science born in 1834 was Philipp Reis (1834–74) a pioneer of the telephone whose apparatus was used so early as 1865 by D. E. Hughes when lecturing before the Emperor of Russia, Alexander II.

Leaving the ranks of the workers in physical science for those of the inventors and engineers, mention may be made of Daimler, Wedding, Preece, Woodbury, Vavasseur and Perkins, who were all born in 1834. Loftus Perkins (1834–91), the grandson of Jacob Perkins, was a pioneer in the use of high-pressure steam at sea, and in 1880

built the yacht *Anthracite*, which crossed the Atlantic using steam at 350 lb. per sq. in.; Joseph Vavasseur (1834–1908) is remembered for his improved method of controlling the recoil of large guns, while Walter Bentley Woodbury (1834–85) was the inventor of Woodburytype and other developments in photography. Sir William Preece (1834–1913) was widely known as a distinguished electrical engineer; Gustav Hermann Wedding (1834–1908) was both an honorary member and Bessemer medallist of the Iron and Steel Institute; while Gottlieb Daimler (1834–1900) will always be remembered as the colleague of Langen, Otto and Maybach, and as the first to construct a high-speed internal combustion engine suitable for road vehicles.

In conclusion, passing reference may be made to the approaching centenaries of the birth of Sir John Lubbock, first Lord Avebury (1834–1913) which falls on April 30, 1834, whose writings on primitive man and on bees and ants delighted a large circle of readers; of August Weismann (1834–1914) the German biologist, born on January 17, 1834, who was the first to think out a coherent theory of heredity, and of Ernst Heinrich Haeckel (1834–1919), born on February 16, 1834, who has been spoken of as "probably the most influential advocate of Darwinism".

Experiments in the Stratosphere

IT has recently been reported in the daily Press that an attempt is shortly to be made by balloon ascent to reach higher altitudes than 61,000 ft. (pressure 50 mm.) claimed to have been reached by Prokofiev and his companions in the U.S.S.R. balloon. It is to be recalled that observations were made by Regener in 1932 using self-registering apparatus attached to rubber balloons up to a pressure of 22 mm. It was reported that the American balloonists Settle and Fordney reached a pressure last autumn of about 64 mm., whilst the minimum pressure from the records of the Belgian flights of Cosyns, Kipfer and Piccard was 73 mm.

The new attempt represents a departure from the previous methods in that the observers are to travel in an open basket but will themselves be completely sealed in flexible rubber suits. To prevent these from ballooning at low external pressure the suits, adequately supported, will be exhausted down to the minimum that a man can withstand with comfort if he be supplied with sufficient oxygen. The advantages claimed are that the great saving in weight by the absence of the heavy gondola of the previous flights will enable the observers to reach greater heights. The apparatus has already been tested with safety up to an external pressure supposed to correspond to a height of 90,000 ft.—roughly that attained by Regener's balloons. These preparatory ground experiments are being conducted by an American, Mr. M. E. Ridge, with the advice of Dr. J. S. Haldane, at the works of Messrs. Siebe, Gorman and Co. Ltd. at Lambeth, London. It is assumed that the ballooning of the suit at the greatest height attainable will not incommode the occupant even though he himself is under a very much reduced pressure. The observer will be enabled to move about freely and make meteorological and other observations with instruments in contact with the atmosphere.

It is true that from the point of view of record breaking, this saving in weight is an important feature, for it was made clear by Dr. M. Cosyns, when lecturing in England a short time ago, that the only practical limits imposed turned on the very awkward elongated cigar shape of an extremely large envelope when filled with hydrogen only to a small fraction—one fifth or one tenth—of its capacity on the ground. The whole risk lies with the possible entangling of the practically parallel ropes supporting the gondola. When once off the ground the mishap cannot be rectified. So great was the risk that, in the last Belgian ascent, the balloon was purposely filled with twice as much hydrogen as was required in order to keep the ropes apart, the surplus being discharged en route.

Turning now to the instrumental observations, it must be remarked at the outset that the values of J, the rate of production of ions per cubic centimetre by the cosmic rays, obtained by the Belgian observers, lie within the limits of those of Regener and agree well with them. Those of the stratostat *USSR* are said to agree slightly better with the Belgian than with Regener's results. Other interesting experimental results from the Russian source are that the composition of the air is the same at the lowest pressure reached as on the ground, the relative humidity fell from 92 per cent on the ground to 42 per cent on the borders of the stratosphere and that, contrary to expectations, gradients of temperature over a few degrees were experienced within the stratosphere. It is noticeable, however, that previous observers have attempted rather too much on each flight, but commenting on the new departure and its relation to previous methods, the barothermograph looks after itself, as does the recording electrometer for obtaining the potential gradient. Perhaps a small advantage would be obtained here in manipulating the leads strung out from the car. The Kolhörster ionisation chamber failed to work on the Belgian flight due to the deposition of body moisture on the insulations, but the advantages of exposing the battery, insulators, electrometers, etc., to the rigorous conditions of the stratosphere are doubtful. Spectrometers for recording the sun and sky light, pyrheliometer for determining the solar constant, air samplers and camera can all be worked in the open. Eyes and ears must unfortunately always