Dr. G. K. Noble, of the American Museum of Natural History. This note briefly summarizes a method for permanent preservation of the human body by paraffin infiltration.

Four essential steps, well known to all familiar with histological methods, are necessary to preserve a specimen—fixation or embalming, dehydration, clearing and embedding. The different solutions used in the above steps were injected by way of heart and vascular system, and at the same time the specimen was immersed in the solutions.

The embalming fluid which maintained the color of the skin and lips most nearly normal was a solution containing liquor formaldehyde 10 per cent., sodium borate and sodium chloride each 1 per cent. Fixation required about ten days.

Dehydration and hardening was accomplished by gradually increasing strengths of alcohol. Dehydration required about forty-six days.

Xylol containing 5 per cent. of liquid carbolic acid was used as a clearing medium. Clearing required about one week.

Paraffin infiltration was accomplished by means of continued injection of paraffin through the vascular system, together with complete immersion of the body in heated liquid paraffin. Embedding required about one week.

The excess paraffin was removed with xylol and washing under running hot tap water.

In all, experience indicates that adult subjects can be preserved by the above method in about seventy days.

A still-born Negro infant has been successfully infiltrated and embalmed by the technique above described. Unlike mummies of old with their characteristic loss of color, shrinkage, removal of organs, artificial replacements, etc., this infant is preserved *in toto,* retaining its original form and identity in every respect. So natural does it appear that any one would readily mistake it for a living child.

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SPECIAL ARTICLES

GENERAL THEOREMS IN DYNAMICS

I WISH to state some new and simple theorems concerning the motion of a particle in a general field of force. The proofs will be published elsewhere. The results concern the relation between the lines of force and the paths or trajectories. We consider first the case of a particle starting from rest, then a particle projected in the direction of the acting force, then an arbitrary direction.

If a particle starts from rest, it begins to move along the line of force and then deviates from it on account of its acquired velocity. The path and the line of force will, therefore, have the same tangent but different curvatures.

THEOREM I: *The main result is that the curvature of the trajectory obtained by starting from rest is one third the curvature of the line of force.*

A separate discussion is necessary when, at the given point, the curvature of the line of force is zero, as for a point of inflection, for then both curvatures vanish. In this case we consider the ratio of the infinitesimal departures of the two curves from the tangent line. In the main case this ratio would be $1:3$; but now it is found to be $1:5$, $1:7$, $1:9$, etc., depending on the order of contact with the tangent line. It is always of the form $1:2n+1$.

THEOREM II: *If the line of force has contact of n-th order with the tangent line, the trajectory produced by starting a particle from rest will also have contact of n-th order; and the ratio of the departure of the trajectory to the departure of the line of force from the common tangent will be* $1:2n+1$.

THEOROM III: If the particle is projected in the direction of the force with a speed different from zero, the initial curvature will be zero and the departure from the common tangent will vary inversely as the square of speed.

It follows, from I and III, that if any dynamical trajectory touches a line of force it will, at that point, either have zero curvature, or else its curvature will be one third that of the line of force.

THEOREM IV: The single infinity of paths obtained by starting at a given point in the force direction with varying speed under the conditions of Theorem II, will have contact of order $n+1$, and will give departures from the common tangent varying inversely as the square of the speed; except for the single path due to zero speed for which case the contact will be of n-th order and the departure ratio will be of the form $1:2n+1$.

These theorems apply to any continuous differentiable positional field of force, conservative or not, in flat or curved spaces of any dimensionality; and therefore can be used, for example, in the gravitational field of an elliptical planet, or in the problem of three bodies, or in the complicated magnetic field of the earth.

If there is a resisting medium, like the air, Theorem I will still be valid. This is true whenever the resistance R_0 due to zero speed vanishes.

THEOREM V: If R_0 does not vanish, as in the case of sliding friction, the ratio of the curvatures is $1: 3 + 2\frac{R_0}{F}$ where F is the acting force.

We observe that Theorem V includes Theorem I as a special case.

If a particle starts from a given point in a given general direction (not the force direction) with varying speed v, we study, in the last part of the paper, the variation of the successive radii of curvature r, r_1, r_2, . . ., and the loci of the successive centers of curvature C, C_1, C_2, . . . of the successive evolutes of the trajectories. The results for r_1, (quartic law) and C_1, (parabolic locus), and also Theorem I about the ratio 1:3, were given in earlier papers by the writer (Trans. Amer. Soc. Math. 1905–1910; Princeton Colloquium Lectures, *Differential geometric aspects of dynamics,* 1913; an application of Theorem I is given by W. H. Roever, *Bull. Amer. Math. Soc.,* 1915, p. 456). For r and C the results are obvious. The general results are as follows:

THEOREM VI: *The locus of* C_n *is a rational curve of order* $n+1$. *The radius* r_n *of the nth evolute of the trajectory varies as a polynominal of degree* $2n+2$ *in the speed v.*

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SOIL WEIGHTS BEFORE AND AFTER DISPERSION

THERE appears to be a rather common belief among soil chemists and physicists that a soil, after dispersion, may weigh more than before dispersion, the dry weight at 105° to 110° C. being used as the basis of comparison. In this laboratory it was first observed, some ten to twelve years since, that, in the quantitative separation of colloidal material from soils, sometimes the total weight of the fractions into which the material was separated apparently exceeded the weight of the original sample. A somewhat similar observation has more recently been made in carrying out mechanical analyses of soils by the pipette method.[1] In this procedure the soil sample, after dispersion, is wet-sieved so that the clay and fine silt are collected in the sedimentation cylinder. By deducting the dry weight of the sands and coarse silt from the dry weight of the sample before dispersion, the weight of the material in the sedimentation cylinder may be obtained. The weight of this material may also be estimated by removing an aliquot from the sedimentation chamber, evaporating to dryness, and weighing. In practically every case where this check was made it was found that the direct determination by the aliquot method gave a slightly higher value than did the determination by difference. It is to be noted that such difference may be occasioned by an error in the aliquot used, which error is magnified by the aliquot multiple. However, it has been usual to attribute such assumed increases of weight to combination with water when the colloidal aggregates are broken apart by dispersion and a greater total surface is exposed. The added water is sometimes spoken of as "water of hydration."

The assumption of weight increases is not wholly absurd. If, as is the usual thought, soil colloids are produced by hydrolysis of minerals, the "water of combination" of the colloids has been added by just such a process. Further, from experiments with silica gel and with charcoal, it appears that microscopic particles are exceedingly effective in condensing and holding vapors. The dispersion procedure breaks down the structure of many of the colloidal particles formed by repeated wetting and drying in the field. New particles are formed when dispersed soil is dried, and it is possible that these new particles may have a different holding capacity for water than the field particles.

It seems, indeed, quite inconceivable that the time required for soil dispersion can effect any measurable increase in the hydrolysis of unhydrolyzed minerals above that effected in the field during the almost infinite period of formation of the soil. It seems quite improbable that any addition products would be formed by dispersion, and remain stable at 105°, which can not be formed and remain equally stable under field conditions. Nevertheless, the belief in the weight increase, as noted above, seemed so general that it appeared worth while to attempt to determine whether it actually does occur. For this purpose the work reported in this report was carried out.

THE SOILS EMPLOYED

Three soils were used. The sample of Cecil clay loam was taken from the soil profile of the Erosion Experiment Station at Statesville, North Carolina. The B horizon, 6–32 inches, was used. It contains 12.1 per cent. silt and 57.1 per cent. clay. It is a lateritic soil, low in organic matter, low in base content and in exchange base capacity. The finer particles are cemented together rather firmly and it disperses with difficulty.

The sample of Beckett silt loam is a part of a profile taken in a forested area in Massachusetts. The B_2 horizon, 13–24 inches, was employed. It has 30.2 per cent. silt and 9.0 per cent. clay. The Beckett is a podsol soil and is exceptionally acid (pH = 4.1) in this horizon. While it has a fairly high exchange base capacity, it is low in bases. The organic matter and iron-oxide content are both high.

[1] U. S. D. A. Tech. Bul. 170, p. 19.