REPORT ON MICROSCOPIC WORK WITH R. H. SAWYER

AT NEWPORT - FEBRUARY 11 - 14th, 1935

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During the week of February 11, 1935 the writer had the opportunity of working with Mr. R. H. Sawyer of the Newport Plant in the microscopy laboratory. The methods and technique as well as the apparatus used will be described in some detail altho other valuable ideas and improvements in technique were acquired which will show only in the quality of future work.

There is available in the Newport laboratory a very substantial optical bench the bed of which may be suspended in a balanced condition so that the optical system mounted on this bed is relatively immune to vibration, a very necessary condition for photomicrography when long exposures must be made. There are in use two distinct optical set-ups which will be separately described in the description of routine examination of pigments in the visual and near-ultraviolet ranges. Each system consists of a light source with a condensing lens system and field diaphram, a microscope, and a camera. The camera and microscope may be used in either the vertical or horizontal position. This optical bench is also of great assistance in lining up the various parts of the system so that they are exactly on the optical axis.

For work in the visual range, 400 to 700 millimicrons, a 10 ampere mechanical feed arc lamp operated on D.C. is used. This aids in permitting short exposures in photomicrography which minimizes any vibration effects or change in focus. The set up is used in a horizontal position when the sample permits, thus eliminating all mirrors from the illumination system and placing the arc, its condenser lens system, the field diaphram for limiting the size of field illuminated, the microscope condenser with its diaphram, the optical system of the microscope and the camera in a single horizontal axis. When the microscope and camera must be used in a vertical position for the study of slurry, three mirrors are interposed in the system between the field diaphram and the substage condenser diaphram. The optical system of the microscope itself employs an apochromatic objective of high numerical aperature permitting best resolution. A 10X ocular is used and the camera is usually adjusted to give 900X magnification in this range. The microscope used for both work in the visual range and in the near ultra-violet is a study instrument intended primarily for photomicrography, of Bausch & Lomb manufacture, and has a fine adjustment which is free working and without backlash.

In most of the work in the visual range, the sample is rubbed out in turpentine to form a rather thick mount, the turpentine evaporated on a hot plate, and the mount immersed in balsam. The cover glass is used to disperse the sample in the balsam. The procedure differs from the one in use at Newark in that we attempt to make our mounts sufficiently thin so that balsam immersion is carried out without disturbing the pigment particles already cemented to the slide. In addition to balsam, glycerine, dammar, Duco cement, and water are used as dispersing mediums. The choice of medium depends upon the difference in refractive index desired, the resolution necessary, the nature of the sample, and the wave length of light used.

As far as possible a blue filter is employed with the light source so that Process film may be used. There are available Wratten K plates and Eastman spectroscopic plates for use when other filters must be used for contrast purposes.

For work in the near ultra-violet, the Bausch & Lomb apparatus is used. The source of illumination is a high intensity mercury arc together with filters for

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isolating the green mercury line with a wave length of 546 mμ and the ultraviolet of 365 mμ. The objective with a magnification of 102 diameters, a working distance of 1.7 mm. and a N.A. of 1.30 is designed so that the green mercury line and ultraviolet line of 365 mu are simultaneously in focus. Thus the microscope is focussed with the green filter, the filter which transmits the 365 mu line is substituted, and the exposure made. For immersing the objective sandalwood oil is used, since cedarwood oil has too high an absorption. The maximum theoretical limit of resolution with the 365 mu line and an objective of N.A. = 1.30 is 0.14 μ as compared with 0.17 μ using blue light with a wavelength of 450 mu. In addition to giving increased resolution, the use of ultraviolet shows differences in opacity by the sample when it is made up of two or more substances having different absorption in this range. One good example is lithopone which shows clearly the transparent $BaSO_4$ distinct from the opaque ZnS when a photomicrograph is made with ultraviolet light. A sample of iron blue, B-57-D, photographed in this manner showed particles which were opaque and others which were transparent. Process film is used and most of the work is done at 1500 diameters. With a transparent mounting medium, an exposure in the order of 30 seconds is necessary. If an opaque mounting medium is used for purposes of contrast, the exposure may be three minutes or more.

One other method may be mentioned, that of examining slurries. The slurry is thinned by rubbing out with Turkey Red Oil until a suitable dispersion is obtained. This is placed in a .005 mm. cell with a cover for examination. It is believed that such a cell would be extremely useful in our work for examining pigment in slurry form.

An Eastman enlarger is used for obtaining positives for particle size counts. Total magnifications of 3000 to 5000 diameters are thus obtained.

Mr. Sawyer loaned us a Spencer Apochromatic objective with a N.A. = 1.30 and a magnification number of 113 diameters together with a Planoscopic 10X ocular. The photomicrographic work which has been done at Newark with this equipment shows a decided improvement over that done with the lenses previously used.

The writer wishes to express his appreciation for the opportunity of working with Mr. Sawyer and for the numerous courteries extended to him while at Newport.

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