SCIENCE

2 May 1975

Vol. 188, No. 4187

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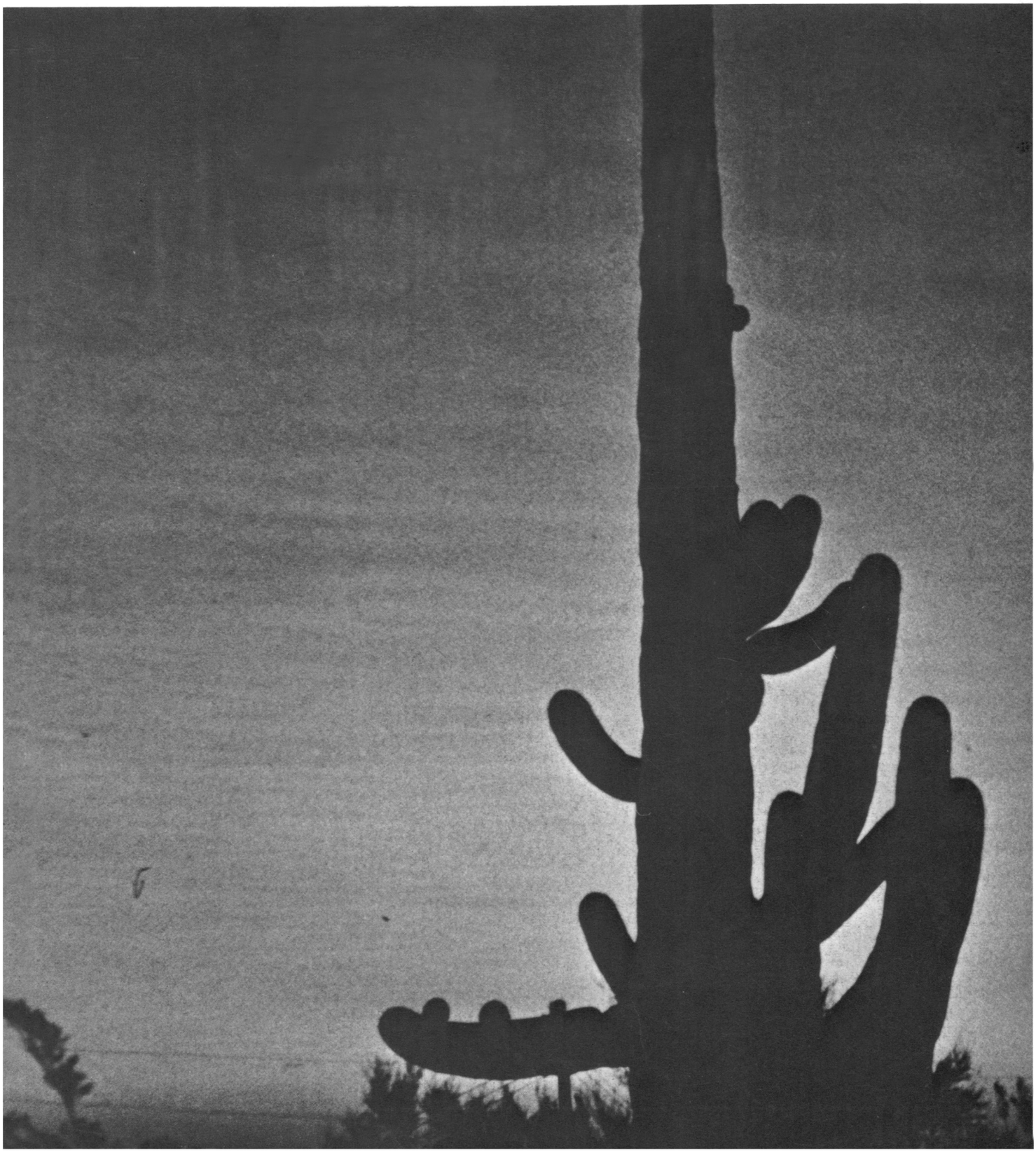
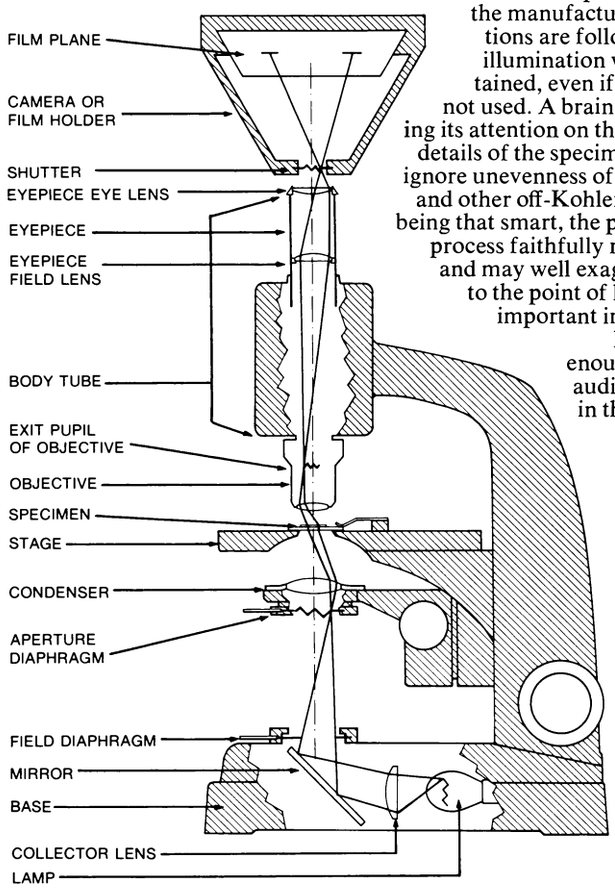


We want to be useful...and even interesting

Communication by microscope

Besides looking through a microscope, you can take pictures with it. You may want the pictures only as a record of what you saw. Or you might want them for communicating to others your thoughts on what you saw. If so – unless you feel there is no room for improvement in your photomicrography – Kodak Publication P-2,* "Photography through the Microscope," may prove helpful. In the course of telling how to get the most out of our products, it discusses things we don't even provide. For example, Kohler illumination:

There are microscope illuminators (in 10th-grade biology labs, perhaps) that do not use lenses to direct the light into the substage condenser. In that case, don't worry about Kohler illumination because you can't have it, nor can you expect as much resolving power from a high-aperture objective as theory predicts. If you have progressed beyond such equipment, carefully read the manual that comes with the microscope. Hope that if the manufacturer's suggestions are followed Kohler illumination will be maintained, even if that name is not used. A brain, concentrating its attention on the fascinating details of the specimen, learns to ignore unevenness of illumination and other off-Kohler effects. Not being that smart, the photographic process faithfully renders them and may well exaggerate them to the point of losing what's important in the subject. It can be bad enough to rob the audience of faith in the cleverness of the communicator.

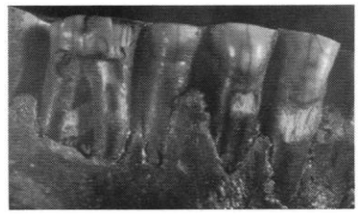


THE KOHLER ILLUMINATION PRINCIPLE

The collector lens gathers light from the emitting source, whether lamp filament or arc. Source should be in sharp focus at the aperture diaphragm. Its image should be centered with that diaphragm, and it should be large enough to extend just a bit beyond the widest opening. If it is much larger, you are wasting light. If it is much smaller, you may be losing some of the resolving power the objective could be delivering. Two further images of the light source will be formed, one by the condenser and objective in combination and the second by the eyepiece. If an image of the aperture diaphragm and within it the relayed image of the light source coincide with the plane of the shutter and are no larger than the shutter opening, the film is getting the full benefit of the light to keep down problems from long exposures, *and it is seeing the most of the specimen's structure and the least of the light source's structure.*

She must have gone to the dentist

Panchromatic



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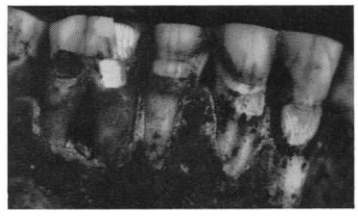
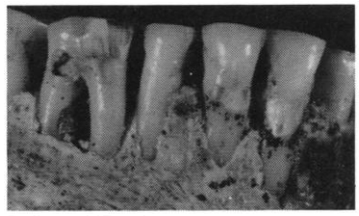


UV-excited visible fluorescence



Reflected IR only

Visible-excited IR luminescence

Since the funeral took place as long ago as 600 A.D. in what the palefaces later named Jersey County, Illinois, the archaeologists took the liberty of disturbing the lady's rest. Their investigations bring new respect for the culture of her people. Therapeutic dentistry, it seems, was not beyond their technological capability. To evaluate the evidence for that, send for the article "Multi-spectrum Investigation of Prehistoric Teeth."* If more interested in the photographic methods than in the findings, get Kodak Publication M-27,* "Ultraviolet and Fluorescence Photography."

Kodak

KODAK Directory of Products and Services for the Health Sciences *is available free from Dept. 55M, Kodak, Rochester, N.Y. 14650, as is the article on the evidence for prehistoric dentistry. Kodak Publications P-2 and M-27 can be ordered from photo dealers, some bookstores, or at $3.25 and $2.25, respectively, from our Dept. 454. (Prices subject to change without notice. Please add applicable taxes.)*

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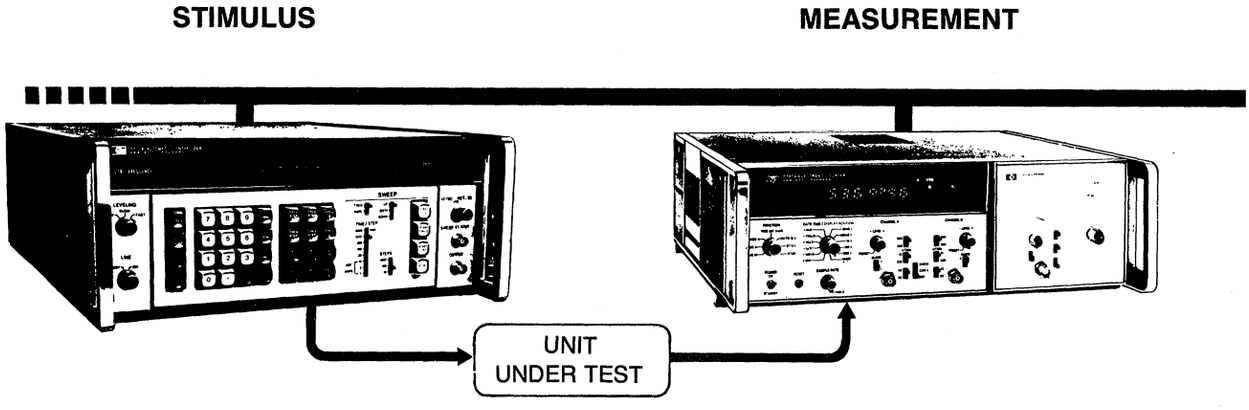
COVER

Twilight illumination of the ash stratum from Tucson, Arizona, 22 November 1974, showing the heavily striated structure of the layer. Saguaro cactus is in foreground. See page 477. [Aden B. Meinel and Marjorie P. Meinel, University of Arizona, Tucson]



A new standard communications link that facilitates conversation among instruments.

It wasn't long ago that all instruments were, in human terms, totally deaf and dumb. They could not hear instructions so you made them do their job by setting knobs and switches. And when the job was done, they could not tell you the results; the only way to find out was to read, and then analyze, their displays.

Many instruments have since learned to "talk." On command, they can output measurement results and transmit them remotely in code. More and more are being equipped to "listen": send them prearranged signals and they can program their own controls, remotely. Add a control function to such instruments—to tell them when to talk and when to listen—and they can communicate with each other automatically.

This sounds easy, but it hasn't been. Although the three basic elements for automatic instrumentation systems—talkers, listeners, and controllers—are readily available, one who sets out to design and assemble such a system quickly runs into severe frustrations. The different elements are rarely compatible; more often than not, they use different logic, speak a different language, and interconnect with different hardware.

Avoiding this electronic Tower of Babel is what the Hewlett-Packard Interface Bus (HP-IB) is all about. A standard interface system, the HP-IB forms a basic communications link that allows interconnected system components to communicate effectively, in an orderly and unambiguous manner. The interface system involves much more than the standardization of interconnecting cables; it also defines the interface logic capabilities within the system instruments, the scope of the data codes used on the interface, and the timing and control techniques for exchanging messages.

To talk or to listen: never a doubt.

In the HP Interface Bus, all system devices are exposed to all system communications. But a device can neither send nor receive a message unless told to do so by the system *controller*: at any given time, it can be either a *talker* or a *listener*, but not both. Listeners receive programming data from a controller or measurement data from talkers; talkers send measurement data to listeners. There can never be more than one active controller or one talker at the same time, but there can be as many as 14 concurrent listeners.

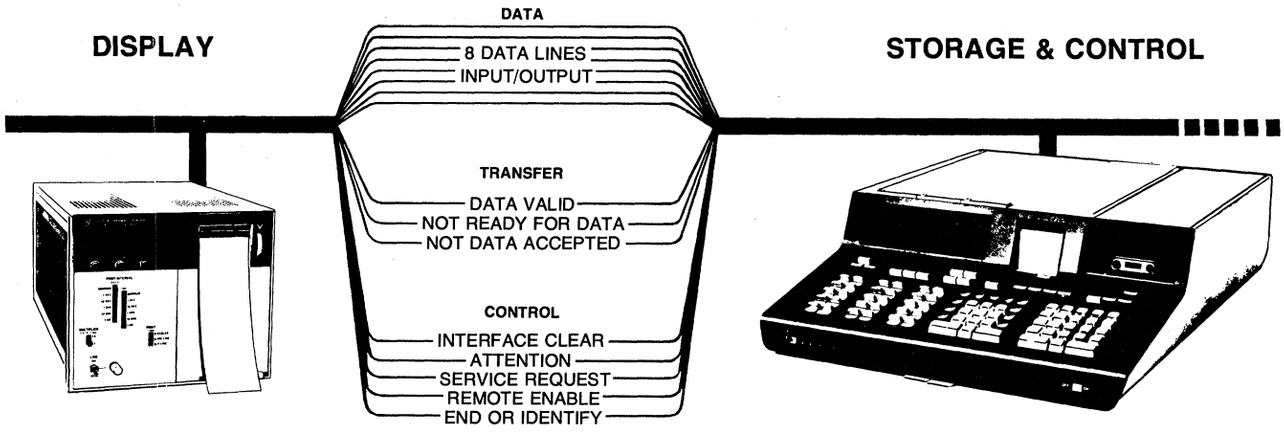
Depending on its capabilities, a device may play more than one role at different times. A calculator or computer, for example, can be talker, listener, or controller; a programmable digital voltmeter alternately talks when it outputs its measurement and listens when it's being programmed; a paper punch can only play the role of listener.

The bus: a common interconnection.

All system devices are interconnected on a common set of 16 signal lines. Eight of these lines form the *data bus* which carries all data messages bidirectionally between talkers and listeners, in bit-parallel byte-serial fashion. The *transfer bus* uses three lines to ensure that data is interchanged only from the intended talker to the designated listeners, through an interrogation and reply sequence. The remaining five signal lines constitute the *control bus*, by which the controller directs an orderly flow of information across the interface, sending commands to the devices and receiving service requests from them. Although system control is always delegated (never assumed), it may be shifted from one system device to another.

HP-IB simplifies systems, small or large.

An HP-IB system can consist of one talker, one listener, and *no* controller; for example, a counter and digital printer for semi-automatic data logging. At the other extreme, a completely auto-



matic system may include as many as 15 instruments possessing stimulus, measurement, display, storage, and control capabilities. Whether a calculator, computer, or the processor of a "smart" instrument, the controller operates the entire system through an interface connection (a single I/O card)—an obvious economy compared to non-bus systems that require one I/O card for each instrument.

System configuration: fundamental problems solved.

Although the HP-IB does not provide instant systems, it does solve the fundamental interface problems that have plagued instrumentation system designers and users until now. Designers no longer need to invent custom interfaces for each new product; users no longer need to familiarize themselves with an interface unique to each new product. Cable and connector problems are minimized by the use of a simple, passive cable interconnection system.

HP-IB protocol allows the designer to assign talk and listen addresses to each device to suit his purposes. Each address is set at the device to any desired value, through a switch on a rear panel, jumper wires on a PC board, or other convenient means.

The HP-IB imposes minimal functional restrictions on data transfer between a talker and a listener. For example, data bytes may consist of from one to eight bits. Once a device is addressed, data can be transferred using any coding and format convention appropriate to the application. The most commonly used codes are the printable characters of the ASCII code set, and the number representations are typically FORTRAN compatible.

Minimal timing restrictions are imposed on the data rates by the HP-IB. Data is transferred asynchronously at a rate that suits the devices involved; burst rates of 1 megabyte per second are possible over limited distances. Data may be transferred directly between devices, thus reducing message traffic on the bus.

More than a theory, HP-IB is a reality now.

Within Hewlett-Packard, the common interface concept has already been incorporated into a growing list of more than 25 instruments and accessory products as well as our computers and programmable desk-top calculators. Additionally, the HP-IB is our implementation of new IEEE Standard 488-1975—and it has served as a model for the IEC Recommendation recently released for ballot among member nations. Thus the possibility exists that this concept will become internationally applicable to the interfacing of instruments, without regard to manufacturer or nation of origin.

Obviously an idea whose time has come, the common interface is here now, still another aspect of the new measurement technology that is taking shape at Hewlett-Packard.

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Career Education and Liberal Arts

Recently there has been considerable debate on the issue of career training versus liberal arts education. In this debate, we would all benefit from an effort to understand the major issues of personal growth with which students are grappling when they enter the college years.

Although we are able to recognize that a 7-year-old is qualitatively different from us, not just smaller and dumber, very few educators seem to realize that a 17-year-old is also qualitatively different from his adult teachers and even from more senior peers. When they enter higher education our students are adolescents, and during much of the time they spend in college the problems of their lives revolve around the transition from childhood to adulthood.

In three major domains of the developmental process—the intellectual, the moral, and the social-emotional—there is a major transition during the late teens and early twenties. The decisive nature of the late adolescent years in these three areas may be illustrated by the work of three major developmental theorists—Jean Piaget, Erik Erikson, and Lawrence Kohlberg. Piaget proposes that the development of formal, logical thought occurs after the twelfth year. Kohlberg suggests that the constancy and universality of ethical principles do not become apparent prior to this time, and it is, of course, during adolescence that Erikson posits the formulation and formation of individual identity.

In the intellectual domain, our students are usually just beginning to develop the abilities to organize knowledge comprehensively and to manipulate abstract concepts without the necessity to refer to particular content. Yet how often do we take one of two easy roads with our freshman students? We either present predigested knowledge as though the students cannot think at all, or we present so abstrusely that they are unable to use their just developing abilities to think formally and logically. When we teach in a fashion that is mindless about our students' level of intellectual development we are not teaching, we are in combat, and many students will lose the battle.

Kohlberg's theory of moral development has, as its culminating stage, a transition to principled thought. The young person begins to comprehend a morality that transcends any individual authorities. This level of universal, relativistic principle can only be reached when a person can think abstractly and have some real understanding of alternative points of view. As one sophomore recently said, "It was only in college that I really began to understand that everyone did not see everything the same way!"

In Erikson's theory of social-emotional development, adolescence is the period for the resolution of identity issues. The idea that one is an individual in a world of others, with mutual and independent responsibilities, appears to become a salient feature of life only in late adolescence.

We propose that abstract reasoning, a universal (or, at least, a coherent) moral stance, and a concept of the future that is linked to a particular and personal past are three important attributes of adult behavior and thought that are incomplete in the college age student.

Recognition of these qualities in our students should serve to inform the debate on careerism and liberal arts education. Our students are "in process." Although, as seems obvious to us, a too early introduction of career choice may serve only to foreclose on optimum adult development, there remains the potential problem of academic learning that is unalloyed by pragmatic experience. In any event, if we do not try to understand who our students are and with what major issues they are struggling, we will remain merely curriculum manipulators and not educators—F. REBELSKY and J. C. SPEISMAN, *Department of Psychology, Boston University, Boston, Massachusetts 02215*

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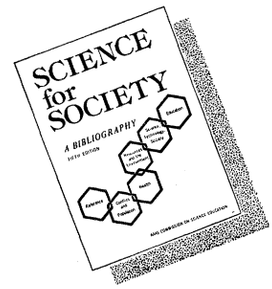

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