tronic configuration are involved will not be evident in the magnetic measurements, but the method will show all those involving electronic shifts of any kind. The Faraday Effect is useful, then, in differentiating between the two types of phenomena involved.

This paper gives in detail the construction of an apparatus for the study of the Faraday Effect, attaining as high a precision as possible by taking advantage of modern equipment, surpassing any others in existence today. With this high precision, fundamental studies of the structure of matter are possible. Briefly, the apparatus consists of a large solenoid magnet situated around the sample to be investigated and producing the rotation of the plane polarized light as determined by the polarimetric system. The dispersion of light is produced by a monochromator placed in the light path. The current actuating the magnet is measured and recorded on a Speedomax recorder by means of a calibrated shunt-potential system. An indication is also made on this current record of either a visual or photoelectric determination of the balance point of the light intensity on the two halves of the field of a polarimeter. Thus when a balance of light intensities is reached for a specified value of the rotation angle, a record of rotation versus current (or magnetic field strength) is obtained at exactly the same moment and the process may be repeated for any number of predetermined times to produce the deviation measure we have set for this work.

The Faraday Effect has already proved its usefulness in showing up compound formation in solution and in the qualitative and quantitative identification of substances in solution. C.E.W.

A Precision Faraday Effect Apparatus. By S. Steingiser, G. Rosenblit, R. Custer, and C. E. Waring., *Rev. Sci. Inst., 21: 109, February, 1950.*

Pressure Balance

In physical and chemical work it is often necessary to use moderately high (10 to 100 atm.) pressures that are reproducible and are accurately known. Conventional techniques for pressure measurement—such as mercury manometers and Bourdon gauges—suffer from the fact that they are either unwieldy or difficult to use accurately. However, a simple piston in cylinder pressure balance, where the pressure is determined by the weight of the piston and its area, is a very simple and absolute method for pressure determination. It offers the additional advantage that the rise and fall of the piston compensates for changes in volume of the system, and thus enables reactions to be studied at constant pressure.

Pressure balances are used to very great accuracies and at very high pressures at a number of laboratories—by Michels at Amsterdam, for instance—and a great deal of skill and experience is necessary to design and use a pressure balance of this type. However, a relatively crude instrument was designed and used in some experiments on the melting curve of helium, and it proved very satisfactory, both as a device for melting pressure measurements and for measurements of the change in volume of the helium on solidification.

With a few modifications, there is no reason why this same simple type of instrument could not be used as a laboratory standard for pressures from 10 to 100 atm., and to accuracies of the order of 0.05 percent. The limit of the accuracy, of course, is mainly determined by the amount of work and time spent on constructing and using the instrument, but this figure seems quite easily attainable. C.A.S.

A Simple Pressure Balance. By C. A. Swenson. *Rev. Sci. Inst., 21:22, January, 1950.*

Integrating Counters

A good crystal counter material must possess a low density of traps and must form large single crystals. The low trap density is necessary so that electrons set free in the crystal can travel far enough before being trapped to induce detectable pulses in the external circuit. The alkali halides have not been effective as counters since the high temperatures at which the crystals are grown make for the formation of a large number of lattice vacancy traps. A crystal with vacancies is uncolored but it takes on color when electrons are released from atoms in the crystal and trapped at negative ion vacancies, forming F-centers. This fact suggests the use of the alkali-halides as integrating counters, the color intensity indicating the total amount of radiation to which the crystal has been exposed.

This paper studies the properties of lithium fluoride, potassium bromide, and sodium chloride as integrating counters for x-rays and cathode rays of energies up to 3 Mev. For heavy exposures (more that 10^4 roentgens) the coloration is determined by illuminating the crystal with white light and measuring the absorption by the F-centers. The results are calibration curves giving F-center concentration as a function of exposure for the different crystals.

The main advantages of this type of counter are the small size, semipermanent storage of data, and the very high dosages which can be measured (larger than 10^7 roentgens). The chief drawback is that 5 to 100 minutes are required to prepare a crystal if it is to be used repeatedly. For high exposures some special preparation is necessary to ensure reproducibility of results. E.P. GROSS

Integrating Crystal Detectors for High Energy Photons and Particles. By R. S. Alger. *J. App. Phys. 21:30, January, 1950.*

Light Intensity

In geometrical optics, light is said to travel along rays, but nothing is said about its intensity. Suppose that along any tube of rays the intensity (which is equal to the energy flux density times the cross sectional area) is constant. Then the ratio of energy flux densities at two points along a tube is the reciprocal of the ratio of the corresponding tube areas. These areas can be determined since the rays forming the tube are given by geometrical optics. Thus the ratio of light intensities can also be determined, since light intensity is proportional to energy flux density. In this article the area ratios are calculated

for tubes which are reflected or refracted at an arbitrarily curved surface separating two homogeneous media. The incident tube is assumed to be conical, corresponding to light from a point source.

While the main result is the distribution of intensity of the reflected and transmitted light, various interesting auxiliary results are also obtained. Thus it is found that at two points along each tube the tube area becomes zero and thus the light intensity is infinite. The locus of such points is called a caustic surface. When two caustics touch, a point image is formed. It is found that only for special kinds of points on the reflecting surface, and for special directions of incidence, can point images occur, e.g., in reflection from an elliptic point on a surface for a particular direction of the incident ray. The focal length and general lens-mirror formula is obtained to determine the position of such point images.

The supposition concerning energy flux along a tube of rays on which the calculation is based is actually valid. A previous precise derivation of geometrical optics from electromagnetic theory (and of geometrical acoustics from fluid dynamics) yields this result, along with the other "laws" of geometrical optics. The derivations do not hold at caustic surfaces.   H.B.K.

Determination of Reflected and Transmitted Fields by Geometrical Optics. By Joseph B. Keller and Herbert B. Keller. *J. Opt. Soc. 40:48, January, 1950.*

High Speed Oscillography

Users of electronic equipment in the field of nuclear physics have been pushing continually toward greater speed. The need for equipment which can respond very quickly and recover quickly is especially great where studies are being made which involve a sequence of changes in nuclear state or the simultaneous emission of two particles.

A synchroscope has been developed for use on the study of components and the testing of circuits for operation at speeds which represent the present frontier in this drive toward greater time resolution. It is not a new kind of device but is considerably faster than similar equipment generally available. It consists of a signal amplifier and a triggered sweep generator used with a commercially available high voltage cathode ray tube and power supply. A relatively new principle called distributed amplification is used in the signal amplifier because conventional cascade amplifiers are too slow in their response. A gain of about 1000 is obtained with a rise time of about 6.5×10^{-9} seconds. The electron beam can be deflected vertically 2 cm in either direction. It can be deflected horizontally across the tube in as little as 0.3 microsecond by the sweep generator.

Stimulus for the development of this instrument lay in studies of Geiger discharges and of the characteristics of various scintillation phosphors. It permits the photography of single pulses from a Geiger or photomultiplier tube, when used with a moving film camera to separate the traces.   G.G.K.

A High Speed Synchroscope. By G. G. Kelley. *Rev. Sci. Inst. 21:71, January, 1950.*

Mathematical Biophysics

A modification of the two-factor theory of nerve excitation is introduced in the September, 1949 issue of the Bulletin of Mathematical Biophysics. As developed by Rashevsky and Hill, the two-factor theory predicts a quantitative relation between threshold value of the exciting voltage and the frequency of an alternating current. Experimental values agree very well with the predicted curve for low frequencies (up to 500 cycles per second). For high frequencies there is a marked and consistent deviation. By introducing a rectification phenomenon and by modifying the concept of accommodation, C. S. Patlak and H. D. Landahl extend the agreement between theory and experiment to a wider range.

In her second paper on the linkage theory of autopolyploids, Hilda Geiringer utilizes the segregation distribution for autopolyploids introduced in the first paper to establish a recurrence formula for the computation of gamete distributions for any generation, the initial distribution being known.

Random neural nets are discussed in a paper by A. Shimbel, who computes distortions in the output of a ganglion in relation to the input (considered as a function of time) due to randomization of synaptic delays. A steady state input-output function is derived for the case of a ganglion with "association connnections," i.e., where the neurons in addition to being stimulated from the outside also stimulate each other.

In a paper by J. B. Best a mechanism is offered to explain the polar transport of auxin-like substances in plants. The model consists of a geometrically constrained enzyme system capable of driving a substance, which acts as a co-enzyme, to one of the enzymes of the system against a concentration gradient.

Mathematical sociology is represented by two papers, both based on the probabilistic approach. N. Rashevsky starts with an aggregate of individuals, each of whom may exhibit one of two mutually exclusive forms of behavior. The determining factor is actually a probability which is a function of a certain quantity which has a distribution function in the aggregate. Moreover there is interaction in the aggregate in that the particular behavior of each individual increases the probability of similar behavior in others. The equations describing the behavior of the aggregate turn out to be generalizations of analogous equations previously derived on the basis of more elementary assumptions.

A. Rapoport derives the distributions of various kinds of social structures based on "peck right," such as is observed in chickens, assuming complete randomness of events determining the peck right between each pair of individuals.

An approach to the mathematical biophysics of mitosis is suggested in another paper by N. Rashevsky based on the assumption of coiling and uncoiling of long chain molecules.   A. RAPOPORT

The Bulletin of Mathematical Biophysics. Vol. 11, No. 3, September, 1949.