to the flood of protest pouring in on them against this betrayal of the Pueblo Indians for the sake of a few New Mexico land-grabbers.—*The New York World.*

SPECIAL ARTICLES

SERIES REGULARITIES IN THE ARC SPECTRUM OF CHROMIUM

THE detection of two sets of related triplets, by Meggers and Kiess, in the course of their work on the arc spectrum of chromium, induced the present writers to undertake a more thorough examination of the spectrum, to find, if possible, other regularities which might lead to series relationships. While a detailed discussion of the work has not yet been completed, enough has been found to warrant the following statements.

At least three sets of series whose members are triplets, occur in the arc spectrum of chromium. Of these, two sets are composed of wide triplets, and one set of narrow triplets. The wide-triplet series are parallel; that is, there exists a constant difference between the wave numbers of homologous members. Each component of the first member of the diffuse series is itself a narrow triplet. In the table are given data for the first members of the principal, sharp and diffuse series of the two parallel systems:

λ I. A. (Vacuum)	ν	Δν	λ I. A. (Vacuum)	ν	Δν	Separation
p			*p*			
4255.53	23498.84	112.44	3579.69	27935.38	115.10	4436.54
4275.99	23386.40		3594.50	27820.28		4433.88
4290.92	23305.02	81.38	3606.35	27728.86	91.42	4423.84
s			*s*			
7464.39	13396.94	112.45	11160.2	8960.4	115.2	4436.5
7402.26	13509.39		11018.6	9075.6		4433.8
7357.95	13590.74	81.35	10908.8	9166.9	91.3	4423.8
d			*d*			
5331.18	18757.57		6982.79	14320.92		4436.65
5330.58	18759.68		6981.75	14323.06		4436.62
5329.80	18762.43	112.78	6980.23	14326.18	115.16	4436.25
.....	.....		6927.90	14434.39		.....
5299.32	18870.35		6927.09	14436.08		4434.27
5298.81	18872.16		6925.96	14438.43		4433.73
5277.56	18948.15	81.29	6885.00	14524.33	91.54	4423.82
5277.09	18949.84		6884.23	14525.96		4423.88
5276.59	18951.64		6883.40	14527.62		4424.02

The narrow triplets which constitute the third set of series are characterized by the frequency differences $\Delta\nu_1 = 8.80$ and $\Delta\nu_2 = 5.65$. Several doublets in which each of these separations exists and also one with the separation, $\Delta\nu = 81.37$, have likewise been found. These are suggestive of inter-series combinations.

C. C. KIESS
HARRIET KNUDSEN KIESS
WASHINGTON, D. C.,
OCTOBER 10, 1922

THE NATIONAL ACADEMY OF SCIENCES

THE autumn meeting was held in New York City on November 14, 15 and 16, on successive days at Columbia University, the Rockefeller Institute for Medical Research and the United Engineering Societies Building. The scientific program was as follows:

Biographical memoir of Harmon Northrup Morse. (By title) IRA REMSEN.

A catalogue of bright stars, a compilation of all the known data concerning the 9110 brightest stars: FRANK SCHLESINGER. The requirements for an abstract are perhaps sufficiently complied with by the title itself, but it may be well to say in addition that the catalogue gives the name of each star, its position for 1900, the Durchmusterung number, magnitude, spectrum, proper mo-

tion, parallax, radial velocity and notes concerning other points of interest.

The status of research on the perturbations of minor planets with special reference to its ultimate significance: ARMIN O. LEUSCHNER.

The structure of the Jura Mountains in France. Lantern: EMANUEL DE MARGERIE (introduced by J. F. Kemp).

Recently discovered evidence bearing on the age of the Sierra Nevada. Lantern: JOHN C. MERRIMAN, R. W. CHANEY and C. STOCK.

American jade and its archeological bearing. Lantern: HENRY S. WASHINGTON. Microscopic study of many jade objects from Chichen Itza, Copan and localities in Mexico shows that the material consists of a jade-like pyroxene and albite in different proportions; varying from pure pyroxene to nearly pure albite. The pyroxene is composed of jadeite and diopside, the combination forming a hitherto unrecognized member of the pyroxene group. Many chemical analyses have been made, and these, as well as the microscopic thin sections, show that the albite is soluble in the diopside-jadeite up to a certain amount, beyond which it crystallizes out separately. In chemical and mineral characters the Middle American jades differ markedly from those of Burma and Tibet, the chief sources of Chinese jade. These differences, the occurrence of a complete series of the rocks, and the original pebble form of many of the American jade objects, indicate that the material of the Mexi-can and Central American artifacts is of American, and not of Asiatic, provenance; thus being adverse to the theory of southeastern Asiatic origin for Middle American races and culture. This American jade has not yet been found in place, but it is probable that it comes from toward the Pacific coast, and two centers of production are suggested as probable, Oaxaca-Guerrero in Mexico and Guatemala in Central America.

Drowned coral reefs of the Liu Kiu Islands, JOHNSON (introduced by J. F. Kemp).

A genetic description of some New England-Acadian shorelines. Lantern: DOUGLAS W. JOHNSON (introduced by J. F. Kemp).

A tentative geological column for central Mongolia: CHARLES P. BERKEY (introduced by J. F. Kemp).

Xenoliths in the Stony Creek granite, Connecticut: JAMES F. KEMP.

A chemical investigation of two typical enzymes: pancreatic and malt amylases: H. C. SHERMAN. This paper reviews briefly some of the results obtained in an investigation carried out during recent years with the aid of grants from the Carnegie Institution of Washington, and describes unpublished experiments which furnish a new line of evidence that these enzymes, in their chemical nature, either are proteins or contain proteins as essential constituents. While alike in this respect, these two starch-splitting enzymes differ markedly in some of their properties and are undoubtedly different substances. Some of the chief points of resemblance and of difference are briefly summarized and the problem as to the conclusiveness of the evidence regarding the chemical nature of these enzymes is considered.

The hydration of sodium monometaphosphate to orthophosphate in varying concentrations of hydrogen ion: H. T. BEANS and S. J. KIEHL. The preparation of sodium monometaphosphate; method of following the hydration; experimental data; formation of pyrophosphate as an intermediate product; discussion of results.

Saturated Bredig gold sols: H. T. BEANS and L. B. MILLER. Briefly summarized the paper will present the results of the continuation of our work on the study of the influence of electrolytes on the composition and behavior of gold sols made by the Bredig method. We have found that a very definite quantitative relationship exists between the maximum amount of gold which can be dispersed by the Bredig method, and the character and concentration of the electrolyte present. The paper will, therefore, consist in a demonstration of this relationship with curves and data which are in support of the conclusions.

Experimental studies on the hydrogen electrode: H. T. BEANS and L. P. HAMMETT. A study of the practical application of the hydrogen electrode and of theoretical questions involved has shown that the hydrogen electrode must function not only as an inert electrode, but as a catalyst for the hydrogen ion reaction. Comparison of various methods for producing the necessary activity is of interest from the general point of platinum catalysis, and indicates the interesting problem of the potential difference between active and inactive electrodes. These results, together with the results of the study of the effect of oxygen upon the electrode have led to a specification of the necessary conditions for precise measurements in buffered solutions, and investigation of the difficulties inherent in the application of the electrode to unbuffered solutions has led to the determination of the reasons underlying these difficulties, and to a new type of electrode which

gives satisfactory results in solutions of potassium chloride.

The interdependence of solvent and solute in ionization phenomena: JAMES KENDALL and MALCOLM M. HARING. In a previous communication (Kendall, *Proc. Nat. Acad.* SCI. 7, 56, 1921) it was shown that compound formation and ionization in solutions proceed in parallel and that solvent and solute play an equally active part in ionization phenomena. The present article discusses the various possible ionic types which may be produced by the disintegration of compounds formed when two substances RX and R¹Y are mixed. Rules are deduced for predicting the relative amount of each type in any particular case from the character of the radicals concerned, and these rules are demonstrated to be in accordance with experimental results chosen from both aqueous and non-aqueous solutions.

Some unusual freezing-point curves in fused salt mixtures: JAMES KENDALL, E. D. CRITTENDEN and H. K. MILLER. In the course of a detailed study of the factors influencing compound formation and solubility in fused salt mixtures, by which 49 new double salts were isolated, some rather remarkable freezing-point curves were encountered. Two illustrative examples are here described. In the first—the system $AlBr_3$:NaBr—a two liquid layer region exists between 2.6 and 16.3 per cent. NaBr, and the freezing-point curve on either side of this descends from 95.4° to a eutectic point. The solid phase in equilibrium with the two liquid layers must consequently be a double salt of intermediate composition, unstable at its true melting-point but melting to give two immiscible liquids at 95.4°. In the second type of system, of which $SbCl_3$:$SnCl_4$ is an example, the two liquid layer region is metastable, but approaches so closely to the freezing-point curve as to induce it to become almost horizontal over a very wide range of composition.

Ferric hydroxide hydrosol: ARTHUR W. THOMAS and A. FRIEDEN (introduced by M. T. Bogert).

A citraconic analog of quinophthalone: M. T. BOGERT and K. ASANO. The well-known dye quinoline yellow (quinophthalone) is prepared by the action of phthalic anhydride upon quinaldine. It is now found that citraconic anhydride does not condense smoothly with quinaldine, but that when the imide is used in place of the anhydride, a dye analogous to quinoline yellow results.

Diaryl thiophenes and diaryl selenophenes: M. T. BOGERT and J. P. HERRERA. 2,4-Diaryl thiophenes and diaryl selenophenes may be obtained in fair yields from ketone anils, of acetophenone anil type, by fusion with sulfur or selenium. The properties of these new compounds and of various derivatives are described.

Factors governing the distribution of plants in Porto Rico and the Virgin Islands: NATHANIEL L. BRITTON.

Growth and form: ROBERT A. HARPER.

Growth and development of children as influenced by environmental conditions: FRANZ BOAS.

Dating prehistoric man in America by methods of distribution and stratigraphy: CLARK WISSLER (introduced by F. Boas).

Measurements on the expression of emotion in music: C. E. SEASHORE. The writer points out that every emotional effect transmitted by the singer or other musician through music is contained in the sound wave. This can be intercepted and recorded with high precision and the musical effects may then be classified in terms of the measurable attributes of the wave; namely, frequency (pitch), duration (time), amplitude (intensity and volume), form (timbre). All musical expression through sound may be expressed in terms of variables in these four factors.

Undernutrition and its influences on the metabolic plane of steers: FRANCIS G. BENEDICT and ERNEST G. RITZMAN. Based upon experiences with humans, who voluntarily underwent ration curtailment, and upon the well-known inequalities in the feeding habits of wild animals, a group of 11 steers were subjected to curtailed rations amounting to approximately one half of their normal maintenance requirements, for a period of about 140 days. Measurements of feces and urine and feed, as well as an extensive series of metabolism measurements inside of a specially constructed respiration chamber, made it possible to study these animals intensively. The curtailed rations resulted in a distinct loss of nitrogen and fat from the body, but the steers recovered their initial state by subsequent feeding with hay, concentrates or pasture. Although carried through the winter on an extraordinarily low metabolic plane, they suffered no permanent damage and all were subsequently fattened for market.

The acetonitril test for thyroid and of some alteration of metabolism: REID HUNT. (1) Toxicity of acetonitril; effects of undernutrition; diet; vitamins. (2) The acetonitril test for thyroid; the relation between iodin content and

physiological activity. Thyroxin. (3) The reaction as a test for thyroid secretion. Grave's disease.

Leucocytic secretions: ALEXIS CARREL (introduced by S. Flexner).

Experiments with an anti-serum for Rocky Mountain spotted fever: HIDEYO NOGUCHI (introduced by S. Flexner).

The protection of the newborn against infection: THEOBALD SMITH.

Experimental herpetic encephalitis: SIMON FLEXNER.

Hydrohepatosis, a condition analogous to hydronephrosis: PEYTON ROUS (introduced by S. Flexner).

Crystalloidal solutions and colloidal suspensions of proteins: JACQUES LOEB.

The ovary in connection with structural and metabolic changes in mammals: CHARLES R. STOCKARD. A general description is given of a method of external examination by which the several stages of the ovarian cycle may be definitely located. The moment of discharge of the ovum from the ovarian follicle may also be accurately determined. The several stages of the ovarian cycle may be experimentally modified and ovulation temporarily or permanently suppressed. The type of modification may be recognized by a study of the structural reactions of the uterus and vagina which are indicated by the cellular composition of smears collected from the wall of the vagina. The ovary may be used as a very exact and valuable indicator for determining the general metabolic conditions of the individual.

The mechanism of selective bacteriostasis: JOHN W. CHURCHMAN (introduced by S. Flexner).

The reduction division in haploid, diploid, triploid and tetraploid daturas: JOHN BELLING and A. F. BLAKESLEE (introduced by C. B. Davenport).

The consequences of different degrees of intermensual correlation for fecundity in the domestic fowl: J. ARTHUR HARRIS (introduced by C. B. Davenport).

Recent studies on the relation of metabolism to sex: OSCAR RIDDLE (introducted by C. B. Davenport).

Sex and sex control in Cladocera: (By title.) ARTHUR M. BANTA (introduced by C. B. Davenport).

The consequences of different degrees of interference, in the crossing-over of the hereditary genes: H. S. JENNINGS. The paper gives the general results of a mathematical study of the relations exhibited in the socalled crossing-over of the genes, and compares these with those bound to occur if the genes are arranged in series and there is interference between breaks at points near together in the series. The observed ratios fall into a peculiar and complex system; by means of a mathematical formula it is shown that this entire system, even to details, is, in all essentials, a necessary result of the serial arrangement with a certain extent of interference. The marked changes that would result from different extents of interference are likewise shown.

A new type of uroleptus formed by permanent fusion of two conjugating individuals: GARY N. CALKINS.

Restoration of fossil human remains its possibilities, value and limitations: J. H. MCGREGOR (introduced by Edmund B. Wilson).

The rôle of the golgi apparatus in the formation of the animal sperm: ROBERT B. BOWEN (introduced by Edmund B. Wilson).

The map of the third chromosome of Drosophila: T. H. MORGAN and C. B. BRIDGES.

Limiting values of the size of the genes of Drosophila: T. H. MORGAN.

Ultraviolet flowers and their possible bearing on the problems of pollination by insects: FRANK E. LUTZ and F. K. RICHTMYER (introduced by Frank M. Chapman). The various colors on the petals of flowers and, indeed, the petals themselves are rather generally believed to have arisen in connection with the pollination of flowers by insects. A few experiments, including some made recently, indicate that insects respond definitely to ultraviolet rays. This suggested an investigation of the reflection by flowers of ultraviolet rays. It was found that some flowers show ultraviolet while others do not, just as some show blue while others do not. If flower colors are important in connection with pollination by insects, its seems that not only the visible spectrum but also the ultraviolet should be considered.

Recent discoveries of fossil vertebrates in China and Mongolia: W. D. MATTHEW (introduced by Frank M. Chapman). Important fossil mammal faunas have been recently discovered in China by the Chinese Geological Survey and American Museum party. The American Museum's Asiatic Expedition has also been extraordinarily successful in Mongolia this summer. Three important mammal faunas, Eocene, Oligocene and Pliocene were discovered, also a rich Cretaceous dinosaur fauna. Large collections

were secured, including complete skulls and skeletons and their study is expected to throw much light on the origin and dispersal of the higher vertebrates and of men.

The Whitney South Sea expedition of the American Museum of Natural History: ROBERT CUSHMAN MURPHY (introduced by Frank M. Chapman). For more than two years the Museum has been conducting ornithological investigations in Polynesia. This paper summarizes the purposes and accomplishments of the expedition, and outlines some of the problems involved in studying oceanic and insular zoology.

Mutations among birds in the genus Buarremon: FRANK M. CHAPMAN. From a study of the 160 specimens of *Buarremon brunneinucha* and *B. inornata* in the American Museum of Natural History the following conclusions are reached: (1) That *Buarremon inornata* is a representative of *Buarremon brunneinucha.* (2) That the variations in pattern and color occurring in the underparts of *brunneinucha,* throughout the range of that species, are individual and are not due to age, sex or season, to climate or other observable environmental factors. (3) That isolation, partial or complete, has alone supplied the conditions needful to the development and establishment of these characters as the specific attributes of *Buarremon inornata.*

On the attraction of a central body in the theory of relativity: GEORGE D. BIRKHOFF.

The equiaffine geometry of paths: OSWALD VEBLEN.

The cosmological equation of gravitation: EDWARD KASNER. It is shown that the two sets of equations introduced by Einstein in 1917 and 1919 are exactly equivalent in empty space. The cosmological factor λ can then be proved to be a constant, instead of being so assumed.

A theory of the various transverse effects of the magnetic field in several metals: EDWIN H. HALL.

The photo-luminescence of flames: E. L. NICHOLS and H. L. HOWES. When flames containing salts of Na, Li, Ca, Ba, Sr, etc., are exposed to light the bright bands in their spectra, in general, are enhanced. The effect, although large compared to ordinary fluorescence, forms a small part of the total brightness of the flame and can not be readily detected except by spectro photometric methods. As in ordinary photoluminescence *excitation is by wave-lengths shorter than those of the band itself.* There is a *measurable quenching by exposure to the longer wave-lengths* and specifically to light identical with the band. So far as now known no new bands are developed as the result of excitation. The light sources thus far used as excitants are the tungsten lamp, carbon arc, mercury arc and iron spark.

The reflection of X-rays by crystals: WILLIAM DUANE.

The analysis of certain crystals by the new X-ray method: G. L. CLARK and WILLIAM DUANE.

The use of isophelimatic lines in historical geography; A new theory of population; A new hydrodynamical phenomenon; Further results in interior ballistics: ARTHUR G. WEBSTER.

The Thermal emissivity of water: MILDRED ALLEN.

The determination of ocean depths by acoustical methods: H. C. HAYES (introduced by W. H. Dall and W. M. Davis).

The gyroscope and its practical application in the arts. Lantern: O. B. WHITAKER (introduced by J. J. Carty and F. B. Jewett).

Electronic tubes of high power: H. D. ARNOLD, Ph.D. Recent developments in the construction of high vacuum apparatus have made possible the use of pure electron currents as large as 30 amperes in single tubes which are capable of controlling powers of 100 k. w. or more. This paper discusses some of the problems in physics and in engineering which were solved in the course of this development, particularly those which relate to the construction of glass and metal apparatus suitable for use with these high powers. The paper will be illustrated by samples of the tubes and by slides showing the general features of their construction.

Carrier type multiplex telephony and telegraphy: E. H. COLPITTS. The underlying principles of carrier are discussed particularly as they apply to carrier telephony, first, where a single channel of communication is provided, and secondly, where a number of channels are provided over the same pair of wires. Apparatus is shown illustrating the various physical steps in the process of transmitting speech from one terminal station to the other. Particularly the performance of filters in discriminating against the passage of currents outside of the band which they are designed to transmit is demonstrated. In these demonstrations use is made of a loud speaking telephone.

Spectrum energy curves of the stars: CHARLES G. ABBOT.

Affine geometries of paths possessing an invariant integral: LUTHER P. EISENHART.