physical space-time continuum is five dimensional (instead of, as formerly, four dimensional) in which the empiric four-dimensionality of the physical continuum can be accounted for by the hypothesis that the physical variables are independent of the coordinate $\times 5$. By postulating a Riemann metric in five dimensions, Kaluza reaches field laws which agree in first approximation with the known field laws of gravitation and electricity.

Among the considerations which question this theory stands in the first place: It is anomalous to replace the four-dimensional continuum by a five-dimensional one and then subsequently to tie up artificially one of these five dimensions in order to account for the fact that it does not manifest itself.

We have succeeded in formulating a theory which formally approximates Kaluza's theory without being exposed to the objection just stated. This is accomplished by the introduction of an entirely new mathematical concept which may be described as follows:

Until now it has been believed that one can introduce into a space of n dimensions only vectors or vector-fields of which the number of components agrees with the number of dimensions of that space. It appears, however, that this restriction is not necessary. It has its origin in the "anschauliche" significance of those vectors responsible for the formulation of the vector concept. We have been successful in introducing into space R_n of n dimensions, vectors $a^i (i = 1 \ldots m)$ of m components and in deriving a calculus of such vectors and tensors which is essentially no more complicated than the well-known absolute calculus.

Our theory arises quite readily from consideration of five-vectors (five components) in the four-dimensional continuum. There follows from that a "five-curvature" of space which is analogous to the Riemannian curvature, and which bears a similar relationship to the laws of the unitary field that the Riemannian curvature does to the relativistic equations of the gravitational field alone.

This theory does not yet contain the conclusions of the quantum theory. It furnishes, however, clues to a natural development, from which we may anticipate further results in this direction. In any event, the results thus far obtained represent a definitive advance in knowledge of the structure of physical space.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PROTECTIVE COATINGS FOR MINERAL AND ROCK SPECIMENS[1]

A LARGE number of density determinations are made in this laboratory on rock specimens, many of which are very porous and some quite friable. The method used was described by Gealy[2] and consists of measuring the volume of the specimen by noting the displacement of mercury in a Russell tube, the weight of the mass and the volume of the grains. In 1920, Melcher[3] described a method for determining pore space of oil and gas sands in which he coated the specimens with paraffin to prevent loss of material and penetration of the immersion liquid. The amount and volume and density of this paraffin had to be determined and account taken of these factors in computing the pore space of the sand. Furthermore, great care had to be exercised in the application of the paraffin to keep it from penetrating too deeply into the specimen and to prevent or eliminate air bubbles in the paraffin itself which would vitiate volume measurements. Gealy substituted mercury for acetylene tetrachloride in the Russell apparatus in order to eliminate the use of paraffin. However, it was found that even mercury has a tendency to penetrate the very large pores of a rock and often erroneous volume measurements were obtained.

This difficulty has now been overcome by the use of a new protective coating consisting of a solution of ordinary photographic film in butyl acetate. The emulsion is thoroughly cleaned off of used film by digestion in hydrochloric acid. Just enough butyl acetate is used to cover the film and it is set aside in a closed vessel to dissolve. Solution takes place quite slowly. It is necessary to filter, using a suction filter, to obtain a product that is free from strings. When applying the coating of film scrap to a specimen it may be diluted with acetone if necessary. The solvent evaporates very rapidly and seems to leave a plug of film in the outer pores that effectually prevents penetration of a non-solvent liquid. No readily discernible coating is left on the specimen. By trial it has been shown that the volume of the coating can be ignored for all practical purposes since it affects the percentage pore space volume only in the third decimal place.

Another very important and possibly extensive use for film scrap solution, once it is known to scientific men, is in the preservation of museum specimens. A specimen of sandstone that was so friable it could not be touched without considerable loss of material was covered with film scrap applied with a camel's hair brush. In a few moments it was dry and in appearance the coated specimen could not be distinguished from an uncoated one. However, it can now

[1] Published by permission of The Gulf Companies.

[2] W. B. Gealy, Bull Amer. Assoc. Pet. Geol., Vol. XIII, 1929, Part 1, p. 677.

[3] A. A. Melcher, Trans. Amer. Inst. Min. Met. Eng., Vol. LXV, p. 469.

be handled with moderate care and no sand grains are knocked off in the handling. Likewise very fissile shale specimens have been preserved *en masse* for laboratory hand specimens.

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A SHORT METHOD FOR THE PREPARATION OF ANIMAL TISSUES FOR STAINING

CUT the tissue in pieces from two to four millimeters in thickness. Drop these in some ten per cent. formalin solution and heat to boiling. Transfer them to acetone for dehydration and leave them in this liquid for one hour, during which time the acetone should be poured off and renewed with fresh material two or three times. The dish should be covered and put in the paraffine oven, as diffusion takes place more rapidly at the higher temperature. Remove the tissue from the acetone and drop it into a container of melted paraffine. Leave this in the oven for one hour.

Embed, mount on block and cut in the usual manner. Smear the slides lightly with Mayer's albumen, float the sections over this on a drop of water, warm gently to expand them and drain off the excess.

Lay the slides out flat in the paraffine oven. At the end of one hour remove them. After they have cooled, put them in xylol to dissolve the paraffine and proceed in the usual way to stain and finish them.

Excellent slides have been made by this method. If quicker results are desired, cut the tissue in smaller pieces. If larger pieces must be used, allow more time for the infiltration of acetone and paraffine.

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SPECIAL ARTICLES

FURTHER EXPERIMENTS ON CORTICO-ADRENAL EXTRACT: ITS EFFICACY BY MOUTH

A RAPIDLY accumulating mass of evidence indicates that extracts of the adrenal cortex which have recently been developed are markedly potent in both experimental and clinical cases of adrenal insufficiency. The methods of Hartman and his associates[1] and Swingle and Pfiffner[2] have been widely used. In experiments reported from this laboratory full support has been given to the observations of the Princeton workers. We have employed a slightly modified Swingle-Pfiffner technique as described.[3]

Cortico-adrenal extract maintains completely adrenalectomized animals in good health for indefinitely long periods. It readily abolishes the severe symptoms of adrenal insufficiency when allowed to develop, and concurrently restores the blood sugar and non-protein nitrogen levels to normal.

Augmentation of the blood sugar to the normal value occurs in adrenalectomized cats showing symptoms within one to three hours after the extract is given. The increase is approximately proportional to the amount of the material injected; it is produced consistently and repeatedly when potent extracts are used. We have observed the effect at least five times within about ten days in the same adrenalectomized animal.

Cats with severe symptoms of adrenal insufficiency invariably show low blood sugar values. In over thirty cases in our experience, cortico-adrenal extract has raised the sugar percentage to within normal limits or higher. Notable increments in blood sugar also occur in unoperated cats, particularly if young animals are used. Biological assay of the extract based on the observed blood sugar effects is suggested from these results.[4]

The decreases in blood non-protein nitrogen, following extract injection, have not been so characteristic in our experiments. They usually occur more slowly than the glycemic changes, and sometimes are long delayed. These differences are possibly referable to the renal condition (damage?) in the different animals, and also to the fluid content of the tissues. In some cases there is considerable urination following extract administration.

Intraperitoneal injections of pituitrin, ephedrine and ergotamine solutions, known to influence the blood sugar in insulin hyperglycemia and other conditions, do not affect significantly the low blood sugar levels or the symptoms of adrenal insufficiency.

The administration of cortico-adrenal extract has been tested by mouth in a series of animals. The large doses which were found to be necessary, and the relatively small supplies of the extract available, as well as the considerable expense of the material, has somewhat curtailed our observations. Cats have been kept alive by oral treatment, however, for two weeks *after* severe symptoms (convulsions) of adrenal insufficiency became evident. Death rapidly fol-

[1] F. A. Hartman, K. A. Brownell and W. E. Hartman, *Amer. J. Physiol.*, 95: 670, 1930.

[2] W. W. Swingle and J. J. Pfiffner, *Amer. J. Physiol.*, 96: 153, 1931.

[3] S. W. Britton and H. Silvette, SCIENCE, 73: p. 322, March 20, 1931; *Ibid.*, p. 373, April 3, 1931; *Amer. J. Physiol.*, 97.

[4] S. W. Britton and H. Silvette, *Amer. J. Physiol.*, in press.