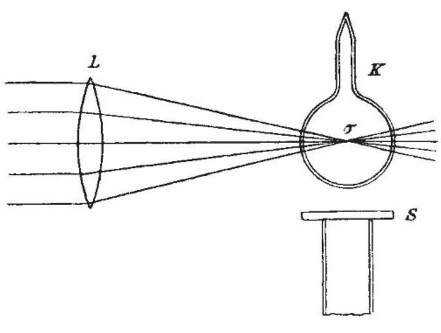
scale similar to those adopted for wind and cloud should have been hitherto used in meteorological reports. Like the above scales, it could only be approximative; but if observers fixed upon conspicuous objects, such as hills, churches, &c., at known distances for their observations, these ought to be at least as accurate as those for wind and cloud.

Nant-y-Glyn, Colwyn Bay. ALFRED O. WALKER.

FLUORESCENCE OF SODIUM AND POTASSIUM VAPOURS, AND THE IMPORTANCE OF THESE FACTS IN ASTROPHYSICS.[1]

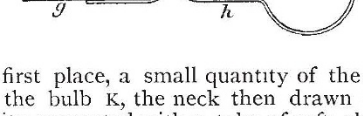
IN the case of unmixed vapours, E. v. Lommel (*Wied. Ann.*, p. 856, 1883) has proved a fluorescence for iodine vapour, and this has been shown also by us (*Wied. Ann.* 56, p. 18, 1895) to be true for the vapours of numerous organic substances. In our latest experiments we have studied the behaviour of the vapour of metals in this respect.

(1) *Order of Procedure.*—For the experiments the following arrangement was adopted. Rays of sunlight were made to fall on a double convex lens, L, of focal length 5 cm., which brought them to a focus at a point, σ, in the centre of a glass spherical bulb, K, filled with vapour.



To one side of the bulb was placed a spectroscope with the slit horizontal, the edge of the prism also being horizontal. The spectroscope was fixed by its legs on a board placed vertically, and could be revolved round its axis by means of a movable cone on the inside part of one of the feet. One was able also to adjust the collimating telescope on the cone of fluorescence proceeding from the inside of the bulb.

The bulbs, which were made principally of hard glass, were filled with sodium, potassium, and other metals in the following manner.



In the first place, a small quantity of the metal was placed in the bulb K, the neck then drawn out, and at its extremity connected with a tube of soft glass, leading to a mercury pump. The metal was then placed in position *a*, and warmed during continuous gentle pumping, in order to get rid of all water vapour and CO_2; each bulb was also several times cleaned out with hydrogen. The heating was then increased, and when a convenient quantity of the metal was distilled the tube was sealed off by means of the blowpipe. In most cases the diameter of the bulb was 5 cm., so that it could be easily enveloped in a flame. We have also employed bulbs made of soft glass and of various sizes, but the optical effects were exactly the same. Difficulties were met with when employing the alkali metals; for, as soon as the vapour began to be formed, the bulbs became browned and blackened, so that new ones had to be substituted.

(2) *Results.*—The experiments showed that the fluorescence of sodium and potassium vapour was bright—the former green, the latter intense red.

The fluorescence can also be beautifully seen by observing the vapours of these metals in the light of an arc lamp. In cases of the less volatile metals, we have not yet been able with perfect confidence to prove its presence, although the vapour of cadmium undoubtedly at the surface of the melting metal displayed a green fluorescence colour. The failure, however, of these experiments may be explained partly by the poor intensity of the rays of the winter sun. We shall, naturally, repeat them in summer.

The fluorescence spectrum of sodium vapour was made up as follows:

675.	Boundary of the red.
675—602·5.	Bright red band.
602·5—540.	Dark band.
540—496.	Green fluted band, composed of single dark and bright lines.

In the blue there is practically nothing visible.

At the less refrangible end of the dark band 602—540, the yellow sodium line appeared.

The appearance of the bright line of sodium was not caused by the presence of the flame used for heating, because when this was removed, the line remained still bright; nor could its presence be explained by the action of chemical processes taking place in the bulb, because the moment the incident light was cut off it disappeared.

The fluorescence spectrum of the vapour of sodium[1] is made up of three parts: (1) the non-fluted band in the red, (2) the fluted band in the green, (3) the bright sodium line in the yellow.

Whilst in the cases of solids and liquids which exhibit fluorescence the fluorescence spectra consist of broad ill-defined, continuous streaks, we meet here also fluted bands, as shown by other gases under the action of electrical discharges, and single lines.

The fluorescence spectrum of potassium displays at 695—615 an intensely red band.

Adjoining this band the dark interspace is relieved by the somewhat brighter appearance of the green, due, perhaps, to the presence of some sodium vapour.

The bright lines of potassium could not be proved, but their absence may be accounted for by the feeble intensity of the incident light.

The fluorescence spectrum of lithium could not be observed, because so soon as the lithium was placed in the bulb and heated, the glass exposed to the light-source became affected. By further heating, the vapour given off displayed only the green fluorescence light of sodium. For the same reason experiments to obtain in discharging tubes, the "elekroluminescenz" of lithium were unsuccessful.

(3) *Validity of Stokes' Law for the Fluorescence Light of Metallic Vapours.*—We have also made investigations to find out whether here the law of Stokes—that is, whether the *excited* rays of light are less refrangible than those *exciting*—holds good. To this end a spectrum was formed by means of a prism, but only a small strip of this was employed, and led by means of a lens into the bulb filled with vapour. In the case of the vapour of sodium the intense green light radiated was excited, in

[1] Translation of a communication to the "Sitzungsberichten der physikal. med. Societat zu Erlangen." By Eilh Wiedemann and G. C. Schmidt.

[1] A comparison of these fluorescence spectra with that which is obtained by the heating of sodium vapour exhibits certain relations (Evershed, *Phil. Mag.* (5), 39, p. 460, 1895); the same is the case with both sodium and potassium, if the positions of the fluorescence spectra be compared with the absorption-band-spectra investigated by H. E. Roscoe and A. Schuster (*Proc. Roy. Soc.* London, 22, 262, 1894). In both cases the radiation towards the red appears altered.

the first place, by the green-blue rays; and the red by the yellow and red rays. Potassium, when excited by red light, emitted light of a deep red colour.

These experiments show that at least no very marked deviations from Stokes' law exist.

(4) *Applications to Astrophysics.*—We wish to point out in a few words the importance, for astrophysical problems, of the preceding observations concerning the fluorescence of the metallic vapours.

We know that in the atmosphere of the sun there exist vapours of different metals which are radiated from the sun; these must also exhibit fluorescence, and that of a bright nature. We must also remember that the intensity of the exciting light in the region of the sun is much greater than that near the earth's surface, and also the same may be said of that of the fluorescent light. These rays of fluorescence do not follow Kirchhoff's law.

The radiated fluorescent light is made up of coninuous and fluted bands and single lines. By mixing several metals together the continuous bands grouped themselves and formed a continuous spectrum, the delicate, and sometimes less recognisable, fluted bands, however, of several substances neutralised each other, and so became invisible. Each of the sharp lines, on the other hand, remained visible. We have thus, for example, a very simple means of explaining the spectrum of the corona, which consists of a continuous spectrum and single bright lines. It is then unnecessary to assume that luminosity is produced by a continuous agitation depending on electrical oscillations; agitations which, nevertheless, play in many cases an important part. Applications of these results may also be found to be closely related to the theory of the chromosphere, certain forms of prominences, &c.

In all astrophysical and other light phenomena (*Strahlungserscheinungen*) special discussions will be necessary, not only from the point of view as to which portions of the ray are the result alone of an increase in temperature, and which depend on "luminiscence" (*luminescenz*), but it must be especially made clear when we have before us "photo-luminescence" and when "fluorescence." In this case the conditions are relatively simple, and for experiment easily accessible.

(5) *General Remarks.*—The case of the fluorescence of rarefied vapours of potassium and sodium as investigated by us, might be the simplest possible when once the light-producing molecules of the vapourous body under investigation are almost uninfluenced by the action of its neighbours, if we disregard the short spaces of time during which two or more molecules occupy in their respective reactions. Then they behave just like the molecules in bodies of a solid and liquid nature.

Further, the vapours of sodium and potassium consist of single atoms (*einatomig*), so far at least as can be judged from vapour densities established up to the present. The fact, that in these vapours not only band- but also line-spectra make their appearance, necessitates, for the theoretical investigation of fluorescence, the adoption of a new point of departure, more especially if the fundamental movements of the molecules among themselves in fluorescence be investigated.

(6) *Result.*—The fluorescence of sodium and potassium vapours is bright; the former green, the latter red. In the fluorescence spectrum of sodium vapour continuous and fluted bands appear, in addition to the bright sodium line.

Stokes' law is probably valid for the fluorescence of the vapours of metals. The fluorescence of the vapours of metals gives a means of explaining a series of astrophysical phenomena.

(Experiments with helium and argon are in process of investigation.)

NOTES.

M. CHATIN has been elected the new Vice-President of the Paris Academy of Sciences, in the place of M. Cornu, who has passed on to the presidency.

THE French Government has paid a graceful compliment to Prof. Virchow, by nominating him Commander of the Legion of Honour.

THE United States Congress has already made a good beginning as to matters scientific and educational. One of the first subjects to which attention was called, after the opening of the current session, was the proposed joint meeting of the three associations of English-speaking people for the advancement of science, at San Francisco in 1897, namely the Australasian, American and British, following the Toronto meeting of the British Association. A Congressman from Brooklyn presented a memorial and petition from one of the original Fellows of the American Association, setting forth the plan for such a meeting of these associations, and requesting aid from Congress to put the American Association on equal footing with the British in regard to transportation of members across the continent, which it is supposed that the Canadian Pacific Railway will furnish nearly or quite free to the latter. The same member a few days later introduced a resolution in favour of the metric system. Should the three science associations succeed in holding a joint meeting, this subject would well deserve careful consideration.

TWO appeals for funds to fit out Polar expeditions have lately been made—one for support of Captain Jackson's scheme for the exploration of the North-East passage, the other for means to equip a British Antarctic expedition. Captain Jackson proposes to determine whether the North-East passage from Europe to China and America is really practicable to merchant vessels properly fitted for the Northern Seas, and to make as many scientific observations as the equipment of his expedition will allow. If he cannot obtain funds to purchase and equip a suitable ship, he announces his intention to proceed to Polar regions in his yacht *Venture*, a boat only thirty-seven feet long. The Honorary Secretary of the Committee that appeals for support on behalf of Captain Jackson's scheme is Mr. E. R. Suffling, Blomfield Lodge, Portsdown Road, London, W.

THE Executive Committee for the British Antarctic Committee hope to obtain £5000 to be expended on outfits and supplies for twelve scientific men to spend a year in South Victoria Land. It is proposed that these investigators shall be conveyed to Cape Adair by a commercial expedition now being formed with the object of operating near Victoria Land. The party is expected to leave on September 1 next. After calling at Melbourne they will sail direct to Cape Adair, which, under favourable circumstances, should be reached in about fourteen days. There they will be landed with their outfit and instruments, and remain for one year, after which period they will be called for and brought back by the commercial party. The following is a general plan of the proposed investigations to be carried on at Victoria Land by the scientific members of the expedition: (1) A land party will work towards the South Magnetic Pole, there to make magnetical observations. (2) The coast-line of the open bay will be surveyed, fjords and bays explored and sounded. (3) Zoological, botanical, mineralogical and geological collections will be made. (4) Dredging. (5) Barometrical, thermometrical, meteorological and pendulum observations. (6) Air and water current observations. If this programme is only carried out in part, valuable additions to scientific knowledge will undoubtedly be obtained. There are many who are eager to labour in the