follow out, in order to acquire methods of accurate observation and technique. This work should be written up and modelled in the form of a scientific paper, and illustrated so far as may be desirable. By means of such an essay the student will become familiar with the elementary procedure in research work, he will acquire some power of independent observation, and learn how to deal with entomological literature, thus gaining some idea of the sources where he will find first-hand information.

Furthermore, I would also insist upon the student forming a small but thoroughly representative collection of insects, so proving that he has had some field practice in collecting, and is able to refer them to their families and genera. By means of such a course as I have outlined, it should be possible to train good, all-round entomologists, capable of tackling a problem unaided when out in the wilds of Africa or the plains of India.

If the student can spare a fifth year, it would be all to his advantage, and the time would be most profitably spent in prosecuting some line of independent entomological research.   A. D. IMMS.

Institute of Plant Pathology, Rothamsted
    Experimental Station, Harpenden.

The Separation of the Isotopes of Chlorine.

IN order to prevent confusion of issues, instead of Cl and Cl' let us write A and B. Then when we say that A and B are identical, we mean that all the properties of A and B are the same except that of position occupied. Thus we are enabled to divide the atoms into two groups, the A group and the B group, in spite of their identity of properties. Then it is quite certain that if the atoms exist as molecules A_2, B_2, and AB, in equilibrium by the reversible reaction $A_2 + B_2 \rightleftharpoons 2AB$, the equilibrium is given by $[AB]^2/[A_2][B_2] = K = 4$.

The following considerations will, I think, meet any difficulties that have been raised in reconciling this reaction with Nernst's heat theorem. In the case of complete identity, if we convert the solids A_2 and B_2 into the solid AB by evaporation to the gases A_2, B_2, transformation into the gas AB, and condensation to the solid AB, we obtain an increase of entropy of $R \log 4$. But this solid is really a solid solution or mixture, since, as we assumed that the vapour pressure over it is equal to the pressure over the solids A_2 or B_2, we must assume that the molecules condense on its surface with "longitudinal indifference." The solid, then, is a solution of the molecules AB in BA.

Now the entropy of a body consists of two parts, one depending on the distribution of velocities, the other on the distribution of the co-ordinates of position. The first term cannot give rise to any change of entropy when the solids are transformed, irrespective of Nernst's theorem, but the second term is a constant, and accounts for the change of $R \log 4$. It may, in fact, be calculated directly by statistical methods.

If we assume that the gas AB condenses to the solid AB (or BA) instead of into the solid solution, then we must take the pressure over this solid as double that over A_2 or B_2, and not equal to them; because, consistently with the assumption of the formation of the pure solid AB, we must assume that the solid rejects half the molecules which strike its surface; that is to say, the molecules AB condense, but not the molecules BA.

This double vapour pressure will make the entropy of the two gram-molecules of AB (or BA) equal to the entropy of one gram-molecule of A_2 *plus* one gram-molecule of B_2.

No essential difference in the argument is made when A_2 differs slightly from B_2.

Prof. Soddy throws out a suggestion for the removal of the term $R \log 4$ which surely must be erroneous. He seems to agree to the distribution of molecules given by $[AB]^2/[A_2][B_2] = 4$ (which must result whatever kinetic process be assumed), but he considers it wrong to write 4 as the equilibrium constant of the reaction $A_2 + B_2 \rightleftharpoons 2AB$, as this gives for the coefficients of the reaction velocities $k_1 = 4k_2$. He therefore would write the reaction $A_2 + B_2 = AB + AB$, and then, taking half the concentration of AB, write $[\frac{1}{2}AB][\frac{1}{2}AB]/[A_2][B_2] = K = 1$. Therefore $k_1 = k_2$.

To write this reaction in this form is unjustifiable. In the first place, that $k_1 = 4k_2$ in no way contradicts the assumption of the identity of A and B. For the velocity coefficients do not depend only on the properties of the atoms or molecules involved, but contain a factor depending on the statistics of the reactions. In this respect the direct and reverse reactions may be different. This is better seen by comparing the two reversible reactions $2A = A_2$ and $B + C = BC$, where A, B, and C are identical atoms. The two reverse coefficients are equal, $k_2 = k_2'$, but the two direct coefficients are not equal, for $k_1 = \frac{1}{2}k_1'$. This is because n atoms B, together with n atoms C, give twice as many B—C collisions as n atoms of A give A—A collisions. If we write the reaction $A + A \rightleftharpoons A_2$, and take half the concentration of A, we still do not find $k_1 = k_1'$, but $k_1 = 2k_1'$.

In the second place, to write the reaction $A_2 + B_2 \rightleftharpoons AB + AB$ suggests that we can divide the molecules AB into two equal sets, and that a significant collision only occurs when an AB molecule from the first set collides with an AB molecule from the second set. Finally, the semi-permeable membrane that may be used in calculating the change of entropy due to the gaseous reaction must be assumed permeable to all or none of the molecules AB, thus giving an entropy change $R \log 4$. So that by no considerations whatever are we justified in taking half the concentration of the AB molecules when calculating the change of entropy.   ANGUS F. CORE.

The University, Manchester, July 24.

Anticyclones.

PROF. HOBBS in NATURE for July 22 gives some experimental reasons for contending that over large ice-covered areas, such as exist in Greenland and the Antarctic continent, the cooled lower layer of air moves outwards in all directions from the centre of the ice-covered area. Under the influence of the earth's rotation the air thus set in motion is regarded as circulating as in normal anticyclones, and Prof. Hobbs on that account speaks of such areas as being anticyclonic. He remarks: "The centrifugal nature of this motion tends to produce a vacuum above the central area of the ice mass, and the air must be drawn down from the upper layers of the atmosphere in order to supply the void. It is here that is located the 'eye' of the anticyclone." He thus postulates an anticyclone with a *low-pressure centre*.

With the physics of Prof. Hobbs's theory there need be little criticism. The point really seems to be: Are the conditions described by him as existing over an ice-cap anticyclonic? An anticyclone has a high-pressure centre, and a cyclone a low-pressure centre, the surface air moving outwards in the former and inwards in the latter, whereas the conditions described by Prof. Hobbs are an *outward flow* and a *low-pressure centre*. Would it not be well to designate such conditions by some other word?

R. M. DEELEY.

Tintagel, Kew Gardens Road, Surrey, July 23