

Dr Körner's Helpful Guide For Mathematicians Seeking A Cambridge Research Fellowship

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8 April 1998

I hope to revise this guide from time to time. Any suggestions for improvements will be gratefully received. This guide has no official status and the opinions expressed are those of the author only. You have been warned! This guide is written in $\text{\LaTeX}2\text{e}$ and is, I hope, available by anonymous FTP as `/pub/twk/fellow.tex` at `131.111.24.1`. It can also be obtained via the web, see the instructions at the end of the guide. My e-mail address is `twk@pdms.cam.ac.uk`. Please contact me if you cannot get this file electronically and I will try to send you a copy by classical means.

From time to time during the year the Cambridge University Reporter (the Cambridge University official newspaper) carries advertisements of the following type.

**Churchill College,
New Hall, and Trinity Hall**
Joint Application Scheme for Research Fellowships

The three Colleges, acting as a group, invite applications from men and women for Research Fellowships which will normally be tenable from 1 October 1998.

The conditions of eligibility of candidates vary somewhat between Colleges, and further details, together with application forms, may be obtained from the Research Fellowships Secretary at Churchill College, Cambridge, CB3 0DS. (Please enclose an A4 or larger stamped self-addressed envelope.)

Five copies of a completed application form must be returned not later than 16th January 1998 for Science Research Fellowships and 23rd January for Arts Research Fellowships. The application should contain a statement of not more than 1000 words outlining the work candidates are prepared to submit in support of their application and the work they propose to do if elected; this statement should be intelligible to scholars in other subjects.

Short listed candidates will be asked to submit three copies of their written work by mid-February. It is suggested that you should consider submitting a piece or pieces of writing of not less than 20,000 words or about a quarter of a Ph.D thesis. This should include some of your most recent work.

Candidates will also be required to arrange for references by two independent referees to be sent to the Applications Office by the closing date for applications.

The stipends of Research Fellows are reviewed at regular intervals; financial support from other sources may be taken into account. Participating Colleges hope to make elections in May. Candidates may be asked to come for interview.

(A summary of other such advertisements which appeared during the last year is given at the end of this guide. Many will now be out of date, but they give a good idea of what is on offer each year. The advertisement above is untypical in that you apply simultaneously to three Colleges (which you place in order of preference).)

The advertisement does not specify the duties of a research fellow. This is because there are none. (Some colleges ask you to make an annual report on your work.) The college offers you a salary (in 1998 typically £12 000 to £14 000), housing if you are single, and one free meal a day for three years while you do whatever research you wish. (Many research fellows do a little light teaching for the college, say one afternoon a week, but this is entirely voluntary and you receive an additional payment.) Cambridge has excellent libraries, extensive computing facilities, the Isaac Newton Institute, a long mathematical tradition, an active mathematical present, and scenery out of a tourist brochure. Research Fellows are made welcome in the Mathematics Departments. The two departments maintain World Wide Web pages which are the usual mixture of the useless, the out of date and the fairly interesting. You might consult them to get some idea of the kind of things that go on in Cambridge. The address is

<http://www.maths.cam.ac.uk/>

among the the links from there is one to

<http://www.cms.cam.ac.uk/colpotw.html>

where you may see a picture of work on the new Centre for Mathematical Sciences which will house the departments from the year 2000.

Each college in Cambridge is a self governing independent corporation and each offers research fellowships on different terms. Some restrict eligibility to Cambridge graduates, some to United Kingdom candidates, but some have no such restriction. If you receive a salary from a different source, like the Royal Society, the college will not pay you a salary but you will continue to enjoy the other privileges of a fellow. If a college offers a *non stipendiary* research fellowship this means that the fellowship carries no salary and you must find financial support elsewhere. Sometimes Research Fellowships may be restricted to one particular subject, but usually they are offered in the Arts (not including Mathematics) or the Sciences (including Mathematics) or with no subject restriction whatsoever (so that a someone whose thesis was on 'Noise Reduction for Jet Engines' will be in competition with someone whose thesis was on 'Ambiguity and Eroticism in the Early Works of Conrad').

The typical successful candidate would be a man or woman in their third or fourth year of research who, on the evidence of the work they have already done, is likely to have a good (or, perhaps, outstanding) academic career.

When you apply for a research fellowship you will usually be asked to fill out an application form, to obtain two or three testimonials, and to provide a statement of your research. On the basis of this information the college decides which candidates to consider further.

Of the three pieces of information before the college, the application form is the least important. If you have an excellent undergraduate record that will count for you (so, if you have been twice winner of the Hungarian Mathematical Olympiad, do include this fact), if you have a poor record it will count against you, but decisions are not made on this basis.

Much more important are the testimonials. An enthusiastic reference from someone the college trusts is the best possible basis for getting through to the next round. Thus, if you can, try to have testimonials from someone who knows the Cambridge system, or, failing that someone who should be known in Cambridge. If you cannot do this you should try to give the College the names of people in Cambridge, or, failing that, in the UK, who should be able to give an opinion of your work.

Since your research supervisor is the most likely mathematician to know your work well he or she will usually be one of the providers of testimonials. Do *not* ask for testimonials from people unacquainted with your research.

The College is not interested in what a charming undergraduate you were, or how helpful you are with teaching at your present institution. The College is interested in your research potential - not your character.

Finally we come to the ‘... statement of not more than 1,000 words ... intelligible to scholars in other subjects.’ In writing this you should remember that the choice of a research fellow is made, not by experts in your field, but by a group of people which will certainly contain physicists, biologists and engineers, and which, in some colleges, may contain historians, linguists and literary critics. One way of dealing with this is the ‘accelerating lecture technique’ in which the first paragraph can be understood by a schoolchild, the second by any educated person, the third by any mathematically literate person, the fourth by any mathematician and so on. My own preference would be to follow the accelerating method for the first three paragraphs but to address the rest to an intelligent and interested, but mathematically uninformed, engineer.

Suppose, for example, that my thesis simplified part of the classification theorem for finite groups. I would start by explaining that,

in some sense, the theory of groups is the study of symmetries. Although mathematicians study symmetries for their own sake, the theory has, as one might expect, many applications to fields like crystallography, data transmission in the presence of noise and to secret codes. [*Warning!* You may be asked to elaborate on your statement at interview.] The study of symmetry now forms an important part of the search for the basic laws of physics. For many years mathematicians have sought a useful classificatory scheme covering all finite groups. Since the notion of a group is such a general one, this looks as hopeless as an attempt to classify all chemical molecules. But, just as all molecules are made from a limited number of types of atoms, so it turns out that all finite groups are constructed in a well understood way from a limited number of types of groups – the simple groups. (Of course, this does not bring the subject to an end any more than the corresponding statement brings chemistry to an end.)

This ‘Classification Theorem’ is justly considered a high point of 20th century mathematics. Unfortunately, whilst important theorems in mathematics usually occupy at most a few pages and can be fully understood The Classification Theorem is the result of combining many different theorems by many different hands. The full original proof thus covers about 5,000 pages. Since the purpose of proof in mathematics is not merely to establish truth, but also to give understanding, this is not satisfactory. One of the most important tasks of group theorists today is to shorten and simplify the proof of the Classification Theorem to the point where one person can grasp it in

its entirety ...

If there was nothing in the actual mathematics which could be discussed in this way, I might, perhaps, devote a couple of paragraphs to a technical discussion.

Most Colleges will expect the account of your research to include not merely an account of what you have done but an indication of what you hope to do. You may be tempted to reply 'If I knew what I was going to do I would already have done it' but it is not unreasonable for a College to look for evidence that you will not fall flat on your face the moment you release your grip on your supervisor's hand. It may be helpful to consider the advice you would give to a student rather brighter than yourself who wanted to do research in your field. What are the main problems, how are they related, and why are they important? Which ones could conceivably be tackled by developing the methods you have mastered or invented? Are there any methods which you have not yet learned which look as though they might be relevant? Would partial answers to some of the main problems be useful and why? Colleges realise that research plans must be tentative. They are well aware that any worthwhile project is more likely than not to fail. (If it is going to work anyway, why do it?) However they prefer researchers who know where they would like to go to those whose only plan is to wait for something to happen.

After all the applications and their associated references have been carefully scrutinised a limited number of applicants will be asked to submit written work. (For the purposes of illustration, they might be three chemists, an astronomer, a zoologist, two computer scientists, two mathematicians, a physicist and two engineers.) Many people submit their PhD dissertation, or some revised version of it, but if some other written work gives the best account of what you have done so far you should submit that. The College then pays experts whose opinion it trusts to read your work and give their opinion on it. (In choosing testimonials you should bear in mind that the College is unlikely to ask a writer of your testimonial to act as the independent expert.)

Using these expert opinions the College then draws up a final short list. (In our example it might consist of the zoologist, the two physicists and one of the mathematicians.) In some Colleges the final decision is then made without an interview. In others the members of the final short list are then interviewed and a final decision made. (If you live in New Zealand, you should ask the College, *before* applying, whether they are prepared to consider you without a personal interview Some colleges will and some will not.)

The interviewing committee may contain an expert in your field or it may not. If it does, you may face a detailed and, apparently, hostile grilling. The

non experts will be watching to see how you hold up under pressure, and the expert will be hoping that you uphold the honour of your subject.

If the committee contains no experts your problems are much greater. On the one hand, they have no idea what to ask you, but, on the other hand, they are usually clever enough to detect an unsatisfactory answer. Your job is thus, in some sense, to provide sensible answers to foolish questions. Let me give some examples.

Question: Do you use computers in your work?

Possible Answer: No.

Better Answer: My work deals with infinite dimensional spaces and computers can only handle finite problems. One could try to look at the finite dimensional analogues of my problems but unfortunately the number of calculations appears to grow exponentially with dimension and even the four dimensional case would need a year on a Cray.

Question: Can you describe your work to us?

Possible Answer: No.

Better Answer: My own work is rather technical but I can explain where the original problem comes from ...

Although you should do most of the talking, you must pause from time to time to let the committee ask questions. Do *not* try to produce answers to please the committee, they are looking for future stars, not 'yes men'. If someone suggests that fractals might be of use in Galois Theory disagree respectfully but firmly. Very occasionally (since every committee has its village idiot) you might be asked something which goes beyond fair questioning ('Don't you think logic is a rather unsuitable subject for a woman?'). Answer it as calmly as you can, you will have the sympathy of the rest of the committee. (On the other hand the question 'How can any sane person believe in a farrago like string theory for which there is not a shred of evidence?' is perfectly fair, and, if you are a string theorist, you had better be able to cope with it.)

At the end of the interview you may be asked if you have any questions. If you do, ask them, but do not ask questions for the sake of asking questions.

If the committee decides that you are its favourite candidate then you will be notified shortly after the day of the interview. If there are reasons why you would like time to think the offer over, you should explain what these are and ask for a couple of days. However it is unfair to the College and, particularly, to whoever would get the research fellowship if you decline it, to delay your decision beyond this.

From what I have said it is clear that Cambridge applicants have an advantage over outside applicants, if only because they know the system.

None the less, the object of those colleges which allow outside applicants is to choose the best candidate, not the best Cambridge candidate. Unless you believe that all the world's best mathematicians are already in Cambridge, an outside application must be worth a try. Competition is fierce but the initial stages of your application do not require much work and, once you enter the final stages, you have a fighting chance of success.

What Is on Offer

Copies of the Cambridge University Reporter are now available on the World Wide Web at

<http://www.admin.cam.ac.uk/reporter/>

Research fellowships are announced under the rubric 'College Notices' and recently have been announced under the separate rubric 'College Research Fellowships' (but it might be as well to check under College Notices as well). Corpus, Darwin, Newnham, St Johns and Trinity Hall advertise directly on the web at

<http://www.cam.ac.uk/CambUniv/Fellowships/>

but some of their sites are out of date.

If you do not have access to the Cambridge University Reporter, or you do not want the trouble of reading it every week the best thing to do is to write to the individual colleges asking to be notified of their fellowship competitions. (A single sentence request along the following lines will do.)

Dear Master's Secretary,

Please send me details of any research fellowships offered by your college during the next 12 months.

Yours Sincerely

Some Colleges have mastered the arcane mysteries of fax and e-mail but some have not. A letter (perhaps enclosing a self addressed envelope) is less likely to get lost. On the whole research fellowships are meant for young researchers but if your research career has been interrupted or started late for some reason, many colleges are sympathetic. Enquire about this before applying. Some of the non-stipendiary fellowships may be intended for people slightly later in their careers.

The following summarises the advertisements which I have seen in the last year. It is unlikely to be complete or accurate and you use it at your own risk¹. If a College advertises a research fellowship for which applications must be in by 1 April 1998 then it is not unlikely that a year later it will advertise a research fellowship for which applications must be in by 1 April 1999. Fellowships generally run from the 1st October in the year following election. (Thus if the selection process finishes in December 1998 or March 1999 the fellowships starts on 1 October 1999.) If you are at all interested in any fellowship you should write *at once*² asking for details and not rely

¹In 1993 one of the application dates was misprinted as one month later than it actually was.

²Now. This minute.

on what is written here. I have not included details of research fellowships restricted to members of a particular college.

Christ's College Applications and 2 references in by 4 November 1996. (Forms to be applied for by 25 October 1996.) Restricted to members of universities in the British Isles who by 31 December 1996 will have completed three but no more than thirteen terms of full time research. Candidates should normally not have passed their 28th birthday by 4 November 1996. Correspondence marked J.R.F to 'The Master's Secretary, Christ's College, Cambridge, CB3 0DS'.

Churchill College, New Hall and Trinity Hall See the first page of this guide.

Clare College Restricted to graduates of or postgraduates at UK universities. Closing date 8 January 1996 Correspondence to 'The Master's Secretary, Clare College, Cambridge, CB2 1TL' tel (0)1223-333241 or e-mail ph10006@cus.cam.ac.uk.

Clare Hall This year offered non-stipendiary fellowships in the sciences so could perhaps offer a stipendiary one next year. Essentially no restrictions. Closing date (including references) 2 December 1996. Applicants must send a stamped self addressed envelope. Correspondence to 'College Secretary, Clare Hall, Herschel Road, Cambridge, CB3 9AL'.

Corpus Christi College In 1998 the research fellowships were in subjects other than mathematics (so the next ones may include mathematics). Applications and 2 two references were to be in by 5 February 1998. Restricted to graduates of any university who on 1 October 1998 will have completed not more than 5 years of research. Correspondence to 'The Research Fellowship Secretary, Corpus Christi College, Cambridge, CB2 1RH'.

Darwin College This year the research fellowships advertised available to mathematicians were non-stipendiary but it is possible that stipendiary research fellowships could be offered in the future. Age restrictions (not more than 30 at start of fellowship) can be waived in appropriate cases. Closing date 5 January 1998. Correspondence to 'The Master's Secretary, Darwin College, Cambridge, CB3 9EU'. Consult the College web page <http://www.dar.cam.ac.uk>.

Downing College Applications in by 14 December 1995. The only restriction is that the candidate should either be under the age of 30 on 1 Oct 1997 or have completed less than 12 terms 'as a registered graduate student'. Correspondence to 'The Senior Tutor, Downing College, Cambridge, CB2 1DQ'.

Emmanuel College Three research fellowships in any subjects. Application

forms must be applied for by 24 October 1997, enclose a large self addressed envelope. No restrictions but applicants over 30 on 1 October 1997 excluded unless they submit satisfactory reasons for exemption. Correspondence to ‘The Master’s Secretary, Emmanuel College, Cambridge, CB2 3AP’. (Or, long live the 20th century, by e-mail res-fell-info-package@emma.cam.ac.uk.

Girton College Applications in by 28 September 1998. No restrictions but ‘normally awarded to candidates who have recently completed their PhD or are close to completion. (Overseas candidates should note that there is an interview at the final stages and, like other Colleges, Girton will not pay travelling expenses.) Correspondence (marked Science Fellowship) to ‘Secretary to the Research Fellowship Electors, Girton College, Cambridge, CB3 0JG’.

Gonville and Caius College Applications in by 13 November 1998. Restricted to graduates of or graduate students at a university in the British Isles who will not have completed 4 years of full time research or the equivalent in part time research by 1 November 1996. Correspondence to ‘The Master’s Secretary, Gonville and Caius College, Cambridge, CB2 1TA’ (or Fax 0-1223-332336). There is a web link <http://www.cai.cam.ac.uk/>.

Fitzwilliam College One stipendiary or non-stipendiary Research Fellowship. Applications in by 21 January 1999. Restricted to those studying for a Ph.D at (or graduates of) British or Irish university who will not have completed 4 years of full time research by 1 April 1999. Correspondence (with stamped self addressed envelope) to ‘The Master’s Secretary, Fitzwilliam College, Cambridge, CB3 0DG’.

Hughes Hall Up to six non-stipendiary. Closing date 15 April 1998. Candidates should normally be under 30 but others considered if research career delayed or interrupted. Only restrictions:-‘Must have obtained a PhD or equivalent within the last ten years or expect to be awarded one by 1 October 1998’. Correspondence to ‘The President, Hughes Hall, Cambridge CB1 2EW’.

Jesus College Applications in by 18 September 1998. Written work by 7 October 1998. Normally no interview. Restricted to graduates of or graduate students at a university in the British Isles. Normally for candidates who ‘in the College’s view’ will not have completed 4 years of full time research by 1 October 1998 (but it is made clear that the College will consider older candidates whose studies were interrupted). Correspondence to ‘The Research Fellowships Secretary, Jesus College, CB5 8BL, Cambridge’.

King’s College Offered a four year non-stipendiary research fellowship without limitation of age or subject. Applications in by 2 November 1998. The College is only likely to offer stipendiary research fellowships of interest to mathematicians occasionally but ‘will advertise widely’ (in a British context

this may just mean putting a small ad in the Times Higher Educational Supplement) when one comes up. Correspondence to ‘The Provost’s Secretary, King’s College, Cambridge, CB2 1ST’.

Lucy Cavendish College Offers a ‘semi-stipendiary’ (up to £3000) fellowships. Applications in by 10 January 1997. Restricted to women holding PhD’s. (In my opinion, likely to be particularly sympathetic to women whose research careers have been interrupted. Lucy Cavendish was set up as a College for women students who begin their university studies at a later age than usual.) Correspondence to ‘The President’s Secretary, Lucy Cavendish College, Cambridge, CB3 OBU’.

Magdalene College Applications in by 28 August 1998. ‘Candidates should normally have completed two or three years of research.’ Correspondence to ‘The Master’s Secretary, Magdalene College, Cambridge, CB3 0AG’.

New Hall In addition to the scheme described above (see **Churchill** . . .) New Hall has offered non-stipendiary research fellowships. The last one offered was not in mathematics. There were no restrictions and the closing date was 15 April 1994. Correspondence to ‘The President’s Secretary, New Hall, Cambridge, CB3 0DF’.

Newnham College Applications in by 1 February 1999. Restricted to women graduates (Newnham is a women only college), no other restriction. Correspondence to ‘The Principal, Newnham College, Cambridge, CB3 9DF’.

Pembroke College Restricted to graduates of or graduate students at a university in the British Isles. Preference for candidates under 28 but older applicants not excluded. Applications by 4 September 1998. In 1993 offered a ‘Post Doctoral Research Fellowship’ in science for which ‘some experience of postdoctoral research will normally be expected’ but with no further restrictions. The closing date was 30 Sept 1993. In 1995 offered a Stokes Research Fellowship in mathematics or physics (closing date 17 Feb 1995), candidates should be under 30 but ‘a body of published work’ is expected. Correspondence to ‘The Tutorial Office, Pembroke College, CB2 1RF’.

Peterhouse Applications in by 6 February 1998. (Forms to obtained by 31 Jan 1998.) Restricted to Oxford and Cambridge graduates and research students under 28 on 1 October 1998. Correspondence to ‘The Master, Peterhouse, Cambridge, CB2 1RD’.

Queen’s College A research fellowship in pure mathematics closing date for applications 14 October 1996. (presumably there will be maths research fellowships only every few years). Applicants must be under 30. Correspondence to ‘Clerk to Tutors, Queen’s College, Cambridge, CB3 9ET’, or e-mail at 115@cam.ac.uk.

Robinson College Offered a research fellowship (not available to mathematicians so perhaps the next one will be) with closing date 9 December

1991. Only restriction:- ‘Applicants must have submitted for their doctoral degree before they take up their fellowship’. Correspondence to ‘The Warden, Robinson College, Cambridge, CB3 9AN’.

St Catharine’s College Closing date 26 December 1996. No restrictions except that candidates must be graduates of a university and under 29 on 1 October 1997. Correspondence to ‘The Secretary for Research Fellowships, St Catharine’s College, Cambridge, CB2 1RL’.

St Edmund’s College Non-stipendiary. No restrictions. For two years with possibility of renewal for another year. Closing date for applications including CV, 1000 word proposal and names of two referees by 3rd March 1997. Two ‘Semi-stipendiary’ (up to £5000 for up to two years) restricted to Cambridge research students. Closing date for applications including CV, short description of research, and sample of work of up to 5000 words 28 February 1997. Two references to reach College by same date. Correspondence to ‘The Master, St Edmund’s College, Cambridge’. Cambridge, CB2 0BN’.

St John’s College Closing date 10 February 1997. Application forms from the domestic bursar’s office. Restricted to graduates of UK universities and/or graduate students at Cambridge who have been engaged in research for no more than the equivalent of four full time years. Correspondence to ‘The College Office, St John’s College, Cambridge, CB2 1TP’.

Selwyn College Applications in by 28 October 1995. ‘Candidates must either be completing a PhD or have completed within the last three years’ but no further restrictions. Correspondence to ‘The Master, Selwyn College, Cambridge, CB3 9DQ’.

Sidney Sussex College Offers from time to time (every three years?) a Knox Shaw Research Fellowship in Mathematics. Last time, applications and references by 31 December 1996. Offered a research fellowship in Science (including Mathematics) and one with out subject restriction closing date Friday 11th September 1998. (No application form but a longish list of things to be included.) Correspondence to ‘Senior Tutor, Sidney Sussex College, Cambridge, CB2 3HU’.

Wolfson College Non-stipendiary, initially for one year, renewable for two more. Applications by 22 January 1998. (The dates when Wolfson offers such things seems to wander a great deal from year to year.) Only restriction:- ‘Applicants should have obtained a PhD or equivalent within the last five years or be in the process of completing their doctoral dissertation.’ Correspondence to ‘The College Secretary, Wolfson College, Cambridge, CB3 9BB’.

I am sometimes asked about other posts and fellowships in Cambridge and the UK generally. Most posts and fellowships in the British University system are advertised in the 'Times Higher Educational Supplement' and more general opportunities may be advertised in the 'New Scientist'. Both journals appear weekly and may well be in your University library or the offices of the British Council. The London Mathematical Society maintains a very useful web site

<http://www.lms.ac.uk/jobs/>

with positions in mathematics in the UK.

[Printed out August 19, 1998. These notes are written in $\text{\LaTeX}2\text{e}$ and stored in directory `~twk/FTP` on moa in (I hope) read permitted form in a file labelled `fellow.tex`. It may be accessed via my web home page

<http://www.pmms.cam.ac.uk/home/emu/twk/.my-home-page.html>.

Also available:-

'An Unofficial Guide To Part III',

'How to Write a Part III Essay',

'In Praise of Lectures' (how to listen to a mathematics lecture)

'A Supervisor's Primer'.]