The iron content has shown roughly the forecast decrease of 0·16 mgm./100 gm. On the other hand, the nicotinic acid content, instead of decreasing, has actually increased slightly. The explanation of this anomaly is probably to be found in the composition of the grists used in milling the 85 per cent flour analysed during the first six months of 1944 and those being used for the 82½ per cent flour in October and November. The following table gives details of the grists.

	Average composition of grist in samples analysed			
	Manitoba wheat	Home-grown wheat	Other wheat	Barley and rye
85 per cent extraction survey:				
January	37·4	59·5	0·5	2·6
February	39·7	57·3	0·5	2·5
March	35·3	61·1	2·1	1·5
April	38·3	58·4	2·8	0·5
May	42·7	53·2	3·6	0·5
June	42·6	54·2	3·0	0·2
82½ per cent extraction survey:				
October 16–30	57·0	38·1	3·8	1·1
October 30–November 13	57·1	38·1	3·8	1·0
November 13–27	57·7	37·7	3·7	0·9

The higher Manitoba content of the grist used in making 82½ per cent flour is reflected in the higher protein content of this flour compared with 85 per cent flour.

Further, Manitoba wheat is richer in nicotinic acid than English wheat. An average figure for Manitoba wheat is 60μgm./gm. against 45μgm./gm. for English wheat.

The amount of added white flour during 1944 has varied between 5 and 12½ per cent. The bulk of this flour is Canadian G.R. (fortified with vitamin B_1 to a level of approximately 1 I.U./gm.), but small quantities of Plate and, just recently, American fortified flour have also been added. Average figures for this last flour are vitamin B_1 1·5 I.U./gm.; riboflavin 2·7 μgm./gm.; nicotinic acid 36 μgm./gm.; and iron 2·9 mgm./100 gm. It is understood that during the period when the 82½ per cent flour samples were analysed, the overall addition of American enriched flour was well below 2 per cent. Even at 2 per cent level, however, the American flour would only increase the values for 82½ per cent flour by the following amounts: vitamin B_1, 0·01 I.U./gm.; riboflavin, 0·03 μgm./gm.; nicotinic acid, 0·4 μgm./gm.; and iron, 0·02 mgm./100 gm. Plate flour and Canadian G.R. flour (except as regards vitamin B_1, where it has no effect) would act in the opposite direction.

Quality of Bread

971 commercial loaves from different parts of Great Britain have been examined during the period October 1–November 30. These were graded for quality (commercial standards) with the following results:

Good	=	98 loaves	=	10·1 per cent
Fair–Good	=	427 ,,	=	44·0 ,, ,,
Fair	=	266 ,,	=	27·4 ,, ,,
Poor	=	180 ,,	=	18·5 ,, ,,

Unfortunately, this harvest was a particularly wet one, and much British home-grown wheat sprouted in the stack. Such wheat has a high maltose content and tends to give a loaf with a doughy crumb. The results, described earlier in this report, showed that some 24 per cent of the flours received from mills gave loaves showing high maltose damage. Of the commercial loaves 298 (= 31 per cent) showed the same defect, and as a result the total percentage of 'Good' and 'Fair–Good' loaves (54 per cent in all) was lower than would otherwise have been the case. There was, however, a marked improvement in the colour of the loaves compared with those made from 85 per cent flour.

This work was carried out at the Cereals Research Station, Ministry of Food, St. Albans.

[1] "High Vitamin Flour" (Ministry of Food, October 1944). cf. also *Milling*, Nov. 4, 1944.
[2] *Nature*, **154**, 582 (1944).

OBITUARIES

Prof. C. G. Barkla, F.R.S.

CHARLES GLOVER BARKLA, Nobel Prizeman in Physics for the year 1917, died at his home, Braidwood, Edinburgh, on October 23. The news came as a shock to his friends, for his death occurred rather suddenly. He had been in poor health for some months and had undergone an operation in June. He had, however, recovered from that and was back at work, looking well and seemingly his bright, happy self again, when suddenly he collapsed, was ill for a week and died.

Barkla was the son of John Martin Barkla, a former secretary of the Atlas Chemical Company of Widnes, in which town Charles was born on June 7, 1877. He was educated at the Liverpool Institute, from which he proceeded to University College, Liverpool, where he read for an honours degree in physics. He graduated in 1898 and obtained the master's degree in the following year. In 1899, on the nomination of his College, he was awarded a research scholarship by the Royal Commissioners for the Exhibition of 1851, and went to Cambridge in the autumn of that year, being admitted to Trinity College as an 'advanced student'. He began research work at the Cavendish Laboratory by investigating the velocity of electric waves along wires of various materials and of different thickness. He studied also the absorption of electric waves by dielectrics. The scholarship was in the first instance for two years, but Barkla's tenure was exceptionally renewed for a third year. It was during this additional year that he commenced his investigations of secondary X-radiation, and so entered the field of research work with which his name will always be associated.

After one year at Trinity, Barkla migrated to King's College. He possessed a powerful baritone voice and during his first year at Cambridge had contemplated the delight of singing in the choir of a chapel of the size and magnificence of King's. Dr. Mann, the organist of King's, encouraged the migration, and Barkla became a member of King's College choir and a regular attendant both at practices and services. His magnificent singing added to the reputation of the College chapel in that respect, and, in his last year at Cambridge, if it became known that Mr. Barkla was to sing the solo part in an anthem, the great chapel of King's was crowded for the occasion.

On leaving Cambridge in 1902, Barkla was elected to the Oliver Lodge fellowship of the University of Liverpool, which he held for three years, continuing his researches on X-rays. During the period 1905–9 he was successively demonstrator, assistant lecturer in physics and special lecturer in advanced electricity at the University. He was then appointed to the Wheatstone chair of physics in the University of London (King's College) in succession to H. A. Wilson, who was leaving to succeed Rutherford at Montreal.

The Royal Society elected Barkla to its fellowship in 1912, and in the following year he accepted the professorship of natural philosophy in the University of Edinburgh, which he held until his death.

During the most active period of his life, Barkla's investigations dealt mainly with X-rays and their absorption by matter, and with the emission of secondary radiation. He was the first to show that the secondary emission is of two kinds, one consisting of X-rays scattered unchanged in quality, and the other a 'fluorescent radiation', characteristic of the scattering substance and accompanied by selective absorption of the primary beam. The secondary radiation of the first kind Barkla showed to be polarized, an experimental result of fundamental importance, for it indicated that X-radiation was to be regarded as similar to ordinary light, a point which, up to that time, was thought to be doubtful.

For the discovery of the characteristic radiation and for the explanation of its origin Barkla was most deservedly awarded the Nobel Prize for Physics in the year 1917. His outstanding achievements were also recognized by the Royal Society, which appointed him Bakerian Lecturer for 1916 and awarded him the Hughes Medal in the following year.

Barkla was a successful teacher who inspired many of his pupils with an enthusiasm for research. He was in great request as an examiner in physics, and few excelled him at this work. His long experience of students in three universities, the wide range of his knowledge of physics, his judgment and common sense made him an eminently fair and discriminating examiner. He would re-read with extreme patience (not always shared by his co-examiner) any script of a 'border-line' candidate which he found difficult to assess, and his verdict, when finally delivered, could be accepted with confidence.

While a lecturer at Liverpool, Barkla married Mary Esther, eldest daughter of the late John T. Cowell, receiver-general of the Isle of Man. He leaves two sons and a daughter. Only in the last year was his life clouded by indifferent health; but the family had previously suffered a grievous loss by the death at Carthage in August 1943 of the youngest son, Flight-Lieutenant Michael Barkla, whose achievements at school and at the university had given promise of a career no less brilliant than that of his distinguished father.

Those who were privileged to know Barkla well will treasure the memory of his open-hearted friendliness and personal charm, of the delights of the Hermitage of Braid—his earlier home in Edinburgh—and of the almost idyllic happiness of his domestic life there.

FRANK HORTON.

Prof. G. D. Birkhoff

THE many friends of Prof. G. D. Birkhoff on the eastern side of the Atlantic are deeply grieved to hear of his death on November 12. For a whole generation he had been a commanding figure among mathematicians and a link between American men of science and their colleagues in both western and eastern Europe.

George David Birkhoff was born at Overisel, Michigan, on March 21, 1884; as the name would indicate, his family was originally Dutch, but it has long been settled in the United States. He studied first at Chicago and then at Harvard, returning to Chicago for his doctorate; and, after a short period as instructor in the University of Wisconsin, was appointed assistant professor of mathematics at Princeton in 1909. It was here that he wrote the memoir on the "General Theory of Linear Difference Equations" (*Trans. Amer. Math. Soc.*, 1911) which first brought him into prominence; the "Jahrbuch über die Fortschritte der Mathematik" devoted more than two pages to a notice of it, a rare honour for a young and unknown author. Fundamental solutions of linear difference equations with rational coefficients were obtained for the entire plane of the complex variable by direct matrix methods, and their nature was studied from the functional point of view. Birkhoff showed that there exists a purely Riemannian theory of the equations, and found quantities which play a part like that of the monodromic group constants of an ordinary linear differential equation. His methods were of wide generality, and the paper constituted a striking advance in the subject, to which he made further contributions from time to time, notably in a memoir in *Acta Math.*, **54** (1930).

A closely related branch of mathematics which also owes much to Birkhoff is the theory of linear differential equations, on which he published many memoirs from 1910 onwards (*Proc. Amer. Acad.* and *Trans. Amer. Math. Soc.*); the earlier ones were particularly concerned with the problem of constructing systems of linear differential equations with prescribed singular points of given character and with a given monodromic group.

Birkhoff's interests were shared between pure and applied mathematics, and his work in dynamics was of great value. In an extensive memoir—almost a complete treatise—on "Dynamical Systems with Two Degrees of Freedom" (*Trans. Amer. Math. Soc.*, **18**; 1917), he reduced all problems relating to such systems, even in the 'irreversible' case, to the problem of determining the orbits of a particle constrained to move on a smooth surface which rotates about a fixed axis with uniform angular velocity and which carries with it a conservative field of force; and he showed how the existence of periodic solutions may be directly inferred, and their form determined. This investigation was followed by others, especially on periodic orbits and the problem of three bodies (*Acta Math.*, *Amer. J. Math.* and elsewhere); a connected account of much of his dynamical work appeared in 1927 as one of the American Mathematical Society's Colloquium volumes, under the title "Dynamical Systems".

His two books on relativity, "Relativity and Modern Physics" (1923) and "The Origin, Nature, and Influence of Relativity" (1925) were useful and widely read, and characteristically original in treatment.

In later life, Birkhoff became much occupied with the discovery of mathematical relations in æsthetics. As is well known, more than two thousand years ago Pythagoras founded the scientific theory of music by showing that simple numerical ratios exist between the lengths of the strings the notes of which yield agreeable melodic progressions. Birkhoff's aim was to create a theory of similar character for the fine arts: the results obtained were described in his book "Aesthetic Measure", published in 1933.

Birkhoff was professor of mathematics in Harvard University from 1919 onwards, president of the American Mathematical Society during 1924–26, president of the American Association for the Advancement of Science during 1936–37; an honorary doctor of many American universities and of St. Andrews, Poitiers, Paris, Athens and Sofia;