smaller than the Brownian energy is not impossible in principle.

The relative motion between the lymph and the wall of the canal, due, on the motion of the head, to the inertia and finite elastic properties of the system, cannot be estimated from the data at present available. But it must be borne in mind that this might well be of at least the same order as the motion due to the Coriolis forces.

Now, obviously, if this theory is indeed the basis of bird direction-finding, one would expect larger birds with larger semi-circular canals to be more efficient at long migration and homing flights than smaller birds. There is no suggestion that this is the case, though our present information on homing flights is too scanty to be of much value. Again, if the theory is true, one would expect the semi-circular canals of birds to be conspicuously large relative to the body size, compared with many other vertebrates; and moreover the canals should be relatively larger in small birds than in large ones. Here again the evidence is meagre, but the work of Retzius[5] gives a few readily accessible facts to go upon. Retzius describes and figures semi-circular canals of eleven species of birds. The accompanying table shows the maximum diameter in each case, expressed in cm., together with the weight in kgm. and wing-length in cm. of the female as given by O. Heinroth[6] and Witherby *et al.*[7] respectively.

It will be seen that while, as is the case with mammals (Prof. G. R. de Beer, personal communication), the canals of the smaller species are relatively larger than those of large species, the majority of birds have the canals well below 1 cm. in diameter; and many small birds which are far-flying migrants and expert homers obviously must have canals smaller still.

	Maximum diameter of semi-circular canals (cm.)	Body-weight, ♀ (kgm.)	Wing-length, ♀ (cm.)	Ratio of wing-length to canal diameter
Anser domesticus ..	0·82	3·0–3·5	41·6–46·8	55
Mergus merganser L. ..	0·79	1·40	25·0–26·7	32·7
Vanellus vulgaris, Bechst.	0·64	0·20	21·6–23·0	34·2
Scolopax rusticola L. ..	0·64	0·27	18·4–20·8	30·6
Columba domestica ..	0·59	0·30	21·0–22·2	36·6
Gallus domestica ..	0·64	1·50	—	—
Turdus musicus ..	0·465	0·07	11·1–12·1	24·3
Cypselus apus	0·43	0·04	16·4–17·9	39·9
Nucifraga caryocatactes L.	0·64	—	17·5–19·0	28·4
Bubo ignavus, Forst. ..	1·42	2·5–3·0	45·0–49·5	33·6
Haliætus albicilla ..	1·29	5·0	61·0–68·5	50·0

In view of all these circumstances, we cannot avoid the conclusion that, sound and ingenious as the theory is from the point of view of the physicist, it encounters very great practical and biological difficulties. It does, however, serve to emphasize the need for repetition and extension of long-distance homing experiments critically controlled and on a much larger scale than hitherto. The design of many past homing experiments has been open to criticism in one way or another, but there seems little doubt that it should be possible to plan experiments which would put Ising's theory to the test.

1 Griffin, D. R., *Quart. Rev. Biol.*, **19**, 15 (1944).
2 Rüppell, *J. Orn. Lpz.*, **92**, 106 (1944); see *Ibis*, **88**, 262 (1944).
3 Ising, G., *Ark. Matematik, Astronomi och Fysik*, **32**A, N. 18, 1 (1945).
4 Lowenstein, O., and Sand, A., *Proc. Roy. Soc.*, B, **129**, 256 (1940).
5 Retzius, "Das Gehörorgan der Wirbelthiere", **2** (Stockholm, 1885).
6 Heinroth, O., *J. Orn. Lpz.*, **70**, 172 (1922).
7 Witherby, H. F., *et al.*, "Handbook of British Birds" (1938–42).

OBITUARIES

Prof. Pierre Weiss

Although Prof. P. Weiss died so long ago as November 1940, there has been a lengthy interruption of the flow of scientific news from France. Tribute to the great teacher and experimenter, whose influence dominated Continental magnetism for forty years, must of necessity be a little tardy.

Weiss was a true son of Alsace, being born at Mulhouse in 1865. Doubtless influenced by family connexions with industry, he began a four-years engineering course at Zurich in 1883. After this he entered the École Normale Supérieure, Paris, becoming *preparateur-assistant* there on the completion of his studies. Interest in magnetic problems had already been aroused by the work of Ewing. In 1895 Weiss took a lectureship at Rennes; and in the following year he presented his doctor's thesis at the Sorbonne, dealing with the properties of magnetite; then followed a move to Lyons, and in 1903 his appointment to the chair of physics at the Federal Polytechnic, Zurich. Already he had produced some twenty or so papers, including the classic ones on pyrrhotine.

The next few years, up to 1914, were Weiss's most productive, and accounted for more than sixty papers. In 1907, the fertile hypothesis of the molecular field and spontaneous magnetization was put forward. With Beck he investigated the relation between specific heat and molecular field for ferromagnetics. In 1910, Weiss spent a period in the laboratories of Kamerlingh Onnes; the influence of this period on the subsequent work of Weiss and his students is most apparent. In 1911 began the lengthy series of measurements of atomic magnetic moments leading to the introduction of a new unit, the Weiss or experimental magneton. Bohr's magneton is a fundamental unit with theoretical justification and, to within a fraction of 1 per cent, five times the Weiss unit. It is a measure of Weiss's enormous prestige that his experimental unit appears to have been preferred on the Continent up to the outbreak of the Second World War. Zurich before the First World War must have been particularly stimulating, with Einstein, Schrödinger, Ehrenfest, Debye, Piccard and Weiss shared between the University and Hochschule. Weiss always took pride in the fact that he was one of the small group that founded the Société Suisse de Physique, and that he was president up to 1914.

During the War, for about a year, Weiss was attached to the Direction des Inventions, Paris. With Cotton he devised a sound-ranging system for locating enemy artillery batteries. During 1916–18 he returned to his Zurich chair.

In 1918 came the call to assist with the building up again of the University of Strasbourg. No finer choice could have been made. In the Institut de Physique, electric light and central heating were quickly installed, the director's apartments were converted into laboratories, part of the basement was given over to accumulators, charging plant and switchgear. The building was wired to provide current for the electromagnets that the workshops made in addition to quantities of galvanometers, potentiometers and other apparatus. (Weiss's design of electromagnet is now standard equipment, and the Paris cyclotron magnet owes much to his interest and advice.)

The research programme of the Institute was divided up, magneto-optics to Ollivier, ferromagnetism to Forrer, paramagnetism to Foëx, X-radiography to Hocart, mathematical physics to Bauer, high-frequency work to Ribaud, to all of whom Weiss conveyed his enthusiasm. Every Monday all the research workers met for a session of "questions de l'ordre du jour". Weiss went to endless trouble at these meetings to help a worker finding honest difficulties; he went to similar trouble in rebuking a worker doing slovenly work or presenting it badly if he or she should have known better. Of particular joy to Weiss was the formation of a Strasbourg section of the Société de Physique française—the first of the provincial sections. There was but one choice for president. In the 1919–39 period Weiss continued his practice of shutting himself in the laboratory one or two days a week and being available to no one. Rather more than forty papers were produced in these years.

Large numbers of foreign workers came to the Institute, and Weiss was always most helpful and kindly to them, going out of his way to assure himself that they were comfortably housed, had sufficient money, and that all was well at their homes. The number of British students was small, but Rumanians and Poles came in plenty. Many of the workers were mature, being schoolmasters to whom the French *lycée* teaching programme afforded plenty of leisure. Weiss was a charming host, and there were many happy receptions held in the long wide corridor of the Institut de Physique following scientific meetings. Everyone met everyone, and not the least charming feature was the manner in which the other members of the Weiss family devoted themselves to putting everyone at ease. Weiss could chat readily in German (including Swiss, Alsatian and Mulhouse patois), Dutch and English besides his native French. Happy, and believing in the value of the work being accomplished in Alsace, Weiss declined advancement in Paris; in 1926 he had been elected a member of the Academy of Sciences. He was also doctor *honoris causa* of Geneva.

Weiss retired from the post of director at Strasbourg in October 1936, but continued to direct the magnetic laboratories until 1939, when the University was dispersed. Weiss himself went to Lyons, and, despite serious heart trouble, worked hard editing and translating papers presented to the International Magnetism Congress held in Strasbourg four months before the outbreak of war. In November 1940 he died in his seventy-sixth year.

I am indebted to Prof. G. Foëx, director of the Institut de Physique at Strasbourg, for furnishing me with some of the details mentioned.

C. R. S. Manders

We regret to announce the following deaths:

Mr. F. W. Frohawk, well known for his illustrations of bird and insect life, on December 10, aged eighty-five.

Brigadier H. St. J. L. Winterbotham, C.B., C.M.G., D.S.O., formerly director-general of the Ordnance Survey, and recently general secretary of the International Geodetic and Geophysical Union, on December 10, aged sixty-eight.

9/-

NEWS and VIEWS

Crystallization of Synthetic Penicillin

The recent announcement in *Science* (**104**, 431; November 8, 1946) that du Vigneaud, Carpenter, Holley, Livermore and Rachele have isolated the crystalline triethylammonium salt of synthetic penicillin-II, identical in all respects with the optically active triethylammonium salt of natural penicillin, has solved one more of the extraordinarily difficult series of problems that this remarkable substance has set. Readers will recall the statement on penicillin chemistry which appeared in *Nature* of December 29, 1945, p. 761, wherein an account was given of the co-operative effort of British and American chemists working under the auspices of the Medical Research Council (London) and of the Committee on Medical Research (Washington), and which will appear shortly in monograph form. During this highly successful essay in trans-Atlantic co-operation, chemists in the United States and in Britain were able to show that in the reaction between certain oxazolones bearing a potential aldehyde group and *d*-penicillamine, antibiotic activity corresponding to a 0·03 per cent yield of penicillin could be produced with regularity, and this could be raised to a 0·22 per cent yield under better conditions. This product, moreover, had a 'bacterial spectrum' similar to that of natural penicillin, and when isotopic 'tracer' technique was applied to the problem by use of penicillamine containing radioactive sulphur, the added natural penicillin was isolated as a triethylammonium salt which could be recrystallized repeatedly without sensible variation of its radioactive sulphur content. In addition, the presence of penicillin in the synthetic mixture was shown by its destruction by the enzyme penicillinase.

The use of partition chromatography by an American firm on the synthetic reaction mixture led to an active material containing 2·6 per cent of penicillin, while an application of the 'counter-current distribution' principle of Craig to this problem by du Vigneaud and his colleagues has raised the yield in one case to more than 16 per cent. The innate instability of penicillin frustrated efforts to fractionate such products, and it was only when the one-stage condensation process was modified to a two-stage process that a readily reproducible yield of activity could be obtained which proved thoroughly amenable to fractionation by the 'counter-current distribution' method. Eventually crystals of triethylammonium penicillin-II were obtained, identical in all respects with the corresponding salt of the natural product. Although use of *l*-penicillamine in the synthesis apparently leads to biologically inactive material, du Vigneaud and his colleagues have found that *d*-penicillamine can be replaced by *d*-cysteine, the thiolthreonines and β-mercaptoleucine with production of new penicillins which may possess different 'bacterial spectra'. It cannot yet be said that "what was only a path is now made a high-road", but the knowledge that is now being garnered with regard to the mechanism of the reaction involved in the two-stage synthesis may one day make it possible for synthetic penicillins to compete with the natural products.