

PROFESSOR O. H. BASQUIN: 'The Bending Moment of a Uniformly Loaded Beam; a New Experimental Demonstration.'

FLOYD FIELD,  
*Secretary.*

#### DISCUSSION AND CORRESPONDENCE.

##### CONNECTION BY PRECISE LEVELING BETWEEN THE ATLANTIC AND PACIFIC OCEANS.

TO THE EDITOR OF SCIENCE: In your issue of April 28, 1905, page 673, is an article by Mr. Hayford on 'Connection by Precise Leveling between the Atlantic and Pacific Oceans.' About twenty years ago I wrote to SCIENCE in connection with precise leveling over the Alleghanies and the Rocky Mountains, and stated that it might be well to have a systematic determination of bench marks at stated intervals owing to the unrest in the earth's crust. At that time I stated that my work on the corps of the Pennsylvania Railroad had shown me that, however carefully the bench marks might be established at any one time, at the expiration of a comparatively few years there would be a discrepancy between them and the datum plane. The Pennsylvania Railroad has reviewed its bench marks a number of times owing to these discrepancies due to earth motion. The want of agreement, therefore, between the levels of the Atlantic and Pacific Oceans, unless the bench marks were established by surveys which began and ended at exactly the same period throughout the entire distance, might be due to earth movements between the times of the beginning and the end of the survey.

I would again suggest, as I did at my first letter to this paper, that the United States Geological Survey secure not only the lists of bench marks of all railroads, but the variations that have occurred in these bench marks as shown by repeated surveys. If these are carefully tabulated throughout a century, we may obtain important information in regard to the upward and downward crustal movements across the continent.

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#### SPECIAL ARTICLES.

##### THE HORIZONTAL PLANE OF THE SKULL AND THE GENERAL PROBLEM OF THE COMPARISON OF VARIABLE FORMS.

In comparative studies of the skull it is customary to select one transversal plane defined by the axis of symmetry with which it is at right angles and by two points, as the standard plane to which the skull is referred. Some authors have made the selection of the two determining points based on morphological considerations, while others have endeavored to determine the physiological horizontal position, determining the latter by two points which are more or less accurately parallel to the direction of horizontal sight.

When this problem is considered from a purely morphological point of view, it will be recognized that there is no justification in selecting arbitrarily two points and disregarding all others, but that the best method of comparison must be based on the assumption that every point of the skull has equal weight and that the nearest approach of all points must be attempted. In this form the problem is applicable to the comparison of all variable forms.

The most favorable superposition of any two forms will be obtained when the sum of the squares of the distances between all pairs of homologous points becomes a minimum. We will refer the body to a system of rectangular coordinates and call  $x'$ ,  $y'$  and  $z'$  the ordinates of a point of the first body,  $x''$ ,  $y''$  and  $z''$  the ordinates of the homologous point of the second body. By moving the second body by the amounts  $u$ ,  $v$  and  $w$  in the direction of the three ordinates, we can modify the relative positions of homologous points without torsion of the body. Then the sum of the squares of the distances of homologous points  $\Sigma(x' - x'' - u)^2 + \Sigma(y' - y'' - v)^2 + \Sigma(z' - z'' - w)^2$  is to be a minimum. Therefore,

$$\Sigma(x' - x'' - u) = 0.$$

And

$$u = \Sigma(x' - x''),$$

$$v = \Sigma(y' - y''),$$

$$w = \Sigma(z' - z'').$$