favorable amount of acid . . . decreases with rise in temperature," and Compton[3] has pointed out that the optimum temperature for maltase "is dependent on the H^+ concentration of the medium."

Recently Lüers and Nishimura[4] have reported observations on the basis of which they conclude that Olsen and Fine were in error. These authors used a highly active amylase preparation and soluble starch in strong acetic acid-acetate buffer solutions and found no change in optimum pH as the temperature was raised from 15 to 70° C.

Lüers and Nishimura in drawing their conclusions failed to take into account that different buffer solutions respond differently to changes in temperature. McIntosh and Smart[5] found the hydrogen-ion concentration of acetate buffers to remain constant between room temperature and 70° C., and Walbum[6] later reported extensive measurements on a number of buffers. Some of these were found not to change in hydrogen-ion concentration as the temperature was raised from 10–70° C., while certain others changed markedly. The following figures are quoted from Walbum:

Buffer	20° C. pH	70° C. pH	Difference pH
Borate	9.23	8.86	−0.37
Citrate	4.96	5.14	+0.18
Glycin-NaOH	8.53	7.48	−1.05

Recent measurements by Hoffman and Gortner[7] have shown that the pH of dilute solutions of hydrochloric acid and sodium hydroxide also respond to changes in temperature.

Inasmuch as Lüers and Nishimura were making their determinations with acetate buffer mixtures which, according to McIntosh and Smart, do not change with change in temperature, their results not only harmonize with those of Olsen and Fine but tend to corroborate the suggestion that the observed differences were due to changes in the activity of the hydrogen-ions. The different results obtained in these two cases emphasize the importance of proper selection of buffer solution where the reactions occur at temperatures other than that at which the acidity is measured.

AKSEL G. OLSEN

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Thermionic emission and the "universal constant" A: EDWIN H. HALL. Richardson, in his "Emission of Electricity from Hot Bodies" (1916), has given three derivations of the equation $I=AT^2\varepsilon \frac{bo}{\tau}$. The first of these, beginning on page 28 and ending on page 33, has been much criticized. The third, running from page 35 to 39, follows the quantum theory and reaches a result, as to the value of A, not very different from that recently found by Dushman in a similar way. The second derivation, given on a single page, 33 to 34, is admirably simple and direct, but Richardson felt obliged to give it up, because of a misgiving as to assigning thermal energy to the free electrons within a metal, though this conception of their condition is a familiar and natural one. The purpose of the present paper is to show that such a misgiving lacks justification, and to restore, with some modifications, suggested by the dual theory of electric conduction, Richardson's "classical kinetic theory" of thermionic emission.

The minimum values of positive quadratic forms: H. F. BLICHFELDT, Stanford University. Having given a positive definite quadratic form in n variables, the important question as to the least numerical value of this form, expressed as a function of n and the determinant D of the form, the variables being allowed to take on only integral values (not all zero), has received a good deal of attention. The minimum in question is $|gD|1/n$, where g is a function of n only. Superior limits to g were given by Hermite, Korkine and Zolotareff, Minkowski and the author. Exact limits are known for $n=2, 3, 4, 5$, to be 4/3, 2, 4, 8, respectively. In the present communication the author states that the exact limits for $n=6, 7, 8$ are 64/3, 64, 128, respectively.

Pressures in discharge tubes: W. H. CREW and E. O. HULBERT, Naval Research Laboratory. The increase in the pressure of the gas in a discharge tube due to the discharge has been measured for those pressures normally used in discharge tubes, from about 0.1 to 30 mm of mercury, for helium, hydrogen, oxygen, nitrogen, air, carbon monoxide and carbon dioxide. The pressure increase is regarded as due to two chief causes, one, the increase in temperature of the gas, and the other, the dissociation of the molecules of the gas into atoms or less complex molecules. Therefore, from the observed pressure increments, the temperatures and the amounts of dissociation of the gas in the discharge have been determined. A long slim discharge tube, 300 cm in length and 9 mm in internal diameter, and a large tube, 80 cm in length and 34 mm in internal diameter, were used in turn. The pressures below 1 mm of mercury were measured by a striation gauge. This consisted of a second discharge tube (joined to the main tube) excited by direct current calibrated so that the shift of the striations of the positive column with pressure was known. The pressures from 3 to 30 mm of mercury were measured by an oil manometer.

Current distribution in supra conductors: FRANCIS B. SILSBEE, Bureau of Standards. Some very clever experiments on the resistance of a tube of tin, when subjected to the magnetic field of currents both in the tube and also in a wire coaxial with it, have been described by Kamerlingh Onnes and Tuyn (Journal Franklin Institute, vol. 201, page 379, 1926). In the present paper the magnetic field distribution to be expected in such a system of conductors is analyzed in detail on the basis of a number of simplifying assumptions and the resulting potential gradient in the tube found to agree fairly well with the observed values. It therefore appears that the phenomena can be accounted for quantitatively by the assumption of a critical magnetic field and do not require the introduction of the concept of "critical current."

Heats of condensation of positive ions and the mechanism of the mercury arc: K. T. COMPTON and C. C. VAN VOORHIS, Princeton University. The two most suggestive lines of approach to the problem of accounting for the current at the cathode of a mercury arc are based on considerations of space charge and of thermal equilibrium. In this paper we wish to point out the significance of some recent work by Guntherschultze on evaporation and conduction heat losses from a cathode and by ourselves on heats of condensation of electrons and positive ions. These latter are important factors in the "energy balance" at the cathode, since the cathode is cooled by the emission of electrons from it and heated by the neutralization of positive ions at its surface. In order to measure these heats of condensation, we immersed a metal sphere in the intensely ionized atmosphere of an arc (in A, N_2 or H_2 gas) by means of three fine wires, two of which formed a thermojunction to measure the temperature of the sphere, while the third carried the current of electrons or ions flowing to it. We were thus enabled to measure the heating effect produced when either an electron or a positive ion gave up its electric charge to the sphere. For electrons the results were in good agreement with those of other observers by other methods. For positive ions our results are the first experimental determinations which have been made. They indicate that neutralization of positive electricity at the surface of a metal is accompanied by radiation of energy. Finally we used these values to interpret the phenomena at the cathode of a mercury arc. By equating all sources of energy input to all sources of energy output, two conclusions of great importance in the theory of the mercury arc are drawn: (1) electrons are pulled out of the cathode by the strong electric forces due to the cloud of positive ions near its surface; (2) mercury lost by the cathode is not all evaporated, but much of it escapes in a spray, as if mechanically extracted.

Magnetic hydrogen atoms and non-magnetic hydrogen molecules: WILLIAM ALBERT NOYES, University of Illinois. Ten years ago the author suggested that two atoms may be held together by an electron rotating about two positive nuclei. Similar suggestions were made, quite independently of each other, by Sidgwick and Knorr, in 1923. Paulus and Grimm and Somerfeld have, more recently, favored this hypothesis, and Glockler has given it some experimental support by a study of the ionization potential of methane. Quite recently, Phipps and Taylor, by a very ingenious modification of the methods of Gerlach and of Kunz, Taylor and Rodebush, have demonstrated that isolated hydrogen atoms are magnetic while hydrogen molecules are not. These facts may be explained very simply by supposing that in the hydrogen molecule the two electrons rotate in opposite directions in parallel planes with the two nuclei located between these planes. An extension of these principles might possibly explain the formation of helium from hydrogen. It is fully appreciated that the suggestion is very hypothetical and can become of permanent value only in case some one finds a method of subjecting it to a rigorous mathematical analysis and it should be found to be in accord with all the experimental facts by which it may be tested. The successes which have attended the development of Dalton's picture of the atom and the pictures of the structure of molecules proposed by Couper and Kekulé, give us some reason to hope that other pictures may be of service.

Relation of the octet of electrons to ionization: WILLIAM ALBERT NOYES, University of Illinois. In accordance with the theory of electronic structures proposed by G. N. Lewis, simple ions consist of an atom with the exterior octet shell characteristic of the atoms of the noble gases but differing from those atoms because the positive charge of the nucleus is greater or less than the number of electrons in the shell by one or more units. Complex ions have a central atom with a similar structure. As atoms of the noble gases are unable to combine with other atoms because they can not share electrons with them, it is suggested that the similar electronic structure of ions and the repulsion between the outer electrons of the shells of two ions when they approach each other may be one reason why the ions remain apart in solutions and why they have some of the properties of independent molecules.

Exhibit of research results in the Grand Canyon: JOHN C. MERRIAM.

Footprints of unknown vertebrate animals in the Carboniferous and Permian of the Grand Canyon, Arizona: CHARLES W. GILMORE, U. S. National Museum. This paper describes the results obtained from two trips to the Grand Canyon of the Colorado, undertaken for the dual purpose of securing collections of fossil tracks for the U. S. National Museum, and at the same time, to prepare an exhibit of the tracks *in situ* for the National Park Service. Both of these projects were successfully carried out, a collection of slabs of footprints some 4,400 pounds in weight were secured for the National collections and a track covered area several hundred square feet in extent was uncovered by the side of the Hermit Trail, thus forming a permanent exhibit of the tracks as they occur in nature. It was found that tracks occur in considerable abundance in three distinct and successive formations. These evidences of past life ranging through 800 feet of strata, confined to horizons that roughly stated lie as follows: Coconino, 900 to 1,030 feet; Hermit, 1,350 to 1,400 feet; and Supai, 1,760 to 1,800 feet below the top of the canyon wall. In the perfection of their preservation and variety of kinds there are but few localities known that outrank this one. In all 24 genera and 33 species of fossil tracks have now been recognized, distributed as follows: Coconino, 15 genera and 22 species; Hermit, 6 genera and 8 species, and Supai, 3 genera and 3 species.

The age of the Hermit shale in the Grand Canyon, Arizona: DAVID WHITE.

Fauna and flora of a new Pleistocene asphalt deposit near Santa Barbara: CHESTER STOCK and RALPH W. CHANEY (introduced by John C. Merriam).

Significance of geological range, or life period of animal species. John C. MERRIAM.

The architectural evolution of Pueblo Bonito: NEIL M. JUDD, U. S. National Museum. Pueblo Bonito, a prehistoric Indian village situated in Chaco Canyon, northwestern New Mexico, was abandoned approximately one thousand years ago. This, at least, is the conclusion reached by archeologists after six years of exploration for the National Geographic Society and after careful weighing of all anthropological, historical, geophysical and other available data. Pueblo Bonito is one of the largest and best preserved Pueblo villages of the southwestern United States whose abandonment is known to have occurred long prior to inauguration of the Spanish conquest in 1540. Ruins of the ancient settlement—a compact, communal building surprisingly similar to our modern apartment houses—cover more than three acres of ground. In its heyday, Pueblo Bonito stood four stories high, comprised nearly eight hundred rooms, and sheltered between twelve and fifteen hundred individuals. Its builders were farmers—agricultural folk who tilled fields of maize, beans and squash, and added to their vegetable diet such desert game as ranged within hunting distance. The Bonitians had no beasts of burden and no metal implements or ornaments excepting a few small copper bells obtained, through intertribal commerce, from Toltec or Aztec Indians of central Mexico. It was formerly supposed that Pueblo Bonito must have been erected from previously prepared plans and as a single cooperative enterprise. Explorations of the National Geographic Society, however, have disclosed definite evidence of four major periods of building activity with recurrent alterations of lesser magnitude in each major period.

Late Tertiary thrust faults in the Mojave Desert: D. F. HEWETT, U. S. Geological Survey. For many years it was assumed that most of the folds and other evidences of compressive stresses in the rocks throughout the Great Basin were due to the intrusion of the Sierra granite in early Cretaceous time. The thrust faults of southeastern Nevada, first recognized in 1919, were so considered. Work in the Goodsprings area in 1922 threw some doubt on this conclusion and work further south in 1924 seemed to confirm the doubt. As they were known to be pre-Miocene, an early Eocene age was assigned to the thrust faults and associated granites. Work in 1926 along the northeast border of the Mojave desert in the vicinity of the Shadow Mountains shows that there is a local zone ten miles wide and at least thirty miles long, in which early Paleozoic and Precambrian rocks, including granite gneiss, are thrust upon upper Miocene sediments. The zone appears to be continuous with the fault traced 150 miles westward through Leach Trough, which separates the Mojave desert from the rest of the Great Basin. Two periods of Tertiary thrust faulting are thus indicated. The depression of Death Valley which typifies many of the closed valleys of the region crosses this fault and is limited by still younger normal faults.

Boring for natural steam in California: ARTHUR L. DAY.

Recent volcanic activity in Japan: ARTHUR L. DAY.

Sea-level surfaces and the problem of coastal subsidence: DOUGLAS JOHNSON, Columbia University. It has previously been shown that many phenomena attributed to recent progressive coastal subsidence are due to local fluctuations in the "high tide surface" (the irregularly curved surface passing through all points reached by the crest of the tidal wave) consequent upon local changes in the form of the shore. The present paper supports the thesis that the "mean sea-level surface" is also an irregularly curved surface, and that local changes in the form of the shore may produce local variations in the elevation of mean sea-level. Such variations of mean sea-level give rise to phenomena erroneously interpreted as indications of changes in the elevation of the land; and of such phenomena those giving fictitious indications of coastal subsidence are most pronounced.

The fundamentals of isostasy: HARRY FIELDING REID, Johns Hopkins University. A consideration of all the forces acting on a point on the earth's surface, together with the fact that the earth's level surface is almost exactly an ellipsoid of revolution, shows, without any assumptions, that to all masses rising above a properly chosen ellipsoidal surface there is a complementary negative mass of matter within the ellipsoid. The condition that the complementary mass shall be equal to the exterior mass is that the ellipsoid shall contain all the matter of the earth. It should therefore be about 200 meters above the sea-level. The observations show, without hypotheses, that the greater part of the complementary mass, which has been called the compensation, lies in the neighborhood of the masses compensated.