radioactive:—$_{10}Ne^{19}$, $_{12}Mg^{23}$, $_{14}Si^{27}$, $_{16}S^{31}$, $_{18}Ar^{35}$, $_{20}Ca^{39}$. They are formed when an α-particle in the normally stable isotopes, $_{10}Ne^{20}$, $_{12}Mg^{24}$, $_{14}Si^{28}$, $_{16}S^{32}$, $_{18}Ar^{36}$, $_{20}Ca^{40}$, possess excess energy such as suggested by Oliphant, Harteck and Rutherford[2]. These 'excess-energy' isotopes lose energy emitting a proton or a neutron. The emission of a neutron results in the formation of the radioactive isotope.

In these radioactive transformations the free proton within the nucleus emits a positron and is transformed into a neutron.

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[1] See Walke, *Phil. Mag.*, **18**, 156; 1934.
[2] *Proc. Roy. Soc.*, A, **144**, 692; 1934.

Galvanometer Amplification by Photo-Cell

I REFERRED recently[1] to the use of a Weston 'photronic' cell arranged differentially for amplifying galvanometer deflections. It has been found since, (*a*) that a Bernheim cell is several times as sensitive, and (*b*) that there is considerable advantage in cutting the cell into two halves, and opposing the two halves *in parallel*. In the previous arrangement the conducting surface only was divided, and contacts made to its two halves: the two half-cells were thus opposed *in series*. With the new arrangement (i) there is at least twice the current in an ordinary low resistance galvanometer for a given difference of illumination, and (ii) for equal illuminations of the two halves there is no current.

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[1] NATURE, **133**, 685, May 5, 1934.

Direct Proof of the Existence of Metastable Molecules in Active Nitrogen

THE two bands λ2760·6 and λ2603·8, which are the (0,6) and the (0,5) bands respectively of the new band system discovered by me recently in gaseous nitrogen[1], have now been observed in the nitrogen afterglow. These bands originate on the $A^3\Sigma$ state, and their appearance in the afterglow provides direct proof of the existence in it of metastable molecules. The tube, in which the afterglow was photographed, was running in the so-called green stage[2], corresponding to the lowest current at which it will show an appreciably strong afterglow. In this afterglow are also present both second-positive and first-positive bands, which originate on vibrational levels higher than those that normally occur in electrical discharges in nitrogen. In fact, it is the presence of these first-positive bands that gives both the afterglow and the discharge their characteristic green-white colour.

In a symposium on spectroscopy in astrophysics, which was held at the joint meeting of the Astronomical Society of the Pacific and the American Physical Society in Berkeley on June 19, I directed attention to the fact that the light of the night sky consists of radiations which can best be explained as bands belonging to the first-positive, the second-positive and the new $A^3\Sigma \rightarrow X^1\Sigma$ systems. In particular, bands originating on high vibrational states seemed to be involved in the explanation of the light of the night sky. The presence in the afterglow of all three of these systems definitely establishes the plausibility of my hypothesis. It is proposed to take photographs of even weaker afterglows in order to test further my view that the light of the night sky is a very weak afterglow of nitrogen.

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July 20.

[1] Kaplan, *Phys. Rev.*, **45**, 675; 1934.
[2] Kaplan, *Phys. Rev.*, **45**, 671; 1934.

Kinetics of Photosynthesis

BALY and Morgan[1] have proposed kinetic equations which account for observations of Warburg[2] and Emerson[3] on the rate of photosynthesis. We wish to direct attention to one of Warburg's observations which is not in accordance with their equations. At low light intensities, the temperature coefficient of photosynthesis approaches unity, while at low carbon dioxide concentrations it remains high. We have confirmed this for five different species of algæ. This leads us to suppose that carbon dioxide is a reactant in the temperature-sensitive reaction, rather than in the photochemical reaction, where Baly and Morgan placed it. Their assumption seems to us untenable because it leads to equations in which light intensity and carbon dioxide concentration are interchangeable, and because according to photochemical principles a photochemical primary process is unimolecular, taking place immediately on the absorption of light.

Emerson and Arnold's[4] observation that the maximum yield in flashing light is reduced by lowering the carbon dioxide concentration indicates that carbon dioxide enters the process prior to the light reaction. If we assume that carbon dioxide, P, and chlorophyll, a, combine in the Blackman reaction to form the intermediate substance x, and that the absorption of light by x leads to the formation of products of photosynthesis and uncombined a, then under stationary conditions, when both reactions proceed at equal rates

$$y = k_1 I x = k_2(a - x)\, P e^{-Q/RT} \qquad (1)$$

where y is the rate of photosynthesis, a represents the total chlorophyll in the system, and I the light intensity. Following Baly and Morgan, we divide by $k_1 I(a - x)$ and let $K - y = k_1 I(a - x)$, and (1) leads to

$$\log \frac{y}{K - y} = \log \frac{k_2 P}{k_1 I} - \frac{Q^1}{T} \qquad (2)$$

where $Q^1 = \dfrac{Q}{2{\cdot}303R}$. (2) is in agreement with Emerson's[3] observations on *C. vulgaris* photosynthesis at different temperatures, just as is Baly and Morgan's equation (2), because these equations are identical except for the constant term.

The elimination of x from (1) gives

$$y = \frac{k_1 k_2 I\, Pa e^{-Q/RT}}{k_1 I + k_2 P e^{-Q/RT}}. \qquad (3)$$

This corresponds to Baly and Morgan's equation (3),