reconstructed so that the culture could be aerated vigorously with preconditioned carbon-dioxide free gas, which was conveyed through alkali towers where the carbon dioxide evolved was adsorbed and measured. Twelve hundred cc of a 24-hour culture of *Azotobacter chroococcum* in a nitrogen free medium was transferred aseptically to the previously sterilized calorimeter. Aeration and mechanical stirring was at once started and the heat and carbon dioxide measurements made.

In every case where equilibrium with respect to the gas phases was maintained the same results, as shown in the figure, were obtained. The rate of respiration remained constant at 78 per cent. oxygen for 4½ hours. The oxygen concentration was between 60 and 90 per cent. oxygen for 6½ hours as shown by eight carbon dioxide determinations. It is interesting to note from the nitrogen fixation standpoint that the oxygen-nitrogen ratio (78 per cent. oxygen), that gave the maximum rate of respiration, is the same as it is in the nitrate ion.

The data just reported are not in accord with those published by Meyerhof and Burk.[2] They measured the rate of respiration of a culture of *Azotobacter* over the entire range of oxygen concentration by the Warburg[3] method. They found the rate of respiration to increase with increasing oxygen tension up to 15 to 20 per cent. oxygen, above which the rate of respiration rapidly decreased until it was from one third to one half that of air at 100 per cent. oxygen. In their experiments the ratio of the gas confined above the culture to volume of culture was about 6 to 1 and the total volume of the apparatus was 12 cc. The gas did not bubble through the medium. The author found it difficult to effectively remove the carbon dioxide at the higher oxygen concentrations when the carbon dioxide free gas bubbled continuously through the mechanically stirred culture at the rate of 20 to 22 liters per hour. This was found to be true even when the ratio of carbon dioxide free gas to the volume of culture was 15 to 1. In some experiments, it was necessary to increase the ratio to 18 to 1.

It is quite possible that the method used by Meyerhof and Burk to remove the carbon dioxide from the culture and to supply oxygen adequately is extremely inefficient and totally unreliable, especially at the higher oxygen concentrations.

J. M. FIFE,
National Research Fellow in the Biological Sciences
DIVISION OF PLANT NUTRITION
AND DEPARTMENT OF CHEMISTRY,
UNIVERSITY OF CALIFORNIA

THE NATIONAL ACADEMY OF SCIENCES. II

Examples of the uncertainty principle: C. G. DARWIN (by invitation). This principle asserts that a simultaneous measurement of the position and momentum of a body can only be carried to a certain degree of accuracy. In the present work an electron is supposed to be at rest, and its position is to be measured by the electric force it exerts on an electrometer. It is shown that the electrometer will exert a reactive force so as to set the electron in motion to just the degree required by the principle. Further examples deal with magnetic forces and with the impossibility of measuring the magnetic moment of the free electron.

The distribution of stresses in welded and riveted connections: WILLIAM HOVGAARD. This paper describes a new method for determining the stresses in a line of weld or rivets and the adjoining structures when the connection is subject to shearing in its own direction. Consider first the elementary case of a bar or narrow plate attached to a plate of greater length and width. We refer to the minor structure as the "bar" and to the major structure as the "plate." Suppose that the plate is subject to elongation due to a simple uniform pull at its ends, then the bar is forced to follow due to shearing in the weld or rivets which connect it to the plate; but it is clear that the bar will resist elongation and that there will be a certain elastic creeping of the bar relative to the plate. Thus every section of the bar will suffer a displacement relative to the corresponding section of the plate, but by symmetry this displacement is zero at the middle, and it is obvious that it will increase to a maximum at the ends of the bar. The assumption is made that the displacement at any transverse section is equal to the shearing stress at that section multiplied by a constant, which we call the "displacement coefficient." The theoretical solution of the problem is obtained by variation of the integral expressing the internal elastic work and furnishes a very simple expression for the shearing stresses in the connection, as well as for the average tensile stresses in the bar and in the plate. The proposed method finds application to several important cases in naval architecture and civil engineering. *Deckhouses* fitted on the strength deck of a ship near the half length where great bending stresses are apt to occur will be in a position similar to that of a bar connected to a strained plate. No shearing stresses will exist at the middle of the deckhouse in its connection to the deck, but excessive shearing stresses are liable to be found at the corners of the deckhouse, and have in fact occurred in many cases. The usual remedy of cutting the deckhouse in two or more sections connected by

[2] *Zeitschr. f. physikalische Chemie,* Abt. A, 139; *Bd. Zeit.,* 117–142, 1928.

[3] "Stoffwechsel der Tumoren," Julius Springer, 1926.

"expansion joints" is liable to aggravate the difficulties by multiplying the points of discontinuity. The remedy is an increase of rivet area and strengthening of the structure at the corners of the deckhouse. *Large hatch openings* in strength decks produce discontinuities which in their effects are quite similar to those produced by deckhouses. It was this action which caused tearing of the deck in the *SS. Majestic* and *SS. Leviathan*. In certain *oil tankers* short intercostal longitudinal girders are fitted to the bottom plating between the transverse bulkheads, to which they are not connected. In each of these girders great shearing stresses are apt to occur at the ends, and may cause leaky rivets. *The cover plates on the chords of bridge girders* are in the same position as the typical bar described above, being riveted to a major strained structure.

The equidimensional convention for electro-magnetic units: A. E. KENNELLY. It was shown by Maxwell fifty years ago that every physical quantity had dimensions, *i.e.*, exponents of length, mass and time. Thus a velocity, being a length divided by a time, has dimensions $L^1\ T^{-1}$, or including mass $L^1\ M^0\ T^{-1}$. He showed also that every electromagnetic quantity had two dimensional formulas —one in the electric system and the other in the magnetic system of units. Thus electric resistance had dimensions of velocity $(1, 0, -1)$ in the magnetic system and the dimensions of inverse velocity or slowness $(-1, 0, 1)$ in the electric system. In 1889, Ruecker showed that electric permittivity κ and magnetic permeability μ necessarily entered into the dimensions of electric and magnetic units along with L, M and T in Maxwell's list. The dimensions of κ and μ are not definitely known, except that their product $\kappa\mu$ is $1/v^2$, the square of the slowness of light. Ruecker added to Maxwell's list of three dimensions in L, M, T, a fourth, using κ in the electric and μ in the magnetic list. On the convention that κ and μ have like dimensions, each that of a slowness, a remarkable simplification takes place in the lists of electromagnetic dimensions. The κ and μ elements disappear, and the electric list coincides with the magnetic list. In other words, there remains one and only one list of electromagnetic dimensions, in terms of L, M and T only. Moreover, the exponents of L, M and T in the resulting list are in each case the arithmetical means of the two series of exponents in Maxwell's electric and magnetic lists. This single equidimensional series is thus also a mean series, which becomes so much condensed and simplified that it is easily memorized.

Relations between nuclear spin, hyperfine structure and isotopes: R. C. GIBBS and P. G. KRUGER (introduced by Edw. L. Nichols). Out of about twenty-six elements with odd atomic numbers whose spectral lines have been examined for structure the lines of twenty-four of them have been reported to have hyperfine structure. Out of about twenty elements having even atomic numbers absence of structure in the lines of ten of them has been reported. Most of the remaining ten elements whose lines exhibit hyperfine structure consist largely of even isotopes, being practically 100 per cent. so in several cases. Two theories, the second a modification of the first, have been advanced to account for the observed results. First, a spin moment of $1/2 \cdot h/2\pi$ is assigned to each proton and electron in the nucleus. These when compounded vectorially give a resultant moment of $i \cdot h/2\pi$ where i is called the nuclear spin quantum number and may assume values of 0, 1/2, 1, 3/2, 2 . . . , the odd half values resulting when the sum of protons and electrons in the nucleus is odd and the even half values, including zero, when that sum is even. When i is quantized with J, the resultant quantum number of the extra-nuclear electrons, an energy level corresponding to a given value of J is replaced by two or more very close levels thus giving rise to hyperfine structure in the radiated lines. When i is zero no structure should be found. So far no structure has been found in the lines of Ag, yet the sum of protons and electrons in the nucleus of Ag atoms is odd. Except for the doubling of certain F levels observed in one multiplet, though not found in another multiplet involving the same levels, the same is true of Al. Possible values of 1 and 2 have been reported for i in the case of Sb. This theory would predict only odd half values. A study of nitrogen band spectra indicates that i should be 1, yet the nucleus of N contains fourteen protons and seven electrons, giving a sum that is odd. So far no definite evidence has been reported as to the value of i determined from the hyperfine structure of N lines. These exceptions, particularly the last one, led to the suggestion that only the number of protons in the nucleus is effective in determining the value of i. With this suggestion, the available data, though rather meager and inconclusive, are in conflict, especially those for Tl and Pb. If we accept this modification, then we should expect to find even half values for i for such elements as Ne, Te, Xe, Ba, Hg, Pb, and Tl. All these elements are known to have lines with hyperfine structure, many of the components being comparatively strong. Some of these elements have only even isotopes and in no case is the percentage of odd isotopes large. A study of the hyperfine structure of lines from these elements has been undertaken with the hope of obtaining critical data with which to test the theory. Such information will help to solve the problem of nuclear structure.

Electric conductivity and optical absorption in metals: EDWIN H. HALL. (1) The resistance term in Drude's fundamental equation of motion of an electron within a metal is highly artificial, for light-wave fields, and any conclusions to which it leads are affected by some measure of doubt. (2) The form which this equation takes when it is applied to a conduction electron is quite as appropriate for an electron that passes directly from an atom to an adjacent ion as it is to a "free" electron. (3) The conduction electrons which Meier (in 1909) found to be about as numerous as the atoms may reasonably be taken to be the "associated" electrons, the electrons that may execute "transits" from an atom to an adjacent ion. (4) The formula $\kappa \frac{\sin^2 n\,T}{n^2\,T^2}$, given by Thomson on page 84 of his "Corpuscular Theory of

Matter,'' when applied to ''transit'' conductivity gives the same results as those obtained in a different way by the author, indicating that when the ratio *wave-period to transit period* drops from 10 to 1, the absorptive power of the transit electrons drops from 97 per cent. of its maximum value to zero. (5) Meier's results, obtained with wave-lengths ranging from 250 $\mu\mu$ to 670 $\mu\mu$, seem to indicate that for wave-lengths of 4 μ or greater the transit electrons should have almost their full, steady-current, conductive power and a corresponding absorptive power. (6) Hagen and Rubens, using wave-lengths 4 μ, 8 μ and 12 μ, got for metals and alloys in general results which seem to indicate that the absorption-conductivity is somewhat less than the steady-current conductivity at all three wave-lengths, the difference being about 12 per cent. at 4 μ, about 1.6 per cent. at 8 μ and about 9 per cent. at 12 μ, with no clear evidence that it would disappear at greater wave-lengths. In the case of bismuth the difference is exceptionally large. (7) This difference, which is hardly to be accounted for by the ordinary theory of the relation between conduction and absorption, may be due to some imperfection of the experimental method used by H. and R. On the other hand, it is worth noting that the dual theory of conduction requires a difference of the kind and of the order of magnitude here observed. For this theory makes the paths of the few free electrons last so long that the rapidly alternating fields of even the longest light-waves would have no net effect upon them. Therefore, it confines the conduction-absorption power of metals to the action of the ''associated,'' or ''transit,'' electrons, and for metals in general the conductivity due to these electrons is about 8 or 10 per cent. less than the total conductivity. For bismuth K_a is exceptionally small, about 67 per cent. of the total K.

An incandescent filament giving a discontinuous spectrum and a study of the emission and absorption of neodymium: R. W. WOOD. The theory of radiation predicts that a substance raised to a high temperature by a flame or electric current will emit no light if perfectly transparent, the emitting power being in proportion to the ability of the substance to absorb light. If the absorption is selective for color, as in colored glass, for example, it should radiate strongly only those colors which it is capable of absorbing. No very striking examples illustrating this phenomenon have been found, however, due chiefly to the circumstance that a very small trace of absorption is all that is necessary to make the body a good radiator, colored glasses giving a practically continuous spectrum when heated to incandescence. A remarkably fine example illustrating the law most strikingly has been found, however, by dissolving oxide of neodymium in fused quartz, in the flame of an oxy-hydrogen blow-pipe. The fused mass is drawn out into thin rods, and these, when raised to incandescence in the flame of a bunsen burner and viewed through a prism, exhibit a spectrum consisting of blue, green, orange and red bands separated by perfectly dark regions. A rod of pure fused quartz, being almost perfectly transparent, is practically non-luminous in the flame, the introduction of the oxide producing absorption in the green, orange and red regions with corresponding powerful emission of these colors. More bands have been discovered by photographing the spectrum of the filament with plates sensitive to the infra-red region, there being nine bands in all, counting the four in the visible spectrum. A somewhat complete study was made of the absorption spectra of neodymium salts at liquid air temperature and in solution in anhydrous liquid ammonia, in which the absorption split up into narrow components.

Stereoscopic three-dimensional models by multiple photography with especial reference to the orbital motion of the electron in the Stark effect: R. W. WOOD. A method was described by which complicated stereoscopic models could be built by multiple exposures with a stereoscopic camera focussed on a wire frame painted white and strongly illuminated in front of a black background. This wire frame is moved slightly in appropriate manner, between each exposure, its images building up a three-dimensional model resembling a complicated wire cage when the finished picture is viewed in a stereoscope. The method has proved very useful for illustrating certain mathematical and physical problems which can not be shown by simple diagrams. The shape of the wire frame can be altered as it is moved or rotated between exposures, or small objects (electrons for example!) moved into successive positions along the wires of the frame, giving a picture of their complicated orbital motions in certain spectroscopic phenomena.

The spectral erythemic reaction of the human skin to ultra-violet radiation: W. W. COBLENTZ, R. STAIR and J. M. HOGUE. The spectral erythemic response curve of the untanned human skin and the energy required to produce a mild erythema are of importance in connection with the question of the unit of dosage and methods of standardizing the dosage of ultra-violet radiation used for healing purposes. The present paper gives new data on the spectral response of a small group of subjects differing widely in erythematic susceptibility. The experimental procedure consisted in irradiating the inner forearm with a monochromatic spectral line and, from a succession of exposures, selecting the one that produced a minimum perceptible erythema. The spectral erythemic response curve obtained by this method is in agreement with observations obtained by other methods. The energy required to produce a minimum perceptible erythema upon 1 sq. cm. of untanned human skin, using monochromatic radiation of wave length 297 mμ (the wave length of maximum erythematic susceptibility), is of the order of 500,000 ergs.

The temperature of the atmosphere of the earth: E. O. HULBURT (introduced by Joseph S. Ames). If the amounts of the various gases of the atmosphere of the earth were known at all levels from sea level upward, if the absorption coefficients of the gases were known throughout the optical spectrum and if the sun were assumed to be the only source of energy, it should be

possible to calculate for all heights the temperature of the atmosphere in radiative equilibrium. This problem has never been worked out completely. Maris (Terr. Mag. and Atmos. Elect. 33, 233, 1928; 34, 45, 1929) recently obtained an approximate solution and derived a number of important conclusions from calculations of the rates of energy absorption and radiation in various levels of the atmosphere. In the present paper an attempt at a fairly rigorous solution is presented, although it contains a number of approximations. By considering the stream of radiation sent upward from the earth, which is heated by the sun, and from the atmosphere and the stream of radiation sent downward by the atmosphere an equation is derived for the temperature of radiative equilibrium. From this equation the temperature of the atmosphere from sea level upward is calculated and is found to agree fairly well with the observed sea level value, 14° Centigrade, averaged over the earth. The agreement may be regarded as a proof that the sea level temperature is approximately that of radiative equilibrium. From 5 to 20 km above sea level the equation yields temperatures which are below those observed. This is as it should be, for calculation shows that in these levels the temperature is not that of radiative equilibrium, but is mainly that of convective equilibrium caused by wind mixing. In higher levels, above 30 km, radiation is probably the controlling factor, as Maris has already shown in detail. If the total amount of carbon dioxide in the atmosphere were doubled or halved, the calculated sea level temperature is increased or decreased, respectively, by about 6°. Such a change in the average world-wide temperature, augmented by the consequent changes in the water vapor content of the atmosphere and the infra-red emissivity of the surface of the earth, is about the same as that which occurs when the earth passes from an ice age to a warm age. Therefore our conclusion is in support of the carbon dioxide theory of the ice ages originally suggested by Tyndall (*Phil. Mag.* 22, 277, 1861). We do not agree with the arguments advanced against the carbon dioxide theory of the ice ages by Angström, Abbot, Humphreys and others. It is hardly necessary to mention that we have not proved that carbon dioxide changes actually caused the ice ages; we have merely shown that, as far as we know now, carbon dioxide changes would have been adequate to cause such ripples in the thermal life of the earth.

Deformation of the Pensacola shore line: FRANK LEVERETT. In a paper presented at the annual meeting in 1930 the part of the Pensacola shore line near Tampa, Florida, was described by the writer and the view expressed that it is sufficiently well preserved to warrant setting its age as not greater than that of the Algonquin beach of the upper Great Lakes, or some 20,000 years or less. This determination was of value in showing the relatively recent date of extinction of certain Pleistocene vertebrates, such as the mastodon and camel and the giant sloths whose remains have been found in close association with those of man in stream channels on the plain below the Pensacola shore line. During the past six months the writer has studied this shore line in the states bordering the Gulf from Florida westward to Louisiana and has found that it decreases in altitude from east to west, being about 40 to 45 feet above present sea-level on the Atlantic coast of Florida, 33 feet on the west coast near Tampa Bay, 25 feet at Pensacola, 22 feet on Mobile Bay, and less than 20 feet on the north side of Lake Pontchartrain. Inasmuch as it becomes lower toward the Mississippi delta, the question naturally arises whether the weighting by delta deposits has been a leading cause of the decline in that direction. Or if not the cause of this wide-spread tilting, to what degree has it produced local effects? To clear up this matter, it seems necessary to study some neighboring shore lines, such as those of Cuba, which are outside the probable range of influence of the delta deposits, and determine whether they show a similar westward decline. If so, it would seem likely that the westward tilting of the shore line in these states is largely independent of the delta's influence.

Paleontology versus DeVriesianism and Genetics in the Factors of Evolution Problem: HENRY FAIRFIELD OSBORN. Forty years ago the American Museum instituted a new method of collecting fossil mammals in the rich Tertiaries of the West, namely, of very close observation of geologic levels and the closely succeeding transitions of form to form or ascending mutations in different phyla or lines of ascent, especially in certain lines of ascent, the horses, the Titanotheres and the Eocene primates. These closely connected stages mirror the evolution of the germ plasm and afford an entirely new and hitherto unknown and even undreamt of progressive and creative heredity. This progressive and creative heredity is set forth in the recent monograph on the Titanotheres as a result of hundreds of thousands of observations and is confirmed and greatly extended in the forthcoming monograph on the creative evolution of the Proboscideans. These well-established principles of progressive and creative heredity are not in accord either with Lamarckism or Darwinism or DeVriesianism or any form of vitalism or entelechy. They are even more directly opposed to the theoretic conclusions recently drawn by experimentalists in genetics as the most recent phase of the Darwinian doctrine of the survival of chance variations. In adaptations which are primarily chemical and depend on sudden alterations in chemical compounds, as in the origin of immunity and non-immunity, there is scope for sudden saltations from type to type. In adaptations which are primarily physical there is less likelihood of sudden mutation. In adaptations which are primarily mechanical sudden mutation is not only theoretically improbable but empirically without the least foundation. Consequently, the known factors of germinal evolution discoverable through paleontology alone are absolutely contrary to recent DeVriesian and genetic hypotheses.

Emotional differences connected with certain signs of race: G. M. STRATTON. In the more critical studies hitherto of the psychology of race, the chief objects of

interest have been the senses and the intellect. Tests of intelligence, for example, have for some years been finding an important application in this field. The present paper, in contrast, is concerned not with intelligence but with emotion—an aspect of our mental life which may in the end prove to be highly important in determining the relative effectiveness of different races and nationalities. By a method described in detail in the *American Journal of Psychology* (Vol. 39, pp. 125–40), a gradation has been made of the anger reactions and the fear reactions of a considerable number of Caucasians in California. And of the same persons, measurements were made of the length and width of their heads, and observations made by which each individual could be classified as to the color of his eyes and the shade of his hair. Computations based on these data indicate a connection between the physical features which are often taken to be signs of race, and the intensity of the emotional reactions in the various groups. A group of persons with narrow heads, for example, may not show the same degree of emotion as does a group with a different cephalic index. And similarly of groups differing markedly in shade of hair, or in color of eyes. The general similarity in the environment of the various groups suggests that the emotional differences may in the main be innate, rather than due to training, and may be the result of a difference in the psycho-physiological endowment of different racial strains.

Inheritance in the tailed form of Chilodon uncinatus—a mutation obtained by use of ultra-violet radiation: MARY STUART MACDOUGAL (introduced by Lorande L. Woodruff). Seven modifications of *Chilodon uncinatus*, obtained by use of ultra-violet radiation, have been described. These include a triploid, a tetraploid and a tailed form which has lived for eighteen months. The homozygous strain, after thirty epidemics of conjugation, shows no reversion to normal. Twelve out of two hundred conjugating pairs of the heterozygous race became normal, and have never shown any sign of an appendage, while eight homozygous pairs were obtained. Two out of the two hundred pairs lost their tails, but retained the changed body shape and ciliation. They were weak, and died after three divisions each. Four out of two hundred pairs showed normal form and ciliation, but had a short tail. This is a hardy race, and, after two conjugation epidemics, no normals have been observed. In a mixed culture of the homozygous and normal races, it was observed recently that for the first time there was wholesale attempt at conjugation. One member of each of the fifty pairs isolated was already dead, though fused to the living member, and none survived the effects of conjugation. Attempts to cross the heterozygous and normal form with a tail with the normal form have been more successful, and these experiments are now under way.

The body temperature and heat regulation of large pythons: FRANCIS G. BENEDICT and EDWARD L. FOX. The large snakes, as other cold-blooded animals, have a temperature regulation entirely different from that of man or other warm-blooded animals. In the latter the mouth or trunk temperature is the highest and the skin temperature somewhat lower, but in practically all cases the body temperature is materially above the air temperature. With snakes the body temperature in the mouth and the cloaca is practically the same, in spite of the fact that it is a long, stretched-out animal. The skin temperature is a little lower than the body temperature. Under ordinary conditions when the snake is quiet and not digesting food, the body temperature and the skin temperature are somewhat lower than the environmental temperature. With activity, such as in the agitated, striking snake, there is a considerable rise in body temperature, because the snake can not lose heat as fast as it produces it. After such a period of agitation the body temperature is several degrees above the initial temperature. During digestion there is likewise a rise in temperature, especially noticeable over the lump where the body of the animal eaten is being digested. These studies show that the most important factor in the temperature regulation of snakes is the vaporization of water. Although the snake has no sweat glands, its entire body gives off water by diffusion. A considerable amount of water is thus lost, in addition to that in the breath, and the entire heat produced by the animal is used in vaporizing water. Indeed, in some cases, such as in hot climates, the snake may actually absorb heat from the air and use this heat to vaporize water. As a result, the snake may be compared in a way to the wet bulb thermometer, the temperature of which is lowered below that of the environment by the continual vaporization of water from the wet fabric around the mercury bulb. With warm-blooded animals about 25 per cent. of the heat produced is lost in the vaporization of water. With the snake and other cold-blooded animals practically the entire amount of heat produced is thus lost.

BOOKS RECEIVED

CAMP, BURTON H. *The Mathematical Part of Elementary Statistics.* Pp. xxi + 409. Heath. $3.60.

CONWAY, A. W., and J. L. SYNGE, Editors. *The Mathematical Papers of Sir William Rowan Hamilton.* Volume I: Geometrical Optics. Pp. xxviii + 534. Cambridge University Press, Macmillan. $20.00.

FORD, ADELBERT. *Group Experiments in Elementary Psychology:* Students' Manual and Notebook. Pp. vi + 241. 55 figures. Macmillan. $1.25.

HEGNER, ROBERT W. *College Zoology.* Third edition. Pp. xxiii + 713. 568 figures. $3.50. Laboratory Guide for College Zoology. Pp. viii + 75. $1.00. Macmillan.

LYDE, LIONEL W. *The Continent of Europe.* Pp. xv + 456. Illustrated. Macmillan. $4.00.

NORTHROP, F. S. C. *Science and First Principles.* Pp. xiv + 299. 6 figures. Macmillan. $3.00.

OSBORN, HENRY F. *Cope: Master Naturalist.* Pp. xvi + 740. 30 figures. Princeton University Press. $5.00.

STAIG, ROBERT A. *The Fabrican Types of Insects in the Hunterian Collection at Glasgow University.* Part I: Coleoptera. Pp. xv + 110. 28 colored plates. Cambridge University Press, Macmillan. $8.50.

WARMING, EUGENIUS, and PAUL GRAEBNER. *Lehrbuch der ökologischen Pflanzengeographie. Dritte Lieferung.* Bogen 31–45. Pp. 481–720. 101 figures. Verlag von Gebrüder Borntraeger, Berlin.

WHYTE, L. L. *Critique of Physics.* Pp. xi + 196. Norton. $3.00.