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*THE MICROSCOPE ITS DESIGN, CONSTRUCTION, AND APPLICATIONS,  
A SYMPOSIUM AND GENERAL DISCUSSION BY MANY AUTHORITIES*

## A NEW RESEARCH MICROSCOPE.

By POWELL SWIFT.

We have, in connection with Messrs. R. & J. Beck, been in consultation with Sir Herbert Jackson and Mr. J. E. Barnard concerning the requirements of a better research microscope for all classes of exacting work than has hitherto been made. This consultation has proceeded only so far as to deal with certain important aspects of the case. We think the advances that are likely to be made in the microscope will be due to constant discussions between the users and the manufacturers of the instruments, and in order that the discussions which have up to the present taken place should be materialised into something definite, we have prepared a model embodying the points that have been so far settled and which should form a stepping stone towards further progress.

Whereas a standard microscope can be produced which may satisfy the requirements of the ordinary worker for a reasonably long period, we do not think that the best type of instrument is likely to remain stationary as long as scientific progress takes place.

Therefore, in putting before you this stand, although we think it marks a distinct improvement due to the helpful suggestions that we have already received, we must take entire responsibility ourselves for the details, and merely express our thanks for the valuable assistance we have received from Sir Herbert Jackson and Mr. J. E. Barnard, without its being supposed that they can be held responsible for an instrument which we have made in order to exhibit at this meeting, without having had time to discuss the final details with them.

The first point which was considered was rigidity, and, while adopting the general principle of our "Wales" model, with its curved limb and radial means of inclination, the casting had been made with a metal tie of great strength to connect the portion carrying the body with that carrying the stage, so that when moving from the vertical to the horizontal position there should be no alteration in focus, due to the slight torsion which is otherwise produced in the curved limb.

The body is 2 inches in diameter, so that a photographic lens placed in its interior enables a large field to be obtained and not cut off by the margin of the tube. A rack and pinion drawtube and supplementary sliding drawtube are provided, so that the mechanical tube length can be varied from 140 to 250 mm. The fine adjustment, which is of the twin side milled head type, is fitted with Messrs. Beck's new double lever adjustment, providing in this manner two very delicate adjustments, one of which is five times as fine as the other.

The entire stage is carried on a very massive right angle cradle, and racks up and down, with all its apparatus for metallurgical work having a travel of 2½ inches. This is more solidly constructed than has been the case with such instruments, so that there shall be perfect rigidity.

The mechanical stage, which rotates concentrically, and is provided with centering screws for adjusting it to the optic axis, is a modification of that of our "Premier" model. The substage introduces an entirely new feature. It is provided with two cradles on the principle of the Sloan Objective Changer, introduced by Messrs. Beck, so that the whole of the substage apparatus, when mounted in interchangeable fittings with centering adjustments, can be instantly inserted in the substage, two pieces of apparatus being capable of insertion at one time. The body of the microscope is provided with a similar cradle, so that nose-pieces of a special character can instantly be interchanged if desired. For instance, the plain nose-piece may be replaced for petrological work with a nose-piece containing an analysing prism, Bertrand lens, quartz plate, etc., or with a nose-piece containing a high power vertical illuminator or other apparatus. The advantage of this system is applicable also to a great deal of physics research, as by introducing special apparatus into the substage or nose-piece, as occasion may require, a most perfect optical bench can be produced for general experimental work. There is a considerable class of delicate optical research which calls for an optical bench possessing the perfect adjustments of a microscope, and we believe that hitherto this requirement has not been met. By examination of the instrument it will be seen that almost any class of apparatus could be applied to the stand for making small and accurate measurements in physics, and although the chief object of this instrument is to provide the most perfect microscope that can be required, the other function for such an instrument has been borne in mind.

The base of the microscope is of the English tripod pattern, but has been provided with a new feature which is specially useful for photomicrography and optical bench work, which will also be appreciated by the ordinary observer. A hook shape casting is supplied which can be screwed down to the bench or camera, and an eccentric bar passing through the centre of the base will slide underneath this hook, when, by a slight motion of a lever at the side, the base of the microscope is locked firmly down in an exact position. Another lever between the uprights of the base clamps the joint by means of a right and left hand screw.

We have not alluded to the rack and pinion adjustments of the body, the stage, and the substage, which are of the usual spiral type, but might well call attention to the great width of the slides employed to give great stability to these adjustments.

It was decided in the consultations which took place towards the production of this microscope that while Messrs. Beck were employed on their standard instrument, we should undertake the manufacture of this special type, which would in all probability be sold by both the firms by which it is manufactured.