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ABSTRACTS

The Dynamics of the Population of the United States. ALBERT A. BARTLETT, Department of Physics, University of Colorado, Boulder, Colorado 80309 and RICHARD L. CONKLIN, Hanover College, Hanover, Indiana 47243.——The simple concepts of kinematics and dynamics can be used to calculate values of interesting demographic parameters. Date from standard statistical sources allow one to estimate that the average speed of Americans is 0.7 m/s. Each decade the U.S. Census Bureau publishes the coordinates of the Center of Population of the U.S. Identifying this with the center of mass (CM) one can use these coordinates to determine the average displacement and hence the average velocity of the CM in the decade. From the differences in velocities of consecutive decades one can calculate the average accelerations of the CM. Vector diagrams representing the velocity and acceleration are historically interesting, and when the various values are used to calculate the kinetic energy, momentum, and accelerating force the results are quite surprising.

On the Measurement of Thermal Diffusivities with Bryngdahl Interferometry. MARSHALL P. CADY, JR., Department of Natural Sciences, Indiana University Southeast, New Albany, Indiana 47150.——Bryngdahl shearing interferometry is a relatively inexpensive but highly accurate method for the measurement of both temperature derivatives of the refractive index and thermal diffusion coefficients of liquid mixtures. This paper reports the results of a numerical analysis into the question: Can Bryngdahl interferometry be used to simultaneously measure thermal diffusivities? The thermal diffusivity is important because it is proportional to the thermal conductivity and it is the coefficient that determines the rate at which temperature changes after boundary temperature conditions are altered.

The numerical analysis uses a model sandwich-cell experiment in which upper and lower boundary temperatures change exponentially with a 5 minute relaxation time and a final steady state gradient equal to 0.7°C/cm is established. To generate data, it is assumed that the true liquid thermal diffusivity equals 0.05214 cm^2/min and that the interferometer shear parameter(2D) divided by the image height(H) equals 0.2648. The Crank-Nicholson finite difference method is then used to solve the Fourier temperature equation on a spatial grid of 30 points/cm every 0.1 minutes subject to the boundary conditions(BC). The interferometer fringe count as a function of time is calculated from the resulting temperature data. It represents the experimental fringe data—a quantity that is highly accurate.

To simulate an experimental effort to determine the thermal diffusivity, random

Gaussian noise is then placed into the BC and the thermal diffusivity in the Fourier temperature equation is systematically adjusted until the experimental fringe data is most nearly reproduced in a least squares sense. This computation is repeated 15 times with the same noise band whereupon the average thermal diffusivity and its standard deviation are computed. The noise band width represents experimental uncertainty in BC knowledge; the standard deviation of the thermal diffusivity represents its subsequent uncertainty.

It is found that thermal diffusivities can be simultaneously measured to within 4% if BC are measured to within 0.006°C and to within 2% if BC are measured to within 0.003°C. This requires a highly automated data acquisition system capable of sampling rates greater than 50 per relaxation experiment.

The Physics of the Grist-mill. VINCENT A. DINOTO, JR., Department of Physics, Indiana University Southeast, New Albany, Indiana 47150.——Taking a step back in time to the time of the founding of the Indiana Academy of Science 100 years ago, we will observe some of the applied physics of this day and time. One of the major needs of the people was the grinding of corn. First animals were used for this purpose and then later water power. The mills were very inefficient and required a fairly large supply of water which must have either a large vertical drop or a swift current or both. Probably more than 500 mills were built in the 1800s in Indiana with few still remaining and even fewer still operational.

The National Optical Astronomy Observatories. FRANK K. EDMONDSON, Department of Astronomy, Indiana University, Bloomington, Indiana 47405.——The newly established National Optical Astronomy Observatories combines three observatories funded by the National Science Foundation and operated under contract by the Association of Universities for Research in Astronomy, Inc. (AURA). They are: The Kitt Peak National Observatory (KPNO), the National Solar Observatory (NSO) and the Cerro Tololo Inter-American Observatory (CTIO). AURA also operates the Space Telescope Science Institute (STScI) under contract with the National Aeronautics & Space Administration.

Indiana University was one of the seven founding members of AURA. The paper will review the history of AURA and the three observatories. The rationale of the new organization will be discussed.

The Manchester Interface Adapter for Commodore and Apple Microcomputers. L. DWIGHT FARRINGER, Department of Physics, Manchester College, North Manchester, Indiana 46962.——An inexpensive interface adapter has been designed for use with the "game" control ports of microcomputers such as the Apple II, II+, and IIe and the Commodore 64 and VIC-20. It provides a convenient and safe way to utilize the digital inputs, digital outputs, and resistive analog inputs which are accessible at those control ports.

The digital inputs are buffered by Schmitt triggers which "clean up" certain kinds of noisy signals and also protect the computer from damage by possible wrong connections to the outside world. The digital outputs are buffered by transistors which can drive external loads to about 50 mA. and 4 volts, and relays can be added for controlling external loads which require external power sources. The analog inputs are provided with switchable capacitors for adjusting the full-scale range of resistance which the computer can read.

Use of this interface adapter with accessories such as optical sensors, thermistors, and various kinds of sensing switches makes possible quite a variety of experiments using the microcomputer as a laboratory instrument.

The low cost, ease of assembly, versatility, and protection of the computer which are afforded by such an interface adapter are features which recommend its use in many high school and college teaching laboratories.

Software for Astronomical Photometry. Jodi Hamilton and Thomas H. Robertson, Department of Physics and Astronomy, Ball State University, Muncie, Indiana 47306.——Computer programs have been developed to support and facilitate observing projects and data reduction for astronomical photometry. These programs are designed for observational support, data acquisition and data analysis. A primary objective for the development of this software was to make the execution of observing programs in observational astronomy more tractable for students with very limited experience. Some system limitations and plans for future program development are discussed.

Licensing and Certification of Physics Teachers by Examination: What are the Dangers? Lawrence E. Poorman, Department of Physics, Indiana State University, Terre Haute, Indiana 47809.——The Indiana General Assembly enacted legislation last spring (1984) mandating competency testing of all prospective teachers for licensing and certification starting July 1985. The State Licensing and Certification Commission, now defunct, recommended the use of national teacher examinations available through Educational Testing Service.

In August, 1984, panels were called to convene at North Central High School, Indianapolis, to validate and determine *minimum* competency levels for certification purposes. This author served on the panel to evaluate chemistry, physics and general science examinations.

There are many concerns. As members of faculties preparing persons for teaching; all should be very concerned with the procedural selection and administration of any certification examination.

A System for Astronomical Photometry. Thomas H. Robertson and Jodi Hamilton, Department of Physics and Astronomy, Ball State University, Muncie, Indiana 47306.——A photometric system has been developed to serve both instructional and research programs. The system consists of a Pacific Precision Instruments model 2426-1 photometer with a model 401 telescope coupler, an Altair computer and a twelve-inch Tinsley cassegrain reflector. The system is capable of both DC and pulse counting modes of operation. Limiting magnitudes observable are currently determined by night sky brightness and the mechanical and electrical imperfections of the telesccope drive system. Preliminary site condition tests and future plans for system upgrading are discussed.

The Great Southern U.S. Geologic Uplift Observed in the Early Months of 1984. Gerald J. Shea, Terre Haute, Indiana 47801.——A land mass bubble of enormous proportions was detected and observed using horizontal pendulum instruments of high sensitivity from January to May of 1984. Its boundaries were estimated as covering an area which included eleven states. The maximum rise appeared to be near Nashville, Tennessee and was computed as being 5 inches. The observations were carried on using instruments located at three different locations along the edge of the bubble.

The significance of the observation is a possible earthquake being due in the affected area which includes the New Madrid Fault zone and the Wabash Valley Fault zone which have been responsible for large earth displacements in the past.

The significance also may be meterological in origin being due to the intense dry hot summer of 1983 which may have disturbed the underlying geologic formations resulting the uplift.

One thing known for sure is no such observations of tilt have been detected previously over the 35 years that the Terre Haute Seismological Station has been in operation.

Astrophotography Using Celestron Telescopes. F.R. STELDT, Department of Physics, Indiana University at Kokomo, Kokomo, Indiana 46902.——A series of slides have been taken of various heavenly bodies using Celestron telescopes. These telescopes included the C-90, C-8, and C-14 models and all utilized portable tripod mounts. Kodak ASA 400 high speed Ecktachrome slide film was used for the majority of the photographs and the film was processed by a local firm using the standard procedure.

Exposure times ranged from 1/500 of a second to ten seconds for the major solar system objects. Constellation and deep space subjects required time exposures from one minute up to twenty minutes. The time exposures required constant manually adjusted guiding to correct the errors in the clock drive in order to keep the subject at the same position on the film.

The 35mm single lens reflex camera was positioned at the prime focus of the telescope for the deep space objects and low magnification photographs of the moon and the sun. The high magnification photographs of the moon and the planets were taken through one of the oculars attached to the telescope. Constellation photographs used the telescope as a guide for the camera riding piggy-back.

Using Toys to Teach Physics to Middle School Students. NANCY WATSON, Burris Laboratory School and JAMES WATSON, JR., Department of Physics and Astronomy, Ball State University, Muncie, Indiana 47306.——Physics of toys explores the science concepts that are used in various toys. Toys can be used to demonstrate scientific concepts at all levels, kindergarten through college. Hot wheels, cereal box toys, and other common toys are examined as examples of scientific concepts. Several areas of physics are explored including mechanics, heat, optics, sound, and energy. The student will learn science by "playing." The principles on which toys work are also the principles that most objects that are used daily also work. A correlation between toys and everyday objects will be emphasized. Students will learn observation and deduction skills as they "play with the toys." Once the basic physics concept is discovered, the student will use the toy to take data in an experimental setting. This data will then be used to confirm the laws of physics.