LETTERS TO THE EDITOR.

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Does Chemical Transformation Influence Weight?

CAREFUL experiments by Heydweiller, published in the last number of Drude's *Annalen* (vol. v. p. 394), lead their author to the conclusion that in certain cases chemical action is accompanied by a minute, but real, alteration of weight. The chemical actions here involved must be regarded as very mild ones, *e.g.* the mere dissolution of cupric sulphate in water, or the substitution of iron for copper in that salt.

The evidence for the reality of these changes, which amount to 0·2 or 0·3 mg., and are accordingly well within the powers of a good balance to demonstrate, will need careful scrutiny; but it may not be premature to consider what is involved in the acceptance of it. The first question which arises is—does the *mass* change as well as the *weight*? The affirmative answer, although perhaps not absolutely inconsistent with any well ascertained fact, will certainly be admitted with reluctance. The alternative—that mass and weight are not always in proportion—involves the conclusion, in contradiction to Newton, that the length of the seconds' pendulum at a given place depends upon the material of which the bob is composed. Newton's experiment was repeated by Bessel, who tried a number of metals, including gold, silver, lead, iron, zinc, as well as marble and quartz, and whose conclusion was that the length of the seconds' pendulum formed of these materials did not vary by one part in 60,000. At the present day it might be possible to improve even upon Bessel, or at any rate to include more diverse substances in the comparisons; but in any case the accuracy obtainable would fall much short of that realised in weighings.

As regards Heydweiller's experiments themselves, there is one suggestion which I may make as to a possible source of error. Is the chemical action sufficiently in abeyance at the time of the first weighing? If there is copper sulphate in one branch of an inverted U and water in the other, the equilibrium can hardly be complete. The water all the time tends to distil over into the salt, and any such distillation must be attended by thermal effects which would interfere with the accuracy of the weighing. RAYLEIGH.

June 11.

The National Antarctic Expedition.

IN consequence of a cable received yesterday from London, telling me that the instructions for the conduct of the National Antarctic Expedition that had been passed by the Joint Committee of the Royal Society and the Royal Geographical Society have been greatly altered, I feel it my duty to resign the post of head of the civilian scientific staff of the expedition, which I had provisionally accepted. The organisation of the expedition now passed leaves the head of the civilian scientific staff nominally responsible for most of the scientific work of the expedition, but gives him no power to secure the performance of the scientific part of the programme.

The responsibility for my withdrawal at so late a date rests with those who have delayed until now the settlement of the programme and organisation of the expedition, which should both have been decided, as I understood they had been, before the ship and most of the equipment had been ordered.

I trust the protest of my withdrawal will secure to my successor more favourable conditions of work than the altered instructions would have given me.

University, Melbourne, May 4. J. W. GREGORY.

The Settlement of Solid Matter in Fresh and Salt Water.

SINCE the publication of the report of Mr. Slidell[1] on the deposits of the Mississippi delta, containing the remarkable statement that while the deposit contained in the river water of the Mississippi took from ten to fourteen days to settle, with solutions of salt, sea water or sulphuric acid the water became limpid in from fourteen to eighteen hours, it has generally been taken as an accepted fact that alluvial matter settles more rapidly in salt than in fresh water. Sir Archibald Geikie, in his "Text-book of Geology," endorses this theory; and in a recent article in the *American Engineering Magazine* on the transportation of solid matter by rivers, Mr. Starling, one of the Government river engineers, states that a small quantity of salt or other foreign material dissolved in water will diminish the suspending power and increase the rapidity of subsidence to a marked degree, sometimes even many hundred-fold.

On the face of it the result naturally expected would be, that as sea water is of greater specific gravity than fresh water, and more viscous, the grains of solid matter would sink more slowly in salt than in fresh water. The very great distance over which solid matter brought down by rivers remains in suspension after reaching the sea, extending from six miles from the mouth of the Rhone to thirty-five from the outlet of the Nile, up to 300 miles over which the sea water is stated to be discoloured by the effluent of the Amazon, appears to indicate that salt water is capable of retaining solid matter in suspension for a longer time than fresh water.

Experiments made by Mr. Vernon Harcourt with alluvial matter placed in suspension in sea water and fresh water, and in solutions containing different strengths of salt and other foreign material, although not of a conclusive character, show that there is little difference between the rate of deposit in sea or in fresh water. Of samples from different estuaries which were allowed to settle in sea water and pond water respectively, the particles of the former took about 9 per cent. more time to subside than the latter. The general conclusion he arrived at was that, though sea water promotes the deposit of "very light clayey matter contained in river silt under favourable conditions, there are no grounds for regarding it as exercising the very preponderating influence on the formation of deltas attributed to it by geologists."[1]

The writer some time ago investigated this subject in connection with researches he was then making as to alluvial deposits in estuaries, and has again more recently conducted a series of experiments the mean results of which are given in the following table:—

Table Showing Rate of Settlement of Solid Matter in Fresh and Salt Water.

No.	Number of grains to a lineal inch	Material	Time taken to settle		Water clear		
			Fresh	Salt	Fresh	Salt	
			m. s.	m. s.	h. m.	h. m.	
1	100	Sand	0 10	—	—	—	Water not discoloured
2	200	do.	0 25	—	—	—	do.
3	—	Whiting ...	12 0	—	0 30	—	
4	—	Plaster of Paris	5 0	—	0 10	—	
5	300	Warp, Trent	0 43	0 45	0 1	0 1	Water scarcely discoloured
6	1400	Fine Warp, Dutch River	12 0	15 0	3 30	22 0	
7	500	Silt, Salt Marsh	2 0	2 0	0 6	0 9	
8	1000	Warp, do. ...	8 0	9 0	1 0	0 33	
9	2000	Alluvium, Boston Dock ...	33 0	28 0	7 0	1 30	
10	600	do., R. Parrett	4 0	2 40	0 15	0 18	
11	1500	do., Tilbury Bsn.	18 0	18 0	10 0	9 0	
12	1600	Brick Clay ...	17 0	15 0	1 30	1 9	

It will be seen from this table that the rate of deposit depends on the minuteness of the particles in suspension, and varies nearly in proportion as the square of the diameter of these.

With sand and silt there was practically no difference in the rate of settlement in fresh as compared with salt water. When the particles of the solid matter were very fine, as in the case of what is generally known as mud or ooze, the rate of settlement was slightly more rapid in salt than in fresh water; but there was nothing to justify the conclusion arrived at by Mr. Slidell.

All the material was first screened through a sieve having ninety meshes to the lineal inch.

The proportion by weight of solid matter to water was that which was found to exist on the average of fourteen large rivers

[1] Report on the Mississippi River by Humphreys and Abbott, 1861.

[1] "Investigation on the Action of Sea Water in Accelerating the Deposit of River Silt" (*Min. Proc. Inst. C.E.*, vol. cxlii.).