THE FLUORESCENCE MICROSCOPE.

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White light as we all know is composed of a mixture of color ranging from violet through indigo, blue, green, yellow, orange to red, the violet waves being the shorter, and the red the longer. When white light is passed through a prism it is broken up into these component colors and the result is known as the visible spectrum. By suitable means, there can be shown to exist at each end of the spectrum other wave lengths known as ultra violet if shorter than 3800 au, infra red if longer than 7600 au. These can be rendered visible by the power possessed by certain substances to convert these invisible wave lengths into visible ones. If the invisible infra red rays are focused by means of a suitable condenser on a piece of blackened platinum the platinum soon becomes heated to redness and emits light. This phenomenon is called calorescence or thermo-luminescence and is due to the conversion of the long invisible infra red rays into shorter and visible rays.

If we now turn our attention to the other end of the spectrum we will find there are a number of substances having the property of converting the short invisible wave lengths into longer and visible ones but this time without heat being developed. Two phenomena will be observed here and will be called Fluorescence or Phosphorescence according to the way the substance under examination acts.

FLUORESCENCE—If the substance under examination emits light while under the influence of the ultra violet radiations but cease to do as soon as the exciting cause is removed the phenomenon is called Fluorescence.

PHOSPHORESCENCE—If on the other hand the emission of light by the radiated substance continues after the exciting cause is removed, it is called Phosphorescence.

Both these phenomena have been known to exist for many years but so far no satisfactory explanation for their existence has been given.

It is not the purpose of this paper to discuss the many theories relative to Phosphorescence and Fluorescence but

to act as an introduction of the Fluorescence Microscope. This apparatus consists of an arc lamp provided with a suitable condensing system, a series of filters and the microscope. The arc light is fitted with carbons so prepared to deliver a light rich in ultra violet. The condensing system is of quartz which is transparent to ultra violet—the filters, 2 in number, consist: one of 2 plates of quartz mounted in a suitable holder between which is a layer of 25% copper sulphate solution. This effectively removes the light waves at the red end of the spectrum. The second filter is two plates of UV glass separated by a layer of P. nitroso dimethyl anilin. The UV glass cuts out the yellow, orange, green and blue while the P. nitroso dimethyl anilin removes the violet. The stage below the microscope is equipped with a total reflecting prism of quartz and the microscope has an Abbe condenser of the same material. Quartz microscope slides are also used in these experiments.

The objectives and eyepiece of the microscope are of the ordinary glass system, quartz not being necessary here as we are dealing with visible radiations.

Since the visible light has been filtered out of the optical system it is necessary to devise some means of showing when illuminant on the optical system is in alignment. For this purpose we use a plate of uranium glass. This is placed in the place provided for it above the quartz prism and the beam of light adjusted until this uranium glass fluoresces brilliantly over this center area. It is then removed from the prism and placed above the Abbe condenser and at this point we should have a brilliant spot of light directly over the center of the condenser. This being accomplished, the microscope is ready for use. The substance to be examined is now mounted on the quartz slide and placed on the stage of the microscope in the usual manner and if it has any fluorescent properties it will become luminous, the light emitted being characteristic of the subject under examination.

The question now arises—since this light is visible to the naked eye, why use a microscope. This is for two reasons: One—Substances which are not usually considered fluorescent may contain minute quantities of substances which are fluorescent. These may be too small to be seen

with the naked eye but will be revealed by the microscope. Two—Many substances, particularly ore minerals are composed of a variety of chemical substances. When these are subjected to ultra violet radiation, the entire mass will fluoresce a single color, but examined under the microscope may be resolved into a number of different colors, each color coming from a different substance.

Minute quantities of impurities in apparently pure chemicals can be detected by this method.

Many of the algae show up beautifully when fluoresced, the chlorophyl appearing a brilliant red.

The number of substances fluorescing to ultra violet light is very great and are found in every line of research. Very little is actually known regarding the application of this phenomenon and much work will have to be done before any definite statements are made regarding the practical application of this type of microscope, or of the interpretation of the findings. However, this opens up a very wide field for research in almost every line of endeavor and gives great promise for the future.