blast-furnaces and coke-ovens, or from the creosote oil of the tar-distiller, by the process foreshadowed in the concluding sentences of the preceding lecture, will then be mixed with the gas from the retorts, and will supply a far higher illuminant than we at present possess. In parts of the United Kingdom, such as South Wales, where gas coal is dear and anthracite and bastard coals are cheap, water gas, highly carburetted, will entirely supplant coal gas, with a saving of 50 per cent. on the prices now existing in these districts.

While these changes have been going on, and improved methods of manufacture have been tending to the cheapening of gas, it will have been steadily growing in public favour as a fuel; and if, in years to come, the generation of electricity should have been so cheapened as to allow the electric light to successfully compete with gas as an illuminant, the gas-works will still be found as busy as of yore, and the holder of gas shares as contented as he is to-day; for, with the desire for a purer atmosphere and white mist instead of yellow fog, gas will have largely supplanted coal as a fuel, and gas-stoves, properly ventilated and free from the reproaches I have hurled at them to-night, will burn a gas far higher in its heating power than that we now use, far better as regards its capacity for bearing illuminating hydrocarbons, and entirely free from poisonous constituents. As soon as the demand for it arises, hydrogen gas can be made as cheaply as water gas itself; and when the time is ripe for a fuel gas for use in the house, it is hydrogen and not water gas that will form its basis. With carburetted water gas and 20 per cent. of carbon monoxide, we shall still be below the limit of danger; but a pure water gas, with more than 40 per cent. of the same insidious element of danger, will never be tolerated in our households. Already a patent has been taken by Messrs. Crookes and Ricarde-Seaver for purifying water gas from carbon monoxide, and converting it mainly into hydrogen by passing it at a high temperature through a mixture of lime and soda lime—a process which is chemically perfect, as the most expensive portion of the material used could be recovered.

From the earliest days of gas making the manufacture of hydrogen by the passage of steam over red-hot iron has been over and over again mooted and attempted on a large scale; but several factors have combined to render it futile. In the first place, for every 478·5 cubic feet of hydrogen made under perfect theoretical conditions never likely to be obtained in practice, 56 pounds of iron were converted into the magnetic oxide; and as there was no ready sale for this article, this alone would prevent its being used as a cheap source of hydrogen. The next point was that, when steam was passed over the red-hot iron, the temperature was so rapidly lowered that the generation of gas could only go on for a very short period. Finally, the swelling of the mass in the retort, and the fusion of some of the magnetic oxide into the side, renders the removal of the spent material almost an impossibility. These difficulties can, however, be overcome. Take a fire-clay retort 6 feet long, and 1 foot in diameter, and cap it with a casting bearing two outlet tubes closed by screw-valves, while a similar tube leads from the bottom of the retort. Enclose this retort, set on end, by a furnace chamber of iron, lined with fire-brick, leaving a space of 2 feet 6 inches round the retort; and connect the top of the furnace chamber with one opening at the top of the upright retort, while an air-blast is led into the bottom of the furnace chamber below rocking fire-bars, which start at the bottom of the retort, and slope upwards to leave room for ash-holes closed by gas-tight covers. The retort is filled with iron or steel borings—alone if pure hydrogen is required, or cast into balls with pitch if a little carbon monoxide is not a drawback, as in foundry work. The furnace chamber is filled with coke, fed in through man-holes or hoppers in the top, and the fuel being ignited, the blast is turned on, and the mixture of nitrogen and carbon monoxide formed passes over the iron, heating it to a red heat, while the incandescent coke in contact with the retort does the same thing. When the fuel and retort full of iron are at a cherry-red heat, the air-blast is cut off, and the pipe connecting the furnace and retort, together with the pipe in connection with the bottom of the retort, is closed. Steam, superheated by passing through a pipe led round the retort or interior wall of the furnace, is injected at the bottom of the red-hot mass of iron, which decomposes it, forming magnetic oxide of iron and hydrogen, which escapes by the second tube at the top of the retort, and is led away—to a carburetting chamber if required for illumination, or else direct to the gas-holder if wanted as a fuel: the mass of incandescent fuel in the furnace chamber surrounding the retort keeping up the temperature of the retort and iron sufficiently long to enable the decomposition to be completed. The hydrogen and steam valves are now closed, and the air-blast turned on; and the hot carbon monoxide, passing over the hot magnetic oxide, quickly reduces it down again to metallic iron, which, being in a spongy condition, acts more freely on the steam during later makes than it did at first, and, being infusible at the temperature employed, may be used for a practically unlimited period. What more simple method than this could be desired? Here we have the formation of the most valuable of all fuel gases at the cost of the coke and steam used—a gas also which has double the carrying power for hydrocarbon vapours possessed by coal gas, while its combustion gives rise to nothing but water vapour.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Candidates for the newly founded Clerk-Maxwell Scholarship in Experimental Physics are requested to send their names to Prof. Thomson, 6 Scroope Terrace, Cambridge, before February 21. Each candidate is requested to forward a statement of the original work which, in accordance with the conditions of the tenure of the Scholarship, he would undertake if elected.

The University Lecturer in Geography (J. Y. Buchanan, F.R.S.) announces a course of lectures in Physical Geography and Climatology, to be given on Mondays and Wednesdays, at 10 a.m., beginning January 26.

The degree of M.A. *honoris causâ* is to be conferred on James Alfred Ewing, F.R.S., Professor of Mechanism and Applied Mechanics, who gave his inaugural lecture on Tuesday, January 20. His subject was "The University Training of Engineers."

On Monday, January 26, the following communications will be made to the Philosophical Society:—Prof. J. J. Thomson, on the electric discharge through rarefied gases without electrodes; Mr. J. Larmor, St. John's College, on diffraction at caustic surfaces.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for December 1890 contains an account, by H. J. Cox, of a waterspout which occurred at Newhaven, Connecticut, on October 19 last, between two thunderstorms about five miles apart. A funnel-shaped cloud rapidly descended, while the water below it rose upward, first about 3 feet, and, when the spout was complete, above 30 feet. The spout was about 300 feet high, and 25 feet in diameter. It moved about two miles in ten minutes, and when it met the thunderstorm it moved back in the opposite direction about a mile.—A summary of Dr. Hann's paper on temperature in anticyclones and cyclones, the subject of which has already been noticed in NATURE.—Observations and studies on Mount Washington, by Prof. Hazen, to determine, by means of the sling hygrometer, the temperature and humidity at each mile by walking down the mountain and up again. The results of sixteen journeys show that in the cases with partly dry air the decrease of temperature with elevation did not differ widely from the theoretical value, but with moist air the theoretical difference per 100 feet was much less than the observed difference.—Cyclones and tornadoes in North America, by J. Brucker. The object of the paper is to show that tornadoes or local air-whirls are analogous to water-whirls, and the subject is illustrated by diagrams.—The cooling of dry and moist air by expansion, by Prof. Marvin. The author refutes Prof. Hazen's objections to the principle that moist or saturated air is warmed by the latent heat set free from that portion of the vapour that is condensed by expansion. Prof. Marvin states, *inter alia*, that Prof. Hazen's calculations are not made by the proper thermodynamic equations, and are incorrect. Prof. Hazen, on the other hand, offers a prize of 100 dollars for the proof of the proposition, that Espy's experiments, when properly interpreted, prove his theory.