'most probable' distribution at the prevailing temperature. The definition is rigorous, and this is indeed all one needs to conduct the present argument. In computations, one needs procedures of estimating the information content as defined. This may be easy or difficult, depending on the desired accuracy. Estimates of the information within structures of any complexity are possible, given the definition of this quantity.

In computing I, one lumps all the chemical thermodynamic information, not distinguishing information as meaningful or meaningless, important or trivial. One may ask whether meaningful and important information should not count more. We dealt with this question elsewhere[6], and our views are as follows: The meaning and importance of a piece of information represent our intuitive estimate of its total impact on the biospheric system; this impact can be measured by the total amount of information, anywhere in the biosphere, that would not exist if this piece of information did not exist. Thus, we consider more important a written message describing the cure to a disesae than another message of equal structural information in the form of nonsensical words because the first message can be responsible for a large amount of information in the form of the individuals whose destruction it can prevent; similarly, an individual responsible for the lives and well-being of many people is more important than one who is isolated from, and useless to his environment. Since in computing I we include the entire system, we are not erring in counting the meaningful message or the important individual as equal to their useless counterparts; our computation will include, from elsewhere in the biosphere, the information that is the basis of their meaning and importance.

In our approach we assume a constant input, and an unchanging environment. Changes, such as a cataclysmic event or a gradual change in climate, will have a transient or a permanent impact on the biosphere and on the evolutionary process. It appears reasonable, however, to analyze the evolutionary process assuming, to a first approximation, an unchanging environment. If an adequate theory is obtained for a constant environment, one may then study the impact of environmental changes on the existing evolutionary mechanisms.

Changes in evolutionary mechanisms do occur even without environmental changes. Although increasing biospheric information characterized all evolutionary stages, different mechanisms correspond to pregenetic, genetic, or cultural evolution. Two events mark the transition between these stages. The first was the appearance of the genetic apparatus; the second was the appearance of human culture which introduced biospheric components maintained and reproduced by man. In each case, the appearance and selection of new components became much faster. While during the pregenetic stage the more efficient components might slowly spread due to a lower destruction rate[3], genetic reproduction allowed the carrier of an improvement to spread rapidly by multiplying faster than its competitors. Similarly, during the stage of cultural evolution, an improvement (e.g., better vision) can arise within the time needed to develop the new tools (e.g., the telescope or the microscope), which is much shorter than the time required for this result via genetic evolution (i.e., mutations toward better vision).

An important feature of any formulation is its predictive value. There are several levels at which one might describe and predict evolution. The first is to describe its direction; a higher level is to predict the rate at which evolution will proceed; a still higher level would be to describe the forms that will be generated. This formulation allows us the first level of prediction; in the absence of environmental changes, the biosphere will in the long run, evolve toward a larger I. With some knowledge of the mechanisms involved, one may be able to reach the second level and predict the average rate at which I will be increasing. It is conceivable, however, that the process through which new components arise may so depend on chance, as to never allow us to predict which of several possible forms will be actually generated.

Résumé. Les auteurs discutent la formulation quantitative de l'évolution comme un procès qui augmente le contenu de l'entité thermodynamique d'information dans la biosphère.

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9 April 1973.

[6] G. C. THEODORIDIS and L. STARK, Math. Biosci. *11*, 31 (1971).

PRO LABORATORIO

A Focusing Adapter for the Polaroid ED-10 Photomicrographic Camera

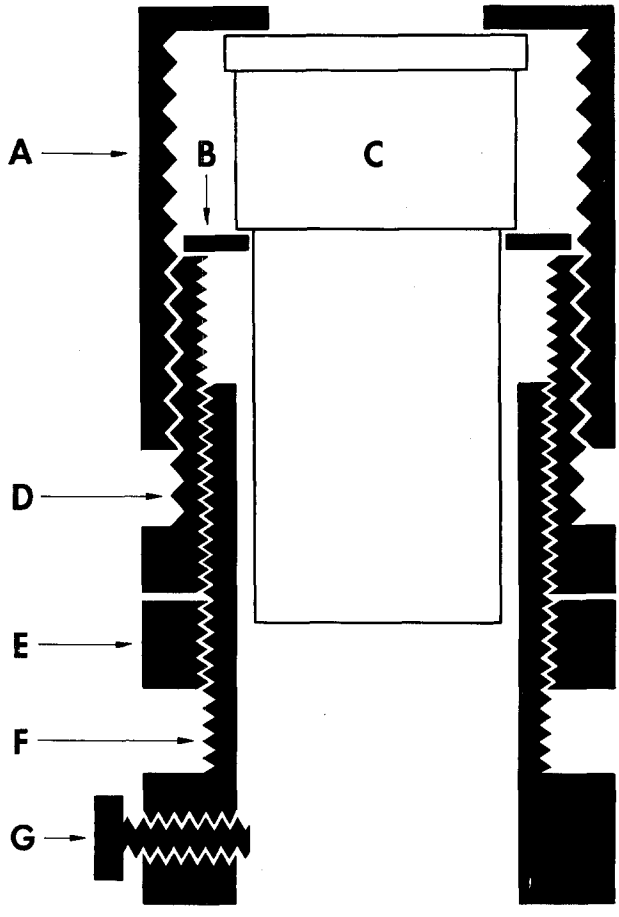
The ED-10 Camera[1] is a moderately-priced instrument designed for instant photomicrography using Polaroid Land film. The main advantage of this camera is that it can be fitted within a few minutes on any standard microscope by means of a universal eyepiece adapter. Several components of the ED-10 system have been markedly simplified for economy's sake. The camera itself has no relay lens, and the magnified image produced by the eyepiece of the microscope is projected directly on the film. Consequently, the quality of the picture depends only on the optics of the microscope; on the other hand, adjustment of focus at the film plane has to be carried out before attaching the camera, by sliding an accessory tube down over the eyepiece adapter and focusing the microscope through a viewing lens mounted in this tube.

The versatility inherent in its design makes the ED-10 camera very useful for obtaining photomicrographs on-the-spot, for instance in the histology classroom, without having to resort to a special or elaborate set-up. Certain features, however, make this instrument less suitable for more exacting purposes. From our experience,

[1] Manufactured by the Polaroid Corporation, Cambridge, Massachusetts, U.S.A.

routine use of the camera is hampered by several steps in the focusing procedure. The image viewed through the accessory tube is of higher magnification than that seen directly through the eyepiece, and its field is very narrow; with relatively thick sections and high-power optics, it may be difficult to select the most important plane within the specimen, i.e. the part which has to be brought into sharp focus. Moreover, the length of the accessory tube is such that this adjustment cannot be made under sufficiently comfortable conditions when the ED-10 system is mounted on a vertical microscope eyepiece tube. Finally, care must be taken not to alter the setting of the microscope, or to misalign the system when substituting the camera to the accessory tube.

These drawbacks prompted us to find a means to focus the microphotographic image without having to use the ED-10 accessory tube. This can easily be achieved provided the camera is mounted on a microscope equipped with an extra tube and eyepiece for photomicrography, as for instance the classical trinocular type. The only requirement is then to project through this eyepiece an image which falls in focus at the film plane exactly when the microscope focus is adjusted through the viewing eyepieces. Since the camera has no built-in relay lens, the light rays emerging from the photographic eyepiece must be made to converge to the required extent by an increase in microscope tube length. The focusing adapter described in this note has been designed to this end, and replaces the eyepiece adapter supplied with the ED-10 system. It has originally been made for Wild M12 and M20 microscopes fitted with a vertical photographic tube, but it could readily be used, directly or after minor modifications, with other instruments. Its purpose is not only to attach the camera to the microscope as does the original adapter, but also to hold the eyepiece used for photography in a slightly lifted, adjustable position in the vertical microscope tube. This critical position has to be determined only once, with the help of the ED-10 accessory tube, for a given combination of photographic and viewing eyepieces. Any eyepiece suitable for microphotography, in conjunction with the objective lens selected, can be used with this adjustable adapter[2].



Cross-sectional diagram of the focusing adapter, showing the position of the photographic eyepiece. A) Top section of the original ED-10 eyepiece adapter. B) Washer of the ED-10 adapter. C) Photographic eyepiece. D) Coupling sleeve: height 30 mm, outer diameter at bottom 44 mm, diameter of female thread 32 mm, length of male thread 25 mm and size fitting that of inner thread of part A. E) Locking ring: thickness 8 mm, outer diameter 44 mm, diameter of female thread 32 mm. F) Holder: height 47 mm, external diameter at bottom 44 mm, diameter of male thread 32 mm and length 35 mm, bore fitting tight a standard microscope eyepiece tube of 25 mm outer diameter (not represented). G) Locking-screw: diameter of thread 4 mm. The pitch of all screw-threads, except the coupling sleeve's male thread, is 0.8 mm.

The Figure shows that the device consists essentially of a series of concentric, overlapping elements. The various parts are screwed together and enclose the photographic eyepiece (C). Items A and B are actually the top section and washer, respectively, of the original ED-10 eyepiece adapter, whereas D, E and F are parts designed to replace its lower section, i.e. the piece which is normally fastened to the microscope tube. These parts are easily made on the lathe, of metal or hard synthetic material; for instance, parts D and E of our adapter were made of brass, and F of solid polyvinyl chloride. The photographic eyepiece rests on the washer, on top of a double-threaded coupling sleeve (D), and is held in this position by screwing down the top section. The system is further assembled by screwing the sleeve on a finely threaded holder (F), which is mounted on the vertical tube of the microscope and firmly secured by a nylon locking-screw (G). The level of the coupling sleeve, relatively to the holder, can be finely adjusted; thus, the photographic eyepiece can be shifted as required along the optical path. The locking ring (E) is tightened when tests using the ED-10 accessory tube indicate that the image at the film plane has been brought in focus, in perfect coincidence with the image focused through the viewing eyepieces[3].

Résumé. Un dispositif simple, destiné à recevoir la caméra Polaroid ED-10, a été conçu pour un microscope équipé d'un tube photographique vertical. Ce dispositif permet de déplacer l'oculaire photographique le long de l'axe optique, et de le fixer dans la position où la mise au point du système photographique correspond à celle du microscope.

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[2] In theory, an eyepiece corrected for photography and featuring an adjustable eyelens could be used with the original ED-10 adapter, and would also enable one to focus the camera through the viewing eyepieces. However, once encased in the adapter, its adjustment by trial and error would be very unpractical. Moreover, few manufacturers offer a complete line of such eyepieces.

[3] This work was supported by grants from the F.R.S.M. and the F.N.R.S.