in which it occurs are in the Outer Hebrides, where it has long been known to the inhabitants, and whence the authors have examined three specimens. It would appear to be quite unknown on the mainland of Britain, where all their endeavours to procure specimens have failed, though they would not be surprised to hear of the occurrence of a melanism of so common a creature as the brown rat. On the continent of Europe the only instance of the occurrence of black varieties of *Mus decumanus* known to the authors is the one recorded by A. Milne-Edwards (*Ann. Sci. Nat.*, 1871, xv. art. 7) for Paris, where, in 1871, it had been known for twenty years in the menagerie of the Museum, and is described as abundant and increasing in numbers.

PROF. J. MARK BALDWIN, writing in *Science* on "infant psychology," points out that this branch of inquiry has the great advantage of offering opportunities for the use of the experimental method. In experimenting on adults, psychologists are confronted with the difficulty that reactions are broken at the centre, and closed again by a conscious voluntary act. The subject hears a sound, identifies it, and presses a button. What goes on between the advent of the incoming nerve process and the discharge of the outgoing nerve process? Something, at any rate, which represents a brain process of great complexity. Anything that fixes this sensori-motor connection, or simplifies the central process, in so far gives greater certainty to the results. For this reason, experiments on reflex reactions are valuable and decisive where similar experiments on voluntary reactions are uncertain and of doubtful value. The fact that the child consciousness is relatively simple, and so offers a field for more fruitful experiment, is seen in the mechanical reactions of an infant to strong stimuli, such as bright colours. Of course, this is the point where originality may be exercised in the devising and executing of experiments. After the subject is a little better developed, new experimentation will be as difficult here as in the other sciences; but at present the simplest phenomena of child life and activity are open to the investigator.

THE "Year-book of Pharmacy" has just been published. It contains abstracts of papers relating to pharmacy, materia medica, and chemistry, contributed to British and foreign journals from July 1, 1889, to June 30, 1890; with the transactions of the British Pharmaceutical Conference at the twenty-seventh annual meeting, held at Leeds in September 1890. The volume has been carefully compiled, and presents a great mass of scientific information. Its utility is greatly increased by a full index.

MESSRS. IMRAY AND SON have issued, for the use of candidates preparing for the Board of Trade examinations, a syllabus of examination in the laws of compass deviation and in the means of compensating it, with explanatory notes and answers, by W. H. Rosser. The paper was written as an appendix to the author's "Deviation of the Compass, considered practically."

MESSRS. DULAU AND CO. have issued a catalogue of zoological and palæontological works which they are offering for sale. The list includes many valuable books.

THE cadmium and magnesium analogues of zinc methide and ethide have been prepared and investigated by Dr. Löhr in the laboratory of Prof. Lothar Meyer at the University of Tübingen, and an account of the work is published in the latest number of *Liebig's Annalen*. The alkyl compounds of cadmium and magnesium have formed the subject of several previous researches, but the results hitherto obtained have been mainly negative, and nothing was known with certainty concerning them. The methide and ethide of cadmium are liquid bodies, spontaneously inflammable when gently warmed. The similar compounds of magnesium are, contrary to expectation, solid substances, which possess the almost unique property of being spontaneously inflammable in carbon dioxide gas, as well as in air, being capable of actually extracting oxygen from its most stable combination with carbon. Cadmium methide was obtained by the following process:—Metallic cadmium, either in filings or pieces of sticks, was placed in a tube closed at one end together with a thin glass bulb containing methyl iodide. The tube was exhausted by the Sprengel pump and sealed. It was then heated to 110° C. for 24 hours. At the end of this time all the methyl iodide had disappeared, and the tube contained a crystalline mixture of cadmium iodide and cadmium methyl iodide, $Cd(CH_3)I$, and gaseous ethane, C_2H_6, at high pressure. After opening the tube so as to permit of the escape of the ethane, the crystalline residue was subjected to dry distillation; when the temperature of the paraffin bath in which the tube was heated reached 260° a small quantity of a liquid distilled over, and was caught in a receiver filled with carbon dioxide. Ten similar experiments were made, and the total product of this liquid was fractionally distilled in a small apparatus also filled with carbon dioxide. By this means the greater part of the admixed methyl iodide was removed, and a heavy residual liquid obtained which was found to consist mainly of cadmium methide, $Cd(CH_3)_2$. Cadmium methide is a clear heavy liquid of most unpleasant odour, violently affecting the respiratory organs, and producing a most persistent nauseous metallic taste in the mouth. It boils at about 105° C. On gently warming it spontaneously inflames, burning with a brilliant sooty flame producing thick clouds, which, according to the amount burnt, take a dark green or a reddish-brown tint. It oxidizes very rapidly to a white mass of ethylate, $Cd(OCH_3)_2$. It reacts most violently with water, producing great heat, and evolving marsh gas. Dilute hydrochloric acid acts similarly, methane being evolved and cadmium chloride formed:

$$Cd(CH_3)_2 + 2H_2O = Cd(OH)_2 + 2CH_4;$$
$$Cd(CH_3)_2 + 2HCl = CdCl_2 + 2CH_4.$$

The liquid solidifies to a white crystalline mass when the vessel containing it is immersed in a freezing mixture. Cadmium ethide is prepared with greater difficulty than the methide. It is a liquid much resembling the methide in properties. Magnesium methide is a solid obtained, mixed with magnesium iodide, when magnesium filings or ribbon are heated in a sealed tube with methyl iodide and acetic ether, methyl iodide alone having no action. It is also obtained mixed with globules of mercury when magnesium is heated with mercury methide in a sealed tube. Its most remarkable properties are its intense action with water, incandescence usually occurring with ignition of the evolved gas; and its spontaneous inflammability in carbon dioxide, the combustion being accompanied by beautiful scintillations. The ethide is a very similar substance.

THE additions to the Zoological Society's Gardens during the past week include two Toque Monkeys (*Macacus pileatus*), a Starred Tortoise (*Testudo stellata*) from Ceylon, presented by Mr. W. J. Bosworth; a Peregrine Falcon (*Falco peregrinus*), British, presented by Mr. A. C. Ionides; a Humboldt's Lagothrix (*Lagothrix humboldti*) from the Upper Amazons, purchased.

OUR ASTRONOMICAL COLUMN.

SPECTROSCOPIC OBSERVATIONS OF SUN-SPOTS.—The *Monthly Notices of the Royal Astronomical Society* for December 1890 contains the main conclusions deduced by the Rev. A. L. Cortie, S.J., from the sun-spot observations made at the Stonyhurst College Observatory in the years 1882-89. The region of the spectrum in which observations have been made is between the lines B and D. The widening of the lines in the sun-spot spectra observed has generally been reckoned in tenths of their

normal breadth, and are classified as "widened," "more widened," and "most widened," for comparison among themselves. At South Kensington only the six most widened lines in the spectrum of a sun-spot are recorded, hence the two sets of observations are not easily comparable. The interval 1882–89 has been divided into two periods in the discussion, viz. the disturbed period of solar activity extending from 1882–86, and the quiet period 1886–89.

In the disturbed period only one of the fifty-three iron lines in the region B—D was observed to have a mean widening. During the quiet period, however, many more iron lines appeared among the more widened. In this particular, therefore, Father Cortie's results confirm the conclusion arrived at by Prof. Lockyer in 1880 from a similar discussion. With respect to other substances, the observations show that seven out of the eleven titanium lines in the region studied were very much affected in the spot spectra at both periods, the lines most persistently widened being among the faintest Fraunhofer lines, and among the brighter of the metallic lines. The mean widening of calcium lines increased slightly during the minimum period. Sodium lines were much affected in the maximum epoch, especially in the large spots. Several lines given by Ångström as "telluric" have been seen widened. The C line has often appeared less dark over sun-spots, but when bright the reversal was generally due to faculæ between the spots. From a total of 2088 individual observations of other lines it is concluded that (1) About the maximum period a great number of faint lines not in Ångström are to be seen in sun-spots. (2) Such lines are not seen exclusively in maximum spots, but reappear in minimum spots when they are large. (3) Some faint lines which have been persistently watched are to be seen greatly widened in every sun-spot, large or small, whether in the disturbed or quiet period. (4) The mean widening of all the five bright chromospheric lines coincident with unknown lines in this region has been low. A Browning automatic spectroscope with a dispersion of twelve prisms of 60° was used for the observations.

TURIN OBSERVATORY.—Some publications of interest have recently been issued from this Observatory. Signor Porro gives the results of observations of the magnitude of the star U (Nova) Orionis throughout a whole period of variation. On November 21, 1889, the star was 8·81 mag.; on April 28, 1890, it was 8·80; and a maximum magnitude = 5·80 was observed on January 21, 1890. Mr. Chandler has given the period of this variable as 371 days, with a maximum on December 7, 1885. Signor Porro finds that the observations made in 1885, in conjunction with those now given, indicate a period of 378·5 days from the epoch December 7.

A large number of determinations of the latitude of Turin has also been made. The mean of 120 observations results in the value $\phi = 45^\circ\ 4'\ 7''{\cdot}942 \pm 0''{\cdot}029$. The observations do not exhibit the periodic variation observed in the latitude observations made at Berlin, Potsdam, and Prague.

Convenient ephemerides for the sun and moon in 1891 have been calculated for the meridian of Turin by Signor Aschieri. The meteorological observations made in 1889 have been tabulated by Dr. G. B. Rizzo.

THE DUPLICITY OF α LYRÆ.—The duplication of the K line in some photographs of the spectrum of Vega taken by Mr. A. Fowler, and from which he inferred that the star was a spectroscopic double of the β Aurigæ type, has not been confirmed by photographs taken by Prof. Pickering, Prof. Vogel, and MM. Henry. Some other explanation must therefore be found to account for the phenomenon.

GASEOUS ILLUMINANTS.[1]

II.

ORDINARY coal gas of an illuminating power of 14 to 16 candles can be produced at a fairly low rate, but if a higher quality is required considerable additional expense has to be incurred in order to enrich it. Up to now, the material almost universally employed for this purpose has been cannel; but as this article is rapidly rising in price, and the best qualities are not easily obtainable, attention is being seriously directed to other means of bringing up the illuminating power of gas. This question of enrichment has been the study of inventors from the earliest days of the gas industry. The methods employed for this purpose may be classified as:—(1) The carburetting of low-power gas by impregnating it with the vapour of volatile hydrocarbons. (2) Enriching the gas by vapours and permanent gases obtained by the decomposition of the tar formed at the same time as the gas. (3) Mixing with the coal gas, oil gas obtained by decomposing crude oils by heat. (4) Mixing with the coal gas, water gas which has been highly carburetted by passing it, with the vapours of various hydrocarbons, through superheaters, in order to give permanency to the hydrocarbon gases.

In the first method, many points have to be taken into consideration, as the hydrocarbons which have from time to time been used for this purpose, vary so greatly in composition; a very volatile naphtha, although it evaporates quickly, and larger quantities of its vapour are taken up by the gas, often giving a less increase of luminosity than a heavier hydrocarbon of which but little is vaporized.

The great trouble which presented itself in the older carburetting systems was that all the commercial samples of naphtha are mixtures of various hydrocarbons, each having its own boiling-point, and that therefore, when used in any of the old forms of carburetters, they gave up their more volatile constituents very freely at the beginning of the experiment, while the amount rapidly diminished as the boiling-point of the residue became higher; so that when 2113 cubic feet of poor coal gas were passed through a naphtha having a specific gravity of 0·869 and a boiling-point of 103° C., the temperature during the experiment being 22° C., the first 80 cubic feet of gas took up 23·2 grains of the naphtha, while the last 450 cubic feet only took up 7·3 grains. Another difficulty found was the increase of evaporation with the rise in the temperature of the gas; as with an ordinary form of carburetter, exposed to atmospheric changes, the enrichment of the gas, which reached 54·4 per cent. in summer with an average temperature of 22° C., fell in winter to only 22 per cent. with an average temperature of 3° C. Of course, in these carburetters a good deal depended upon the form of apparatus; and it was found, on trying different shapes with the same naphtha, that when the gas merely flowed through a box containing a layer of it, only about 3·2 grains were taken up; while with a carburetter in which the naphtha was sucked up by cotton fibre, so as to expose a large surface to the gas, as much as 22 to 23 grains were absorbed. One of the most important points noticed during these experiments was, that it was only a poor gas which could be enriched in this manner, and that if a rich cannel gas was passed through the naphtha, it became robbed of some of its illuminating power.

It must be clearly borne in mind, in approaching this subject, that the evaporation of a hydrocarbon into a permanent gas—*i.e.*, a gas which does not liquefy within the ordinary range of temperature—is a question neither of specific gravity nor of boiling-point, although the latter has more to do with it than the former. It is purely a question of vapour tension. Most liquids, when left to themselves in contact with the atmosphere gradually pass into the state of vapour, and disappear; and those which evaporate most quickly are said to be most volatile. If ether, for example, is dropped upon an exposed surface, it at once disappears, and causes, by its evaporation, considerable cold; and the lightest forms of naphthas do the very same thing. But although this evaporation takes place with rapidity with liquids of low boiling-point, it must not be forgotten that even many solids have the same property—naphthalene, camphor, and iodine being cases in point. It must also be remembered that evaporation occurs over a very wide range of temperature; but that for each substance there is a limit below which evaporation does not seem to take place. So that, when considering the suitability of a liquid for carburetting in this way, it is far more important to determine its vapour tension than its specific gravity or its boiling-point.

So far all systems for carburetting gas with liquid hydrocarbons at the burners have proved failures, but in the albocarbon light the vapour of naphthalene is caused to mingle with the gas just before combustion, the volatilization being effected by a spur of metal heated by the flame itself, which conducts the heat back into a chamber containing solid naphthalene, through which the gas passes, and this process has proved very successful.

Any system to be generally adopted must be applied to the gas in bulk before distribution. In doing this, there are two factors to be considered: the vapour added must be in such proportion to the gases which have to carry them that no fear need exist of their being deposited by any sudden cooling of the gas;

[1] Continued from p. 235.