the use of concerted methods of geology, paleontology and prehistory, and to search for early hominids and fossil anthropoid apes to advance our knowledge of man's evolution and his earliest cultures.

RALPH E. CLELAND, Goucher College, Baltimore, in support of his work for a cooperative cytogenetic and taxonomic attack upon the phylogeny and systematics of Oenothera (evening primrose), with special reference to the sub-genus onagra.

F. K. RICHTMYER, Cornell University, to enable him to continue his work on the determination of the widths, shapes and relative intensities of the lines in the x-ray spectra of the several elements; and the use of these data to compute the distribution of energy in the excited states of atoms.

FARRINGTON DANIELS and B. M. DUGGAR, University of Wisconsin, in support of a fundamental research in photosynthesis, concerned with a determination of the quantum efficiency in this process when employing monochromatic light in different regions of the spectrum using algae as test material.

K. LARK-HOROVITZ, Purdue University, in support of his investigation on the intensity of electron scattering by means of homeo-polar compounds.

HARRY SHULTZ VANDIVER, University of Texas, to enable him to continue his work on the computation and investigation of the properties of Bernoulli numbers with special application to Fermat's last theorem, perhaps the best known of all unsolved mathematical problems.

FRANK G. DUNNINGTON, California Institute of Technology, to enable him to continue his work on a precision determination of the specific charge of a free electron by a new deflection method.

N. T. BOBROVNIKOFF, of the Perkins Observatory, for investigations of stellar spectra, mostly in the red and infra-red, with a special attention to the band spectra.

JUDSON DALAND, Philadelphia Institute for Medical Research, in support of work on the biological effects of thymus extract (Hanson)—the accruing acceleration in the rate of growth and development in successive generations, from the extract of thymus.

FRANK C. JORDAN, for the Allegheny Observatory, to cover expenses in connection with the work on the measurement of plates and computations for the determination of stellar parallaxes.

C. E. MENDENHALL and G. BREIT, University of Wisconsin, in support of the experiments on nuclear disintegration and scattering with protons and deutons accelerated by about 300 K. V.

ALEXANDER PETRUNKEVITCH, Yale University, to enable him to continue his work on the physiology of digestion and digestive enzymes in spiders.

CHARLES E. ALLEN, University of Wisconsin, for the determination of the chromosome complements of heteroploid clones of sphaerocarpos.

HENRY A. PILSBRY, Academy of Natural Sciences, Philadelphia, to enable him to collect and make field studies of mollusks of Sonora and Sinaloa, Northwestern Mexico, with the object of determining the relation of the Sonoran fauna of our Southwest to the neotropical fauna of Mexico.

FRANCIS W. PENNELL, Academy of Natural Sciences, Philadelphia, to enable him to collect and make field studies of plants, especially of the family scrophulariacea, in Sonora and Sinaloa, Northwestern Mexico, considering the composition and distribution of the flora and its relation to that of the Southwestern United States and Southern Mexico.

EDGAR F. HOWARD, University Museum, University of Pennsylvania, to investigate the problem of man's antiquity in America, with particular reference to a study of possible routes of migrations from Asia.

FREDERICA DE LAGUNA, University Museum, University of Pennsylvania, to make an archeological investigation of the lower Yukon Valley from Koyukuk to Holy Cross.

CHARLES P. OLIVIER, Flower Observatory, University of Pennsylvania, for the study of meteor trains, including their heights, durations, drifts, spectra, constitution and other physical characteristics.

ALEXANDER BIDDLE, for the National Economy League, for (1) the state-wide gathering of facts on the 5,635 tax-levying units in Pennsylvania by the Pennsylvania Economic Council; (2) the study of Philadelphia government by the Philadelphia committee.

HARLAN T. STETSON, Harvard University, for investigation of cosmic terrestrial relations.

SPROUL OBSERVATORY, Swarthmore College, to determine the magnitude of stars utilizing the energy received from them in wave-lengths in the red and infra-red parts of the spectrum.

PERCY BUCHANAN, Naka Ku Nagoya, Japan, for the investigation of the early linguistic origins of Japanese.

CHARLES A. KOFOID, University of California, for a morphological and physiological investigation of the neuromotor system of the ciliate protozoa in all the major types of ciliates, with a view to defining the structure and function of such system.

REAR ADMIRAL JOHN D. NARES, for the International Hydrographic Bureau, Monte Carlo, for the preparation of base charts.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE PHOTOGRAPHIC RECORDING KYMOGRAPH[1]

WE wish to describe a photographic recording device which we have found so convenient and so satisfactory that we believe it may prove useful in other laboratories where kymographs are employed. Many tracings, ordinarily written on smoked drums, may advantageously be recorded with this apparatus, and the friction of lever points on paper and the laborious adjustment of these points to the writing surface may thereby be eliminated. Furthermore, this direct and practically undistorted recording of changes in the level of a liquid in a manometer provides an accurate

[1] Submitted for publication April 9, 1935.

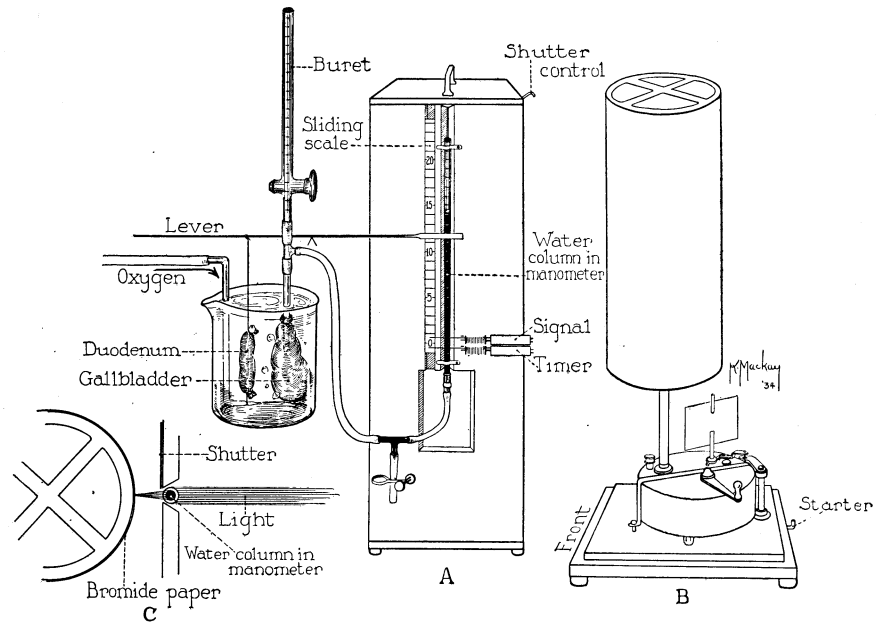

FIG. 1. The recording device in use. The significance of the initials is given in the text.

record of volume and pressure changes in any given system.

As early as 1883, E. A. Schäfer[2] utilized the photographic method to record changes in volume, whereas Baldes[3] and Corbeille, in 1929, utilized the method in recording plethysmograms.

Records were made on photographic bromide paper fastened to the drum of a "Harvard" kymograph (Fig. 1, B), which is enclosed in a light-tight box (Fig. 1, A). A vertical slit, 2 mm wide, opened or closed by means of a shutter, was made along the front elevation of this box and a water manometer was placed immediately in front of this slit. The source of light was an ordinary projection lamp, which was placed about 30 feet (9 m) from the recorder, so that the light rays were directed against the manometer. To secure optimal results it is essential that the effective light rays, the long axis of the manometer, the midline of the slit in the box and the axis of the revolving drum should be properly aligned (Fig. 1, C). The manometer, containing a liquid, functioned as a lens, so that light passing through the liquid was focused on the light-sensitive paper fixed to the revolving drum of the kymograph. It is apparent that changes in the level of the liquid were recorded on the paper by the marked contrast between the intensity of exposure above and below the level of the meniscus. Likewise, any movements of levers, time signals or markers may be recorded simultaneously with the changes in the level of the meniscus.

A manometer tube, of the type employed clinically for measuring spinal fluid pressures, was found convenient in our experiments. These tubes are of particular value for records of this sort, since they are accurately calibrated and the photograph of these lines on the record is of value in computing changes in the level of the meniscus. These tubes contain 0.02 cc of fluid per centimeter of length and thus permit the recording of changes in pressure without appreciable changes in the volume. A satisfactory type of contrast bromide paper, 70 feet (21.3 m) in length and either 6 or 12 inches (15.2 or 30.4 cm in width), is obtainable in rolls. A developer which gives the maximum of contrast must be used.

Reproductions of records made with the apparatus that has been described above accompany an article by Deissler and Higgins, entitled "The Extrahepatic Biliary Tract during Anaphylaxis"; this article has been accepted by *The American Journal of Physiology*.

KARL DEISSLER
GEORGE M. HIGGINS
CHARLES SHEARD

THE MAYO CLINIC AND
THE MAYO FOUNDATION,
ROCHESTER, MINNESOTA

A MICRO-METHOD FOR DETERMINING THE UTILIZATION OF CARBOHYDRATES AND POLYHYDRIC ALCOHOLS BY MICROORGANISMS

IT is sometimes desirable to know whether a single colony of bacteria, without further sub-culture, is composed of organisms capable of utilizing one or more particular carbohydrates. This can be easily and quickly accomplished by the following micro-technique.

[2] E. A. Schäfer, *Jour. Physiol.*, 5: 127–129, 1883–1884.
[3] E. J. Baldes and Catherine Corbeille, *Proc. Soc. Exper. Biol. and Med.*, 26: 711–715, May, 1929.