Bernal institute: a possible approach?

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Abstract. The author outlines his own background, which included work in several of the polytropic Bernal domains, and some interaction with Bernal. He then suggests points of contact between the ‘Bernal domains’ and the current Irish context, and relates these to existing current research in Ireland. He goes on to suggest inter-domain synergies, in a networked inter-institutional Bernal Institute structure, having a high-profile contact-point in one particular location, such as to enable an export problem-solving consultancy service to develop, supporting global conflict-resolution and various post-colonial nation-building processes.

1. Background
My own interest in Bernal goes back to my student days in the late 1940s in Trinity College Dublin, in the context of the attempt we made, as the immediate post-war student generation, to organise to ‘change the world’ under the influence of left-wing ideas. In this context I read Bernal’s Social Function of Science, and picked up a feel for the width of the gap which then existed between science in TCD, and indeed in the other Irish universities, and the requirements of Ireland as an emergent post-colonial nation [1]. The result of this gap was not only that Irish science was pitifully weak, but that most science graduates emigrated.

On graduating in 1951 I went to France where I worked for two years on cosmic ray physics with the Laboratoire Leprince-Ringuet. This enabled me to pick up a feel for team-work, and the role of technology in the support of science at the frontier; we developed a sort of automated factory for the processing of scientific information, using the electronic techniques which had earlier been developed at Los Alamos. Thus the science-technology interaction is complex and non-linear; scientific discoveries do not simply become technologies by a linear process, as sometimes is suggested.

I returned to Ireland in 1953 and joined Cormac O Ceallaigh in the Dublin Institute of Advanced Studies, where cosmic ray work had been initiated earlier by Janossy, a Hungarian anti-fascist refugee. There followed a fruitful period of work on the identification and characterisation of the emergent family of mesons and hyperons which fed the theoretical work of Gellmann and others. I contributed to the development of the experimental technology, enabling improved precision in the measurement of momentum and velocity and whence mass [2].

We were in direct contact with Berkeley and CERN, thanks to Cormac O Ceallaigh’s standing as the discoverer of the K-meson. Ireland however had no official relationship with CERN; we got in ‘on the black’ and had access to the high-energy proton beams for our work. Thus the DIAS was a sort of implanted enclave, networked with global science, but largely decoupled from the Irish techno-economic requirements; this was the ‘black fifties’ with massive emigration and
the population in decline. So the DIAS experience, while being fruitful in its own right, posed seriously the 'science and society' problem, of which I became acutely aware.

In 1960 I dropped out of basic science and went into industry, where it turned out that the experience of development of experimental technology in basic science was useful; I found myself evolving into systems engineering and operational research. Experience of 'dirty statistics' and a difficult 'signal to noise ratio' proved to be essential.

During the 1960s, while working in Aer Lingus on various techno-economic modelling projects, I got into correspondence with Bernal, then in declining health. The context was the aftermath of the 1963 OECD Report 'Science in Irish Economic Development', which had been authored by Patrick Lynch of UCD and H M S 'Dusty' Miller, an engineer who then headed the Bord na Mona R&D unit. Both admitted privately to being 'Bernalist' but at the time it was not politic to say so. The OECD Report put the 'science and society' issue firmly on the Irish government agenda, and resulted eventually in the setting up of the National Science Council in 1970.

Subsequently the late Derry Kelleher and I started the Kane-Bernal Society, which used to meet for a period in the 1970s in TCD; it attracted some support and addressed some techno-economic and environmental issues. By this time I had taken on doing a weekly ‘Science and Technology’ column in the Irish Times, thanks to the late Douglas Gageby, and this then became the focus; there were many Bernal references, and I was able to use it to write a positive obituary for Bernal (Section 1.2 in the Policy group of the Irish Times collection, October 20, 1971, see below).

I collected my 1970s Irish Times material in the mid-1980s with a view to publishing it with Tycooley for the UNDP market, but this project lapsed with the demise of the publishing-house. It is however accessible via my website [3] and is under consideration by the Royal Irish Academy history of science committee as a possible contribution to a historical archive.

In the 1980s I encountered the Goldsmith biography which I thought did not do Bernal justice. I managed to make contact with the family and with the group, organised by Brenda Swann and Francis Aprahamian, which was developing an omnibus biography written by various people who had known him. I undertook to contribute a chapter on Bernal's Irish roots, and this was published, after much delay, by Verso in 1999 [4].

There was in 1980 a Royal Irish Academy discourse on Bernal by Dorothy Hodgkin FRS, which amounted to his 'posthumous rehabilitation' in the Irish context; the vote of thanks was proposed by T P Hardiman, then leading the National Council for Science and Technology, the National Science Council successor-body.

The unveiling of a plaque to Bernal in Nenagh in October 2005, which was supported by Hardiman among others, was the trigger for the arousal of interest in Bernal by a group in Limerick University, and to the subsequent organising of this seminar, in the context of which I prepared a note for circulation to some of the participants, from which this paper has evolved. The seminar took place on 1 June 2006 at the Limerick Institute of Technology, and the current Institute of Physics publication is the Proceedings. I participated in the seminar, and contributed to the discussion. I welcome this opportunity to expand on what I had in mind. I am using the key points in my note as headers under which to suggest some possible constructive sources of development in the contemporary Irish context.

The name Bernal is associated, 'polytropically', with the following domains, all of which are currently relevant:

- Science in History; Science and Society; Science and Government;
- Science in War and in Peace; the Peace Dividend;
- Dynamics of the Science-Technology interaction; the Socio-economic Dimension;
- The 'Third World', Technology Transfer, Development Economics, the Brain Drain process etc.
• Modelling complex systems in a stochastic environment (Operations Research)....

The following questions arise:

(i) If a ‘Bernal Institute’ were to be set up and funded, in the current Irish context, with an interest in these apparently disparate domains, would there be synergy; would there be benefit in cross-linking them, as Bernal did?

(ii) Which domain would be likely to contain the strongest market requirement for services, and how would the other domains relate to it?

(iii) Who specifically might be the sponsors and users of the results of the research?

It is also appropriate to consider possible co-operative or networking structures which might be compatible with the existing Irish third-level resources relevant to one or more of these domains, and how such a dispersed network structure might be combined with a focal Institute having a suitably high profile.

2. How these ‘Bernal Themes’ relate to Ireland

It is useful first to examine the above themes, to see how they relate to current Irish requirements in each domain, and to identify possible contact-points with existing relevant resources.

2.1. A View of Irish Science in Historical Context

The history of science in Ireland needs systematic study, primarily in the context of the emergence of Ireland as a post-colonial nation. The transition from ‘science as imperial tool’ to ‘scientific knowledge as national resource’ needs elucidation, with the lives and times of the key people concerned being a good starting point, together with their organisations and the interactions of the latter with successive governments, and with civil society.

The Cromwellian [5] and Williamite wars laid the basis for imperial science; the beginnings of science as a national resource emerged embryonically [6] in the 18th century and blossomed during the Napoleonic wars, the French influence [7] being significant. The 19th century saw both threads co-existing, with many important role-model figures, and much organisational tension. These threads can be traced episodically in the contents of the British Association meetings in Ireland, and more continuously in the proceedings of the Royal Irish Academy and the Royal Dublin Society.

I wrote a paper on the British Association meetings in Ireland [8] for the Crane Bag in 1983, at a time when that scholarly critical learned journal, then edited by Mark Hederman and Richard Kearney, was toying with the idea of taking an interest in the ‘science and society’ domain. The journal, alas, did not survive, and the niche it occupied has since remained ill-served by a sequence of ephemeral subsequent publications. The niche may perhaps be defined in terms of the interface between the results of scholarly research in the arts and in the natural and social sciences, on the one hand, and on the other hand the political and business elites, who seek to make decisions based on up-to-date knowledge and analysis.

I began during the latter 1980s and 1990s to take an interest in the RIA and RDS Proceedings, with the idea of trying to make the case that their comparative study in a European and British Imperial context needed scholarly analysis, as part of the nation-building process. I was aware that there was no centre in existence in any Irish university concerned with the history of science, and its interaction with technology and society, in the specifically Irish context. I felt this should be of interest to development economists and to cultural historians who were concerned with the colonial to post-colonial transition.

The Irish experience is an important 20th century case-study of nation-building at the fringe of an imperial system, worthy to be compared with Finland and Norway, and indeed the post-1914-18 Balkan States. I was however unable to pursue my RIA/RDS studies in this mode, due
2.2. Science and Government

The situation as it was pre-1914 set the stage for addressing the problems created by the two major 20th century wars, in the context of the emergence of the Free State and later the Republic, taking into account the influence of Partition. The science-technology interface in the Irish context remained weak for many decades, with scientists tending to emigrate, and engineers tending to work with imported technologies. This ‘science and government’ interaction, though weak, needs to be analysed historically, with a view to learning from successes and failures, and assessing the role of government policy. Comparative study with Denmark and Finland in the post-1922 period needs to be done.

The roles of the successive OECD Reports, the National Science Council and successors, need to be analysed; likewise the emergence of the Regional Colleges and their roles as foundations for the ‘Celtic Tiger’ process. Why did it take so long for Government in Ireland to appreciate the importance of science? The National Science Council was set up only in 1970, under the influence of the 1963 OECD Report ‘Science and Irish Economic Development’. As mentioned in section 1, I recollect much OECD-generated politicking; in particular the work of Noel Mulcahy in setting the stage for the Regional Colleges deserves analysis.

2.3. Military Science; the Peace Dividend

While the Irish economy does not support a ‘military industrial complex’ in any complete sense, there are elements of the NATO military-industrial support system which overflow into the Irish economic system, and this sometimes is a matter for contention. The evidence for this is anecdotal, but there is enough of it around to indicate a need for analysis. The global problem to be addressed is how to convert this activity in such a way to generate something useful, how to re-deploy the high-level skills of the work-force. This is a non-trivial techno-economic analysis problem, deserving serious knowledge-based attention.

The Peace Dividend in the current Irish context of course means the gains to be made in the context of non-violent political development in Northern Ireland. There is a danger that participation in the global military-industrial complex may be seen in this context in a positive light, as a job-generator. This conflict of interest needs to be addressed constructively.

Opportunities also exist for adapting the steps which led to the peace process in Northern Ireland to current ongoing situations in Bosnia, Kosovo, Macedonia, Palestine, Kashmir, etc. This constitutes a challenge for existing bodies like the Irish Peace Institute [11] in Limerick University, which was set up by Brendan O’Regan under the combined challenges of the Northern crisis and the global challenges suggested by Glasnost and Perestroika in the USSR.

2.4. Dynamics of the Science/Technology interaction; the Social Dimension

The creation of a friendly environment for the transformation of the results of scientific research into useful innovative productive systems is a key problem in development economics at the macro level. At the micro level, the problem is how best to set up the management and organisation of the post-graduate system and its interaction with industry, how to develop positive career-profiles for the research community, and how to encourage the development of innovative enterprise at the periphery of the research system.

At the core of this is the problem of how basic scientific research relates to problem-oriented applied science: can the cultures of MSc people and PhD people, despite differing motivations, be encouraged to interact creatively in a complex environment where all sorts of work is going on? In my experience, the common ground was the process whereby experimental technologies
developed in basic scientific research and got transferred into the production process, over a period of time, with mobility of personnel.

There is also the problem of how to quantify the contribution of science, and knowhow relating to innovative science-based technologies, to economic development; this bridge needs to be made, perhaps via the Economic and Social Research Institute (ESRI), where currently no-one explicitly specialises in the science domain.

2.5. Development Economics and the Third World
The problem of handling constructive technology transfer, in a development economics situation, in a post-colonial nation, tends to be dominated by government ignorance, dependence on 'foreign experts', with local expertise undeveloped and often emigrating under the 'brain drain' process. This is a key current global issue, and a Bernal Institute in Ireland would have much to offer in the form of access to Irish experience, in its positive and negative aspects, from which much can be learned.

The problem is how best to interface people influencing the development economics environment with people involved in innovation and technology transfer; also how to ensure that those in government are aware of the positive role of locally-available scientific expertise, and of the importance of avoiding the 'brain drain' process. If native scientists and engineers go abroad, it should be to learn, with option to return, and opportunity to contribute to building up the new nation.

2.6. Operational Research and System Analysis
The modelling of specific productive processes, as complex systems in evolving stochastic environments, deserves some attention, perhaps in the context of current economic modelling expertise as done currently in the ESRI. This needs to be extended to take account of the role of scientific and technological expertise in the innovation and enterprise development process. As I hinted earlier, I am not aware of any explicit interest in the ESRI in quantifying the socio-economic effects of government investment in scientific and technological knowhow. This development, if it were to occur, would be in the direct line of descent from Bernal’s pioneering work in Operations Research.

One possible approach might be to have an alternative to national macro-economic modelling, perhaps in the form of a statistical ensemble of interacting micro-economic models, the latter being at the level of realistic quantified models of a representative sample of firms, in many interacting sectors. Another possible approach, in a specific identified current micro-domain, would be to apply modelling techniques, perhaps based on simulation or queue-theory, to the ongoing problem of waiting-lists in the healthcare system [12]. It would not be appropriate here to attempt to spell out a detailed agenda. All I can do is suggest that some of the abstracted coefficients used by economists in their macro-models perhaps deserve knowledge-based analysis, to give some idea how they might perform in contexts where serious changes take place. A key motivation is the need to maximise the utility per unit energy, and to create an economic environment where people are strongly motivated to do this, in the interests of dealing with the global warming threat. There is more to it than the energy-efficiency of appliances. The problem will need to be faced of how to organise human settlements and activities in such a way as to minimise the need to travel.

The foregoing polytropic Bernal domains which I have attempted to characterise can perhaps be represented as in 1.

3. Existing Related Research Experience in Ireland
Thus the projected Bernal Institute would need to include strong historical, political, economic, scientific and mathematical components, in the form of a multi-skilled interactive team, fit to
supply a consultancy service relevant to contemporary local, national and global problems, using tools honed in the analysis of Irish experience.

In this context we need to take into account the prior existence of Bernal-related themes which have already arisen within the Irish academic system. The following list is not to be taken as anywhere near complete, but it suggests some networking start-points.

For example, there was a Science Policy Research Unit in UCD set up by the late Patrick Lynch in the 1970s as a conscious element of support for the implementation of the recommendations of the earlier OECD Report, of which he had had a hand in the authorship. This however has not survived, though Joe Cogan, who ran it, remains active in the domain in retirement; he recently gave a presentation to the Futures Academy in the Dublin Institute of Technology. This latter body seeks to develop knowledge-based strategic problem analysis, primarily in the urban planning domain, and is also a candidate contact-point on the network.

There exists currently a ‘Networks of Science and Culture in 19th Century Ireland’ project which is associated with Dr Aileen Fyfe in the NUIG History Department and Professor Peter Bowler in the QUB Anthropological Studies section of the School of History and Anthropology; the latter includes Irish Studies. Prof Bowler is primarily interested in the history of Darwinism, and Dr Fyfe in the development of steam power, and in the role of publication and popularisation of science.

There is, or was, in DCU a Science, Technology and Society centre in the Schools of Communications, though its web-site is archived, suggesting that it is not currently active. It is however associated with Dr Helena Sheehan, who contributed a paper to this seminar, on Bernal’s philosophical background, and it is thus evident that there is re-development potential for DCU as a node in a Bernal-related network. There is also a ‘science and society network’

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**Figure 1. Bernal Domains**

Developing Economies
- Brain Drain
- Technology Transfer
- Peace

Science
- Physics
- Maths
- Chemistry
- Biology
- Computing

Technology
- Basic Research
- Enterprise

Society
- Social Analysis
- Art
- Governance
- Peace

Government
- Operations Research
- Policy Impact

History
- Peace Dividend
- Irish Science
involving Brian Trench in DCU and others including Catherine O’Mahony in UCC, which organises an annual seminar.

Jason Harris also in UCC is interested in early science history, in the Renaissance epoch. Ellen Hazelkorn in DIT is interested in research strategy and management, and in university-industry links. Bernadette O'Regan in UL is interested in assessing current sustainability impacts of future sustainable development policies, and in establishing an eco-industrial network for SMEs. The foregoing came up under a ‘science and society’ search in the Expertise Ireland knowledge-base.

The Economic and Social Research Institute in Dublin does not have any explicit ‘science and technology’ theme in its current agenda, though it has in the past considered energy-related issues, and the process of the transformation of scientific knowledge into economic utility is clearly within its remit.

Under ‘Development Economics’ in Expertise Ireland there are listed 14 academic experts in 7 institutions. Under ‘Technology Transfer’ there are 18 research centres and 41 experts. Thus at first sight many of the ‘Bernal domains’ are well served. The problem remains, however, of how to encourage the dynamics of the cross-linking, and this is tentatively examined in the next section.

The foregoing partial list needs systematic development with the aid of the Expertise Ireland knowledge-base, using keywords related to the main ‘Bernal domains’. The resulting extended panel could then be scanned for evidence of cross-linking aspirations. For example, in the ‘Development Economics’ group if someone shows up with evidence of interest in science and society, technology transfer, innovation, the peace dividend etc., then they could be identified as potential nodes on a Bernal Institute network.

4. A Possible Institutional Model
What seems to want to emerge from the foregoing analysis is a high-profile focal centre which would provide a knowledge-based consultancy service, primarily for export, but also, where appropriate, for the home market; it would also provide a postgraduate training service, across the spectrum of the polytropic but related Bernal domains.

The natural location for such a focus is Limerick, given the interest aroused by the unveiling of a plaque to Bernal in neighbouring Nenagh his birthplace. This interest has been instrumental in initiating a working group in Limerick University, on the initiative of the president Roger Downer, of which the convenor is Professor David O’Beirne. The subsequent seminar in Limerick Institute of Technology, of which this is the proceedings, is a further indication of focal interest.

The Irish Peace Institute located in UL would be a significant contributor to this focus, given the ‘world peace movement’ emphasis in the Bernal legacy.

It would be unrealistic however to expect the full range of relevant cross-linked disciplines to exist in the one location. The focal location would need to act as a high-profile contact-point, and indeed co-operative marketing organisation, for a network of resources dedicated to the promotion of science and appropriate related technologies in a development economics context, for export to emerging post-colonial nations, and indeed to fringe-European nations with problems identified in development socio economic terms having a scientific dimension.

We have identified above some of the elements of this network which would need to be organised so as to enable postgraduates coming from abroad to work in one or more locations, on cross-disciplinary projects relating to problems recognised on their respective home grounds. These projects might be defined creatively as a result of international consultancy work done by members of the Bernal Institute network, for whom the focal Bernal Institute had been the high-profile international marketing agency generating the demand for their consultancy.

There would need to be a prestigious governing body, composed of experts in all relevant domains having international consultancy status, to which a suitably experienced Director would
periodically report. The Director, and associated staff (which would include a librarian charged with developing a relevant knowledge-base having a creative combination of print and hypertext) would service an inter-institutional panel of relevant academic experts recruited according to stringent criteria to service the export consultancy targets. From the ranks of this panel would be drawn the supervisors of the various postgraduate projects generated in the context of the international consultancy.

I have outlined earlier some potential participants in the Bernal Institute network. It would be premature to go into any more detail at this stage. It could be that the final shape would emerge in the context of a major international project supportive of some current post-colonial problem situation, perhaps Palestine. A key factor in the marketability of such a project is of course the degree of success of the current Northern Ireland political process.

References
[1] I have given an account of this period in my Century of Endeavour, a revised edition of which was published in April 2006 by Tyndall/Lilliput; p 96ff.
[2] ibid p148ff.
[3] See http://www.iol.ie/~rjtechne/itimes/itimes70.htm for an edited version of the Irish Times column, which ran weekly from 1970 to 1976. It is also accessible in the hypertext support system of my Century of Endeavour book, which is accessible to purchasers by arrangement. The Bernal obituary is also on p 307ff of the book.
[4] See Swann B and Aprahamian F 1999 J D Bernal: a Life in Science and Politics, (London: Verso); see also my Century of Endeavour as above, p 349ff.
[5] Sir William Petty has been credited as the founder of the economics domain, as well as the arts of statistics and land surveying, though very much from the imperial perspective.
[6] The critical economic writings of Swift, Berkeley, Molyneux, and the work of Dobbs and Prior in setting up the (later Royal) Dublin Society as a source of applied-scientific competence, has been identified by Salim Rashid (U Illinois) as evidence of an emergent school of Development Economics relevant to the colonial fringe.
[7] For example, William Higgins (1763-1825), Chemistry Professor at the RDS, took up with the work of Lavoisier and attacked the ‘phlogiston’ establishment
[8] See: http://www.iol.ie/~rjtechne/scihist/cranebag.htm for a website version; it will be seen I was continuing to make a conscious effort to bridge C P Snow’s ‘Two Cultures’ in the Irish context, having begun the process earlier via my weekly Irish Times column (1970-76).
[9] See my Science in a Post-Colonial Culture http://www.iol.ie/~rjtechne/scihist/ireview.htm and also my Scientific Culture and National Identity http://www.iol.ie/~rjtechne/scihist/index.htm
[10] I produced my Boyle Medal paper with the centenary in mind, but the RDS people found it unduly controversial, and it remained unpublished in hard copy. It has however been seen as useful background by post-centenary Boyle Medallists, under the new regime in association with the Irish Times. The URL is http://www.iol.ie/~rjtechne/boyle/index.htm
[11] See their web-site http://www.ul.ie/ipi/
[12] Some preliminary discussion along these lines has begun to emerge from Operational Research people in Britain and Australia, which I am supporting with a newsletter; see http://www.iol.ie/~rjtechne/millard/index0.htm.