in moving the train over the mountains. Indeed there is much more sense to such a statement than to say no work is done in holding out a mass at arm's length.

In Fig. 1 is shown the way in which the hand carries a kilogram mass at arm's length over an interval of time. The movement is magnified three fold, while the time interval between the vertical and parallel lines is 30 seconds. Involuntarily the arm sinks a short distance, lowering the mass, then the muscles contract and raise it again. Each time the mass is raised work is done, and unlike the Milwaukee system there is no regenerative process on the down slope. Thus from a purely physical standpoint work is being done in holding out a mass and this work must come from an expenditure of muscular energy which produces bodily fatigue.

It will be noted that at the bottom of each downward motion there is a sudden and quick return, making each low point in the movement sharper than those at the top where the beginning of the letting down process seems to be more deliberate.

Any one who carries a load along a level pathway is also unconsciously letting his load fall to be raised a moment later and so doing work. The swinging stride of one walking along a level path also raises and lowers the load carried and again energy is dissipated. The energy which is thus being utilized is not created out of nothing. It must come from bodily exertion and so we experience fatigue.

This relation between bodily fatigue and work could be amplified still more by the physiologist showing how energy is dissipated in the mere tension of the muscles.

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EFFECTS OF BREED ON EMBRYO SIZE IN THE DOMESTIC FOWL AND THE RABBIT

CASTLE and Gregory[1] have published recently a very ingenious interpretation of Byerly's[2] data on the effects of breed on the growth of the chick embryo. The validity of their interpretation seems to hinge on the soundness of their assumption that the average weight of the unincubated blastoderms in the eggs from Single Comb White Leghorn fowls, 0.0030 gram, is significantly greater than the average weight of the unincubated blastoderms in eggs from Single Comb Rhode Island Red fowls, 0.0028 gram. Byerly judged the difference between these weights to be obviously insignificant and treated his data in accordance with that assumption. Since Castle and Gregory have assumed that the difference in average blastoderm weight is significant, it has seemed necessary to make further measurements of blastoderm weight and to obtain a statistical measure of the variation.

Each blastoderm was washed as free from adherent yolk as possible and transferred to a weighing bottle. Water was removed with a capillary pipette. Some water remained and this accounts for the slightly greater average weights of the blastoderms in the present study than in those described in the writer's former paper[2] for the earlier weights were obtained by weighing several blastoderms at one time. It was possible to remove relatively more of the adherent water in the case of group weighings than in the case of individual weighings. All blastoderms were weighed to the nearest 0.0001 gram.

Twenty-one Single Comb White Leghorn blastoderms had an average weight of 0.00342 ± 0.000181 gram; 22 Single Comb Rhode Island Red blastoderms had an average weight of 0.00333 ± 0.000132 gram. The difference between the average weights, 0.00009 ± 0.000222, is less than half its probable error. Assuming the same variation in the earlier material, the difference between the average blastoderm weights, 0.0002, would be approximately equal to its probable error. Certainly no significance may be attached properly to differences of such magnitude. Byerly[2] was justified, therefore, in his subsequent treatment of his data and therefore in his conclusion that no consistent differences due to breed were present in his data for the first half of the incubation period. Subsequent investigations on growth of the chick embryo make that interpretation still more likely.

Henderson[3] concluded that there are slight, if any, differences in weight of embryos of the same age from matings of Single Comb White Leghorns, of Dark Cornish, and from reciprocal crosses of these breeds. Byerly[4] has shown that a hypothesis that the inherent rate of cell division is the same but that absolute rate of growth under uniform physical conditions of incubation is determined by food supply, is sufficient to account for differences in weight of embryos of the same age in eggs from matings of: Rose Comb Black Bantams; Bantam ♂ × Barred Plymouth Rock ♀; F_1 hybrids from the reciprocal crosses between the Bantams and Plymouth Rocks. The hypothesis is also sufficient to account for embryo size in small eggs, normal-sized eggs, and double-yolked eggs from fowls of breeds which normally produce eggs of standard weight.

Byerly[2] pointed out that different numbers of cells may be present in embryos of the same age, due to

[1] SCIENCE, n. s. 73, June, 1931.
[2] *Jour. Morphol. and Physiol.*, 50, December, 1930.
[3] *Missouri Agri. Exp. Sta. Bul.* 149, Sept., 1930.
[4] *Jour. Exp. Biol.*, in press, 1931.

different percentages of cells in large and small embryos having been capable of division at any given time in the course of development. Such an effect may be produced at any time during the growing period of the animals by many different sets of conditions, for example, by differences in food supply. Castle and Gregory,[1,5] and Gregory and Castle[6] maintain that there is an inherent difference in rate of cell division between their large- and small-race rabbits. Such a difference must be present throughout the period of growth of the normal animals.

Gregory and Castle have collected conclusive evidence that large-race-rabbit embryos have more cells than small-race embryos at the 40- and 41-hour stages. However, their data for hybrid embryos between the two races does not rule out the possibility that the difference in cell number at those stages is due to some factor in the environment of the embryo or in the previous history of the egg. Hybrid embryos from a large male and small female mating had significantly fewer cells at 41 hours than large-race embryos of the same age. The difference in average cell number was 2.39 ± 0.568, 4.2 times its probable error. The difference between small-race embryos and those of the hybrids was only 0.62 ± 0.592. This is not a significant difference since it is only slightly greater than its probable error. Therefore, whatever factor inhibited or delayed cell division in the small-race embryos may also have operated on the hybrid embryos from small females and need not have been inherent in the embryos.

In summary, Byerly[2] offered the more probable interpretation of his data. This has been supported by the results of subsequent investigations. Gregory and Castle[6] have not yet precluded the possibility of other interpretations of their own data.

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[5] *Jour. Morph. and Physiol.*, 48, Sept., 1929.
[6] *Jour. Exp. Zool.*, 59, April, 1931.

OESTRUS-PRODUCING HORMONES

RECENTLY Doisy and his coworkers[1] have reported the isolation from the urine of pregnancy of a crystalline substance possessing oestrus-producing activity, which is distinct from the active substance theelin previously described by them. The latter substance to which they gave the formula $C_{18}H_{21}(OH)_2$ was shortly afterwards isolated by one of us[2,3] and by Dingemanse and coworkers.[4] It was shown subsequently[5] that this substance is represented by the formula $C_{18}H_{22}O_2$ and that it behaves either as a hydroxy ketone or as a dihydroxy alcohol.

There is no doubt that the second substance isolated by Doisy and his coworkers to which they give the formula $C_{18}H_{21}(OH)_3$ is identical with that fully described earlier by one of us.[6,7] Although Professor Doisy refers to the triol previously isolated, there is no suggestion in his papers that it had also been characterized as a trihydroxy substance of the formula $C_{18}H_{21}(OH)_3$. His view that the substance described by one of us is a mixture of both active substances is apparently based solely on a difference between the uncorrected melting points. The evidence of the analytical data, which clearly shows this supposition to be untenable, is ignored.

A year ago when the presence in urine of two distinct oestrus-producing substances was clear to us, we were considerably puzzled over the relationship between them. The suggestion was tentatively advanced[7] that the substance $C_{18}H_{22}O_2$, on treatment with hot alkali, took up the elements of water to form $C_{18}H_{24}O_3$. This supposition was subsequently shown to be incorrect,[8] since the former substance proved to be unchanged by such treatment. At the same time it was shown that both substances occur together in urine, and that by distillation in a high vacuum with potassium bisulphate, $C_{18}H_{24}O_3$ could be converted into $C_{18}H_{22}O_2$. Professor Doisy has made no adequate reference to this work and has advanced the earlier view which has been shown to be untenable.

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JULY 23, 1931

[1] Doisy *et al.*, *Proc.* Soc. Exp. Biol. Med., 28, 88, 1930; *J. Biol. Chem.*, 91: 641, 647, 653, 655, 1931.
[2] A. Butenandt, *Naturwiss.*, 17: 879, 1929.
[3] A. Butenandt, *Deutsch. Med. Woch.*, 55: 2,171, 1929.
[4] Dingemanse *et al.*, *Deutsch. Med. Woch.*, 56, 301, 1930.
[5] A. Butenandt, *Zeit. f. physiol. Chem.*, 191: 140, 1930.
[6] G. F. Marrian, *Chem. and Ind.*, June 20, 1930.
[7] G. F. Marrian, *Biochem. J.*, 24, 1,021, 1930.
[8] A. Butenandt, Abh. d. Ges. d. Wissensch. zu Göttingen; Math. phys. Kl. III Folge, Heft 2, 1931.

AN ADDITION TO THE HERPETOLOGICAL FAUNA OF KANSAS

A SINGLE specimen of *Bufo punctatus* Baird and Girard was secured in the vicinity of Elkhart, Morton County, Kansas, by W. H. Burt and a party of students from the Museum of Birds and Mammals, University of Kansas, between June 25 and July 5, 1927.

I believe this to be the first record of this species in Kansas. The systematic papers on Kansas herpetology, including the recent "List of Reptiles and Batrachians of Morton County, Kansas,"[1] make no mention of it.

[1] E. H. Taylor, *Univ. Kansas Sci. Bull.*, XIX, 6: 63–65, 1929.