arsenic acids are reduced at low redness with sublimation of annuli of arsenic. When the powder is dropped into a warm solution of iodic acid, iodine is liberated, and if a mixture of amorphous boron and crystallized iodic acid is slightly warmed, it takes fire, and a cloud of iodine vapour is produced. Gaseous hydrofluoric acid attacks amorphous boron at low redness, hydrogen being liberated, and fluoride of boron produced. Hydrochloric acid only reacts at bright redness.

Steam does not react with boron below a red heat, but the moment incandescence commences at any point the decomposition proceeds with explosive violence, hydrogen being liberated and boric anhydride produced. Carbon monoxide is reduced by boron at 1200°, with formation of boric anhydride and deposition of carbon. When amorphous boron is heated to low redness in a current of nitrous oxide, incandescence is produced, and boron nitride and boric anhydride are formed. Nitric oxide, however, does not react with boron under these circumstances.

Metallic oxides are much more readily reduced by boron than by carbon. For instance, when a mixture of copper oxide and amorphous boron is heated in a glass test-tube, the heat produced in the act of reduction is so great that the glass immediately fuses. Oxides of tin, lead, antimony, and bismuth are immediately reduced upon slightly warming, and the mass becomes white hot. When peroxide of lead is rubbed in a mortar with amorphous boron, a violent detonation occurs. Oxides of iron and cobalt are reduced at a red heat, but the alkaline earths are not attacked by boron. When caustic potash is fused in contact with amorphous boron, a vigorous reaction occurs, with rapid evolution of hydrogen.

The great affinity of boron for oxygen may be readily shown by making a gunpowder in which carbon is replaced by boron; if such a mixture of amorphous boron, sulphur, and nitre is made, it will be found to explode considerably below the lowest red heat. If a few particles of amorphous boron are allowed to fall into fused potassium chlorate, quite a pyrotechnic display is produced. The behaviour of certain fluorides towards amorphous boron is interesting. Silver fluoride, for instance, reacts in the cold upon simple contact in a mortar, with incandescence and detonation. Many other fluorides are similarly decomposed on warming.

Sulphates of potassium and sodium are reduced to sulphides at a low red heat by amorphous boron with great energy, the mass becoming white hot. Fused nitre, however, only reacts at the temperature at which oxygen commences to be evolved, but fused nitrites of the alkali metals react with violence, and production of light and heat. Sodium carbonate, moreover, is reduced at the temperature of low redness with vivid incandescence. The reducing capabilities of boron appear to be even manifested in presence of water, for the powder rapidly decolorizes a solution of permanganate, and reduces solutions of ferric salts to ferrous. Silver nitrate in solution is reduced with deposition of crystals of metallic silver; gold chloride also yields an immediate precipitate of finely divided gold, and platinum chloride is likewise reduced with precipitation of platinum upon warming.

A. E. TUTTON.

THE MANCHU RACE.

THE origin of the Manchus—the race to which the reigning dynasty in China belongs—is discussed by a writer in the *North China Herald*, of Shanghai. He says that the Tungus people are scattered about in Siberia and Manchuria in rather small communities of several hundreds or thousands each. In 1854 there were about thirty-five or forty thousand persons altogether in Siberia belonging to this race. Being hunters and fishers they find it best to live on the banks of rivers and on the seaside for fishing, and in wooded hill countries for hunting. They are met with, consequently, on the shores of the Baikal, and on the upper waters of the Lena, which rises among the mountains west of that inland sea. These few colonies of this race are under the jurisdiction of Irkutsk. Still farther west there are a tribe or two on the Yenissei. Those on the Lena are near the part where the mammoth and other wild animals formerly had their haunts. The frozen remains of these ancient creatures are found chiefly at the mouth of the Lena, which flows north to the Arctic Sea through about twenty degrees of latitude from the neighbourhood of Baikal. On the east of the Baikal, Nerchinsk and the banks of the Orchon and Onon Rivers are preferred by this people, who are irregularly scattered among the Buriat tribes in this part of Siberia. In the Amur territory of Russia they occupy parts of the sea coast, and are known as the Orotches and Goldi. It is because the salmon and other fish that they live on are found in abundance that they here build their movable huts. In the Russian Amur province there are about forty thousand of them, representing an ancient race which, as their language, joined with the facts of Chinese history, shows, must have occupied these same territories and prosecuted these occupations for thousands of years. In Kirin province there are, it is likely, a corresponding number, for the trade with China always demands sable skins, otter skins, squirrel skins, beavers, ermines, and fox skins in an ever increasing quantity. It is this demand for skins that maintains the tribes in the north part of Kirin province residing on the banks of the Usuri and other streams which flow north into the Amur.

The Tungus tribes to which the Manchus belong first appear in history in the Chow dynasty. They are the Sokdin or Sushen of that age, and they were powerful in the eleventh century before our era. They are mentioned in the preface of the Book of History, so that we have next to classical authority for their existence at that distant period as a powerful state. The historian Tso mentions them in the sixth century, and from the way in which he speaks they were the strongest race in Tartary at the time. But in the third century, after nine hundred years of honour, their star went down, and the age of Turkish ascendency arrived. The Hiung-nu Turks of the Han dynasty had emperors of their own, who at least on one occasion were received in China on terms of equality with the haughty sovereigns of their southern neighbours. They could call themselves eldest sons of heaven and brothers of the sun and moon, just as the Chinse could, and therefore they did so. But their star also went down. The Turkish race has been used to rule wild tribes for 2000 years. We know that the Hiung-nu were Turks by the words left of their vocabulary which are found recorded in Chinese history. But their power declined, and then the Sushen, or Tungus, rose again to influence, and it was because they lived in the eastern provinces, where the valleys are rich in productive power, and because they had the good sense to profit by Chinese teaching. When China conquered the Moukden province and Corea, a century before the Christian era, the result was that the habits of life of the Chinese and their moral and intellectual activity spread to the east and north-east. Tungus and Corean tribes came under this new influence, and grew more powerful in proportion to the progress they made in the adoption of a civilized life. The Tungus Ambassadors arrived at Loyang in A.D. 263 and 291; and a few years later, when the Tsin Emperor had removed his Court to Nanking, they appeared there. Probably they came from the mouth of the Newchwang River by sea, for we know that the Chinese junk-masters navigated the Gulf of Pechili fully 2000 years ago. The troops which subjugated Corea at that time were there in large junks. Meanwhile other branches of the Tungus race had become sufficiently powerful to disturb the quiet of North China. Among them were the Owan and Sien Pi. The Sien Pi and the Hiung-nu conquered large portions of Chinese territory. The Tungus people ruled in the province of Peking. The Turks occupied Shansi, and Tibetan tribes took possession of Shensi. Each of these races seized on that part of North China which lay contiguous to their homes in Tartary. This state of things lasted till the latter part of the fifth century, when the Chinese drove the Tartars out. Again, however, at the beginning of the twelfth century a Tungus race conquered North China, and was followed later by a Mongolian dynasty, to which the Chinese of north and south all submitted for a hundred years.

The Mongols as a race are probably an offshoot from Tungus stock. There are differences, but there is on the whole a great resemblance. The consanguinity that exists between Manchu and Mongol is greater than that which is found to prevail between Mongol and Turk; and therefore it may be concluded that the Tungus, either in Siberia or in Manchuria or on the Amur, threw off a branch which became Mongol. This would be of a very ancient date, for otherwise the grammars of the Mongol and Manchu would be more alike than they are. Genghis Khan and his tribe started on the conquest of the Asiatic continent from the neighbourhood of the gold mines in Nerchinsk, and the Mongols are not fishermen by preference nor hunters of the sable martin and the beaver. They are rather keepers of sheep and riders of horses and camels. They

might easily develop their language in the vicinity of the Altai Mountains and the Baikal.

As to the Manchus, they have forgotten their early occupations since coming to China, and they attend now only to the duties of the public service or to military training. The language, like the Mongol, is rich with the spoils of antiquity. All the various forms of culture, whether belonging to Shamanism, Confucianism, or Buddhism, with which they have become successively familiar, have contributed a share. To these must be added the vocabulary of the huntsman, the fisherman, and the shepherd, and all the terms necessary for the feudal relationship as well as those of the trades and occupations of the old civilization.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 11.—Prof. A. W. Rücker, F.R.S., Vice-President, in the chair.—Mr. H. M. Elder read a paper on a thermodynamical view of the action of light on silver chloride. In the decomposition of silver chloride by light, chlorine is given off, and a coloured solid body of unknown composition (sometimes called "photochloride") formed, the reaction being indicated by the formula $nAgCl = Ag_nCl_{n-1} + \frac{1}{2}Cl_2$. If the experiment be carried out in a sealed vacuum, the chloride is darkened up to a certain point, but regains whiteness when left in the dark. These facts have led the author to believe that the pressure of the liberated chlorine is a function of the illumination or intensity of light falling upon the chloride, in the same way as the pressure of a saturated vapour is a function of the temperature. Since illumination is a quantity in many respects analogous to temperature, he considers it not unreasonable to apply thermodynamic arguments, and regard chlorine in presence of silver chloride and "photochloride" as the working substance in a "light engine." He therefore supposes a Carnot's cycle to be performed on the substances at constant temperature, the variables being pressure, volume, and illumination. Since the cycle is strictly analogous to Carnot's, except that illumination is written for temperature, he infers that the efficiency is a function of the two illuminations. It also follows that just as Carnot's cycle is used to determine an absolute scale of temperature, so this cycle may be applied to determine an absolute scale of illumination. It only remains to determine an empiric scale analogous to the air thermometer, and to compare it with the photodynamic scale, provided a method of making the comparison can be devised. Assuming the axioms applied to Carnot's cycle are true when illumination is written for temperature, the author shows mathematically that $p \propto I^{\rho/T}$, where p is the pressure, I the illumination, T the absolute temperature, and ρ the heat of combination per gramme-molecule of chlorine evolved. If P be the heat of formation of silver chloride, the fraction ρ/P may be considered as expressing the fraction of the total chlorine that can be removed by the action of light upon it, supposing the gas removed so as to keep the pressure below that corresponding to the illumination. The chemical equation might then be written—

$$P/\rho AgCl = Ag_{P/\rho}\, Cl_{P/\rho - 1} + \tfrac{1}{2}Cl_2;$$

thus the formula for "photochloride" would be $Ag_{P/\rho}Cl_{P/\rho-1}$. Prof. Rücker read a letter from the President (Prof. Fitzgerald) on the subject of the paper. He inquired what axiom corresponding with the second law of thermodynamics was employed. He was not sure that the engine was perfectly reversible, and felt doubt on the subject of phosphorescence mentioned in the last operation of the cycle. Nevertheless, the paper was a most interesting one, and very suggestive. Prof. Herschel pointed out that Becquerel's phosphoroscope showed that all kinds of light produced phosphorescence, and thought that, in considering the subject, the non-thermal character of photogenic light should be kept in view. Mr. Baker said he had been working on silver chloride for several years, and found that no darkening whatever took place if kept dry and *in vacuo*. He considered oxygen necessary to the action. Dr. C. V. Burton, referring to the mobility of the system, said that only a small fraction of the energy of the illumination was actually made use of. He also thought it necessary to consider how far the second law of thermodynamics could be treated as an axiom. He himself had been led to believe the law did not hold for mixtures of substances differing in a finite degree from one another. Some time ago he experimented on a solution of sodium sulphate placed in a dialyzer kept at constant temperature. The more acid portion passed through the membrane, and on mixing a rise of temperature was observed; the dialyzer thus acted like Maxwell's demons, and the mixing increased the motivity of the system. Prof. Rücker expressed his doubts as to whether the cycle described in the paper was strictly analogous to that in Carnot's problem. In the latter case the parts of the working substance only differed infinitesimally from one another, whilst in the former the working body was a mixture of two solids and a gas. In order that the increased illumination should not alter the temperature, heat must be carried away. According to the paper, the first part of the cycle must be both adiabatic and isothermal. This seemed hardly possible. If the chlorine alone be considered, it could not be true, and it could only hold if the chloride absorbed all the heat given out by the compression of the chlorine. This seemed improbable, but, if true, it would be very important. Captain Abney saw another difficulty in the fact that at low temperatures silver chloride is not acted on even by violet light, whereas heating greatly increases the action. In his opinion the conclusions arrived at required confirmation, but the paper would form a starting-point for many new experiments. Mr. Elder, in reply to Prof. Fitzgerald, said the axiom corresponding to the second law as stated by Clausius might be formulated thus: Energy cannot of itself pass from a less bright to a brighter body. In the paper he had assumed that the energy given out during compression at the lower illumination was of the same quality as that absorbed at the higher. The whole question depended on comparisons of intensities of illuminations of different wave-lengths. In the expression $p \propto I^{\rho/T}$, ρ was probably a function of T, and Captain Abney's objection was not necessarily fatal. Speaking of the presence of oxygen being essential to decomposition, he believed some sensitizing body was necessary, but judging from experiments he had seen, an infinitesimal quantity would probably be sufficient, for the action seemed to be of a catalytic nature. He felt the weight of Prof. Rücker's objections, but thought they might possibly be met.—A paper on choking coils was read by Prof. Perry, F.R.S. Regarding a choking coil as a transformer with one primary and many secondaries represented by the conducting masses, he pointed out that all the secondaries might be replaced by a single coil of n turns, and resistance r ohms, short-circuited on itself. Assuming no magnetic leakage, the equations for the two circuits at any instant are $V = RC + N\theta I$, and $O = rc + n\theta I$, where N and n are the turns, R and r the resistances, I the total induction (in 10^8 C.G.S. lines), and C and c the primary and secondary currents respectively. Since the exciting current, C, is all-important in choking coils, and its value depending on the law of magnetization, the equations are treated in a different manner from that adopted in ordinary transformer calculations. Expressing the magnetic law as a Fourier series, $I = \Sigma A_i \sigma_i \sin ix$, the value of A (viz. $NC + nc$) is deduced, and when V or I is given as a periodic function of the time, C may be calculated. Assuming $V = V_0 \sin kt$, the author finds

$$C = \frac{V_0}{N^2\sigma k}\left[\sqrt{1 + 2e\sin f + e^2}\,.\sin\left\{kt - 90 + \tan^{-1}\left(\tan f + \frac{e}{\cos f}\right)\right\} - b\cos 3kt - m\cos 5kt\right],$$

where $e = n^2\sigma k/r$, f is the hysteresis term, and b and m constants depending on the law of magnetization. For ordinary transformer magnetizations, $b = 0{\cdot}2$, and $m = 0{\cdot}05$. From the above expression it will be seen that if there is no hysteresis (*i.e.* $f = 0$), the effect of the eddy currents, e, is to increase the amplitude of the important term, and to produce a lead of $90° - \cot^{-1}e$, whereas the effect of hysteresis without eddy currents is to leave the amplitude unaltered, and produce a lead f. Putting $f = 0$ gives results in accordance with experimental observation, hence the author is inclined to believe that there is no hysteresis in transformers. He also points out that the higher harmonics must exist, and thinks it probably that a choking coil with finely divided iron may prove a method of increasing frequency by mere magnetic means. Taking the case of a 1500-watt transformer (2000 volts) unloaded, in which the loss in eddies was 40 watts, it is shown that a secondary of 2 turns, and resistance 1·9 ohms, would replace the eddy