

Spring

**The Zeiss-Nomarski differential interference equipment
for transmitted-light microscopy**

By R. D. Allen, G. B. David, G. Nomarski

With 19 figures

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Introduction

Equipment for differential interference contrast in transmitted light microscopy designed by NOMARSKI (1952, 1955) and manufactured under licence from the C.N.R.S. by Carl Zeiss/Oberkochen (German Federal Republic), has recently become generally available. It is one of a series of devices that rely on the interference of a pair of wavefronts (PILLER, 1962) to generate contrast, and it is constructed in such a way that it can be used as an accessory on the standard Zeiss microscopes. A brief description was issued by the manufacturers in December, 1968 (Zeiss-Publication). The Zeiss equipment necessary for differential interference microscopy in transmitted light comprises the following accessories: (I) a single beam-splitting slide, consisting of a modified quartz Wollaston prism oriented at 45° to an attached analyser, and mounted in a screw-driven carriage (so that a variable amount of bias compensation can be introduced at will), which is accommodated in the normal analyser slot between the objectives and eyepiece; (II) a strain-free achromatized condenser, fitted with three auxiliary modified Wollaston prisms, in addition to two annular stops for phase-contrast microscopy (Zeiss-Publication, 1968). A detailed theoretical and practical evaluation of the prototype was undertaken by us over the last four years, at the request of Dr. HORST PILLER of Carl Zeiss. The results were presented at the Centenary Conference of the Royal Microscopical Society in London, 1966 (ALLEN, DAVID, HIRSH, 1966; DAVID, ALLEN, HIRSH, WATTERS, 1966). These will be published in full later, in the Journal of the Royal Microscopical Society.

The purposes of the present paper are to illustrate and to describe briefly some of the properties of differential interference microscopes. This paper is complementary to, and should be read in conjunction with, the Zeiss description of the equipment now being produced (1966). It is meant as an introduction to differential interference microscopy for those who until now used only phase-contrast microscopy and image-duplication (PILLER, 1962) interference microscopy in their work, and as a short practical guide to the interpretation of differential interference images. Several hundred scientists have already acquired the Zeiss/Nomarski equipment in the brief period since our first publications about it (ALLEN et al., 1966; DAVID et al., 1966; BAJER, ALLEN, 1966; BAJER, ALLEN, 1966), and it is becoming an indispensable tool for biological and medical work of many kinds. The discussion that follows (except for