a piece of glass tubing of the desired diameter and about 4 cm long. A 3-hole rubber stopper is inserted in one end, and the other end is fitted with a narrow piece of soft rubber tubing, which furnishes a cushion for the leaf. The center hole of the stopper is for the glass tubing through which the fresh air can be supplied. The thermometer is inserted in the second hole and the third will accommodate the exhaust tube. This tube may be bent in such a way that it can be attached to the stem by means of friction tape and thus support the air-chamber.

For convenience in calculating the results, the diameter of the glass tube from which the air-chambers are made should be carefully chosen, so that the area of the opening is exactly 1/10, 1/7, 1/5, or any simple fraction of 100 sq. cm. The inside diameter of the brass ring which holds the leaf in position corresponds to the opening of the cup. The activity of a definitely limited area is thus determined so that it is unnecessary to measure the total leaf surface. Where the same area is used, the air supply can be accurately regulated and held constant in successive determinations. This is important if the carbon dioxide supply is not to become a limiting factor in the results. Where the suction available is not sufficient to supply at least 2 L of air per hour for each sq. cm of leaf surface, an air-chamber with smaller diameter may be used.

The results obtained with these cup chambers have been slightly higher on the average than those obtained with the Cellophane envelopes. This may be due to the fact that no account is taken of the gaseous change that might occur through the upper surface of the leaf, but mainly to the fact that excessively high temperatures are avoided and that the air supply is always adequate for maximum rates.

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ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING. III.

(*Continued from page 496*)

Recent studies on chemical mediation of nerve impulses: W. B. CANNON. Previous studies by Cannon and Bacq proved that a substance, which they called "sympathin," is given off from smooth muscle when it is stimulated by sympathetic nerve impulses. Sympathin is carried in the blood stream and has sympathomimetic effects on denervated structures (salivary glands and cardiac and smooth muscle) elsewhere in the body. Adrenin likewise has sympathomimetic effects; it has been assumed that sympathin is the same as adrenin. The present investigation has shown that sympathin differs from adrenin and that two kinds of sympathin are produced: one from smooth muscle when made to contract, that causes elsewhere only motor or excitatory effects, sympathin E; the other from smooth muscle when made to relax, that causes elsewhere only inhibitory effects, sympathin I. These observations introduce a new phase in our knowledge of chemical mediation of nerve impulses.

Studies on the function of the adrenal cortical hormone and the cause of death from adrenal insufficiency in dogs: W. W. SWINGLE (introduced by E. G. Conklin). The chief function of the adrenal cortical hormone appears to be the regulation and maintenance of a normal circulating volume of fluid within the vascular system. In the absence of the hormone, fluid is continually lost from the circulation, presumably by transudation through the capillary walls, with the result that the adrenalectomized animal is unable to maintain his normal blood volume, and eventually dies from circulatory collapse due to insufficiency of circulating fluid. Accompanying the progressive decrease in blood volume is a progressive fall of blood pressure to the death level. The decline in arterial pressure is apparently a direct result of the decreased volume of circulating fluid. The decrease in blood volume and blood pressure are not terminal phenomena in adrenalectomized animals but first appear within twenty-four to seventy-two hours after discontinuing hormone injections, and before active symptoms of insufficiency appear. Both volume and pressure steadily decline to the death point which may not occur until eight to twelve days later. Hemoconcentration, decreased renal activity, rise in blood non-protein and urea nitrogen, increased blood viscosity and the marked slowing of the circulation which invariably appears, are all directly correlated with and chiefly dependent upon the decline in plasma volume and blood pressure. Adrenalectomized animals, in the absence of the cortical hormone, are apparently unable to draw fluid back into the blood stream through the capillary walls. Following administration of adequate amounts of cortical hormone to prostrate animals, the blood volume, blood pressure and blood constituents return to normal. The animal is able to dilute its blood and build up a normal blood volume and all symptoms of adrenal insufficiency disappear. It is our opinion that all of the manifestations, symptoms and physiological peculiarities, which have been described as occurring in adrenalectomized animals are merely results of a progressively failing circulation due to decreasing volume of circulating fluid in an animal which is unable to compensate (as do normal animals) for its low blood volume and blood pressure by dilution.

The progressive degeneration of nerve: G. H. PARKER and V. L. PAINE. When the lateral-line nerve of the

catfish, Ameiurus, is cut near its origin in the fish's head, the nerve degenerates over its whole distal length. If degeneration in the medullary sheath and the neurofibrils is studied, the process is found to take place progressively, beginning near the degenerative cut and spreading away from the region of injury. Degeneration progresses over the nerve at a rate of from three to five centimeters per day and is best seen between six and thirteen days after the degenerative cut has been made. Progressive degeneration of nerve is contrary to the ordinarily accepted view which is based, for the most part, on a study of nerve in warm-blooded animals. Here the rapidity of the process makes it difficult to observe the real operation which is better studied in such a cold-blooded form as the catfish.

Concerning reticulo-endothelial cells and the utilization of the magnet to procure them: PEYTON ROUS and J. W. BEARD. Fixed on the walls of the blood vessels of certain mammalian organs are peculiar cells, usually termed reticulo-endothelial, which rapidly remove bacteria from the circulation and destroy them. They also remove damaged blood corpuscles and injected particulate matter, becoming greatly engorged therewith on occasion. It is supposed that these cells constitute a physiological system having various important activities; but of this there is no certainty, because the cells have appeared to be inaccessible to direct study. The authors find that they can be obtained alive from deeply anesthetized animals by injecting particles of highly magnetic ferric oxide into the blood stream; loosening the iron-containing cells afterwards from their principal situation, within the liver, by means of massage and a stream of fluid; and selecting them from the host of other elements in suspension by means of an electromagnet. The reticulo-endothelial cells so procured flourish under suitable conditions outside of the body and behave characteristically, manifesting their recognized activities. Experiments to test their presumptive functions are under way.

Human insensible perspiration as a laboratory and clinical measurement: FRANCIS G. BENEDICT. The ordinary person sitting quietly loses in weight about 30 grams per hour, due chiefly to the vaporization of water from the lungs and skin. This insensible loss in weight, the so-called "insensible perspiration," is closely correlated with the total heat production, and hence varies with the size of the individual and with the metabolism. This measurement has important relations to studies in so-called "water balance" and is of significance in cases where the metabolism can not be measured directly. Thus its use for estimating the total heat production of people for twenty-four hours has been of great value.

Primary and secondary 1n+1 types, a new unbalance in the jimson weed: A. F. BLAKESLEE, S. SATINA, A. D. BERGNER and A. G. AVERY. Among the plants of *Datura stramonium* growing in the greenhouse this past winter, there were two small individuals which resembled haploids (1n) in appearance, but which at the same time had peculiarities suggestive of the known effects of extra chromosomes in certain primary and secondary 2n+1 types. Their preliminary classification as 1n+1 forms has been confirmed cytologically by finding 13 chromosomes in pollen-mother-cells and root tips instead of the 24 characteristic of normal diploids (2n). Judging from appearance, the first type has the primary 15·16. If this is true, we have identified four types with characters brought about by unbalance of this 15·16 chromosome extra and its formula would be 1n+15·16. The series in order of increasing unbalance would be 4n+15·16, with unbalance of 1 vs. 48; 2n+15·16 with unbalance of 1 vs. 24; 2n+2 (15·16), with unbalance of 2 vs. 24 (or 1 vs. 12); and 1n+15·16, with unbalance of 1 vs. 12. The second plant from appearance is probably a 1n+7·7 type. This haploid secondary, if it actually is a secondary, would have twice the numerical unbalance of the diploid secondary 2n+7·7, which was its female parent. It would have an unbalance of two ·7 halves vs. 12, which is the most extreme unbalance so far secured in any type of Datura. It is hoped it will be possible to confirm the tentative classification of the extra chromosomes if offspring can be obtained from these extremely weak plants and if a sufficient number of pollen-mother-cells can be secured at the proper stage of division. Lesley and Frost have reported a haploid Matthiola with a small chromosomal fragment extra, but apparently these two 1n+1 plants in Datura are the first haploids to be reported with a whole chromosome extra.

Gene constitution and endocrine quality in determining growth reactions: C. R. STOCKARD. In various crosses between structurally contrasted pure breeds of domestic dogs localized structural peculiarities occur, resulting from the presence of one or more genes which determine a given structural pattern. The growth and pattern in one body region may be quite normal, while a modified pattern is developed in another region in spite of the same chemical or endocrine environment existing in the several regions. A significant example of these facts is shown in the inheritance and development of the short-twisted tail of the English bulldog when crossed with the long-tailed short-legged basset-hound. The bulldog-tail is transmitted as a double recessive in inheritance and its expression is related to two factors probably located in different chromosomes. The homozygous double recessive appears in the second generation in only one in sixteen individuals. Dystrophy in the cartilages of the skull and of the tail vertebrae in the bulldog might be thought of as similar reaction in the two separate regions to a common internal cause. However, some of the second generation hybrid individuals from crosses between the bulldog and basset-hound may show almost normal hound-like heads and yet possess the deformed short-twisted bulldog tail. Such individuals, homozygous for both recessive factors determining "screwtail," develop chondrodystrophy of the tail vertebrae in the same endocrine environment in which the skull and extremities grow and develop quite normally. This would seem to indicate that general endocrine conditions may be in-

effective in regulating the type of growth response in opposition to the genetic constitution. For illustration, ordinary individuals may not respond in their growth reactions to pituitary modification in the same manner as might those inheriting acromegaly.

Retinal rivalry as a neglected factor in stereoscopic vision: MARGARET F. WASHBURN. This paper argues that a neglected but important factor in stereoscopic vision is, not the combination of two slightly different images on corresponding points of the two retinas, but the alternation of these images in retinal rivalry. That rivalry occurs when the stereoscope is used is well known. This paper demonstrates (a) that it occurs in our ordinary perceptions of solid objects, a fact apparently hitherto unrecorded; and (b) that when similar figures, each containing all the lines of both the right and left views of a solid object, are combined by a stereoscope the figure looks flat, because rivalry is absent, although it contains all the retinal elements for a stereoscopic effect. Since solidity is itself primarily a motor experience, involving the movements of handling and grasping an object, it seems natural that it should be suggested not by a static fusion of retinal images but by an apparent movement. Rivalry occurs both in the stereoscopic slide and in ordinary vision, and as one eye's image becomes dominant over that from the other eye, the apparent movement produced is identical with that which would be produced by part of the object's approaching or receding in the third dimension.

The "spread" or "scatter" phenomenon in learning: EDWARD L. THORNDIKE. A satisfying after-effect of a mental connection works back upon it to strengthen it. But this confirming influence of a reward is not entirely concentrated on the one connection to which the reward belongs. The influence strengthens also neighboring connections in the series. Curves are presented showing the extent and amount of this "spread" or "scatter" for several representative sorts of learning. The significance of the discovery of this phenomenon for general theories of modifiability is discussed briefly.

Basic approaches to a science of music and speech: CARL E. SEASHORE. Our researches in the psychology of music have revealed the surprisingly close relationship between the science of music and the science of speech, which it is important to recognize in the further organization of research. The paper classifies the types of relationships which have been discovered through experiment, and, on the basis of these, outlines a program for a laboratory of phonetics devoted to the science of these two arts.

Aristogenesis, the observed order of biomechanical evolution: HENRY FAIRFIELD OSBORN. This is the author's ninth contribution on the problem of the origin of species and principles of biomechanical evolution observed in paleontology. The term "biomechanical" applies to organic mechanisms. No more apt term than "aristogenesis" can be applied to the observed order of biomechanical adaptation exemplified in the grinding teeth and horns of mammals, as closely observed during the past half century. Aristogenesis is a concrete principle; it has no theoretic significance such as the "entelechy" of Aristotle, the "pangenesis" of Darwin, the "vitalism" of Driesch, the "bathmism" of Cope, the "emergence" of Morgan, the "holism" of Smuts. Like the "biogenesis" of Haeckel signifying recapitulation, aristogenesis signifies adaptive origin. As a process of nature it is not to be challenged as a concept, still less as an explanation, hypothesis or theory. We know how it works, but at present we have no hypothesis as to why it works or as to what its causes are. A definition of aristogenesis is as follows: Aristogenesis is the gradual, secular, continuous, direct, reactive, adaptive origin of new biomechanisms. It is a creative process from the geneplasm, of entirely new germinal characters. It is the orderly creation of some better or more adaptive biomechanism. Certain lines of descent are distinguished by the potentiality of creative origin from the geneplasm of new adaptive biomechanisms. Germinally predetermined origin of new biomechanisms tends toward betterment, and arises independently, in widely separated geographic areas, at same or different aristogenic rates. Aristogenesis is a secular genetic and adaptive reaction rather than an immediate adaptive somatic reaction to new habit or environment as in Lamarck's theory. *Aristogenes* in origin and early development are wholly independent of the natural selection principle of Darwin. Whereas *Aristogenes* are predetermined by germinal potentiality, progressive differences in species arise also through more or less profound changes of form and proportion distinguished as *Allometrons* and expressed in measurements and indices, for example, in the familiar proportional changes of the head expressed in the Greek terms brachycephaly (broad-headed, index 80) and dolichocephaly (long-headed, index 70). Allometrons are relatively rapid in development or temporal, whereas aristogenes are relatively slow or secular. The 19 aristogenes of a lower Miocene mastodont occupy from 10 to 14 million years in rising to the 34 to 37 aristogenes of an upper Miocene mastodont. So far as the modes in which the "origin of species" is defined by biomechanisms we are now on absolutely sure ground. This ground is contra-Lamarckian and contra-Darwinian. It is also contrary to the neo-Darwinian evolutionary hypotheses of the leading biologists and geneticists of our day.

The general formula of heredity: HARRY H. LAUGHLIN (introduced by Henry Fairfield Osborn). Most inborn qualities, whether structural or functional, which are constitutionally important in human life, which are essential to well-bred domestic plants and animals, and which are therefore highly hereditary, are not single Mendelian units, nor are many of them based upon so few as two or three genes working additively. For the most part, each such valuable quality is the somatic end-product of many genes, which in development interact in many ways. Many such multi-genic traits are definitely measurable as end-products in the individual, and consequently we can compute the probability that the particu-

lar quality developed to a specified degree will appear in a pre-indicated or random-selected offspring. The basis of such prediction is the degree of development of the selected quality in each of the several near blood-kin. The traits or qualities which can be thus predicted may be structural or functional, vital or insignificant, useful or injurious, but they must be measurable as entities in the individual, and they must show a definite tendency to "run in families." For all such traits, the formula of heredity works out mathematically: $K = f(M, R)$. K is the probability that the pre-indicated or random-selected offspring, with a given M or prediction basis, will fall within the selected R or class range of offspring. The mathematical model of this formula is always a "skewed saddle."

Evidences of man's ancestral history in the later development of the child: C. B. DAVENPORT. It has long been known that man, in his foetal development, passes through many stages reminiscent of the course of the evolution of the human species. Thus tail, gill-slits, tubular heart, amphibian-like kidney, for example, are ancestral. It is less well appreciated that at birth the child is still far from an adult in proportions of parts, and has still to pass through a series of changes shown by adult primates. At birth of the child the chest is a cylinder of approximately circular cross-section. This is the shape of the chest of the foetus of other primates and many other mammals. It is the generalized, undifferentiated form of the chest. In running quadrupeds, like the gazelle and horse, the depth of the chest becomes greater than the breadth. But in man, the breadth becomes greater than the depth. The circular-cylindrical chest is rather characteristic of adult tree-climbers, and fits them for the undifferentiated movements required in climbing; for specialization in upright walking it is convenient that the arms swing free of the torso, and this result is attained in adult man's broad shoulders; but these broad shoulders are achieved relatively late in development. Again, the upper and lower segments of the leg of the human foetus are, in the early months, very unequal, since the thigh takes the initiative in rapid growth. This appears to be an undifferentiated condition. Later the lower leg grows rapidly so that it approaches equality with the thigh; that is, about 90 per cent. at eleven or twelve years. This is the condition that is rather characteristic of tree-climbers. After this pre-adolescent stage the femur forges ahead, and the leg index falls in the adult condition to about 84 per cent. This long thigh takes the adolescent out of the childish, ape-like class of climbing, jumping, romping animals into that of walkers and runners. The human foot shows remarkable adaptations to supporting the great weight of the body upon the spool-like talus and distributing that weight to the whole foot in the most efficient fashion. But the adaptive changes are completed only as adolescence appears. The infant has a rather low instep, like anthropoid apes. This instep increases to adolescence, and gives a valuable resilience to the step. The human fetal foot is at first long, as compared with the lower leg, just as in the anthropoid ape. This may be regarded as a generalized condition. In later months this foot index diminishes from 95 per cent. to 90 per cent.; in the adult boy to 65 per cent., while it remains at about 90 per cent. in the adult gorilla and chimpanzee. A long heel is a human characteristic. The foetus has a relatively short heel bone, a condition that is retained by adult chimpanzee and orang-utan, but the heel bone increases in childhood up to adolescence. The parallelism of ontogeny and the phylogenetic series is clearly due to the fact that the higher forms pass through the same embryological stages that the lower forms do, but they go beyond the point at which the less evolved species stop their development.

Racial aspects of the pathology of the ear: ALEŠ HRDLIČKA. The collections of the division of physical anthropology, U. S. National Museum, include now over 15,000 racial crania, over three fourths of which are American. This American material is largely precolumbian and comprises a number of series ranging from hundreds to several thousands of specimens, including the contents of entire large burial grounds, and these series are not only of great value to anthropology but also to the study of prehistoric American pathology. One of the most interesting categories of pathological conditions shown by the material comprises the defects and diseases of the bony ear structures. The present paper deals with the two most striking conditions of this nature, namely, a complete congenital absence of the external auditory meatus and apparently of the whole tympanic bone; and ear exostoses. In the present communication the speaker reports the results of personal examination for ear exostoses in 7,814 skulls, Egyptian, Eskimo, American Indian, Polynesian, Negro and Melanesian. The abnormalities are shown decisively to be most frequent in certain inland groups of the Indian, and next in the Polynesians. They are never congenital, and rare in childhood, developing essentially during the earlier half of the adult life. They are moderately to considerably more common in the males than in the females, more frequently bilateral than unilateral, and when unilateral they show a tendency to develop more commonly on the left side. They vary much in number, size and shape, and often show more or less symmetry on the two sides. They, the speaker concludes, are not incidental or chance formations, but represent a generalized pathological entity, an oto-exostotic diathesis, which manifests itself in different degrees in different racial and local human groups, according to local checking or favoring conditions.

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