Calendar of Discovery and Invention.

July 3, 1769.—Arkwright's famous patent for spinning by rollers was taken out on July 3, 1769, a few months after Watt's still more famous patent on the separate condenser for steam engines. A barber by trade, Arkwright became interested in the cotton-spinning problem in 1766 when thirty-five years of age, and his first machine was exhibited in the old Grammar School at Preston two years later. His machine of 1769 is preserved in the Science Museum, South Kensington. There are four rollers in pairs, the top rollers being covered with leather, while the lower rollers are fluted, the several pairs being weighted to ensure contact. His roller drawing principle exists to-day.

July 4, 1840.—The first steam vessel to carry the mails between England and America, and the first vessel of the famous Cunard Steamship Company, the s.s. *Britannia*, sailed from Liverpool on her maiden voyage on July 4, 1840, and reached Boston in 14 days 8 hours. She was built of wood and driven by paddles, and could accommodate 115 passengers.

July 5, 1639.—The incident related of Galileo watching the lamps swinging in Pisa Cathedral dates back to 1582. Many years afterwards, on July 5, 1639, in a letter he suggested the use of a swinging pendulum for astronomical purposes, and about the same time an arrangement was devised and set out on a drawing, for driving a pendulum by weights.

July 6, 1787.—On July 14, 1787, John Wilkinson, the famous Shropshire ironmaster, wrote: "Yesterday week my iron boat was launched. It answers all my expectations and it has convinced the unbelievers who were 999 in 1000. It will be a nine days' wonder, and then be like Columbus's egg." This iron canal barge, the first of all iron boats, was followed by several others, but iron as a constructive material did not come into general use for half a century.

July 7, 1879.—Among the most important observatories of the Far East are those of Zikawei, near Shanghai, and Manila, founded by the Society of Jesus, which alone among the great religious orders has been famous for its scientific work. The Manila observatory was first situated at Ateneo, and then at Ermita, and was founded in 1865 by Father Faura, S.J., who after some years of meteorological work, on July 7, 1879, predicted that a typhoon would pass over North Luzon. The event justified his warning. This was the first time that the existence, duration, and course of a typhoon had been predicted in the Far East. Father Faura's subsequent work proved so valuable that the merchants subscribed for its continuance, and with the connexion of Manila and Hong Kong by submarine cable came the beginning of the system of weather forecasts which has proved such an immense boon to shipping in the China Seas.

July 8, 1814.—One of the visitors to Paris soon after the fall of Napoleon was Edward Stanley, Bishop of Norwich, who, writing to his wife on July 8, 1814, gave an interesting account of his visit to the Jardin des Plantes, where "everything is arranged in such order that it is almost impossible to see it without feeling a love of science; here the mineralogist, geologist, naturalist, and entomologist may each pursue his favourite studies unmolested. Here, as everywhere else, the utmost liberality is shown to all, but to Englishmen particularly, your country is your passport."

July 9, 1908.—Following up the methods of Sir James Dewar, Kamerlingh Onnes, of the University of Leyden, liquefied helium, the only remaining gas that had not been coerced into that state, on July 9, 1908. E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 23.—J. C. McLennan and J. H. McLeod: On the wave-length of the green auroral line in the oxygen spectrum. In 1925, McLennan and Shrum found a line in the spectrum of highly purified oxygen of wave-length λ 5577·35±0·15, and provisionally identified it with the green auroral line. Reinvestigation with a Fabry-Perot interferometer now determines the wave-length of this line as 5577·341±0·004. Babcock's value for the wave-length of the auroral line being 5577·350±0·005, there would thus seem to be no doubt as to the identity of the lines. Apparently oxygen as well as nitrogen is present in those regions of the upper atmosphere whence the auroral light is transmitted.

A. Caress and E. K. Rideal: The combination of nitrogen and hydrogen activated by electrons. A study of the combination of nitrogen and hydrogen to form ammonia in a triode valve has been made. Hydrogen atoms formed by thermal dissociation at a hot tungsten emitter combine with nitrogen at platinum and nickel surfaces to form ammonia. Hydrogen atoms excited by collision with *ca.* 13-volt electrons react with molecular nitrogen in the gas phase to form ammonia. In the absence of hydrogen atoms (by using a mixed barium calcium oxide emitter) no ammonia is observed until a voltage of 17 volts is attained, and a further rise in rate of formation occurs at 23 volts. These two rises are attributed to the chemical reactivity of N_2^+ and N^+. Ammonia seems to be produced by interaction of N_2^+ and N^+ with hydrogen to form primarily excited hydrogen atoms. The electron-efficiency of ammonia-formation from nitrogen ions is at least one ammonia molecule produced for the passage of four electrons; in the case of excited hydrogen atoms the efficiency appears to be even higher.

J. F. Lehmann and J. H. Osgood: The total ionisation due to the absorption in air of slow cathode rays. Electrons ejected from a hot tungsten filament were accelerated to an anode, by a potential difference of 200 up to 1000 volts and a portion passed through a carbon capillary into an ionisation chamber. The electron current entering the chamber, and the positive ion current due to the absorption of these electrons, were measured alternately. Ratio of ionisation current to electron current gave average ionisation per electron. Using an electron beam of given initial energy, ionisation per electron is approximately proportional to pressure of absorbing air, provided this pressure was less than a certain 'critical pressure.' For greater pressures, ionisation per electron was constant. The magnitude of the critical pressure was determined by the initial energy of the electron beam. Ratio of ionisation current to electron current, at pressures greater than critical pressure, represents average total ionisation due to complete absorption of an electron. This is directly proportional to initial energy of electron, and the ratio, initial energy of electrons/average total ionisation per electron, gave average energy expenditure associated with the formation of a pair of ions. This average per ion pair was 45 electron-volts, whereas the ionisation potential of air is 17 volts.

J. F. Lehmann: The absorption of slow cathode rays in various gases. A homogeneous beam of electrons of definite initial energy was introduced into an ionisation chamber. For complete absorption of the electron beam the average ionisation per electron was directly proportional to the energy of the electrons, the constant of proportionality varying markedly

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