A pioneering geophysicist: Rosemary Hutton

Bruce A. Hobbs[1]* and Alan G. Jones[2,3]

[1]School of GeoSciences, The King's Buildings, James Hutton Road, Edinburgh EH9 3FE, UK

[2]Dublin Institute for Advanced Studies (DIAS), School of Cosmic Physics, 5 Merrion Square, Dublin 2, Ireland

[3]Complete MT Solutions Inc., 5345 McLean Crescent, Manotick, Ottawa, Ontario, Canada K4M 1E3

AGJ, 0000-0002-3482-2518

*Correspondence: Bruce.Hobbs@ed.ac.uk

Abstract: Violet Rosemary Strachan Hutton ('Rosemary') graduated from St Andrews University in 1948 and a few years thereafter embarked upon a pioneering career in geophysics, a rare and challenging choice for a single woman at that time. Her impressive research career, starting in 1954, was largely devoted to the investigation of how geophysical methods, in particular electromagnetic techniques, could reveal the structure of the Earth's continental crust and upper mantle. She spent 15 years in Africa at the universities of Ghana, Zaria and Ibadan. Working in comparative isolation, she studied the equatorial electrojet and micropulsations and produced 13 high-quality papers of which three, including her first, were published in *Nature*. This demonstrated a remarkable combination of resourcefulness and self-reliance. In 1969, she joined the University of Edinburgh Geophysics Department and remained at the cutting edge of her science until retirement, investigating crustal electrical conductivity structure, continental rift systems, geothermal regions, geomagnetic source fields and the closure of the Paleozoic Iapetus Ocean. She inaugurated the now highly-successful biennial series of Workshops on Electromagnetic Induction – a high point in the International Association of Geomagnetism and Aeronomy calendar. To recognize her contributions, the 'V.R.S Hutton Symposium' was held by the European Geophysical Society in 1992. She was elected Fellow of the Institute of Physics and Fellow of the Royal Society of Edinburgh in recognition of her pioneering and outstanding contributions.

Violet Rosemary Strachan Hutton, who appears both as V.R.S. Hutton and as R. Hutton in the literature, was known simply as 'Rosemary' to the many hundreds of people she worked with, whom she influenced and who knew her.

Rosemary was born in Dundee in 1925, took an honours degree in Physics and Mathematics at St Andrew's University, and subsequently worked for the British Jute Association for several years – this experience was enough to convince her that she needed something much more challenging in her life.

So, at the age of 29, she upped-sticks and went to Africa to begin a new career in the-then fledgling geoscience subdiscipline of Geophysics. As a female working in a very male-dominated field at that time, she was considered a pioneer with exceptional courage.

Her 15 year African adventure started with a Lectureship at the University of Ghana. She then moved to Ahmadu Bello University in Zaria, Nigeria, and thence to the University of Ibadan in Nigeria. She worked in comparative isolation during those 15 years, and correspondence by letter took many weeks. The University of Ghana was associated with London University at that time and she registered for a PhD that was awarded in 1961. Being in Africa near the Equator, she studied the Earth's equatorial electrojet, an intense eastward electric current flowing in the day-side ionosphere above the magnetic dip equator at an altitude of around 110 km, and her very first paper, arising from her PhD, was published in *Nature*. She went on to publish a further 14 papers whilst in Africa in scientific journals of world renown, including another two in *Nature*. Consequently, her name became widely recognized and respected amongst her peers in the international geomagnetic community (International Association of Geomagnetism and Aeronomy: IAGA) and more widely across the broader field of geophysics (International Union of Geodesy and Geophysics: IUGG). Most importantly, her research came to the attention of Professor Alan Cook FRS, the first Head of the newly-establishing Department of Geophysics at the University of Edinburgh in 1969, and he invited Rosemary to join the department as Lecturer. She remained at Edinburgh for the rest of her career in academia, becoming Senior Lecturer in 1973 and Reader in 1982, retiring as an Honorary Fellow of the University of Edinburgh in 1991.

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Rosemary: an enabling scientist

We would first like to address what kind of person Rosemary was, what she did in a wider context and what she did for other people outside of her science, as this gives insight into her achievements in science. In Edinburgh, she lived with her sister Doreen and their mother, and together they would entertain often and royally. Their dinner parties were renowned, her African curries were a by-word and, of course, any overseas visitors to the department would be an excuse for lavish entertainment. She kept ties with colleagues and new researchers in Africa, and, during her time in Edinburgh, had three research students from that continent. She always ensured that overseas students, who could not afford a return trip home during vacations, were not left alone – she would support them with social events and had some to stay at her house. She made them comfortable and feel 'at home'.

Rosemary was particularly focused on getting her students to international meetings and, when there, promoting them at every opportunity – especially making sure they met the important people in their research area. This reaching out and caring for others was evident right from the start in Ghana, where as part of her auxiliary duties she was Deputy Warden of Volta Hall, University of Ghana. It continued at Edinburgh where she was, for an extensive time, Director of Studies for undergraduate students, looking after not only their academic concerns but also their general well-being. Also, she helped to establish the Geophysics Department at the University of Edinburgh. This involved putting together a 4-year degree course and writing appropriate lectures. Members of the department, a year after she arrived, are shown in Figure 1.

In 1972, Professor Cook left the nascent Department of Geophysics at Edinburgh to go to Cambridge, and Rosemary was acting Head of Department for over a year.

Something of tremendous value and importance for which she will always be remembered and recognized is the establishment of IAGA Workshops on Electromagnetic Induction. Two of her international friends, Professors Attia A. Ashour (Egypt) and Walter Kertz (Germany), in a coffee queue at the 1971 IUGG in Moscow, suggested having a meeting of those interested in electromagnetic induction of the Earth using primarily natural sources, and that Rosemary should arrange for it to happen. She immediately set to work on the idea, becoming principal organizer and enlisting others in the department to help. This culminated in an announcement that the first Workshop on Electromagnetic Induction of the Earth would be held in Edinburgh in 1972. The style at this workshop set the precedent for all future workshops – some key review presentations, a few presentations of new unpublished ideas, and lots of time for explanations and panel discussions. Not

Fig. 1. Department of Geophysics, 1972. Front row, from the left: Cecilia Hobbs, Rosemary Hutton (Lecturer), Isabell Cook, Professor Alan Cook (Head of Department), Vicky Hipkin and Lydia Wilson (Secretary). Back row, from the left: Bruce Hobbs (Lecturer), Ebong Mbipom (research student), Alex Jackson (Technician), Roger Hipkin (Lecturer), Ulla Hipkin and Calum Keith (research student).

only was she principal organizer, she was, of course, social secretary. She immediately established that the workshop programme included one full day in the middle for a local excursion, something else that has become a hallmark of these workshops. She had great fun sorting out where to visit and, of course, where to have lunch and dinner. As Professors Ashour and Kertz, and many other greats in our field, started arriving in Edinburgh and meeting Rosemary her face was a picture of great relief and enormous excitement that this was actually taking place. The midweek excursion visited Culross and an example photograph is shown in Figure 2.

Those early workshops became a stunning success and became the highlight of the IAGA Division I Working Group I.2 programme and a recognized biennial even-year feature of the IAGA. So much so that in 2016 the Working Group was elevated to that of a Division in its own right within the IAGA – it is now Division VI – and all started by Rosemary. Another photograph from the first workshop shows Rosemary as the centre of attention (Fig. 3).

Table 1 shows how the workshops have developed over the years – they have been held every 2 years throughout the world.

Unfortunately, we do not have a group photograph from the first workshop in Edinburgh but Figure 4 shows one from the second workshop held in Ottawa, Canada in 1974.

The seventh workshop in 1984 went back to her roots in Nigeria, and was attended by approximately 25 international scientists and 25 African scientists. Figure 5 is from a later workshop showing how attendance had grown to the numbers we see today, of the order of 350–400 academics, students, government and industry scientists.

Fig. 3. Rosemary at the first Workshop reception with Professor and Mrs Price to the right.

When Rosemary retired she had a house built in Peebles, and she and Doreen were active in the local art and music scene. After their mother died, Rosemary and Doreen moved to St Andrews, where sadly Rosemary died of a brain tumour in 2004. Doreen died later and in her will she left a bequest to the University of Edinburgh for the establishment of a 'Rosemary Hutton Memorial Lecture'. The first lecture in this series was given by Rosemary's second student Alan Jones (co-author of this paper), and the biennial series has continued with talks by Dr Eleonora Rivalta (2015), Professor Veronique Dehant (2017) and Professor Maya Tolstoy (2019).

Fig. 2. First Workshop excursion: Rosemary (left), her mother (centre) and her sister Doreen (right).

Table 1. *Workshop venues 1972–2024, the two planned future workshops are shown in italics*

Year	Place	Country	Year	Place	Country
1972	Edinburgh	UK	1998	Sinaia	Romania
1974	Ottawa	Canada	2000	Cabo Frio	Brazil
1976	Sopron	Hungary	2002	Santa Fe	USA
1978	Murnau	Germany	2004	Hyderabad	India
1980	Istanbul	Turkey	2006	El Vendrell	Spain
1982	Victoria	Canada	2008	Beijing	China
1984	Ile-Ife	Nigeria	2010	Giza	Egypt
1986	Neuchâtel	Switzerland	2012	Darwin	Australia
1988	Sochi	Russia	2014	Weimar	Germany
1990	Ensenada	Mexico	2016	Chiang Mai	Thailand
1992	Wellington	New Zealand	2018	Helsingør	Denmark
1994	Brest	France	2022	*Kuşadasi*	*Turkey*
1996	Onuma, Hokkaido	Japan	2024	*Beppu*	*Japan*

Rosemary: the science

Rosemary's first paper, titled 'Regular micropulsations of the Earth's field at the equator', arose from her PhD studies and was published in *Nature* (Hutton 1960). Here she showed from observations that micropulsations of the Earth's magnetic field, arising from reactions between the solar wind pressurizing the Earth's magnetic field and causing fluctuations in the magnetospheric boundary, not only occurred during the day, as previously known, but also at night. In fact, she showed they could be more frequent and of higher amplitude at night. Astounding by modern standards is that she cited only two preceding papers on the subject, demonstrating just how cutting edge her work was. A series of observational papers on the equatorial electrojet followed throughout the 1960s, most published in the American Geophysical Union's prestigious *Journal of Geophysical Research*, becoming more theoretical as Rosemary moved around sub-Saharan North Africa. She published two more papers in *Nature* before she left Africa (Hutton 1962, 1969), all three being single-authored papers, and these showed her growing interest in determining the structure of the Earth through its electrical resistivity properties using natural electromagnetic (EM) sources.

In Edinburgh, over the quarter of a century that followed, she made a profound impact on the growth and development of the Department of Geophysics, in the quality and direction of undergraduate teaching and on the research side where she established a thriving and world-renowned group working principally on the three general topics: 'The electrical conductivity structure of the Earth', 'Continental rift systems and geothermal regions' and 'Source fields of geomagnetic time variations'. 'Magnetotellurics' was the technique that enabled her to address most of the problems she tackled.

The essence of magnetotellurics, known as MT, is depicted in Figure 6. Measurements are made of variations in the Earth's electric field in one direction, say north–south, by measuring the potential difference between two electrodes placed some distance apart, typically 100 m or so. Electric field variations are also measured in the orthogonal direction (east–west). Simultaneous measurements are made of variations in the Earth's magnetic field, again in the same orthogonal directions. The ratio of a horizontal magnetic field (H) to its orthogonal electric field (E), as a function of frequency, is termed the impedance (Z), as shown in equation (1):

$$Z(\omega) = \frac{H(\omega)}{E(\omega)} \tag{1}$$

where ω is angular frequency. The apparent resistivity, defined by

$$\rho_{\mathrm{a}} = \frac{1}{\omega\mu} \lfloor Z(\omega) \rfloor^2 \tag{2}$$

where μ is magnetic permeability, determines the resistivity of an equivalent half-space.

This amplitude (apparent resistivity) and the phase of the impedance as a function of frequency may be mapped to variations in the actual subsurface resistivity, thereby determining the structure, or at least the electrical conductivity structure, of the subsurface. The depth of penetration (km) of electromagnetic variations is given approximately by

$$\delta(T) \approx 0.5\sqrt{T\rho_{\mathrm{a}}} \tag{3}$$

where T is the period of the variation in seconds.

Fig. 4. Group photograph from Ottawa Workshop 1974. Rosemary is in the second row from the front, third from the right-hand side.

Fig. 5. The Darwin Workshop group photograph 2012.

In 1972, Rosemary commissioned the building of MT and magnetovariational (MV: measuring the three components of the magnetic field only) systems based on designs in the literature, and Figure 7 shows the first instruments being tested.

These instruments, rudimentary by modern standards but nevertheless functional, measured, amplified and filtered the magnetic and electric field time variations and recorded the output onto paper charts. Variations with periods of less than 1 s usually arise from lightning strikes, periods greater than this from fluctuations in the magnetospheric boundary. For a typical value of $\rho_a = 100\ \Omega$ m, electromagnetic induction at say $T = 4$ s gives information to a depth of around 10 km (see equation 3). Observational sites had to be prepared

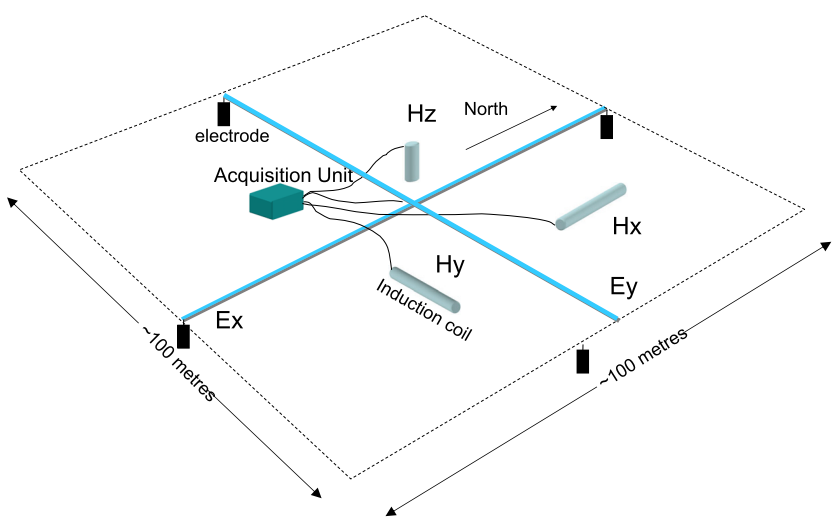


Fig. 6. Elements of a magnetotelluric and, with Hz, a magnetovariational field station (provided by OpenEI, courtesy of Moombarriga Geoscience Pty Ltd).

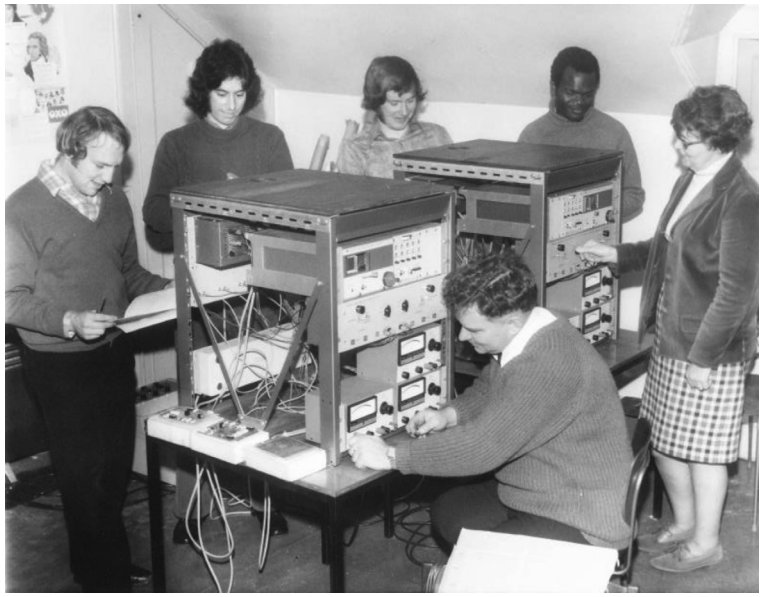


Fig. 7. Ian Brazier (kneeling), builder of the first instrumentation for Rosemary. In the background, from left to right: an undergraduate, Dennis Rooney (Rosemary's first research student), Alex Jackson (Technician) and Ebong Mbipom (research student).

very carefully; it then might take several days to obtain enough measurements at each frequency for stacking to provide meaningful estimates. Weeks or sometimes months were required for long-period variations that elucidate very deep Earth structure (down to the base of the lithosphere at 250 km in some places). The whole process was very time-consuming – but now, at least, Rosemary had her own equipment. Figure 8 shows output from these first instruments.

These paper chart records had to be carefully hand digitized – a laborious process. One such record is shown in Figure 9 of some 2400 s in duration recorded at Borland in southern Scotland on 26 April 1975 (Jones 1977) where micropulsations at around $T = 100$ s arising from the time variations in the magnetosphere can be seen with correlations between the magnetic and electric fields.

These digitized records then had to be Fourier transformed to determine transfer functions between electric and magnetic fields as a function of frequency. These transfer functions are then modelled to yield the Earth's subsurface resistivity structure.

The first use of the equipment was, of course, in Africa, in the Kenyan Rift Valley in 1973 and 1974, and was with her first student Dennis Rooney (Rooney and Hutton 1977). A year later, and the subsequent year, Alan Jones deployed the instruments in the Southern Uplands for two campaigns (Jones and Hutton 1979*a*, *b*).

In addition, in the mid-1970s Rosemary initiated a long-term collaboration with Professor Ian Gough of the University of Alberta in Edmonton. Gough and a colleague had designed and built a set of 40 three-component magnetometers, and had undertaken a number of very successful campaigns in western and central USA and Canada in the late 1960s and early 1970s. Rosemary convinced Gough to loan her 20 of the 'Gough–Reitzel' instruments for a campaign in Scotland, and installed them initially in northern Scotland and subsequently in southern Scotland. The first paper from that study was naturally yet another *Nature* paper (Hutton *et al.* 1977). Alan Jones joined her group just after the northern sites were installed, and was responsible for retrieving the sites and installing them in southern Scotland. One of his tasks was a camera-changing trip to southern Scotland to retrieve data in the winter. Whilst doing so, his field assistant, Surrinda Chita, turned the Land Rover over in the snow, the batteries shorted out and a fire broke out in the back of the vehicle. Alan telephoned Rosemary to report all this and her first words were 'Did you get the data?'.

This collaboration with Gough was symptomatic of Rosemary's style – many international scientists were invited to Edinburgh, and were plied with good food and drink until they revealed all their secrets and agreed to collaborate with her. The many co-authorships on her more than 60 papers

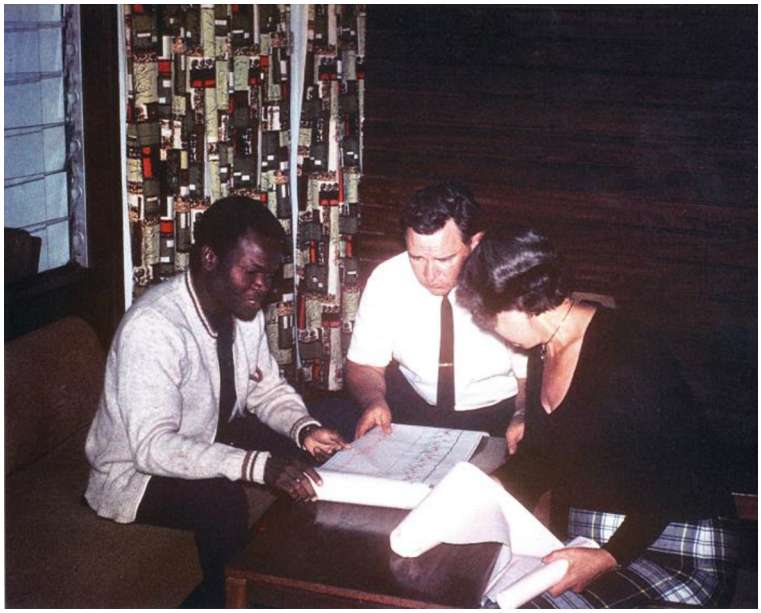


Fig. 8. Ebong Mbipom, Ian Brazier and Rosemary pouring over the chart output.

testify to her broad appeal to the whole of the international community.

In 1979–80 Rosemary commissioned the design and construction of a state-of-the-art system called the Short Period Automatic Magnetotellurics (SPAM), and she employed a research associate Graham Dawes for the design and build. She knew what she needed and he built it. In fact, he built many designs, some of which are still in use today. Figure 10 shows a schematic of the new computer-controlled design with digital recording.

These systems became very sought after, and were sold to colleagues in Canada, India and Germany. The GFZ German Research Centre for

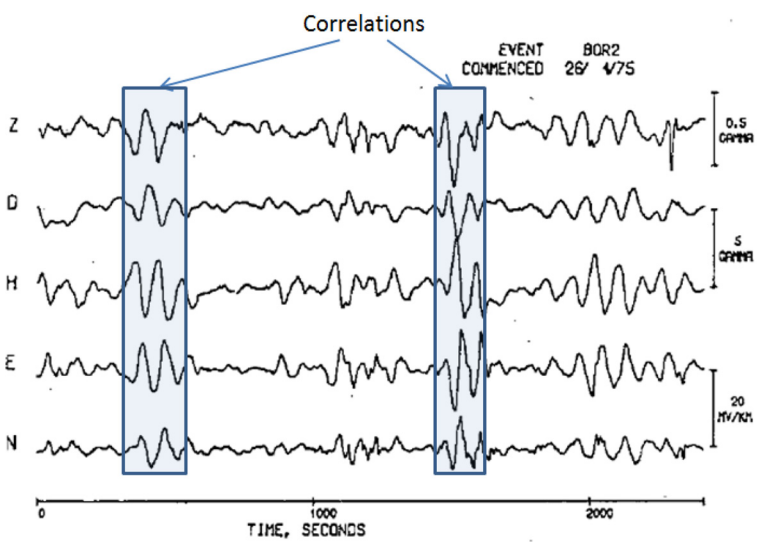


Fig. 9. Electric (E and N) and magnetic field (D, H and Z) variations after hand digitizing. Note the correlations between H and E, and between D and N.

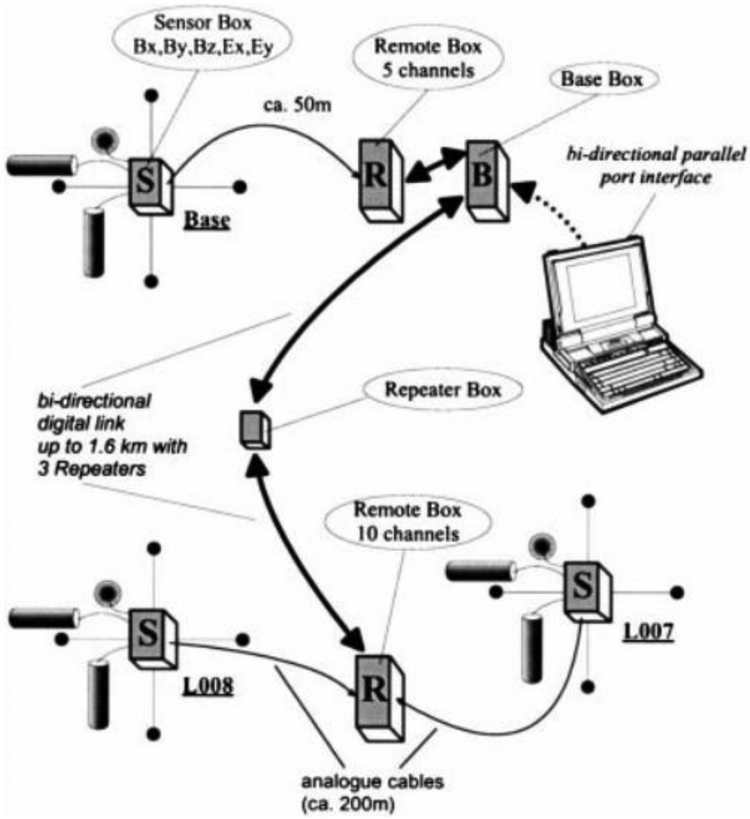


Fig. 10. Elements of the SPAM system. Remote nodes measure electric and magnetic field variations, and repeater boxes and remote nodes allow for many stations to operate simultaneously. From Ritter *et al.* (1998), with kind permission of Oliver Ritter and Oxford University Press on behalf of the Royal Astronomical Society.

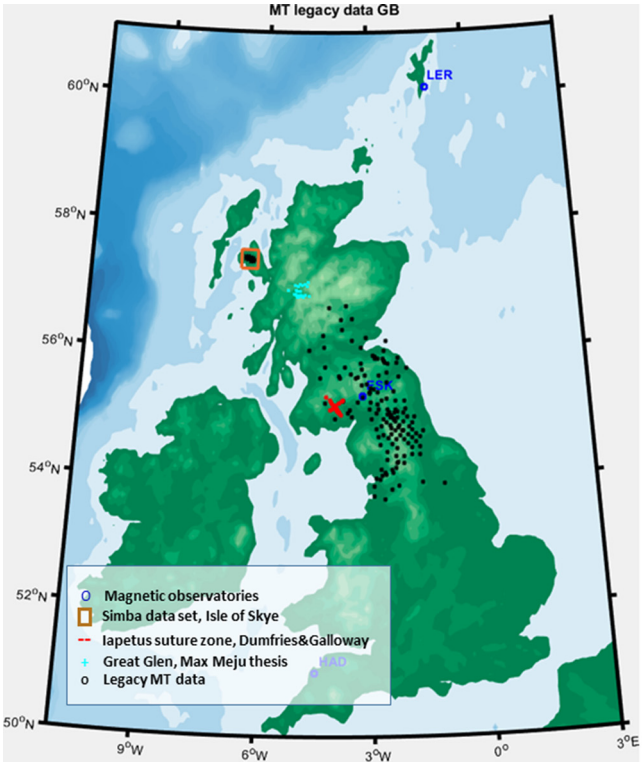
Geosciences in Potsdam in particular requested many of them to form the basis of their geomagnetic equipment pool for hire (Ritter *et al.* 1998). They also became part of the Natural Environment Research Council (NERC) Equipment Facility and were loaned to UK universities for several decades. In fact, they are only now (2020) being replaced by later designs. This was another success story for Rosemary.

Her work in southern Scotland and northern England over two decades was principally concerned with the enigmatic 'Eskdalemuir anomaly' – now known to be a consequence of the closure of the Paleozoic Iapetus Ocean and continent–continent suturing of Laurentia with Gondwana. She and her students collected a vast amount of data over 20 years, starting with Alan Jones in 1974 (Jones and Hutton 1977) and ending with Peter Sule in 1991 (Sule *et al.* 1993) – her last published paper. Some of the sites occupied during that time are shown in Figure 11.

Data from these stations, in the period range $T = 0.005$–6000 s, provide, for example, depth to top of basement maps, as in Figure 12, and traverses can be extracted and modelled in more detail.

The transect in Figure 12 through the Alston Block, the Northumberland Trough and the Southern Uplands was modelled using concatenations of 1D inversions, refined by 2D modeling, and the results are reproduced in Figure 13. This shows a conductor, of resistivity 20–70 Ω m, dipping to the north at depths of between 10 and 30 km, which spatially correlates, to some extent, with the Iapetus Suture Zone identified through nearby offshore vertical incidence seismic reflection profiles such as the NEC and WINCH lines of BIRPS (British Institutions Reflection Profiling Syndicate). This conductive suture zone separates middle- and lower-crustal European provinces from palaeo-North American (Laurentian) affinity, providing further evidence of structure.

Rosemary's research group extended the geographical area of their investigations from the Southern Uplands of Scotland and northern England to Ireland (also to study the Iapetus closure) and



Location of legacy MT data

Simba and Iapetus data are of modern standards,
The legacy data has only limited frequency range (sometimes only 1 data point at 60s) and usability (some data in 'cph' – cycles per hour)
MT transfer functions are available from geomagnetic observatories (electric field collection since 2012)

Fig. 11. Some of the magnetotelluric sites from Rosemary Hutton's research group. Prepared by, and with kind permission of, Juliane Huebert, British Geological Survey.

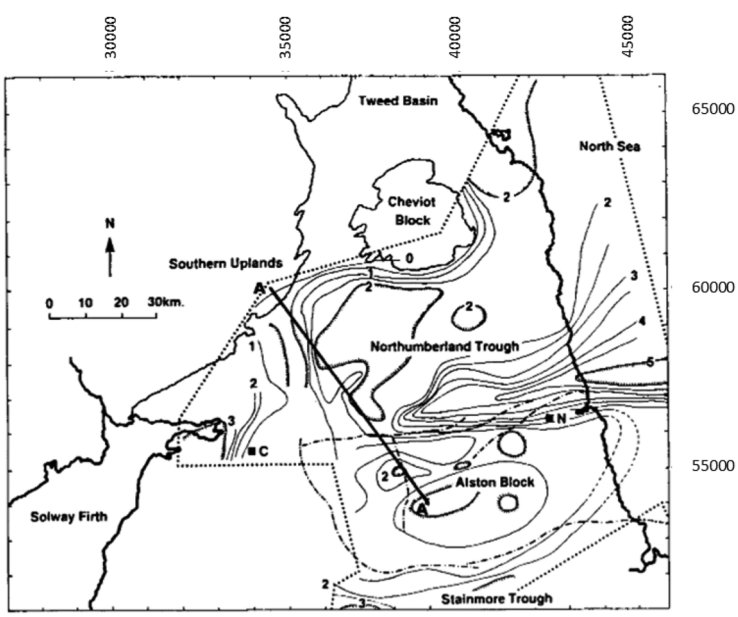


Fig. 12. Contour map of depth (in km) to top basement for southern Scotland/northern England (from Parr and Hutton (1993), fig. 9b).

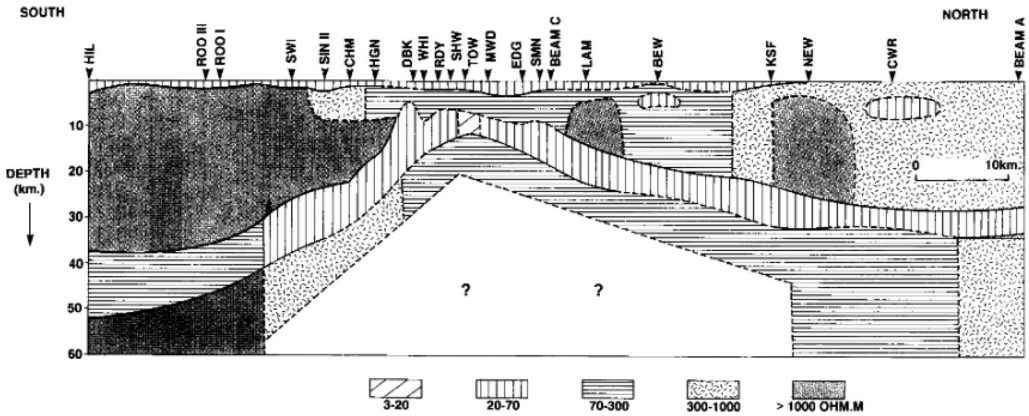


Fig. 13. South–north crustal resistivity section through the Iapetus Suture Zone (from Livelybrooks *et al.* 1993; originally from Parr 1991).

also neighbouring regions of continental Europe. She integrated her studies with seismic, magnetic and gravity data, and impressed upon her students the value of combining datasets from various disciplines.

Rosemary was aware of the need to boost the rather limited amounts of funding available from the UK research councils. In 1985, the Royal Society funded her project entitled 'Lateral Variations in Lithospheric Electrical Conductivity Structure in Italy', part of her Geothermal Research Programme initiated in 1980 for the Travale Geothermal Field. Importantly, she was one of the first staff members of Edinburgh University to be awarded a research contract from the E.E.C.; that one was supporting a 'Feasibility Study of Magnetotelluric Measurements on Milos, Greece'. Rosemary also succeeded in gaining substantial financial support from several different industrial sources. These took her group to Portugal and Kenya, and she worked for the Cambourne School of Mines looking for fluid-filled fractures identified by resistivity changes from the surroundings. An early result from the Travale field in Italy shows the geothermal reservoir, in this case the highly fractured basement in which hydrothermal fluids are circulating, and this is presented in Figure 14.

Rosemary published some 60 papers – 15 in her 15 years in Africa and another 45 on her return to Edinburgh. This is a rate of over two per year and was hard to achieve bearing in mind the length of time it takes to obtain magnetotelluric data before analysis to form the basis of a paper.

Rosemary trained 15 research students over a 20 year period, as shown in Table 2. They came from the UK and from West Africa, Kenya, India and Brazil. Almost all of them have gone on to very successful careers in geophysics and are now training students of their own. Figure 15 shows Rosemary with a few of her students.

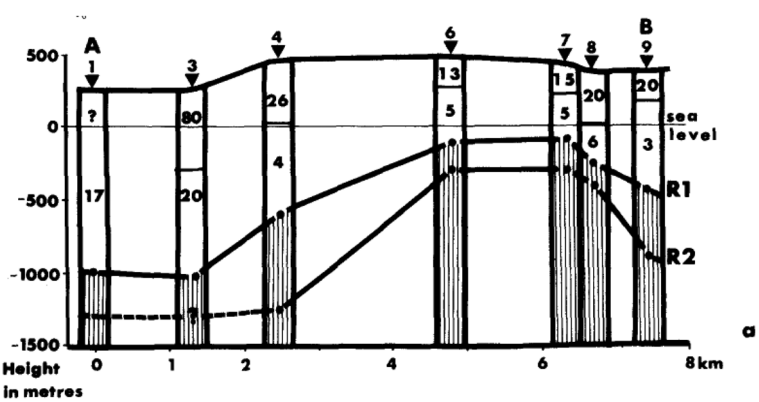


Fig. 14. Concatenation of 1D resistivity inversions showing the dome of the low-resistivity geothermal field (from Hutton *et al.* 1985).

Table 2. *Research students supervised by Rosemary together with their thesis titles*

Surname	First name	PhD Awarded	Thesis title
Rooney	Dennis	1976	Magnetotelluric measurements across the Kenyan Rift Valley
Jones	Alan	1977	Geomagnetic induction studies in southern Scotland
Mbipom	Ebong	1980	Geoelectric studies of the crust and upper mantle in northern Scotland
Ingham	Malcolm	1981	Lateral variation of the electrical conductivity structure across south Scotland
Novak	Martin	1982	A broadband magnetotelluric study in the north England high heat flow region
Devlin	Teresa	1984	A broadband electromagnetic induction study of the Travale Geothermal Field, Italy
Sule	Peter	1985	Broadband magnetotelluric investigation in southern Scotland
Travassos	Jandyr	1987	Investigations of the analysis and modelling of magnetotelluric data
Hill	Roger	1987	Magnetotelluric study in the Moine Thrust region of northern Scotland
Harinarayana	T.	1987	Lithospheric electrical conductivity structure across southern Scotland and northern England
Meju	Maxwell	1988	Deep electrical structure of the Great Glen Fault, Scotland
Fontes	Sergio	1988	Electromagnetic induction studies in the Italian Alps
Galanopolous	Dimitrios	1989	Magnetotelluric studies in geothermal areas of Greece and Kenya
Parr	Ronald	1991	Development of magnetotelluric processing and modelling procedures: application to northern England
Jones	Philip	1992	Electromagnetic induction study of south Cornwall, England

Her scientific lineage is presented graphically in Figure 16.

Rosemary: her influential lineage

Rosemary has left a legacy of research students, equipment for magnetotellurics used throughout the world, an immensely successful and continuing series of workshop meetings, and, of course, her scientific findings. But how did she get to be who she was – what were the influences on her – what were the driving forces? We need to turn from her scientific lineage to her personal lineage. This is shown in Figure 17.

Fig. 15. Front row, from left to right: Andrea Tzanis (Greece), T. Harinarayana (India) and Phil Jones (UK). Back row, from left to right: Sergio Fontes (Brazil), Maxwell Meju (Nigeria), Rosemary, Ronald Parr (UK), Dimitrios Galanopoulos (Greece) and Roger Hill (UK).

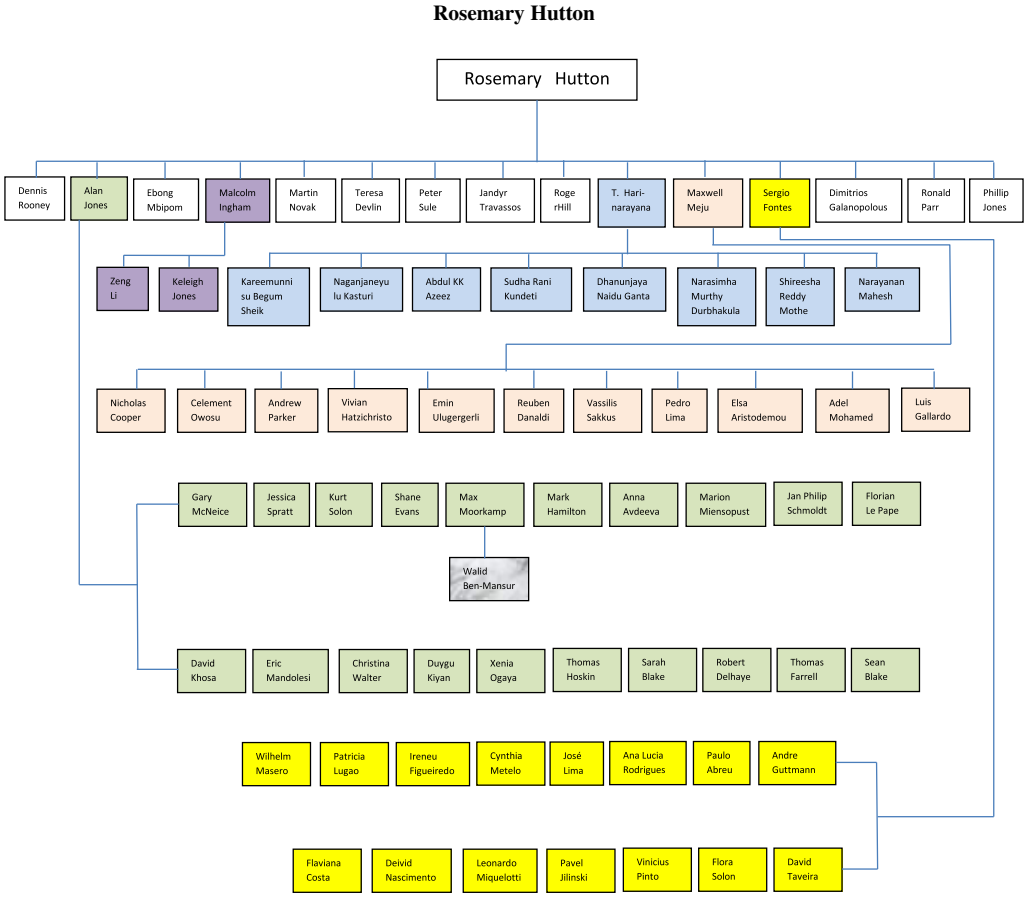


Fig. 16. Rosemary's scientific lineage.

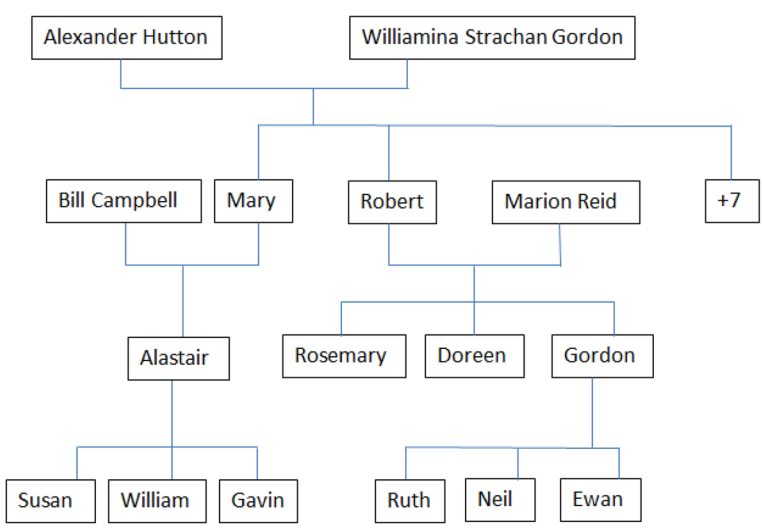


Fig. 17. Rosemary's personal lineage.

Fig. 18. Family gathering from the late 1930s. Back row, from left to right: (standing) man, woman, man (these are three of the other eight siblings of Rosemary's father), Rosemary's father Robert, Doreen (Rosemary's sister), two of Rosemary's other cousins. Middle row, from left to right: (seated) Rosemary's grandmother (Williamina Strachan Gordon) and grandfather (Alexander Hutton). Front row, from left to right: (seated on the ground) unknown girl, Rosemary's brother Gordon, Rosemary, wife to one of her other uncles (partly hidden), Rosemary's mother Marion and Rosemary's cousin Alastair.

Her mother, Marion, we have already mentioned – she was a very 'proper' lady who entertained superbly – so there is one influence on Rosemary. Her father Robert was a very strong character – he lost a leg through a cycling accident early in life but that didn't hold him back – he worked hard and became a very successful grain merchant in Dundee. She will have gained strength and tenacity from there. But it is, perhaps, her Grandmother Williamina to whom we must turn for the spirit in Rosemary. As a young woman in the late 1880s, Williamina went to India to work in a mission school for educating girls and this became a lifelong interest. Upon returning from India she married a farmer with whom she had nine children. But she did not see it as her responsibility alone to bring up those children – she regularly accepted teaching jobs away from the family home, including one in Shetland while she was pregnant! This might explain the travelling desire in Rosemary. Figure 18 shows a family gathering from the 1930s.

In turn, passing on her courage and strength to the next generation, it seems Rosemary may have had some influence on at least her niece Ruth, who has an academic career in animal behaviour, currently in Norway, and second cousin Gavin, who trained in geology and who singles out Rosemary as sparking his interest in this field after she invited him and his brother to visit a research site at the Dollerie estate in Perthshire. He remembers being fascinated by chart recorders making measurements of the Earth's magnetic field via various sensors planted in the ground. He is now a chartered engineering geologist with more than 30 years' experience.

Rosemary: the accolades

To commemorate and honour her overall research contribution, Alan Jones (then at the Geological Survey of Canada) and close collaborator Dr Volker Haak (of the Geoscience Centre, Potsdam, Germany) organized the 'V.R.S. Hutton' Symposium entitled 'Electromagnetic Studies of the Continents' that was attended by her peers of many nationalities during the 1992 Assembly of the European Geophysical Society held in Edinburgh. Its central theme of 'Electromagnetic Studies of the Continents' epitomized the diversity of Rosemary's interests and the regard in which she was held by the community and provides a fitting tribute. Twenty papers were published as a special volume of *Physics of the Earth and Planetary Interiors* (vol. 81, pp. 1–345, 1993), edited by Jones and Haak.

Rosemary became a Fellow of the Royal Astronomical Society in 1970 and was elected to Fellowship of the Institute of Physics (1965–80) and the

Royal Society of Edinburgh (1983). She was a member of the American Geophysical Union (1963–89) and the Society of Exploration Geophysicists (1982–93). She was also a member of several influential committees relevant to her research. These included the International IASPEI/IAGA Committee for the Electrical Conductivity of the Asthenosphere ('ELAS') Project (1983–88); the UK National Committee for Geomagnetism and Aeronomy (1985–87); and, as a representative of the Royal Society of Edinburgh, the British National Committee for Geodesy and Geophysics (1984–87). She was invited on many overseas visits, notably in 1984 by the USSR Academy of Sciences for a three-week visit to the Academy Institute at Troitsk, Moscow and the University of Leningrad; in 1985 to the University of Calabar, Nigeria; and also in 1985 to the University of Tasmania, the Australian National University at Canberra, La Trobe University, Melbourne, and the Victoria University of Wellington, New Zealand. In 1986 and 1987 she went as a NATO Visiting Professor to the Istituto di Fisica Terrestre, University of Padua, Italy; in 1987 to the University of Uppsala, Sweden; and in 1988 to the Institute of Planetary Physics at the University of Alberta, Canada as a Distinguished Visitor. Also in 1988, she returned to the Academy Institute at Troitsk, and to Sochi to participate in the International Electromagnetic Induction Workshop. In 1989, she spent time at the National Geophysical Research Institute, Hyderabad, and the Institute of Geomagnetism, Bombay, sponsored by the British Council.

So that is Rosemary – truly one of the world's first female pioneering geophysicists who left an enduring legacy of curiosity-driven science, passionate commitment and broadly-trained people.

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