seem to be out of all proportion to the actual differences between the adult genera or species.

The facts would seem to force us, if we still cling to the idea that in chromosomes we are to find specific morphogenic substances, to some such postulate as the one already suggested, that only the more superficial and fluctuating qualities are borne in the chromosomes, for then we might appreciate how considerable fluctuation in the number of chromosomes in different species might be reconcilable with the relatively smaller differences between the adults.

However, this idea of the respective rôles of cytoplasm and nucleus in inheritance was offered only as a suggestion, and not as a theory and such it must remain, unless some more convincing evidence is forthcoming. Its only value in this connection is to show that we are not restricted to a consideration of the chromosomes as the sole vehicle of heredity, and that equality in the amount of chromatin contributed by each parent, even should we succeed in assigning heritable qualities to the chromosomes, does not necessarily imply that we inherit equally from each parent.

Michael F. Guyer
University of Cincinnati,
March 12, 1907

Thrusts and Recumbent Folds, a Suggestion Bearing on Alpine Structure [1]

Let it be assumed that as a result of a shearing strain a thrust fault, *A*, is initiated in the crystalline basement of a sedimentary series, and that displacement occurs along a plane which rises at a gentle angle to the plane of stratification. Let it be assumed further that the strata comprise a soft shale overlain by a limestone of moderate thickness, above which is a thick series of sediments.

The immediate effect on the shale will be to thicken it in front of the overthrust crystallines (as was repeatedly observed in the case of soft layers under similar conditions of pressure in experiments on folding described in the Thirteenth Annual Report of the U. S. Geological Survey). In swelling the shale will have somewhat the effect of a laccolithic intrusion and will raise the overlying limestone, forming an anticline.

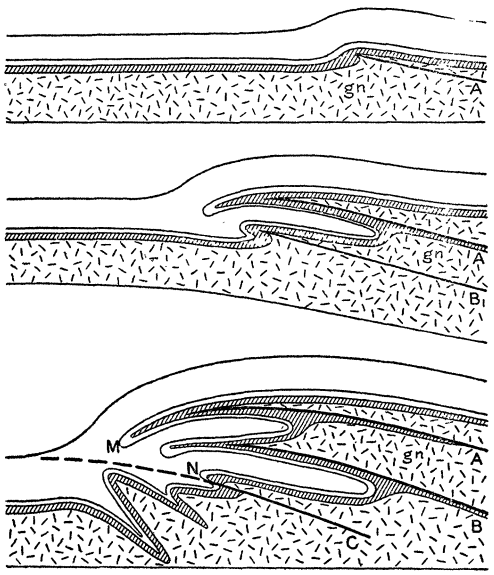

Fig. 1. Hypothetical Development of Recumbent Folds from Overthrust Faults.

If the plane of the thrust forms an acute angle with that of the bedding, the shear may follow the bed of shale, thus separating the limestone and overlying strata from the underlying; and the stress transmitted by the advancing tongue of gneiss to the limestone may roll the latter back upon itself. The overlying strata would become more or less involved in the overfold.

The recumbent fold will develop to a length determined (1) by the competency of the strata to transmit thrust; (2) by the effect of the resistance, which increases as the strata pile up; and (3) by the conditions favoring the development of a second thrust fault, *B*.

If the movement continues to the production of a second thrust, *B*, the plane of the thrust, *A*, and the recumbent beds will be raised into an anticlinal attitude, as the flat strata were in the first instance. Thus the point of the overturn, *M*, will appear to be bent downward, and if movement continues on the thrust, *A*, it may become bent under. Such movement could not, however, continue

[1] Read before the Geological Society of Washington, April 10, 1907.

far, before the thrust, *B*, would take up all the stress.

There is no obvious reason to limit the development of the schuppenstruktur, *A* and *B*, to two thrusts. A third and possibly a fourth might be produced. It might, however, occur that the accumulated thickness of piled-up strata should become so great, or the conditions of slight resistance in the plane of shear so favorable to displacement, that the whole recumbent mass would move forward upon a great major thrust, *C*, to an indefinite distance.

It is apparent on inspection of the diagrams that the length of the strata involved in the recumbent folds between *M* and *N* bears a relation to the total displacement on the overthrusts. The two are not equal, for the strata in the overturned limbs of the recumbent folds are stretched; but the two lengths may be said to be of the same order of magnitude.

The preceding hypothetical relations of recumbent folds to overthrusts were developed from a study of the extraordinary recumbent folds of Mont Joly as described by Ritter.[2] It followed from measurement of Ritter's sections that the length of strata involved in the recumbent folds was about 130 kilometers, whereas that included in the supposed roots was but 16 kilometers. If the folds and roots bear the relations attributed to them the lengths of the strata when developed should be at least of the same order of magnitude. The further analysis of the problem led to the conclusion that the recumbent folds represent a sequence of thrusts, as described above. The probable total displacement on thrust planes might be as much as 80 kilometers. The present position of the thrust planes would be above the Alps, or in the alpine summits, on the assumption that they have been raised during later elevation of the range. Their extent would carry them over the range to the southern slope.

At first sight this conclusion appears to accord closely with the phenomenal nappes des recouvrement of Lugeon, but there is a distinction. Whereas the nappes are supposed to have been projected over the Alps at their present elevation, the thrusts are believed to have developed in a shear zone beneath the surface, before the Alps were the visible mountains of to-day, and to have risen from a considerable depth toward the surface, as is the habit of thrusts. On independent evidence the date of thrusting is assigned to a pre-Eocene (pre-Flysch) date. The elevation which has raised the fully developed, one might say exhausted and dissected, thrust planes to the height of the summits of the Alps is, on the other hand, assigned to the middle Tertiary epoch of diastrophism, which also caused folding and the more obvious overthrusting.

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[2] 'La bordure sud-ouest du Mont Blanc,' Bull. des Serv. de la carte de la France, No. 60, profile I., Plate I.

QUOTATIONS

TEACHERS' SALARIES AND MINNESOTA

THERE has been recently among the alumni in various eastern colleges and universities, notably of Harvard and Princeton, a movement to secure funds to advance the salaries of instructors. The movement has appealed with some success to the loyalty of alumni and the benevolence of interested friends. A similar movement was actively started among the alumni of the University of Minnesota last fall, with the result that the regents of the university now have at their disposal an annual appropriation of $165,000, made by the legislature of the state, available for current expenses. Salaries of instructors have already been materially advanced in some cases to a level which places the University of Minnesota in active competition with the leading universities of the country so far as the compensation of its instructors is concerned. This must be regarded as a very important advance in the development of state universities. Its economic importance as bearing upon the general problem of the compensation of teachers is even greater, for the alumni of Minnesota appealed not only to loyalty and benevolence, but to a legislature responsible for the proper support of the first educational institution in its state. They carried through