GEORGE BARKER JEFFERY

George Barker Jeffery, Director of the Institute of Education, University of London, who was President of the Society in 1935, 1936, died on 27 April, 1957. He came from a Quaker family (he was Swarthmore Lecturer to the Society of Friends in 1934) and was born on 9 May, 1891. He was educated at Wilson's Grammar School, Camberwell, and from there in 1909 entered University College, London, to begin a course, common at that time, of two years at the College to be followed by one year's training as a teacher. He was not an entrance scholar of University College, and later was strongly opposed to the specialization that competition for such scholarships usually requires, but he immediately showed his outstanding quality and was elected to a University Scholarship in mathematics at the end of his first year.

The year 1911-12 was a variously important one in Jeffery's career: he entered the London Day Training College and was to become Director of the Institute into which the College evolved; he met there Elizabeth Schofield whom he married in 1915; and he read his first paper [**1**] before the Royal Society in June 1912, the month following his 21st birthday. In the following year Jeffery returned to University College as a research student and assistant under the late L. N. G. Filon in the department of applied mathematics, of which he was left in charge when Filon went away on war service in 1914. As a Quaker Jeffery could take no part in the war and was not allowed to remain at University College after 1916; he served a short term of imprisonment as a conscientious objector and was afterwards directed to other work until 1919. These were clearly difficult years, but Jeffery managed somehow to go on with his work; there was an interlude of three years after the first paper, but this was followed by a long period of rapid publication in a widening field in the course of which he was in 1926 elected a Fellow of the Royal Society. Shortly after the war Jeffery was appointed reader in mathematics at University College and in 1922 professor at King's College, London. In 1924 he returned to University College to succeed the late M. J. M. Hill as Astor professor of mathematics and held this appointment until 1945. In the second war Jeffery acted as pro-provost for the section of University College that went to Bangor, and was appointed to succeed Sir Fred Clarke as Director of the Institute of Education shortly after the College returned to London.

Jeffery was an inspiring teacher with wide interests in the teaching of mathematics and indeed in teaching generally. A primary concern was naturally the teaching of mathematics in the University, and he probably did more than anyone else to improve it. A direct attempt at a comprehensive change of syllabus for the honours course was unsuccessful, but as a compromise an alternative syllabus, Syllabus B, was finally (in 1930)

[JOURNAL LONDON MATH. SOC. **34** (1959), 251–256]

allowed; the older syllabus did not long survive the comparison, and Syllabus B was left in sole possession of the field. These interests etermined his choice of subject in some addresses, with the fortunate result that he put on record, much more fully and more precisely than do most mathematicians, what he thought about mathematics. Presumably he would not have agreed with Hardy that " it is a melancholy experience for a professional mathematician to find himself writing about mathematics ". In the course of his address to this Society [**22**] he imagined that, with his professorial colleagues, he was given a sheet of foolscap and asked to set down his reasons for thinking his own subject important. Jeffery thought that he, almost alone, would be in difficulty. His colleagues would write down their replies at once and be ready to write one for him as well; but his considered reply would be " pure mathematics is a good subject because I like it " and he added that " if all the implications of my answer were fully thought out it might appear to be a better answer than any of the others ". He did not speak of the relation between pure mathematics and applied, although here his impressions would have been of particular value; for his sustained interest in pure mathematics was evident, and yet he wrote only two papers ([**3**], [**9**]) in the *Proceedings* and the bulk of his published work would be reckoned as applied in the usual rough classification. In his early days in the department of applied mathematics he was playfully accused of being a pure mathematician by Filon —who was himself somewhat sensitive about his own interest in geometry. It is perhaps relevant that the subject of much of Jeffery's work was the exact solution of partial differential equations, in fields where such solutions were rare and were consequently of enhanced value; he was much less entangled in approximations and arithmetic than most workers on theoretical mechanics.

In both his addresses to the Mathematical Association ([**24**], [**25**]) he spoke of the teaching of elementary mathematics and stressed the value of a subject which permitted the definite attainment of a short-range objective, of a subject, that is to say, in which 100 per cent could be awarded instead of the usual α. On both occasions he was concerned to defend mathematics as a school subject, and there is a sterner note in the later address. " Mathematics is peculiarly open to attack by the anti-intellectual forces that are rampant in our national educational thought. . . . It is sought to escape from the stern disciplines that teach us that good things demand hard work for their achievement, and we are offered the alternatives of soft options and sagging standards ". The imperfections of examinations are admitted but " it would be idle to deny the stern discipline they effect by discriminating between sound knowledge and verbiage and between conscientious preparation and slacking ". These are strong words from one of whom tolerance was an obvious characteristic; few, if any, mathematicians had a wider knowledge on which to base an opinion.

As has been stated Jeffery thought that too early specialization was undesirable; he said in [**24**] " I would far sooner have a boy with a three subject H.S.C. from a school which encourages hobbies and crafts than the typical product of the scholarship class. He has a better foundation on which to take a university course in mathematics. He may know less mathematics, but he has a better furnished mind ". This opinion is a suitable introduction to Jeffery's own wide interests in craftmanship. He was a highly skilled cabinet maker of long standing; he was proud to have come through his grandfather from a family of wheel-wrights, and possibly his interest and skill (which he has transmitted to his son) were inherited from this source. Enduring examples of his craft adorn University College and no doubt the other institutions with which he was concerned. The desk he made for his college room was unfortunately destroyed in an air raid; this was a striking piece of work with the appearance so far as was possible of a solid rectangular block with the minimum interference by drawer-handles, etc., with the planes. When he was about 60 he took to silver-smithing and was said to have derived great pleasure from the registration of his own hall-mark with the Goldsmith's Company. Since 1952 he had been Dean of the College of Handicraft, and tribute has been paid to his enthusiasm by the Master of the College, Mr. R. A. Butler. He died suddenly while driving home from the annual conference of the College; his wife, with him in the car, has fortunately recovered from the serious injuries she sustained in the accident that followed.

In Jeffery's first paper [**1**] a solution of Laplace's equation was found in orthogonal coordinates appropriate to the space between two non-intersecting spheres, and this was used in calculating the electrostatic capacity of two equal spheres and in some similar problems which had previously been solved by series of images. This and some other solutions of Laplace's equation were shown in their relation to Whittaker's general solution in a series of early papers ([**2**], [**7**], [**8**], [**9**], [**10**]).

Jeffery's work in hydrodynamics was mainly concerned with the slow motion of viscous liquids, but in [**5**] some exact solutions of the equations of finite motion were found. In a steady two-dimensional motion with conjugate functions α, β of x, y used as orthogonal coordinates, it was assumed first that the vorticity was a function of α only; a general solution was then found, but the assumption was, of course, restrictive and none of the possible motions was of much physical interest. No general solution could be found on the second assumption that the stream function was a function of α only, but in working through a particular case Jeffery made one of the first important contributions to the problem of the finite motion of viscous liquid between inclined plane boundaries.

In the papers on slow motion it was proved in [**3**] that there is a simple relation between the motion of viscous liquid caused by the rotation of a symmetrical body about its axis and the symmetrical flow of perfect liquid past the body. The subject of [**16**] was the motion of ellipsoidal particles immersed in viscous liquid; this was a long and difficult paper, of great interest in both its mathematical and physical aspects, and the results have been widely quoted. Immersed spherical particles had been considered by Einstein, who found $1+\frac{5}{2}V$ as the proportional increase in the coefficient of viscosity, V being the volume of particles in a unit volume of the liquid; Jeffery's work brought in the difficult question of orientation and here nothing could be determined by slow-motion theory. If inertia is ignored, the axis of a spheroidal particle, moving under the fluid reactions only, does not tend towards a position that is fixed in relation to the undisturbed flow, but can execute (in infinitely many ways) a motion like that of a spinning top. Jeffery accordingly made the assumption that among the possible motions, the one that actually took place was characterized by the smallest rate of dissipation of energy. (The familiar theorem of minimum dissipation holds under specialized conditions and is not applicable in this case.) Definite conclusions could then be drawn; thus it was possible to say that prolate spheroidal particles immersed in a fluid in laminar motion would set themselves with their axes perpendicular to a plane and would rotate about these axes with constant angular velocity, and that there would be a formula of Einstein's type for the viscosity with the factor $\frac{5}{2}$ replaced by a smaller constant which depended on the shape of the particles.

Jeffery wrote only one paper [**11**] on elasticity, but few writers have made so important a contribution to a subject by a single paper. This was a comprehensive account of the two-dimensional problems of elasticity in the space bounded by two non-intersecting cylinders; it was written some years before the use of complex variable methods became general, little had been done with conformal transformation (except in the case of inversion) and many difficulties of analysis had to be overcome. The same technique was employed in [**15**] in discussing the slow viscous flow caused by the rotation of two circular cylinders. The work of these two papers was perhaps suggested by the application to two-dimensional elastic systems of Photo-Elasticity, the study of which is now approaching its 50th anniversary at University College; so also possibly was that of [**16**], for according to a theory due to Ambronn double refraction in a liquid can be accounted for by the orientation of suspended particles.

Jeffery was so exceptionally gifted as an administrator and so wise and tolerant a personality that it was inevitable that his services on boards, advisory councils, and so on should be sought after, and his preoccupation with work of this sort became increasingly heavy long before his appointment as Director of the Institute of Education.

In 1948 the Institute became the Training Organization for a large area round London; the organization was made up of two Constituent Departments (in King's and Goldsmith's Colleges) and over 30 Constituent

Colleges, among them most of the Training Colleges in the London area, and was ultimately responsible for the training of more than a quarter of the teachers in England. Besides this expansion in scope, there was in the post-war years a period of very rapid expansion in the Institute itself and it had finally over 1,000 students, 300 of them from overseas. From the beginning Jeffery had had much to do with the setting up of the organization, and it fell to him as Director to supervise both aspects of the expansion. Many tributes have been paid by his colleagues to his handling of this heavy task, and in 1956 when he reached the age of retirement at 65 his appointment was extended for a further three years.

The Institute has a Department of Education in Tropical Areas, and this is most appropriate in view of Jeffery's particular interest in education in Africa and elsewhere overseas; he was Chairman of the West African Study Group, a member of the West African Examination Council, and his several visits to West Africa were an immense stimulus to education; Mr. R. A. Butler has recorded that he was given a great welcome on his last visit which was at the time of the Ghana Independence celebrations.

It was inevitable that Jeffery should find increasingly less time for original work in mathematics; the quality of his work shows what a loss this was in the specialized field, but it was an immense gain to the study of mathematics as a whole that he should have played so prominent a part in setting it in its proper perspective.

Publications.

1. "On a form of the solution of Laplace's equation suitable for problems relating to two spheres", *Proc. Royal Soc.* (A), 87 (1912), 109–120.
2. "On spheroidal harmonics and allied functions", *Proc. Edinburgh Math. Soc.*, 33 (1915), 118–121.
3. "On the steady rotation of a solid of revolution in a viscous fluid", *Proc. London Math. Soc.* (2), 14 (1915), 327–338.
4. "The equations of motion of a viscous fluid", *Phil. Mag.* (6), 29 (1915), 445–455.
5. "The two-dimensional steady motion of a viscous fluid", *Phil. Mag.* (6), 29 (1915), 455–465.
6. "On self-intersecting lines of force and equipotential surfaces", *Phil. Mag.* (6), 29 (1915), 832–836.
7. "Cylindrical harmonics", *Quart. J. Pure and Applied Math.*, 47 (1916), 50–55.
8. "Bipolar and toroidal harmonics", *Proc. Edinburgh Math. Soc.*, 34 (1916), 102–108.
9. "The relations between spherical, cylindrical, and spheroidal harmonics", *Proc. London Math. Soc.* (2), 16 (1916), 133–139.
10. "Transformation of axes for Whittaker's solution of Laplace's equation", *Proc. Edinburgh Math. Soc.*, 35 (1917), 32–37.
11. "Plane stress and plane strain in bi-polar coordinates", *Phil. Trans. Royal Soc.* (A), 221 (1921), 265–293.
12. "On the path of a ray of light in the gravitational field of the sun", *Phil. Mag.* (6), 40 (1920), 327–329.
13. "The field of an electron on Einstein's theory of gravitation", *Proc. Royal Soc.* (A), 99 (1921), 123–134.
14. (With F. W. Hill), "The gravitational field of a particle on Einstein's theory", *Phil. Mag.* (6), 41 (1921), 823–826.

15. "The rotation of two circular cylinders in a viscous fluid", *Proc. Royal Soc.* (A), 101 (1922), 169–174.
16. "The motion of ellipsoidal particles immersed in a viscous fluid", *Proc. Royal Soc.* (A), 102 (1922), 161–179.
17. "The identical relations in Einstein's theory", *Phil. Mag.* (6), 43 (1922), 600–603.
18. (With O. R. Baldwin), "The relativity theory of plane waves", *Proc. Royal Soc.* (A), 111 (1926), 95–104.
19. (With O. R. Baldwin), "Electronic orbits on the relativity theory", *Proc. Royal Soc.* (A), 111 (1926), 104–110.
20. (With M. Stimson), "The motion of two spheres in a viscous fluid", *Proc. Royal Soc.* (A), 111 (1926), 110–116.
21. (With K. Pearson and E. M. Elderton), "On the distribution of the first product moment-coefficient, in samples drawn from an indefinitely large normal population", *Biometrika*, 21 (1929), 164–201.
22. "Mathematical studies in the modern universities" (Presidential address to the London Mathematical Society), *Journal London Math. Soc.*, 13 (1938), 67–77.
23. "Louis Napoleon George Filon", obituary notices of the Royal Society, No. 7, vol. 2 (1939), 501–509; also *Journal London Math. Soc.*, 13 (1938), 310–318.
24. "Mathematics in school and university" (Presidential address to the London branch of the Mathematical Association), *Math. Gazette*, 23 (1939), 26–34.
25. "Mathematics as an educational experience" (Presidential address to the Mathematical Association), *Math. Gazette*, 32 (1948), 6–14.