and Dr. Merriam, and located on Yavapai Point, is an achievement in architectural propriety as well as in fitness for its definite object. Yavapai, one and one third miles from Grand Canyon station, is particularly scenic and it commands views of the Bright Angel, the Yaki and the Tonto trails. It directly faces the splendid lateral canyon of Bright Angel Creek. The equipment and preparation of exhibits under the direction of the Grand Canyon committee of the academy has been supported financially by the Carnegie Corporation.

Conforming to the idea of aiding the visitor to develop an understanding of the scientific problems through his own observation, the work of the specialist consists largely of short informal talks at the observation station, on different phases of Canyon history and Canyon life. During these expositions reference is made to the exhibits *in situ,* which, like the rushing river, are in view from the station and may be seen very distinctly by means of telescopes ranged along the parapet. The speaker enlarges and helps to extend the discoveries of the layman. A relief model of the Canyon and the hand specimens brought from the field exhibits for nearer view are useful in the explanatory discussions.

The exhibits *in situ* are nearly all located either near one of the trails or within easy reach by short lateral trails. They are so arranged and prepared that the observer can hardly fail to develop on his own initiative the conclusion that the very remarkably distinct and highly varied footprints in a sandstone ledge of the red Supai series, for example, pass onward along the plane of deposition far beneath the towering plateau to the south; that the landscape in which the animals lived extended across the Canyon, where again the same kinds of animals were wandering about; that the environment was one of relative aridity at the particular time, molds of salt crystals being seen in the sun-cracked shales, and that vast lapses of time and great changes of level of the land and of animal and plant life took place during the interval represented by the strata in the Canyon walls.

In order better to aid the tourist, it has been found necessary for the expositors themselves to learn more about the Canyon. This has led to a number of investigations of problems of the history, extinct life, physiography, metamorphism, structure, etc., of the region. A more detailed study, with mapping, of the faunal zones and their characteristics is being made by Vernon Bailey, who is now at the Grand Canyon with Mrs. Florence Merriam Bailey.

The keenly appreciative interest of the tourists last summer proved not only the unique advantages of conducting such educational work in the impinging presence of stupendous examples of the natural phenomena under consideration, but also that the tourist who visits these places is psychologically peculiarly responsive to the impressive demonstrations spread before him by nature. The occasion is particularly fitted both for developing a conception of the processes of nature and for the growth of his philosophy of life.

DAVID WHITE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STANDARD MICROCINEMATOGRAPHIC APPARATUS

IT has been proved by many investigators and lecturers that the motion picture camera has been used advantageously as an instrument for recording experiments as well as for demonstration. The advantages of demonstration are obvious and have been explained repeatedly perhaps better than can be done here. There are still investigators, however, who have not yet realized the great possibilities of the motion-picture camera in research laboratories.

The greatest value of the motion picture as applied to science lies in its domination of time, for by its use it becomes possible to analyze thoroughly motions which are too fast or too slow to be perceived with the naked eye. Very rapid movements photographed with the slow motion camera and very slow movements taken with the time lapse camera are translated into perceptible speeds.

Another point in favor of the use of the motion-picture camera is the ease with which *microscopic* phenomena may be shown to large audiences. By means of the microfilm, composed of a series of photographs of successful experiments, it is possible to present, at a moment's notice, the best examples and results of research work. Microprojection as sometimes used in classrooms is limited in its application because it can be used only for low power, it requires much time for the preparation of material and equipment, the subject of the experiment does not always act as it should and the lecturer is often obliged to work the apparatus himself, a procedure which requires considerable skill. Many experiments can hardly be duplicated and the microprojection apparatus is expensive.

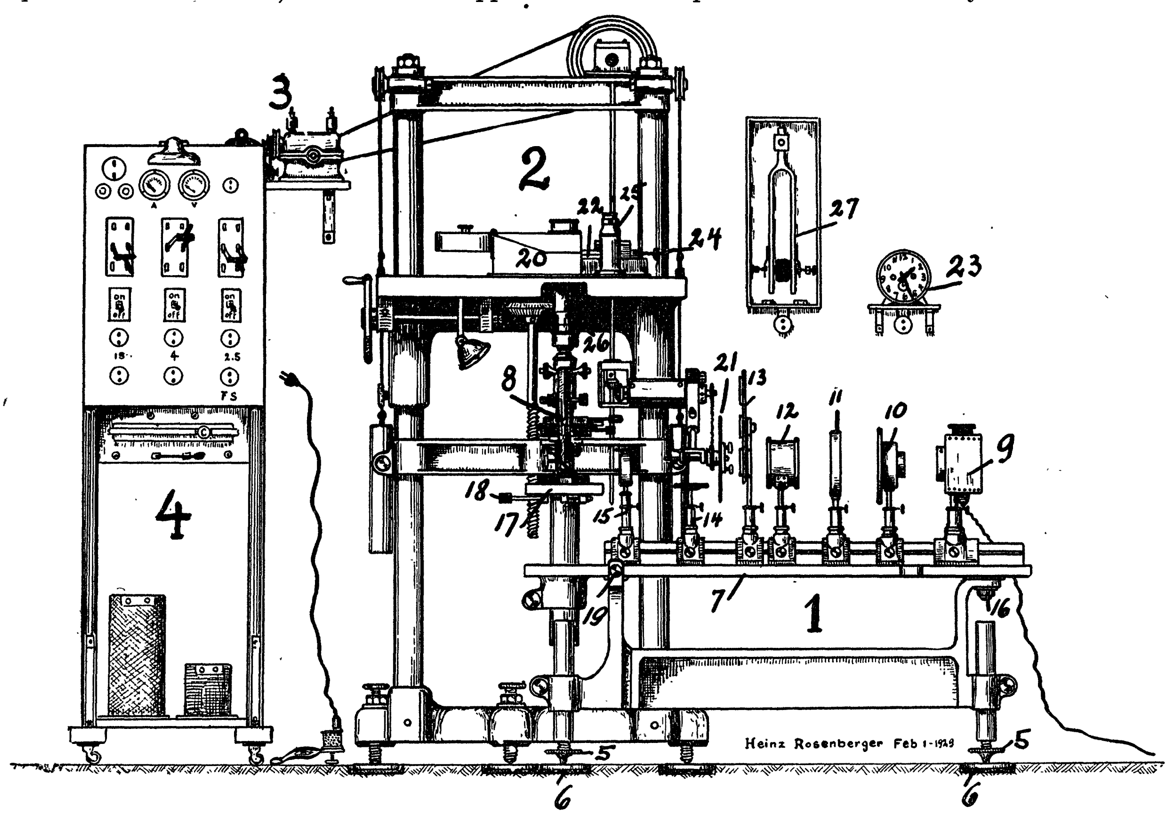
The application of microcinema to research work offers great opportunities. The microcinema camera is used here as an automatic recording instrument which takes successive photographs of a subject at certain time intervals which, of course, are determined from the actual speed and the projection time to be desired. This camera records microscopic phenomena during an unlimited period of time and it catches, therefore, many details which certainly would escape observation otherwise.

Up to the present there has been on the market no microcinema equipment which would work universally and efficiently. Most investigators already having made microfilms had to use all their ingenuity to contrive some sort of apparatus which was in the end very ineffective. These complicated combinations were used for one experiment only and were then taken apart to be rearranged for another experiment. Much patience was required to obtain mediocre results that scarcely justified the amount of effort, time and money expended.

Both in this country and abroad microscope manufacturers attempted therefore to construct microcinema apparatus, but the results were not at all encouraging. They were looked upon generally as instruments for amateur photographers. Due to the fact that the designers had no idea whatsoever of the requirements of the work, none of these apparatus incorporated the parts and features which are essential for serious research work, nor were they effective for high magnifications.

The constant demand for a microcinema machine which would be satisfactory not only for use in a research laboratory but also for the production of educational microfilms brought the author, a microscopist as well as a trained engineer, to the study of what such a machine must accomplish. Apparatus devised by the author have been used in the production of the films of Dr. Alexis Carrel on living cells and of the late Dr. Hideyo Noguchi on Leishmanias and Trypanosomas. The requirements are as follows:

(1) The apparatus must be absolutely rigid so as to be free from vibration; (2) it should be as compact as possible to permit easy transport; (3) it should be simple yet effective; (4) it should be adaptable for different uses in the laboratory; (5) it should be adjustable for a wide range of frequencies from perhaps one exposure every hour to thirty-two exposures per second; (6) it should permit easy control of focus at any time during the experiment; (7) it should permit the use of the various standard microscopic instruments now sold; (8) it should be within the means of the average laboratory carrying on microscopical examinations of any kind.



A Standard Micro-Cinematographic Apparatus.

As the outcome of these considerations the following new microcinema apparatus was devised. The instrument is composed of four separate units: (1) the optical bench with microscope and light source; (2) the camera table and stand with driving and timing mechanisms, exposure counter and revolving shutter; (3) the motor and reduction gears, and (4) the panel for the various electrical connections. The separation of parts 1, 2 and 3 was chosen in order to eliminate the transmission of vibration.

The optical bench is rigidly constructed of cast iron. Its height is adjustable. There are leveling screws (5) under each leg which rests on a vibration absorber (6). The upper part (7) carrying the microscope (8), the light source (9) and the optical equipment (10–15) can be pivoted about the point (16). The microscope rests on a special table (17) the height of which may be adjusted according to the kind of illumination desired for the work. This table forms a unit with the pivoted part (7) of the bench. By means of adjusting screws (18) and (19), the microscope may be moved either sideways or back and forth.

The optical bench when isolated may be applied for purposes other than microcinematography, such as microprojection and still microphotography. The microscope may be used vertically or horizontally, for its position may easily be changed by adjusting the table on which it rests. For work with material such as tissue cultures, when the temperature must be kept above normal, an incubator may be slipped over the microscope without deranging it or the rest of the apparatus.

The camera unit (2) is composed of two parts: the stand and the camera platform. The stand has a T-shaped, cast-iron foot with a leveling screw resting on a vibration absorber, at each one of its three extremities, two vertical steel rods and a cross-bar. The platform may be raised or lowered the entire length of the vertical steel rods by a hand pulley or simply by sliding.

Synchronously connected with the camera (20) is the revolving shutter (21) which provides intermittent illumination when high frequencies are used. For low frequencies, down to perhaps one exposure per minute, an electric timer (22) is used for starting and stopping the motor and for turning the light on and off. This timer is governed by an electric clock (23) which closes a circuit at certain predetermined intervals. This is accomplished by means of a relay which starts the driving motor. When the camera drive has completed one revolution one exposure has been made, the machine stops automatically and is ready for a new impulse from the clock. The length of exposure is regulated by an adjusting screw (24).

The motion-picture camera (20) is mounted on a slide so that it can be moved from side to side in order to align the tube of the focus control (25) with the optical axis of the microscope.

There is no mechanical connection between the microscope and the camera; a telescope tube (26) hanging into a collar attached to the microscope excludes outside light and allows only the projected light to come on to the film. Instead of the telescope tube an observation tube (so-called) beam splitter or a bellows slipped in from the front part of the camera platform may be used.

If *macroscopic* pictures are to be taken the microscope is removed and a photographic lens is screwed into the face plate of the bellows. The adjustable microscope table can then be used to hold the objects to be photographed. With this arrangement the apparatus is employed for ordinary vertical cinematography (for objects immersed in water, for small animals, or even for animated drawings).

In order to photograph phenomena which have to be taken horizontally, for example, objects in aquariums and slow chemical reactions in test-tubes, a 45-degree mirror is attached to the photographic lens.

Film records can be taken, therefore, without using the optical bench with the microscope.

The motor is connected by a leather belt, directly for high frequencies, or indirectly, by means of the reduction gears, for low frequencies including stop motion. An electrically driven tuning-fork (27) can be used as a time control when high frequencies are desired.

The distributing panel from which all electrical connections to the machine can be made is a novelty. The panel supports rheostats for the motor and for low and high intensity arc lamps, connections for foot switch and light increaser, and several additional plug receptacles.

Casters under the panel permit its being moved about so as to be close to the hand of the operator at all times.

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SPECIAL ARTICLES

SINANTHROPUS PEKINENSIS: THE RECOVERY OF FURTHER FOSSIL REMAINS OF THIS EARLY HOMINID FROM THE CHOU KOU TIEN DEPOSIT[1]

IN the course of the excavations continued by the Cenozoic Laboratory of the Geological Survey of China at Chou Kou Tien during the season of 1928

[1] Announcement of the discovery of this extensive additional fossil material referable to the genus Sinanthropus was first made at a meeting of the Geological Society of China held on December 14, 1928; a brief preliminary description of some of the specimens formed the subject of a paper communicated at the society's annual meeting on February 14, 1929.