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

ON October 4, 1904, a Coast and Geodetic Survey party, running eastward from Seattle, Wash., met a similar party, running westward, at Hunts Junction, in the southeastern part of Washington. The party running from east to west had started in the beginning of the season from a bench mark of which the elevation had been fixed by a long line run during several seasons and extending westward from the precise level net, composed of many circuits, which covers the eastern half of the United States. As far west as Norfolk, Nebr., the elevations in this net had been checked by completed circuits of precise leveling of the highest grade of accuracy. The joining of the two lines at Hunts Junction completed the first connection by precise leveling between the Atlantic and the Pacific.

The discrepancy developed at the junction was .615 ft. (=187.5 millimeters), the Pacific being apparently higher than the Gulf of Mexico and Atlantic.

The old question at once arises: is the Pacific at a different elevation from the Atlantic? The discrepancy of .615 ft. must be due either to errors in the tidal observations which furnished the connection with mean sea level, or errors in the leveling, or to a real difference in the elevation of the mean sea surface at the points at which the tidal observations were made.

The three principal connections with sea level concerned are at Sandy Hook, near New York City, at Biloxi, Miss., and at Seattle, Wash. Six years of tidal observations were taken at Sandy Hook and five years at each of the other points. The range in the six annual means at Sandy Hook was .322 ft., and of the five annual means at the stations at Biloxi and Seattle was, respectively, .100 and .204 ft. These ranges are not sufficient to account for the discrepancy of .615 ft.

The shortest line of leveling of the highest grade of accuracy from Seattle to Sandy Hook is 4,600 miles (7,400 kilometers); to Biloxi, 3,500 miles (5,700 kilometers); and to Norfolk, the point at which the line to the westward leaves the thoroughly checked portion of the precise level net, is 2,000 miles (3,300 kilometers).

If it is assumed that the discrepancy (.615 ft.) is simply an accumulated error in leveling and that the rate of accumulation is uniform between Seattle and Biloxi, it is at the rate of one foot in 5,700 miles (.033 millimeters per kilometer). Even if it is assumed that the accumulation all occurred between Seattle and Norfolk, it is at the rate of one foot in 3,300 miles (.057 millimeters per kilometer). This is an extremely small error of leveling.

Another test to determine whether the discrepancy is a possible error of the leveling may be applied. The probable error of the elevations at Seattle, as carried westward from the Gulf and Atlantic, the computation being based upon the discrepancy developed in the circuits in the eastern part of the United States, was ± 76 millimeters. The actual discrepancy is two and one half times this. According to the doctrine of chances, such a discrepancy, two and one half times the probable error, should occur about once in ten times.

Therefore, it is not safe to make the statement that the Pacific is higher than the Gulf and Atlantic; the extremely small discrepancy being well within the possible limits of error of the precise leveling alone, even though it be assumed that the leveling in question is of as high a grade of accuracy as any yet done anywhere in the world.

One is apt to associate observations of such extreme accuracy as this precise leveling with slow progress and high cost. It is interesting, therefore, to note that three thousand miles out of the thirty-five hundred between Seattle and Biloxi have been leveled since the beginning of the field season of 1899, and that the average rate of progress, during the period 1900–1904 (a total of 3,900 miles), with the new type of precise level now in use in the Coast and Geodetic Survey, was 64 miles of completed line per month, for each observer, and that the average cost, per completed mile, was $10, including salaries, transportation and bench marks. Each completed mile was leveled over at least twice, and, in some cases, four or more times. This rate of progress is

comparable with that ordinarily secured in wye leveling, which is of a much lower order of accuracy.

JOHN F. HAYFORD.

BOTANICAL NOTES.

RECENT CLASSIFICATIONS OF THE GREEN ALGAE.

THE appearance of the fourth edition of Engler's 'Syllabus der Pflanzenfamilien' (whose preface is dated May, 1904, although so far as the green algae are concerned this edition does not differ from the third, dated July, 1902); Blackman and Tansley's 'Revision of the Classification of the Green Algae' (1903); West's 'Treatise on the British Freshwater Algae' (April, 1904), and Oltmanns's 'Morphologie und Biologie der Algen' (July, 1904) enables us to bring together in parallel columns the different systems of classification which they employ (see table). It will be seen that there is little agreement as to the taxonomic grade of the groups. There is even less agreement as to subdivision of groups, and least of all as to their arrangement.

TABLE SHOWING OUTLINES OF CLASSIFICATIONS OF GREEN ALGAE.

I. (Engler).	II. (Blackman & Tansley).	III. (West) *	IV. (Oltmanns).
Branch ZYGOPHYCEAE.	Class *Isokontae.*	Class *Bacillariacae.*	(Class) *Heterocontae.*
Class *Bacillariales.*	Series Protococcales.	Order Centricae.	(Class) *Acontae.*
Class *Conjugatae.*	Series Siphonales.	Order Pennatae.	(Order) Conjugatae.
Branch CHLOROPHYCEAE.	Series Ulvales.	Class *Heterokontae.*	(Order) Bacillariaceae.
Class *Protococcales.*	Series Ulotrichales.	Order Confervales.	(Class) *Chlorophyceae.*
Class *Confervales.*	Class *Stephanokontae.*	Class *Chlorophyceae.*	(Order) Volvocales.
Class *Siphonales.*	Class *Akontae.*	Order Protococcoideae.	(Order) Protococcales.
Branch CHARALES.	Series Desmidiales.	Order Conjugatae.	(Order) Ulotrichales.
Class? *Characeae.*	Series Zygnemales.	Order Siphoneae.	(Order) Siphonocladiales.
	Class *Heterokontae.*	Order Cladophorales.	(Order) Siphonales.
	Series Chloromonadales.	Order Microsporales.	(Order?) Charales.
	Series Confervales.	Order Schizogoniales.	
	Series Vaucheriales.	Order Ulvales.	
		Order Chaetophorales.	
		Order Oedogoniales.	

* The sequence is reversed here so as to facilitate comparison with the other systems. West begins with higher forms and proceeds from these to lower forms.

In comparing these four systems it must not be forgotten that Engler's and Oltmanns's are general, including all algae, while that of Blackman and Tansley's includes the green algae only (excluding the Diatoms and Charales), and West's is confined to British freshwater algae (including the Diatoms, but not green algae into four classes upon a single character, namely, the cilia on the zoospores and gametes, resulting in four parallel lines (classes). Their 'series' are equivalent to 'orders' in other systems. In West's system the old group Chlorophyceae is nearly the same as Engler's, but with the addition of the Conjugatae. Oltmanns's system, as far as it can be made out from the first volume ('Spezieller Teil'), is much like West's, and includes three larger groups (classes?), the second and third divided into lower groups (orders?) which in turn are divided into families. Oltmanns does not use the terms 'class' and 'order' in the volume at hand, and for this reason brackets are used in the table.

The class Stephanokontae of Blackman and Tansley includes the single family Oedogoni-