LETTERS TO THE EDITOR.

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Molecular Attractions in Solutions.

THE following is, so far as I know, a new method of attacking this problem. I have been working at the experiments for some time, but on account of the war progress in the matter has come almost to a standstill. It seems desirable to publish this brief preliminary note now.

Let A and B be two pure liquids miscible (completely miscible would be better still) over a large range of concentrations. Let the densities and compressibilities of the liquids and their mixtures be known. Then, taking the simplest case (*i.e.* one in which there is no association either in the mixture or in the pure liquids), we may postulate that if there be a change in volume on mixing, this change is caused by the algebraic sum of the alterations in the attractions of A to A and B to B, together with the added effect of the new attractions of A to B.

The sum of these three effects can be calculated with considerable plausibility. Consider any definite mixture, the coefficient of compressibility of this mixture being supposed known over a wide range of pressure. As we know the coefficient for the separate pure liquids, we could calculate the theoretical coefficient of the combination. From these data we can get an approximate value for the mean coefficient of compressibility of the mixture while passing, so to speak, from the theoretical combined state to that which ultimately prevails. Then the change in volume divided by this mean coefficient gives the change of internal pressure on mixing. Now, if this method be followed by a number of different concentrations, a series of different changes in internal pressures will result.

If it is desired to disentangle the various internal attractions from one another, this can only be done by trial and error. The following development of Laplace's method may be tried. Assume that the attractions are proportional to the mass of the operative particles, then, calling the changes of pressure P_1, P_2, etc., and referring the concentrations to a gram-mol. of liquid A, let V be the volume of the mixture which contains 1 gram-mol. of A, and n the accompanying mass of component B.

The change of attraction of A to A in mixture (1) will be proportionate to α/V_1^2.

The change of attraction of B to B in mixture (1) will be proportionate to $\beta n_1^2/V_1^2$.

The change of attraction of A to B in mixture (1) will be proportionate to $n_1\gamma/V_1^2$.

From these quantities we get a set of equations:—

$$P_1=(\alpha+n_1\gamma+\beta n_1^2)/V_1^2,$$
$$P_2=(\alpha+n_2\gamma+\beta n_2^2)/V_2^2, \text{ etc.,}$$

where α, β, and γ are algebraic quantities.

There are some reasons for supposing that γ may be equal to $(\alpha\beta)^{\frac{1}{2}}$; if so, α and β can be calculated from any two of the equations, when P_1, n_1, etc., are known, and hence the validity of the assumption may be tested over any range of concentrations. Obviously a formula of this type would not meet the case in which the two liquids can mix in all proportions without change of volume; but it is possible that although the total pressure now remains constant, yet there may have been a redistribution of pressure among the constituents.

It may be mentioned that even an empirical formula giving approximate values for the separate internal pressures would be of considerable help in deducing a correct equation of state for the osmotic pressures of solutions.

BERKELEY.

Foxcombe, May 24.

Meteorological Conditions of a Blizzard.

As used to signify a certain type of snowstorm primarily characterised by fine, dry, powdery, or sand-like snow driven before a gale of wind, the temperature of which is extremely low (say 20° below zero F.), the term "blizzard" is, of course, wholly inapplicable in the British Isles; and it is, moreover, ridiculous to apply the name to every little occurrence of sleet after the manner of the daily Press, referred to by Mr. Dines. But there is another type of severe snowstorm peculiar to damp, stormy, and relatively warm winter climates like our own, the natural breeding-grounds of which are the wild tracts of bleak, elevated moorland which cover so much of the north of England and Scotland; and I fail to see why "blizzard," which, after all, comes from the same root as "blast," should not be as expressive of a British moorland snow gale, with its relatively large damp flakes, as it is of the fine dry crystals of North America or the polar regions, produced by meteorological conditions practically unknown in this country. The huge falls of snow swept by heavy gales which isolated many high-lying districts of Great Britain for weeks together in February and March of the present year (see *Symons's Meteorological Magazine* for April), bringing in a few weeks an aggregate depth of some 10 ft. to the Black Mountains in South Wales, were, it seems to me, not inappropriately described as "blizzards"; but for the sake of distinction it might be advisable to restrict the use of the term to the American type of storm.

Mr. Dines refers to January 18, 1881, as affording the nearest approach to an American blizzard in the S.E. of England; but possibly an even better approximation was the great storm of March 9–13, 1891, in the S.W. of England. In Devon and Cornwall the "great blizzard" of that spring is now a household word, and I do not think that anyone who either experienced that west-country visitation or has read the vivid narratives regarding its effects will feel inclined to quarrel with the designation.

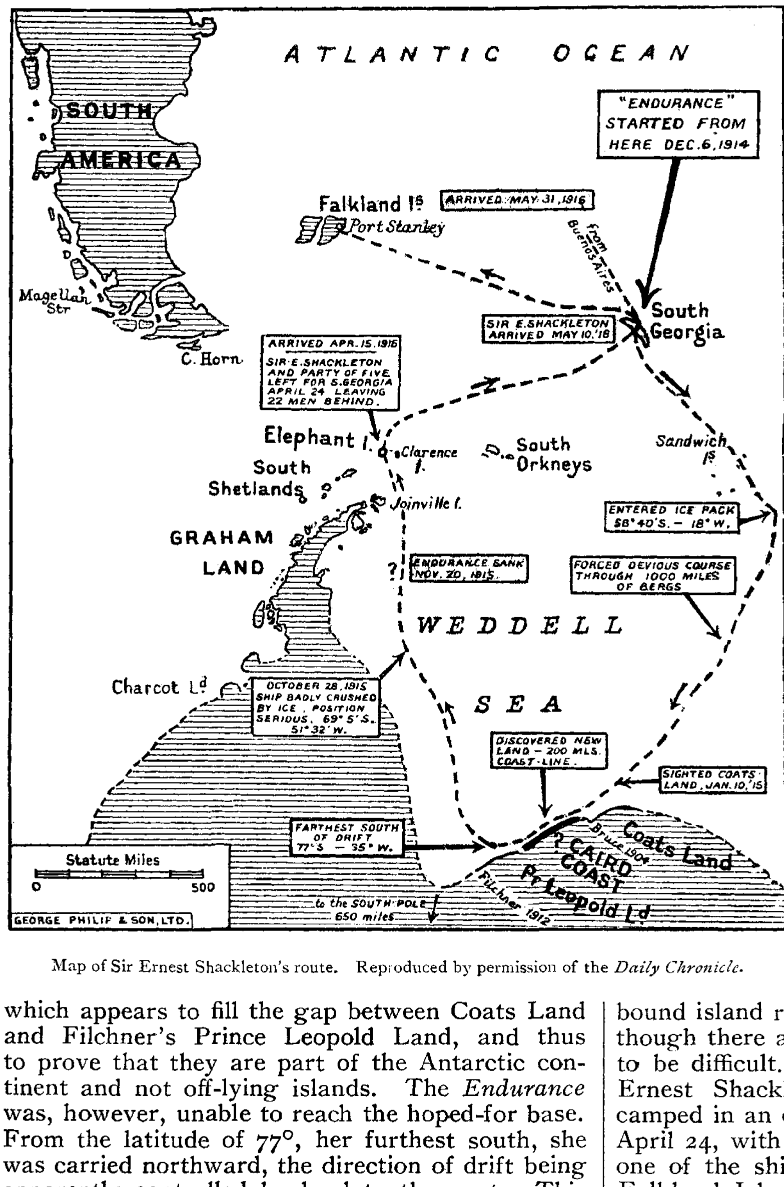
L. C. W. BONACINA.

Hampstead, N.W., June 2.

SIR ERNEST SHACKLETON'S ANTARCTIC EXPEDITION.

SIR ERNEST SHACKLETON has fully justified the faith of those who were confident that if he did not cross Antarctica his expedition would make valuable additions to the geography of the little-known area of the Weddell Sea and that he would act with the combined daring and sound judgment necessary to success in what was admittedly almost a geographical forlorn hope. He is to be congratulated on his return after one of the most adventurous of Polar expeditions; for its voyage on the ice-floes has been only equalled in perils by that of the Hansa Expedition; his heroic passage in search of help across the stormy seas south-east of Cape Horn during an Antarctic winter will rank among the finest examples of seamanship achieved in an ordinary ship's boat; and, having landed on the uninhabited side of South Georgia, he has achieved the fine mountaineering feat of the first traverse of that rugged ice-capped island.

The narrative of Sir Ernest Shackleton in the *Daily Chronicle* of June 2 confirms the expectation that the *Endurance* had come to grief in the heavy ice of the Weddell Sea. She left South Georgia on December 6, 1914, and sailed to the south-east, entering the pack at 58° 40′ S., 18° W. After a passage of 1000 miles through crowded ice-floes Coats Land was sighted on January 10, 1915. The expedition, continuing westward, discovered 200 miles of new land, the Caird Coast, which appears to fill the gap between Coats Land and Filchner's Prince Leopold Land, and thus to prove that they are part of the Antarctic continent and not off-lying islands. The *Endurance* was, however, unable to reach the hoped-for base. From the latitude of 77°, her furthest south, she was carried northward, the direction of drift being apparently controlled by land to the west. This land does not, however, extend as far east as was thought. Capt. Benjamin Morrell, an American sealer, claimed to have discovered land, which he called New South Greenland, in 1823. Morrell was generally dismissed as the Munchausen of the Antarctic until Dr. Bruce accepted his records, largely on the ground that his other record of new land was supported by Ross's observation of apparent land at 75° S., 44° W. If those two records had been confirmed, the land to the west of Weddell Sea would project north-westward in two great peninsulas, Grahamland to the north-west, and Morrell's New South Greenland to the south-east. The axes of these lands would have been concentric with one another, and also with the line, further to the north-west, of the South Shetlands and South Orkneys.



Map of Sir Ernest Shackleton's route. Reproduced by permission of the *Daily Chronicle.*

Sir Ernest Shackleton has found 1900 fathoms of water over the site of New South Greenland. He has therefore restored to the Weddell Sea its great extension westward and modified the possible interpretation of the structure of the Grahamland region. Morrell may have mistaken ice for land or may have been merely wrong in his longitude—a very excusable mistake at that date; and that an extensive land exists not far west of the course of the *Endurance* is suggested by the exceptionally heavy ice pressures by which she was wrecked; but the supposed peninsula to the south-east of Grahamland and Ross's apparent land are definitely disproved.

The *Endurance* was crushed on October 28, and sank on November 20 as the ice opened during the drift further to the north. The expedition camped on the floes, and passed in sight of Joinville Island, off the north-eastern end of Grahamland, but it was inaccessible. The expedition endeavoured to reach Deception Island, where there are huts and stores of food; but it was unable to force a way to the western end of the South Shetlands and landed, on April 15, on Elephant Island, one of its north-eastern members. It is a rugged, cliff-bound island rising to the height of 3500 feet, and though there are fair anchorages, landing appears to be difficult. As the food supply was low Sir Ernest Shackleton left twenty-two of his men camped in an excavation in the ice and started, on April 24, with Capt. Worsley and three others, in one of the ship's boats for South Georgia. The Falkland Islands are nearer; but South Georgia offered an easier course and the attraction that one of its whalers might be available for the immediate rescue of the party on Elephant Island.

Shackleton reached the western coast of South Georgia and climbed over the Allardyce Range to the whaling station at Stromness Bay. The fact that the island had not been crossed before gives some indication of the difficulty of this feat, which can also be realised from the map and photographs published in Mr. Ferguson's recent memoir on the island (Transactions Roy. Soc. Edinburgh, vol. l., part iv., 1915). A relief expedition was at once despatched to Elephant Island, but only an eighty-ton vessel was available, and the ice was too thick for her to force a passage to the land.

The Government has already promised the funds for the larger rescue expedition which had appeared necessary. The problem is now much simplified, as the work to be done is definitely known. Elephant Island—in 61° 10′ S., about the latitude of the Shetlands—though sometimes surrounded by drift ice, can apparently be reached by a suitable vessel at any season of the year. Relief is obviously wanted urgently. The party on April 24 had only five weeks' provisions, which it can doubtless supplement by penguins and perhaps seals. The name Elephant Island refers to the once-abundant sea-elephants; but as the island is easily accessible they have been practically exterminated there; and Sir Ernest Shackleton's account of the locality where his comrades are camped suggests that it may be a very difficult hunting-ground.

The larger South Georgia whalers are probably now on their way to Europe, and unless a suitable steamer can be obtained in Argentina or at the Falkland Islands it is to be hoped that the whaler nearest to South Georgia can be promptly intercepted and sent back there, *en route* for Elephant Island.

RETURN CURRENTS AND ELECTROLYTIC CORROSION.[1]

THE two memoirs referred to below are part of the series of valuable contributions which are being issued by that admirable institution, the U.S. Bureau of Standards, under the able directorship of Dr. Stratton.

The publications before us relate to the troubles which arise from the electric return currents that leak through the soil from electric tramways and railways, in consequence of their setting up electrolytic corrosion in buried pipes or other metallic objects in the neighbourhood of the tramway or railway lines. This was an acute question in Great Britain as well as in North America some twenty years ago when electric traction was a novelty. But, so far as England is concerned, it long ago ceased to be acute in consequence of the prompt action of the Board of Trade. That often abused body framed a regulation that the maximum allowable voltage drop between any two points of the earthed return-system, near which underground metallic structures are laid, should be limited to seven volts. This limitation, though not an absolute safeguard against stray currents, has practically solved the difficulty; and we never, or seldom, hear any suggestion of electrolytic corrosion. Were any considerable difference of potential between two points of an earthed return system to be allowed to subsist, that difference of potential would have the result of forcing a fraction of the current to leave the return rails at some point of higher potential and to find its way through the soil or other available path, to re-enter the return rails at some point of lower potential, presumably nearer the generating station or sub-station. If such stray or vagabond currents merely traverse moist soil in widespread paths they do no damage; but if a waterpipe, or other metallic object, lie along their course, some of the current will find a readier path along such conductor; and wherever the current emerges from the metallic conductor into moist surroundings, electrolytic action will ensue, corroding and pitting the metal surface—sometimes with disastrous effects. Various palliatives, such as the better bonding of the return rail tracks, the use of return feeders, the careful connecting of the negative side of the system to the metallic pipes or other objects by metal connectors, have been used, including the employment of appliances called negative boosters.

The first-named of the monographs before us is devoted to a discussion of the electric conductivity of various kinds of soils under various conditions of moisture, pressure, and temperature, and the effects of these factors on the electrolytic corrosion question. Methods of measuring the resistivities of soils *in situ*, as well as in the laboratory, are discussed. The soil of cities appears to be more highly conductive than that of country districts by reason of absorption of drainage and sewage. The presence of refuse in "made" land is distinctly promotive of conductivity, and therefore of electrolytic corrosion. The authors of the monograph, Messrs. McCollum and Logan, have done their work thoroughly, and have added statistical tables, which, in countries like the United States, where legislation has not intervened to stay the damage, must be very valuable.

The second memoir, by Messrs. Rosa and McCollum, is a lengthy discussion, as an engineering problem, of the mitigation of electrolytic corrosion, or as they rather unfortunately describe it, of "electrolysis." They deal with corrosion in reinforced concrete; with attempts to prevent corrosion by protective coatings of paint; with the use of insulating joints in pipes; with electrical means of combating or compensating the tendency to stray currents; with summaries of the various legal regulations in use in different countries. It appears that the Bureau of Standards has issued eight different publications on this subject. The present memoir alone extends to more than 143 pages.

1 "U.S. Department of Commerce. Technologic Papers of the Bureau of Standards (Washington)." No. 26, Earth Resistance and its Relation to Electrolysis, etc. No. 52, Electrolysis and its Mitigation. (Washington: Government Printing Office, 1915.)