wave-length 503, and is probably that described by Cornu as sixth in order of brightness, at wave-length 500. At the end of last month the brightest line was about 484, probably the F hydrogen line. Since December 27 the new star has always appeared to me orange. Has not this star received any name yet?

Sunderland, January 26 T. W. BACKHOUSE

KÜHNE'S RESEARCHES ON PHOTO-CHEMICAL PROCESSES IN THE RETINA

ON January 5, Dr. W. Kühne, Professor of Physiology in the University of Heidelberg, read before the Naturhistorisch-Medicinisches Verein, of Heidelberg, a paper entitled "Zur Photo-chemie der Netzhaut," so full of interest to the physicist and physiologist, that I think an abstract of it will be acceptable to the readers of NATURE.

A short time since, Boll (a pupil of Max Schultz and Du Bois-Reymond, who now occupies the chair of Physiology in Rome) communicated to the Berlin Academy the remarkable fact that the external layer of the retina, *i.e.*, the layer of rods and cones, possesses in all living animals a purple colour. During life, according to Boll, the peculiar colour of the retina is perpetually being destroyed by the light which penetrates the eye; darkness, however, restores the colour, which vanishes for ever almost immediately after death.[1]

The wonderfully suggestive nature of Boll's discovery led Kühne to repeat his observations; in doing so, whilst he has confirmed the fundamental statement of Boll, he has ascertained a number of new facts of great interest.

Kühne's observations were made on the retinæ of frogs and rabbits. In the first place, implicitly relying upon the statements of Boll, he examined, as soon as possible after death, the retinæ of animals which had been kept for some time in darkness. He soon found that the beautiful purple colour persists after death if the retina be not exposed to light; that the bleaching takes place so slowly in gas-light, that by its aid the retina can be prepared and the changes in its tint deliberately watched; that when illuminated with monochromatic sodium light the purple colour does not disappear in from twenty-four to twenty-eight hours, even though decomposition have set in.

These first observations of Kühne on the vision-purple (*Sehpurpur*), as he terms it, whilst they showed that the disappearance of the colour is not, as Boll had asserted, a necessary concomitant of death, removed many of the difficulties which stood in the way of a careful investigation. Carrying out his preparations in a dark chamber illuminated by a sodium flame, Kühne was able to discover the conditions necessary to the destruction of the vision-purple as well as some facts relating to its restoration or renewal.

As long as the purple retina is kept in the dark or is illuminated only by yellow rays, it may be dried upon a glass plate without the tint changing; the colour is not destroyed by strong solution of ammonia, by saturated solution of common salt, or by maceration in glycerine for twenty-four hours. On the other hand, a temperature of 100° C. destroys the colour, and alcohol, glacial acetic acid, and strong solution of sodium hydrate produce the same effect.

Kühne's next observations were directed to the discovery of the influence of light of different colour upon the vision-purple. It would appear that the more refrangible rays of the spectrum have the greatest action, and that the red rays are as inactive as the yellow.

Kühne now found the incorrectness of Boll's assertion that the retina of the living eye exposed to ordinary daylight does not exhibit the vision-purple, for on preparing the eyes of animals which had just been exposed to light, as rapidly as possible in the chamber illuminated by sodium light, he discovered that the retina was of a beautiful purple. It was only when eyes were exposed for a considerable time to the direct action of the sun's rays that a fading of the purple colour was perceived.

A most suggestive experiment now threw some light upon the circumstances which retard the decolorisation, and which restore the vision-purple. The two recently extirpated eyes of a frog were taken; from one the retina was removed, whilst an equatorial section was made through the other eye, so as to expose the retina and still leave it *in situ*. Both preparations were exposed to diffuse daylight, until the isolated retina had lost its purple colour. On now taking the other preparation into the yellow chamber and removing the retina, it was found that its colour yet remained: it was *dark red*, but was bleached when exposed in its naked condition to daylight.

This experiment was confirmed by others, in which the effect of strong sunlight was substituted for that of diffuse daylight.

But the most curious results of Prof. Kühne's experiments have reference to the restoration of the vision-purple. If an equatorial section be made through a recently extirpated eye, and a flap of retina be lifted up from the underlying choroid and exposed to light, the purple colour of the flap will be destroyed, whilst the colour of the rest of the retina persists. If, however, the bleached portion of the flap be carefully replaced, so that it is again in contact with the inner surface of the choroid, comple restoration of the vision-purple occurs. This restoration is a function of the *living* choroid, probably of the living retinal epithelium (*i.e.* of the hexagonal pigment cells, which used formerly to be described as a *part* of the choroid), and it appears to be independent of the black pigment which the retinal epithelium normally contains. As it is absolutely dependent upon the life of the structures which overlie the layer of rods and cones, it is natural that it should be observed to occur for a longer time after somatic death in the frog than in the rabbit.

Kühne's researches, though suggested by the interesting observation of Boll, have not only corrected many errors which that observer had committed, but have led to the discovery of facts which add immensely to the importance of the newly-observed vision-purple.

They have shown that the living retina contains a substance which under the influence of light undergoes chemical changes, which vary in intensity according to the intensity and character of the luminous rays, and they point to the existence of structures in connection with the retina which as long as they are alive are able to provide fresh stores of substance sensitive to light.[1]

Since the above account of Kühne's researches was written, he has published in the *Centralblatt der medicinischen Wissenschaften* (January, 1877, No. 3) a short paper, dated January 15, in which he announces the startling confirmation to his previous researches afforded by his *having been able to obtain actual images on the retina which corresponded with objects which had been looked at during life* (!).

The discoveries of Boll and Kühne must, as the latter remarks, have led to the thought that after all there might be some truth in the stories which we all have heard of images of things seen in death being left imprinted upon the eye. After his first researches Kühne endeavoured over and over again to observe on the retina of rabbits bleached spots corresponding to the images of external objects, but his endeavours failed. As Kühne remarks, and as all readers who have understood his experiments will allow, in order to obtain a permanent photograph, or, as he terms it, *optogramme*, the effect of the light would have to be so prolonged or so intense as to destroy the balance between the destruction of the vision-purple and the power of the retinal epithelium to restore it.

Kühne took a coloured rabbit and fixed its head and one of its eye-balls at a distance of a metre-and-a-half from an opening thirty centimetres square, in a window-shutter. The head was covered for five minutes by a black cloth and then exposed for three minutes to a somewhat clouded midday-sky. The head was then instantly decapitated, the eye-ball which had been exposed was rapidly extirpated by the aid of yellow light, then opened, and instantly plunged in 5 per cent. solution of alum. Two minutes after death the second eye-ball, without removal from the head, was subjected to exactly the same processes as the first, viz., to a similar exposure to the same object, then extirpation, &c.

On the following morning the milk-white and now toughened retinæ of both eyes were carefully isolated, separated from the optic nerve, and turned; *they then exhibited on a beautiful rose-red ground a nearly square sharp image with sharply-defined edges; the image in the first eye was somewhat roseate in hue and less sharply defined than that in the second, which was perfectly white. The size of the images was somewhat greater than one square millimetre.*

Prof. Bunsen was amongst the witnesses of this beautiful experiment. ARTHUR GAMGEE

[1] This account of Boll's researches is taken from Kühne's paper. The latest number of the *Monatsberichte* of the Berlin Academy which has yet reached Manchester, which includes the Proceedings for September and November, does not contain Boll's communication, which is of later date (November 12).

[1] I have repeated all the more important observations of Kühne with the eyes of several *Ranæ temporariæ*, and with those of two rabbits, of which one was an albino, and can entirely confirm all his interesting facts. In ordinary daylight, the purple-red colour of the frog's retina, and its subsequent decolorisation, may be most satisfactorily demonstrated. The use of the dark chamber illuminated by sodium is, however, useful in cases where the dissection of the eye has to be conducted with care.—A. G.