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XLV. *Intelligence and Miscellaneous Articles.*

ON PROFESSOR LANGLEY'S "SELECTIVE ABSORPTION."

BY C. H. KOYL*.

DURING a series of years, beginning with 1859, Prof. Tyndall carried on experiments which demonstrated the great absorptive power of water, carbonic dioxide, and the vapour of water in the infra-red region of the spectrum, and which also demonstrated the non-absorptive character of these substances in the visible parts. Other investigators have, almost without exception, arrived at the same conclusions; and it now appears beyond dispute that pure water with its vapour and pure carbonic dioxide deeply absorb the long-wave rays, but exercise little influence upon the shorter. The same series of experiments proves also that dry oxygen and dry nitrogen, either singly or mixed, are almost without effect upon any part of the spectrum.

Our atmosphere is composed principally of oxygen, nitrogen, watery vapour, and carbonic dioxide. It follows, then, that when there are not clouds or suspended haze the sky may be, as far as pure absorption is concerned, almost perfectly transparent to the visible rays of solar energy, but to the longer waves opaque, to a degree dependent upon the amount of dissolved aqueous vapour.

Until within a short time actual experiments upon the absorption of the earth's atmosphere as a whole have been of little value because of deficient apparatus; but since the invention and application to this work of the bolometer by Prof. Langley, we are able to arrive at approximate results. In his late paper he shows that the ratios of energy in different wave-lengths stopped by our atmosphere are not by any means such as we should expect from the laboratory experiments above mentioned, but that if ϵ' , ϵ'' , ϵ''' represent the amounts of energy transmitted, (ϵ') to our atmosphere, (ϵ'') through it on a clear day with a noon sun, and (ϵ''') with a low sun, the ratios will be about as follows for three representative wave-lengths, in the ultra-violet, in the green, and in the infra-red:—

	V.	G.	R.
$\lambda \dots$	·375	·500	1·000
' ...	353	1203	309
$\epsilon'' \dots$	112	570	235
$\epsilon''' \dots$	27	225	167

demonstrating immediately the fact that though some 54 per cent. of long-wave energy is transmitted at low sun, only about 8 per

* Abstract of remarks at a meeting of the University Scientific Association, May 2, 1883.

cent. of short-wave radiation reaches us under similar circumstances. The intermediate rays are transmitted in amounts proportional to some direct function of the wave-length. It seems almost certain, from Tyndall's experiments above quoted, that these short waves are not *absorbed* in the ordinary acceptation of the term. What then becomes of them?

In 1869 Tyndall demonstrated that if ordinary light fall upon a cloud of suspended matter in sufficiently great subdivision, the long waves pass through unhindered, while the blue are reflected; and from this he deduced an explanation of the colour of the sky. In 1880 I published a brief paper experimentally extending these results to ordinary coatings of oxides of the metals projected upon charcoal by a blowpipe-flame. From these it was shown that an oxide in thin layers might reflect only a beautiful blue; that if the coating naturally absorbed blue, it reflected in preponderance in thin layers the next longer wave-length; and that, in fact, the amount and character of reflection depended upon the size of particles and thickness of layer. No quantitative measurements were made; but from the magnificent character of the blues obtained, I concluded that nearly all the incident light of that wave-length was reflected. Applying this theory to the sky, we have an explanation not only of its blue colour and of its sunset tints, but also of Prof. Langley's results that through the lower air, full of these floating particles, the rays of shorter wave-length do not penetrate. It is not selective absorption; it is selective reflection.—*Johns Hopkins University Circular*, August 1883.

ON THE RECIPROCAL EXCITATION OF ELASTIC BODIES TUNED TO
NEARLY THE SAME PITCH. BY DR. G. KREBS.

When two strings tuned perfectly alike are stretched upon the same monochord, it is well known that each is capable of causing the other to vibrate with it. The same is true of two tuning-forks of exactly the same pitch placed opposite each other on two resonators.

But if the pitch of two strings is not exactly the same, the deeper-toned one can excite the higher, but not the higher-toned one the lower, provided that the difference between the numbers of vibrations amounts to at least 2 or 3, at most 3 or 4.

Conviction of this is obtained when the strings are first brought to exactly the same pitch, and then the tension of one of them somewhat relaxed: if now one of the strings be struck or pulled in the middle with the finger, after a paper rider has been placed on the other, it can be distinctly seen that the rider leaps from the higher-toned string if the difference of the numbers of vibrations amounts to 3 or 4, while, conversely, the rider upon the deeper-toned string remains almost unmoved when the higher-toned is struck.

If the difference of the numbers of vibrations amounts not to 2, each string is in a condition to excite the other; but the deeper-