

hydrogen molecule has a resonance potential at 11.6 volts. The present results therefore show that hydrogen molecules can be made to react at ordinary temperatures with copper oxide after they have been brought into their first higher quantum state by electron impact.

A detailed account of these experiments will be given in another place in collaboration with W. P. Baxter and R. H. Dalton.

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At the autumn meeting of the National Academy of Sciences held in Philadelphia on November 8 and 9 the following papers were presented:

New proofs of solar variation: C. G. ABBOT.

Various critics having recently expressed themselves as unconvinced of the validity of the proofs of solar variation either in long or short intervals, it occurred to the author to test the matter in a new way.

The difficulty which the critics find inheres in the fact that the observer is situated underneath the ocean of atmosphere whose influence in diminishing the intensity of solar radiation must be allowed for. Since the atmosphere contains variable constituents, critics are doubtful as to whether the apparent variations of solar radiation are really solar or are due to atmospheric variations which the observer is unable to eliminate.

If the observer were situated on the moon, with no atmosphere interposing, accurate direct measurements of the intensity of solar radiation, when compared from time to time, would furnish true indications of the solar variability. Similarly, if the observer underneath the atmosphere of the earth could restrict his measurements to instants when the transparency of the atmosphere is identically the same, such a selective series of observations would also give the true solar variability.

The author attempts to realize this latter condition, in the first place by confining data to months of the same name in successive years. In this way temperature variations of the apparatus, the surroundings, and the atmosphere are minimized, and possibly yearly periodicities in the sensitiveness of the apparatus are eliminated. Secondly, the measurements are chosen always with the sun equally high above the horizon, so that the thickness of the air traversed is the same. Thirdly, days are selected in which the total atmospheric humidity as observed spectroscopically is identical. And fourthly, days are selected when the apparent transparency of the atmosphere as indicated by observations at different air-masses is nearly identical.

The author exhibited results for the month of July in the years 1910 to 1920, as obtained at Mount Wilson, Calif., and results for the twelve months for the years

1920 to 1925, as obtained at Mount Montezuma, Chile. Both series indicated real variations of the sun which were in close agreement with the variations already found for corresponding days by solar constant measurements. Both series indicated that higher solar radiation prevails at times of numerous sunspots.

Forty years of Blue Hill Observatory: Precipitation.
E. B. WILSON.

A Pneumatic-drive method for measuring the fatigue of metals at high frequencies: L. J. BRIGGS and D. H. STROTHER (introduced by George K. Burgess).

The vibration of a flat bar with free ends mounted on pivots at its nodal points is maintained by a pneumatic drive, consisting of nozzles ending in flat discs which are mounted adjustably near the nodal points. The air escaping through the narrow space between the disc and the flat bar causes a reduction in pressure in this space, so that the bar is forced toward the disc. This force (which varies with the distance between disc and bar) operating in conjunction with the elastic restoring force and the inertia of the system keeps the bar in vibration at its natural frequency. The extreme fiber stress may be computed from Rayleigh's theory of a free bar in vibration if the amplitude and the dimensions of the bar are known. Alternating fiber stresses of 15,000 lbs./in.² at frequencies of 200 cycles per second have been continuously maintained in duralumin bars until failure occurred near the center of the bar.

Note on the thermodynamics and kinetics of gaseous explosive reactions: F. W. STEVENS (introduced by George K. Burgess).

A condition under which the gaseous explosive reaction may run its course at constant pressure, greatly simplifies the processes of the explosive reaction, as it simplifies those of the ordinary reaction, by eliminating a number of variables: A constant pressure insures a constant concentration of the initial gaseous components the zone of the reaction is entering. This condition is found to result in a constant linear rate of propagation of the zone of reaction within the explosive gases; a constant reaction process within, and hence a constant temperature gradient across this zone; and a constant temperature and composition of the reaction products as they leave this zone. To secure a condition of constant pressure under which the explosive gaseous reaction may run its course is, therefore, to bring its processes and hence the experimental methods for their study and analysis to a degree of simplicity and precision comparable to those met with in the study of the gaseous reaction at constant pressure and temperature below their ignition point.

This favorable condition for the gaseous explosive reaction—a constant pressure—may be closely realized in practice by holding temporarily the explosive gases within a soap-film container and firing the bubble from the center. This simple device functions as a bomb of constant pressure and thus provides the complement to the bomb of constant volume in the relation $p v = nRT$.

Being transparent, it permits an accurate photographic time-volume record of the reaction to be secured. This record, for thermodynamic studies, gives the initial volume of known concentrations and, at the instant the explosive action is completed, it gives the volume of the equilibrium products. This final volume corresponds to the reaction constant

$$K = \frac{[A]^{\frac{1}{n_1}} [B]^{\frac{1}{n_2}} [C]^{\frac{1}{n_3}}}{[A]^{\frac{1}{n_1}} [B]^{\frac{1}{n_2}} [C]^{\frac{1}{n_3}}}$$

Because the concentrations of the explosive gases remain constant, during the reaction, under the condition of constant pressure, it is found that the rate of propagation of the zone of reaction relative to these gases also remains constant and its value,

$$s = k.[A]^{n_1} [B]^{n_2} [C]^{n_3}$$

is proportional to the product of the initial concentrations of the gases.

Luminescence due to radio-activity: D. H. KABAKJIAN (introduced by Edgar F. Smith).

Luminescence of radio-active compounds is well known. The nature of this luminescence has been made the subject of numerous researches and a number of theories have been advanced to explain the observed phenomena. These are mentioned. It is shown that none of these theories are wholly adequate to explain all the known facts. Experiments and researches conducted in this laboratory are described and the results are discussed in connection with the theories already advanced. The discrepancies are pointed out but no new theories are given. Experiments are shown in radio-luminescence and thermo-luminescence.

Recent measurements of the velocity of light: A. A. MICHELSON.

The experiments described are a continuation of the work reported to the academy a year ago. The results of five series of observations with revolving mirrors having 8, 12 and 16 facets showed a remarkable agreement, and gave as a final result for the velocity of light between Mt. Wilson and Mt. San Antonio, 299,796 kilometers per second.

Transformations of manifolds: S. LEFSCHETZ.

An n dimensional manifold M_n is a locally homogeneous configuration built up by means of a finite number of non-interpenetrating n dimensional pyramids. The enumeration of the fixed points of the continuous transformations of M_n into itself or part of itself is of well known importance and has been treated by many authors. The more general problem of the number of coincidence points of two transformations T, T^1 (points with a common transform by T and T^1) has been considered only for algebraic curves. The enumeration for reasons inherent to the problem is carried out by "weighing" the points with positive and negative integers and adding these. Their sum N is characteristic of classes, rather than of individual transformations. By means of an associated M_{2n} we have determined N in terms of the

matrices describing the effect of the transformations of M_n on its cycles. These matrices are class invariants and the formulas obtained correspond to the most general situations possible. They include as very special cases whatever else has been obtained hitherto along that line—they do not cover such specialized transformations within a given class as were considered by Poincaré in his famous ring problem so elegantly solved by Birkhoff.

The density of oxygen and its compressibility below one atmosphere: G. P. BAXTER and H. W. STARKWEATHER.

Continuing earlier work presented to the academy further determinations of the density of oxygen have been made with two liter globes. The average density at 0° and one normal atmosphere, 1.42896, agrees closely with that found earlier with one liter globes, 1.42898.

The compressibility was found by density determinations with two liter globes at three quarters, one half and one quarter atmosphere with the following results:

	Density
$\frac{3}{4}$ atmosphere.....	1.07148
$\frac{1}{2}$ atmosphere.....	0.71415
$\frac{1}{4}$ atmosphere.....	0.35699

The deviation from Avogadro's rule between 0 and 1 atmosphere calculated from these values is 1.00095 and the limiting value of molal volume is 22.415.

The density, compressibility and atomic weight of nitrogen: G. P. BAXTER and H. W. STARKWEATHER.

The density of nitrogen has been determined with two liter globes at one, two thirds and one third atmosphere, with gas prepared from ammonium nitrite and by oxidation of ammonia. The following results are referred to 0° and the normal atmosphere.

	Density
1 atmosphere.....	1.25036
$\frac{2}{3}$ atmosphere.....	0.83348
$\frac{1}{3}$ atmosphere.....	0.41667

The deviation from Avogadro's rule calculated from these values is 1.00050 and by combination with the results for oxygen the atomic weight of nitrogen is found to be 14.007.

The apparition dates of the Andromede or (Bielid) meteor swarms: WILLARD G. FISHER (communicated by Harlow Shapley).

The apparition dates of the Andromede swarms, from 1741 to the present, have hitherto seemed to show almost no system. In the following paper, the dates found in a search of the literature have been reduced to the equinox of 1850 by the method of H. A. Newton, and tabulated; and the tabulation is exhibited graphically.

The points, plotted with year of apparition as abscissas, "1850 dates" as ordinates, tend to group themselves, not in a single line, but in a band, which displays a general regression of the nodes where earth meets swarms. Three (or four) of the points lie distinctly outside of this band. Nine of the nineteen points in this

band lie on three straight lines, which converge to the "1850 date," 1935 November 16; while most of the others are related to the nine as subsidiary apparitions, not maxima, or are close to one or another line.

This convergence may be pure chance; or it may indicate some approaching meteoric event. In either case, two additional tables show close relations between the doubled period of Biela's comet and the intervals between apparitions.

A decade of eclipse observations: JOHN A. MILLER (introduced by C. E. McClung).

The paper is a brief summary of the observations made and the results obtained by eclipse observers during the last decade. A great many large scale photographs of the corona have been made. A study of them shows that the material of the corona moves and that the motion is sufficient to be detected by comparisons of plates made at stations at widely different longitudes. This motion has also been found by a study of the Fraunhofer spectrum of the corona. Excellent results have been obtained with photometers and with thermo couples. "Flash" spectra have been made of hitherto unexplored regions of the "flash" spectrum. All observations made to test the deflection of the light as predicted by Einstein have been made in this decade.

The method of dependencies for solving equations, with an application to photographic positions of asteroids, etc.: FRANK SCHLESINGER.

This method is applicable to the case where the chief interest of the computer is some function of the unknowns involved in the original equations. The dependencies are factors which when applied to the observed quantities (and the products are added) give the desired function. A simple method for deriving these dependencies in the case of linear relations is given and some interesting properties of them are discussed.

Family traits as determined by heredity and environment: FRANZ BOAS.

The paper dealt with the discussion of the determination of bodily form by inheritance and the degree of similarity in fraternities. The variability of family lines will be discussed and the attempt is made to show that it can not be explained by heredity alone but that environmental influences have to be taken into consideration.

Some physical characteristics of the American Negro population: MELVILLE J. HERSKOVITS (introduced by Professor Franz Boas).

Studies of the physical anthropology of the American Negro show, after a number of generations of crossing, the formation of a relatively definite type. This type in spite of its heterozygous character, is quite homogeneous, and has been effected by a social selective mechanism involving the desirability of Caucasoid traits, dark men choosing light-colored wives. It is important, however, to investigate differences within this population

which occur with differing environments, various places of birth, and different occupations, and such differences are analyzed in this paper.

Elden Pueblo: J. WALTER FEWKES.

The object of the communication was to announce the discovery, by archeological methods, of a prehistoric pueblo which had never been described. This ancient pueblo is situated six miles east of Flagstaff, Arizona, and about two hundred yards west of the National Trail Highway. An attempt is made to indicate the affinities of its former inhabitants as shown by the objects found illustrating the arts and customs of these people.

This pueblo was excavated during the period from June to September of the present year. It was practically unknown to any scientific man before May, although the artificial appearance of the clearing in the pines had been recognized as the site of a settlement from the time Flagstaff was settled by the white people.

The name "Elden Pueblo" was given to the ruin by the author on account of its neighborhood to Elden Mesa, an eastern spur of the San Francisco Mountains. Its form is rectangular in shape, oriented north and south, measuring one hundred and fifty feet long by about one hundred and twenty-five feet wide. It contains one ceremonial room corresponding to a kiva, which was used for councils and religious purposes. The masonry of the walls is perhaps the crudest of that of all the pueblos. Many of the stones that formed the walls were megaliths, unworked and set on edge. It was found necessary to cement the top of the walls in order to prevent the water from percolating through the structure; in this way the rocks were fastened in place; only a few of them were squared or set in series. Apparently the wall of the structure was two stories high, and with the exception of one opening there were no lateral entrances.

A Pliocene bear from Oregon: JOHN C. MERRIAM and CHESTER STOCK.

The history of the bear group in America is of exceptional interest, both by reason of continuity and evolution in the geological history of this group, and because of the bearing of the biological aspect of this problem upon questions concerning geographical history of the northern hemisphere.

Numerous specimens representing the bear group in the three geological periods preceding the present have been found in the last few years in America. A specimen of exceptional interest discovered in connection with the paleontological and geological work in eastern Oregon furnishes new information regarding relationship of American bears to those of the Old World, and is of much importance in determining the geological age and relationships of one of the best known units in the geological sequence of eastern Oregon.

The embryology of Amphioxus and the equipotential theory of development: EDWIN G. CONKLIN.

The general result of these studies on the normal and experimental embryology of *Amphioxus* is to show (1)

that the localization pattern in the egg and embryo is essentially the same in Amphioxus, ascidians and amphibians, (2) that while the power of regulation is greater in Amphioxus and amphibians than in ascidians, in none of these do posterior blastomeres give rise to neural plate, notochord or elongated embryos, (3) in all of these chordates anterior blastomeres may develop neural plate, notochord and elongated embryos, but in ascidians and amphioxus, at least, such embryos are deficient in mesoderm, (4) in no case of isolated or partially isolated blastomeres of Amphioxus or ascidians is there any evidence that the intrinsic axes and polarity have been changed. (5) Finally, the potency of individual blastomeres is determined by their material substances and not by immaterial entelechies.

An experimental study of organization in the egg: D. H. TENNENT (introduced by C. E. McClung).

The work of which this is a brief report was begun by C. V. Taylor and D. H. Tennent at Hopkins Marine Station, Pacific Grove, Calif., in 1923, and continued by them during the summer of 1924 at the Tortugas Laboratory of the Carnegie Institution of Washington. It was brought to its present form by C. V. Taylor, D. H. Tennent and D. M. Whitaker, at Tortugas during the summer of 1926.

In 1901 Boveri showed that in eggs of the sea urchin *Paracentrotus lividus* scattered pigment became concentrated, during maturation, in a ringlike zone lying in the vegetative half of the egg and standing at right angles to the egg axis. Boveri concluded that the vegetative, unpigmented cap furnishes the primary mesenchyme, that the pigmented zone forms the intestine and its derivatives, and that the unpigmented animal half gives rise to the ectoderm.

It has been very generally inferred that a similar zone exists in the eggs of other sea urchins, although it is not made visible by the localization of pigment, and that this zone separates the animal half, containing potential ectoderm, from a vegetative cap of micromere-forming material.

Our experiments show conclusively that in the egg of the sea urchin *Lytechinus variegatus* there is no localization of micromere-forming material before fertilization, and that although the micromeres may be separated by the fourth cleavage at the definitive vegetal pole of the egg, the material thus separated has neither been in position as a polar cap, nor has it had any other localized distribution.

By means of Taylor's apparatus, eggs were cut in any plane desired, giving a pair of fragments, one nucleated, the other non-nucleated. Both members of a pair were then fertilized, and kept under continuous observation throughout critical cleavage stages. Many of these pairs were also reared to blastulae, gastrulae and plutei for evidence on later processes of development.

The evidence indicates an epigenetic development of micromere-forming substance from material from which both ectoderm and endoderm are differentiated. The number and relative distribution of micromeres is independent of the plane of section, and within limits, of

the size of the fragment. The number and distribution of micromeres is not dependent on the n or $2n$ quantity of nuclear material. The orientation of the cleavage planes, the place of formation of the micromeres, and the place of invagination of the archenteron indicate that the definitive polarity of the egg fragments is in an axis lying at right angles to the surface of section. Micromeres are formed and the archenteron invaginates from the newly established vegetative pole.

General principles of the relation between growth and behavior in vertebrates: G. E. COGHILL (introduced by Henry H. Donaldson).

Growth is here regarded, not in the phase of change in size or mass, but as progressive change in structure, or, technically, cytomorphosis. In this sense growth within the nervous system causes progressive development of behavior. This has been demonstrated in studies on *Amblystoma*. Upon the basis of the results of these studies correlated with facts from other sources the following conclusions may be stated as general principles underlying the development of behavior in vertebrates.

1. Growth of the nervous system before nervous functions begin is localized in definite foci, and these become centers of control of the behavior pattern of relatively advanced or even adult life.

2. The growth of nerve cells into non-functional or nascent organs while these same nerve cells are functioning in an earlier behavior pattern compels the earliest movements of such organs to be, not local reflexes of the adult type, but inseparable components of the total behavior pattern of the individual.

3. The individuation of organs and organ-systems out of the total behavior pattern into discrete systems of specialized function is anticipated in the central nervous system by the growth of elaborate mechanisms for the integration of their functions.

4. In the early phases of the development of behavior the individual is possessed of nervous organization far beyond that which is required for its immediate capacity to react to or upon its environment; and the degree of this "forward reference" to behavior in the growth of the nervous system in embryonic and later life appears to be, at least in a general way, directly proportional to the learning capacity of the species.

5. These conclusions or principles point to growth as the creative function of the nervous system.

Mammalian growth curves: C. B. DAVENPORT.

The comparison of curves of growth increments in guinea pig, rat and mouse show that, as in the case of man, there is a circumnatal spurt, of great velocity, which reaches its climax just as the placental connection with the mother is severed.

This is followed by a decline in the rate of growth for three or four days which represents the period of adjustment to terrestrial life. This is quickly followed by a return to the standard velocity of growth which in the rat, but not in the guinea pig, is greater, though only slightly greater, than the circumnatal velocity.

In all cases the velocity of growth soon thereafter de-

clines to a minimum which, in the case of the guinea pig, is about 42 days, in the case of the rat 9 days, in the case of the mouse 7 days. This minimum corresponds to that which recurs at 3 years in the human child.

But whilst in the human infant some 7 years elapses before the adolescent spurt starts, in the case of the 3 rodents that spurt begins without delay. The crest of this spurt coincides with the beginning of sexual maturity. It stands, in the guinea pig at about 70 days, in the rat about 50 days, in the mouse at about 25 days.

The maximum length of the ordinary human life span may be taken as 295 hundred days, that of the guinea pig at 15 hundred and that of the mice as 10 hundred days. Reducing these life spans each 100 per cent., we may determine the percentage of the whole constituted by each of 4 periods; namely, intrauterine, prepubertal, reproductive and senescent. The most striking contrast in this comparison is the prepubertal life of the child—relatively 2 or 3 times as long as in the other mammals plotted. The second outstanding fact is that the reproductive period in man is relatively short, only about two thirds that of the mouse. On the other hand, man's post-reproductive period is correspondingly prolonged.

Thus, as compared with some other mammals, man has a relatively brief intrauterine life, a long childhood, a brief reproductive period and a long post-reproductive period. Evidently this result permits of prolonged training for the period of maturity when a man's best work is done. It tends to lead man to minimize the real importance of reproduction to the species. It tends to emphasize training and achievement and the accumulation and transmission to the next generation of the results of experience which are possible where life is prolonged beyond the reproductive period. The tendency of modern, intensive professional training and the stress on economic status is to extend the pre-reproductive period throughout the first third of life, so that practically only about 25 per cent. of the maximum life span is available for reproduction.

The high development of the human species in matters economic, social and intellectual has been favored by his slow development and brief reproductive period. The pressure for development on the social and economic sides in the intellectually more advanced biotypes of *Homo sapiens* cuts into the reproductive period so deeply as greatly to handicap the numerical strength of that biotype in the population; indeed it constantly threatens to result in the extermination of that biotype.

The synthesis of isomers of proflavine and of neutral acriflavine: M. T. BOGERT and P. G. I. LAUFFER.

Proflavine base (2, 8-diamino acridine) and Neutral Acriflavine 2, 8-diamino-10-methylacridinium chloride) have proven to be valuable bactericides and general antiseptics, and were used with considerable success during the recent war and in the treatment of wounds. It was thought of interest, therefore, to prepare isomeric compounds in which the amino groups were para and not meta to the acridine N, and we have synthesized the 3, 7-diamino derivatives by the following series of reactions: o-chlorobenzoic acid $\rightarrow$ 2-chloro-5-nitrobenzoic acid

$\rightarrow$ 2- (p-nitrophenylamino)-5-nitrobenzoic acid $\rightarrow$ 3, 7-dinitro acridone $\rightarrow$ 3, 7-diamino acridone $\rightarrow$ 3, 7-diamino acridine (Proflavine isomer) $\rightarrow$ 3, 7-diacetylaminio acridine $\rightarrow$ 3, 7-diacetylaminio-10-methylacridinium methyl sulfate $\rightarrow$ 3, 7-diamino-10-methylacridinium chloride (Neutral Acriflavine isomer). These new products are now being tested pharmacologically by Professors Hirschfelder, of the University of Minnesota, and Lavis, of the University of Nebraska.

The electrolytic dissociation of water in salt solutions:

HERBERT S. HARNED (introduced by Edgar F. Smith).

A method is outlined for evaluating the activity coefficient and ionic concentration products of the hydrogen and hydroxyl ions in aqueous salt solutions.

It is shown that the dissociation of water increases rapidly, passes through a maximum value and then decreases upon salt addition. The dissociation of water at a given salt concentration is greatest in the solution of the electrolyte which possesses the highest activity coefficient. By comparison with values obtained for the dissociation of formic acid in salt solutions, it would seem that weak acids and bases may all behave in a similar manner.

Fluo-germanates of the univalent metals: JOHN H. MULLER (introduced by Edgar F. Smith).

Review of the literature of germanium shows that salts of the hypothetical acid H_2GeF_6 , with the single exception of the potassium salt, have not been hitherto prepared. The complete series of the alkali metal fluo-germanates and the corresponding compounds thallous thallium and silver are described together with methods of analysis of these new compounds and determination of their respective densities, melting points and solubilities.

All these salts are beautifully crystalline and colorless, those of sodium, potassium, rubidium and caesium are much more soluble in hot than in cold water and may be easily purified by recrystallization from hot water on cooling. On the other hand the lithium, thallous and silver salts are so soluble even in cold water that their preparation in crystalline condition is much more difficult. The silver salt is peculiar insofar as it is soluble in water in all proportions near its melting point (80°) and dissolves in about its own weight of water at 30° .

All the alkali fluo-germanates are remarkably stable and in aqueous solution are entirely undecomposed by hydrogen sulphide both in presence and absence of free hydrofluoric acid or in dilute or concentrated solution. This would indicate of course that the anion of fluo-germanic acid is a rather firmly bound complex, incapable of yielding the germanium ion in solutions of its salts.

It should be stated that Dr. R. W. G. Wyckoff, of the Geophysical Laboratory in Washington, has undertaken the X-ray spectral examination of these new salts and through his kind cooperation has already shown that caesium fluo-germanate differs strikingly from its potassium analogue in possessing a cubic structure. Similar measurement of the other members of the group will undoubtedly make their preparation well worth while.

(To be continued)