therefore, have been greater rainfall in the past when erosion had not accomplished so much of its leveling effect, and remarks that a map of that old-time distribution of rainfall is capable of construction on the basis of the approximate land elevations of the land before denudation took place. In this sense the denudation of the land has been accompanied by diminution of precipitation. It should be remembered, however, that regional uplift has the opposite effect and has not infrequently been the occasion of increase of rainfall and denudation. The Black Hills of South Dakota, for instance, have more rainfall than the region about because of the domed uplift of the region above the plains. It is estimated that 3,000 feet have been removed from their summits by denudation since this uplift and this Kassner would suggest must have been accompanied by diminution of rainfall. But it is quite conceivable that the summits have never been more than 700 feet above the sea, for denudation has been lowering them at the same time that doming has thrust them up. In that case there has been no reduction in height or diminution of rainfall. When uplift ceases and denudation alone controls the elevation, rainfall must undergo the diminution spoken of, but the complete cycle of changes began with increase of rain as the doming first began. This supplied the abundant transporting agent with which erosion resisted further effective uplift and brought increase of precipitation to a halt much as the governor controls the throttle of an engine. From what we may call a mature stage of rainfall, reached likely enough in geographic maturity of the mountain forms, Kassner's diminution must come in.

Mark S. W. Jefferson
Ypsilanti, Mich.

Special Articles

The Development of Unfertilized Frog Eggs Injected with Blood

During three successive springs (1905–7) the writer has experimented on unfertilized frog eggs by injecting them with blood or lymph of either male or female frogs. In all some fifteen hundred eggs have been so operated upon. Shortly before the time for laying, the eggs were taken from the uterus with every precaution to prevent contamination by sperm. Those nearest the cloacal opening were always set aside as a control and in not a single instance did any of them develop. The other eggs were pricked with a very fine-pointed capillary tube which had previously been charged with lymph and corpuscles by dipping it into the lymph or the blood of another frog.

In eggs so treated numerous instances of cell proliferation and embryonic development have been observed, provided the eggs were fully matured and ready for fertilization. Many eggs after six or eight days showed upon sectioning that they had approximated the full blastular and in some cases the gastrular stages, although the condition came about apparently by some sort of internal nuclear arrangement, as no superficial cleavage furrows were observable and no demarcation into cells was visible from the exterior until the third or fourth day, when close inspection showed in some cases numerous small vesicular or cellular outlines.

In some instances definite organs were developed, though frequently distorted and misplaced. Cross-sections of one embryo, for example, showed such pronounced defects as two neural tubes anteriorly. Of the whole number of eggs operated upon only two developed into free-swimming tadpoles and these were apparently normal as far as superficial examination disclosed. They have not yet been sectioned. After sixteen days one died and the other was killed to insure proper fixation for histological study.

Apparently the white rather than the red corpuscles are the stimulating agents which bring about development, because injections of lymph, which contains only white corpuscles, produce the same effect as injections of blood. Whether or not the fluid part of the lymph or blood produced any effect could not be definitely determined from the material at hand. The whole effect seems, however, to be the result of the proliferation of the leuco-

cytes themselves, which, as they become more numerous, tend to migrate to the surface of the egg and finally form into one or more layers. Each nucleus apparently acquires a local area or zone of protoplasm which ultimately becomes marked off from adjacent areas as more or less of a definite cell. The pigment of the egg accumulates around the boundaries of the more superficial areas, which thus appear to be sharply delimited, as seen in sections under the microscope. Although the internal mass of yolk contains numerous nuclei, frequently undergoing amitotic division, the central mass of the eggs remains in a syncitial condition for considerable time.

I am inclined to believe that, in some cases at least, the female pronucleus of the egg takes no part in this cell proliferation, because I have been able to find in sections in several instances a comparatively large clear protoplasmic zone, variously placed in the egg, which, although invaded more or less on all sides by nuclei, itself remains undivided, and in it is visible what appears to be a degenerating nuclear-like structure, presumably the remainder of the female pronucleus.

Many eggs show no development, but this is not to be wondered at, since doubtless a number of them, although pricked, received no corpuscles from the orifice of the capillary tube. Other eggs, presumably not fully ready for fertilization, did not develop; although the corpuscles apparently proliferated extensively, they later ran together to form giant cells and frequently seemed to become phagocytic in nature. In still other cases, what seemed to be phagocytosis was visible on one side of the egg, while on the other side the nuclei appeared to be ranging up into a definite cellular layer. A detailed description of the experiments is in preparation.

MICHAEL F. GUYER
THE UNIVERSITY OF CINCINNATI,
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TRANSMISSION INHERITANCE DISTINCT FROM EXPRESSION INHERITANCE[1]

CONJUGATIONS of sex-cells of higher plants and animals have two results, an intermediate and a final product. The intermediate product of conjugation is a new organism, the final product a new equipment of sex-cells. The new organism is built up by vegetative subdivisions of the conjugating pair of sex-cells. The conjugation is not completed until the new generation of sex-cells is to be formed. Fertilization is the beginning of the process of conjugation, which may not conclude for months or years after fertilization has taken place. The organism which is built up during conjugation may be called a conjugate organism, or *conjugate*. It belongs to the same generation as the sex-cells which initiate the conjugation. The next generation may be called *perjugate*, since it has passed through the conjugation of the preceding generation and represents its completed results.

When sex-cells of diverse parentage are associated in conjugation the organisms they build up (conjugates) may be like one parent, or like both parents, or intermediate between the two parents, or different from either parent. The same latitude of alternatives of expression is found in the perjugate generation. The crossing of two varieties of pink-eyed mice yields black-eyed conjugates. Two varieties of smooth-seeded cottons gave smooth-seeded conjugates, but woolly-seeded perjugates. Such instances prove that the expression-tendency of a gamete can be altered by association with another gamete of diverse parentage. Either the conjugate generation or the perjugate generation, or both, may show characters which neither of the parent gametes would have brought into expression if it had secured a partner of its own kind. There is no corresponding proof that transmission inheritance is altered by such associations. The reappearance of such characters as the black eyes and the woolly seeds, which have been abeyant through many generations, shows that failure of expression does not prove failure of transmission.

Transmission inheritance may be thought of as the dial of a compass which carries many character-directions, though the needle of expression points to only one. This expression-polarity is called dominance in conjugate organisms and potency in gametes. Nobody

[1] Read before the Botanical Society of Washington, April 13, 1907.