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Ageing between Gerontology and Biomedicine

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Abstract
Over the past two decades, public interest in the basic biological processes underlying the phenomenon of ageing has grown considerably. New developments in biotechnology and health maintenance programmes appear to be forging new relationships between biology, medicine and the lives of older people. A number of social scientists describe the process as the 'biomedicalization of aging'. In this article, we argue that contemporary biogerontology, an important sub-field of gerontology that could be construed as the primary actor in the process of 'biomedicalization', should be regarded instead as advancing a critique of biomedicine. We then provide a genealogy of the critique and close the argument by pointing to sources of uncertainty within biogerontology, which should be taken into account in any further studies of the relationship between biology, medicine and the lives of older people.

Keywords Ageing, Biology, Biomedicine, Evolution, Governance, Medicine, Public Health

Over the past two decades, interest in the basic biological processes underlying the phenomenon of 'ageing' has grown considerably. The emergence of the so-called 'anti-ageing' movement and the controversies surrounding its promises to extend human longevity have captured the attention of the British and American public, but so have the more sober assessments presented in popular books such as Leonard Hayflick's *How and why we age* (1994) and Thomas Kirkwood's *Time of our lives: The science of human aging* (1999). This interest has motivated both consultations on public attitudes toward research into the causes of ageing (Alliance for Aging Research, 2005; MORI, 2006) and political interventions such as the White House Conference on Aging (2005) and the House of Lords

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report *Ageing: Scientific aspects* (2005). These developments have been accompanied by an intensification of research on the biology of ageing, and the therapeutic value of a number of biomolecules characterized during the course of such research is currently being tested in animal and human trials. Lastly, clinicians would appear to be willing increasingly to provide these and other life-extending treatments to older individuals. This entire situation has captured the attention of social scientists, many of whom refer to the 'biomedicalization of aging'.

Estes and Binney (1989) first coined the phrase 'biomedicalization of aging' as a label for the processes whereby ageing comes to be defined as a matter of 'biomedical' interest, processes which would appear today to be intensifying and be increasingly associated with the reorganization of health care around technological intervention and the modes of prevention and consumption (Clarke *et al.*, 2003; see also Kaufman *et al.*, 2004). Contemporary biogerontology, a sub-field of gerontology that is simultaneously engaged in the biomolecular and biodemographic characterization of the processes associated with the development of the individual from birth to death, presents a paradox, however.[1] One of its distinctive claims is that it provides an alternative model for understanding those diseases that are commonly associated with advanced age, such as cardio-vascular disease, cancer and dementia. Rather than pursuing the disease-specific model that has been deployed within many other branches of the biomedical enterprise, biogerontologists argue that increases in health and longevity are more likely to be achieved by focusing research on the common biological basis of all those diseases that would seem to characterize the lives of older people. Furthermore, in reconstructing these diseases as part of a wider set of 'degenerative diseases' that are only connected contingently to the organism's chronological age, biogerontologists would appear to call into question the status of ageing as a biological process. In other words, the development of biogerontology seems to undermine the possibility of any straightforward conjunction of biology and medicine which the phrase 'biomedicalization of aging' conjures almost by definition. In drawing attention to this paradox, we follow Keating and Cambrosio (2003) and their definition of biomedicine as a set of practices that was established during the second half of the twentieth century and that has organized the relationship between the laboratory and the clinic by means of hybrid 'bio-clinical' entities. Viewed from this perspective, biomedicine is less the systematic application of biological standards and products in clinical work (Canguilhem, 1991) than it is a set of conventions that are specific to work on particular diseases and that enable the coordination of bench and bedside within these delimited domains alone.

In this article, we articulate this counter-intuitive understanding of biogerontology by first exploring the conceptual presuppositions of recent proposals that have emerged from within biogerontology to reorganize not just gerontological research, but biomedical research more generally. We then offer a genealogy of the situation by turning to the middle decades of the twentieth century, when gerontology first gained institutional recognition and the biology of ageing was a domain contested between those who argued for a 'basic' approach and those who proposed to focus on the differences between 'normal'

1 Defining biogerontology, especially in relation to the 'anti-ageing' movement and medicine, is fraught with difficulties and ambiguities (Fishman *et al.*, 2008; Juengst *et al.*, 2003), but we hope that the account we provide here goes some way toward clarifying differences.

and 'pathological' ageing. We then consider how the latter approach came to dominate the organization of gerontological research in both the United Kingdom and the United States, but for very different reasons, and how it was eventually embedded in the activities of the National Institute of Aging (NIA). We then trace how the NIA's blueprint for research into the causes and treatment of ageing initiated a transatlantic biogerontological critique of biomedicine. Our aim is to establish that the development of biogerontology contrasts sharply with the many successful relationships that have been established between the laboratory and the clinic by means of mediating, hybrid versions of the 'normal' and the 'pathological'. If, as Boltanski and Thévenot argue, 'the less pure a situation is (in the sense that it contains objects from different worlds), the easier it is to denounce it' (1999: 374), biogerontology has harnessed the internal tensions of biomedicine, seeking to construct a field of action whereby the historical opposition of biomedicine and public health is no longer relevant and the laboratory, preventative medicine and health maintenance programmes can be integrated seamlessly. In the concluding section of this article, however, we point towards some important sources of uncertainty within the biogerontogical project.

Biogerontology and biomedicine

In the past decade, the organization of gerontological research has gained wide political recognition. In the United States, for example, a group of biogerontologists and policy makers who attended the White House Conference on Aging (2005) drew attention to the minute proportion of the annual budgetary allocation for the National Institutes of Health that is dedicated to understanding the basic biology of ageing, and called on legislators to reconsider the situation because 'the aging research field [is] on the threshold of a new way of thinking—shifting from a focus on specific age-related illnesses to a search for an understanding of aging itself (Alliance for Aging Research, 2005: 4). In the United Kingdom, the Science and Technology Committee of the House of Lords, has advanced a similar argument, noting that: 'most of the research on ageing and health ... is focused on specific diseases and medical conditions for which age is the single largest risk factor', and then bemoaning the paucity of support for much more promising programmes of research on the 'basic processes of ageing' (House of Lords, 2005: 103).

The focal point of these arguments about the current organization of gerontological research and its limitations is the dependence on clinical definitions of those diseases most commonly associated with old age. According to the authors of a position statement on health promotion and disease prevention in the twenty-first century (Butler *et al.*, 2008), such dependence is troubling because it is an effect of an anatomical division of the body that was forged in the nineteenth century and no longer provides a useful way to understand disease. The clinical worldview, these authors maintain, was well-suited to pathologies characterized by discrete and specific aetiologies, but is inadequate to address the chronic, long-term illnesses of the late twentieth and early twenty-first centuries. The protracted temporal unfolding of these illnesses is so nearly coterminous with ageing that it unsettles the epistemic pairing of the 'normal' and the 'pathological' that underpins the clinical perspective on ageing. Furthermore, this pairing assumes that the two states can be situated proximally

and intervened upon directly, but this obscures understanding of the diverse and complex processes involved in the declining functional capacities of the organism such that the perspectives of the laboratory and clinic must be integrated with programmes of health screening and maintenance. A further criticism of biomedical research is that, by relying on methodological and epistemological structures that are wholly incommensurable with the phenomenon studied, it cannot but fail to deliver effective treatments for those pathological states commonly associated with old age. As the House of Lords (2006a) notes: 'generic research into the process of ageing ... may be "the most direct route to developing novel interventions and therapies"'. In sum, the charge is that the current organization of biomedicine may serve many clinicians and researchers well, but it fails to secure health and longevity.

At the same time, the biogerontological critique of biomedicine also aims to redraw the contours of the relationship between biology, medicine and society. As the following extract from an interview with a biogerontologist suggests, what is required is a wholly new approach to disease.[2] Having been asked about his expertise, this biogerontologist foregrounds the issue of normal ageing:

> [My] scientific interest is to explain the occurrence of age associated diseases. Some people call that ageing, some people call that normal ageing, [and] some people say it's different from normal ageing. I don't make a distinction between them.

When pressed on the importance attached today to research on the causes of Alzheimer's Disease (AD) as answer to the problems posed by old age, this biogerontologist adds:

> What's behind, let's say the senile muscle, is of equal importance ... because people can't go out any more and they suffer from it. What's normal? There's nothing like normal ageing.

What is important, according to this biogerontologist, is a historical disjunction between the genome and the environment to which the genome is exposed:

> [We] were not meant to live longer than forty years, and the system is optimized in an environment like Africa. But now we don't live in Africa.... [Our] life history is ... the result of ... an old, optimized genome ... now ... exposed under modern, affluent conditions. But it's not meant to be ... it's not meant to be exposed under these conditions.

From this perspective, normality is a historically specific discrimination of little biological significance, at least insofar as biology is equated with attention to the evolutionary dynamics shaping the life course of the organism. This argument has gained considerable momentum in the context of what has become known as 'evolutionary medicine' (Nesse and Williams, 1996) and encapsulates a more general approach that undermines the long-established recourse to a categorical contrast between normal and pathological states, whereby problems that could be regarded as 'of equal importance' are instead organized

2 The interview was conducted in the context of the ESRC funded project 'Boundary work, normal ageing and brain pathology'.

hierarchically, focusing primarily on disease and ultimately reflecting the organization of medical specialities and markets.

How are we to understand this critique of biomedicine which, in many ways, contradicts extant analyses of the science of ageing? Our thesis is that it is rooted in gerontologists' complex and fraught relationship to the enterprise of biomedicine as the latter took shape during the latter half of the twentieth century. Consequently, in what follows, we document diverse attempts to forge some relationship between biology, medicine and ageing, and how these enterprises were ultimately incorporated into a biomedical approach that emphasizes the medical pathologies of old age, rather than focusing on ageing as a complex biological phenomenon. To avoid any misunderstanding, we must emphasize at this point that what we are seeking to offer is a genealogy of the present situation, a 'history of the present', rather than any account of origins.

Between unity of causes and unity of effects

Between the late 1930s and early 1950s, a variety of public and private actors became interested in the biology of ageing. Underpinned by a burgeoning volume of actuarial projections of an 'ageing population' and preoccupation about economic deprivation and illness (Haber and Gratton, 1994; Thane, 2000), such interest was not matched however by any pre-existent, agreed set of epistemic commitments among the variety of actors studying ageing as a strictly biological phenomenon. Instead, it excited a number of debates over the definition of ageing, which resulted in a diversity of possible answers to the questions posed by these public and private actors. Such divergence was particularly evident during the conferences supported by two of the most active philanthropic supporters of research on ageing, the Josiah Macy Foundation in the United States and the Nuffield Foundation in the United Kingdom.

The Josiah Macy Foundation was responsible for funding surveys of ageing in the 1930s and commissioning a seminal conference on the biology of ageing at the end of the decade. As Park (2008) has documented, Edmund Cowdry's edition of the published proceedings of this conference was riven by disagreement between the various contributors, mostly around the 'parameters' and 'standards' by which to contrast normal and pathological ageing. Similarly, the Nuffield Foundation was a key sponsor of ageing research and is renowned for having sponsored the Survey Committee on the Problems of Ageing and the Care of People, which brought the living conditions of older citizens to the attention of the British public (Thane, 2000). What is less known is the Nuffield Foundation's support for research into the biology of ageing, which started in 1940 and eventually resulted in an extensive network of laboratories across the United Kingdom. Here too, however, the uncertainties were profound and, when the Nuffield Foundation sponsored a symposium in 1956 to showcase its achievements in this domain, there was conflict between those who wanted to find standards by which to contrast normal and pathological ageing and those who considered this endeavour entirely pointless.

The questions of definition raised during these diverse encounters were most clearly delineated during the first CIBA Foundation Colloquium on Ageing, which was held in 1954, immediately after the first meeting of the International Gerontological Association. The

list of participants included the leading experts of the day on the biology of ageing. According to the published proceedings of the colloquium, following the chairman's introduction of the concluding, general discussion, Alex Comfort, Nuffield Research Fellow in the Department Zoology at University College, London, intervened in the following terms:

> I would like to put in a plea for [Professor Medawar's] definition of senescence as the increase in liability to die with advancing age. It may be proper to distinguish ageing from senescence, but in that case I think we can scrap ageing altogether and call it development, because gerontology is an entity which only comes into existence to describe a process human beings don't like, a deteriorative process, and I take it that it is senescence with which we are concerned here.
>
> Earlier in the meeting Dr. Lansing made a declaration of faith on the subject of the overall unity of the senescent process. I don't want to speak out of turn, but I'm somewhat sceptical of [the] underlying unity of any ageing process.

Comfort's call for a conventional definition of 'ageing' did not go unchallenged. Albert Lansing, from the Department of Anatomy at Washington University, responded:

> *Lansing*: But take the male rotifer: it is born, it has no alimentary trait and dies of starvation within twenty-four hours after fertilizing. Does he die of senescence? I'd rather put him in a special category, as a very degenerate character who starves to death in the twenty-four-hour period that he is busy fertilizing.... When I think of senescence I think of something that happens not to children or to infant rotifers, but to the organism that has become an adult and then undergone some type of change, to wind up dead sooner or later. That's what I mean by senescence. The maturation of the embryo, the new born child, the adolescent, the changes with time prior to maturation, to me are not senescence.
>
> *Cowdry*: Yours is the downswing of life, then.
>
> *Lansing*: Yes, after adulthood has been reached. I can't define adulthood too well, and in some cases the changes that occur in adulthood are said to be improvements rather than losses.
>
> *Cowdry*: You don't have to define it if you just call it the downswing, that implies that after a height you start to go down.
>
> *Comfort*: Do you agree then that for various organisms the factors that contribute to that downswing tend to differ very radically from phylum to phylum?
>
> *Lansing*: I'm not prepared to agree to that. I think we have special cases which bring about death, but not all death is due to senescence.... The declaration of faith I made yesterday stems in part from the various types of survival curves that Dr. Comfort showed us.... It would be quite a coincidence if all these processes all expressed themselves in the same way.
>
> *Comfort*: Raymond Pearl plotted a survival curve for automobiles which was again the same shape!

At this point, Nathan Shock, the Director of the Gerontology Section of the National Heart Institute/National Institutes of Health and effective founder of the International Gerontological Association, interjected:

> *Shock*: I think the argument that because two different phenomena can be made to fit the same mathematical formulation they have common processes behind them is an extremely hazardous one.
>
> *Lansing*: I said only that it's a possibility, I'm not prepared to say that we have as many kinds of protoplasm as we have species. I think there is common protoplasm with basic properties of multiplication and growth, decline, irritability and so on, varying in detail, not in principle.

Shock sought to bring the argument to a close in the following terms:

> I would agree that protoplasm is probably fundamentally much the same stuff, although we know that various tissues develop different functions, so that their enzyme systems must vary quite widely between different cells in the same animal. To that extent, I would agree that perhaps if you knew what it was that caused a cell to lose its ability to maintain concentration gradients, maintain its metabolic processes, you would be a long way toward understanding the ageing process. But it seems to me that the techniques that we have for investigating single cells are very meagre. Dr. Cowdry feels that if you take a cell out of its tissue it is no longer a cell. If we accept this position we are limited to unicellular organisms for study, but unfortunately most of these species simply divide and form two new cells so that 'ageing' fails to occur. Thus, we are faced with the problem of studying more complex animals or tissue, using both biochemical and physiological techniques. Since changes in the environment of the cell, produced by changing the diet of the animal, will often result in alterations in cellular enzymes, it seems to me that perhaps we are going to have to look at the problem of ageing from a number of different levels simultaneously and not try at the moment to conceptualize the entire problem in one framework. Prof. Medawar has approached the problem from a statistical evaluation of life tables; I am not prepared to accept this approach as the only way out of the difficulties. I think the examination of life table might be an index as to what you were doing to a process, but if you are going to explain ageing as a process I think ultimately you have to look at individuals, and perhaps the best way is to look at them from different points of view and at different levels of organization. I doubt if it would be possible to formulate a definition of ageing that would be acceptable to everybody and would cover all the aspects of the problem as it now stands. (Wolstenholme and Cameron, 1955: 240–244)

This debate can be regarded as the confrontation of three different visions of the biology of ageing, underpinned by disparate epistemic and political commitments. The first of these was that advanced by Comfort and Peter Medawar, Professor of Zoology at University College, London. Theirs was the perspective of population geneticists working with life tables and relying on evolutionary arguments to explain differences between populations and species. On their account, ageing or senescence was an age-specific aggregation of biological phenomena that were physiologically unrelated and peculiar to animals protected from the rigours of natural selection. This understanding suggests that any interventions they might have envisioned would operate at the aggregate, population level. Against this perspective was that of experimental biologists such as Cowdry and Lansing, who relied on particular organisms to produce models of physiological phenomena that were assumed

to hold across different species. From this perspective, ageing was to be regarded as a unitary phenomenon that occurred in all organisms at some point in their developmental cycle and any interventions should operate at the cellular level. The third perspective, represented by Shock, was first that the first two perspectives were epistemologically equivalent, and, second, that the individual should be regarded as the fundamental biological unit, which could then be examined 'from different points of view'. This programme was to be delivered by physiological measurements of the ageing individual in the laboratory, clinic or community so as to establish standards of 'normal ageing', and would leave to clinicians the task of managing the pathologies of ageing.

Importantly, Shock's ability to subsume the first two perspectives and to do so with sufficient authority to close the debate, at least temporarily, was not underpinned by some alternative disciplinary approach, but by changes happening elsewhere. Shock's proposal to embrace 'different points of view' aimed to integrate gerontology in the institutional transformation sparked by the creation of the National Institutes of Health and correlated private and public investments in research programmes on cancer and heart disease that have come to define the biomedical enterprise (see Gaudillière, 2002; see also Keating and Cambrosio, 2003). It is to the project of integrating gerontology with the emerging biomedical enterprise that we now turn.

Coordinating medicine, biology and old age

There can be little doubt that, during the 1950s and 1960s, Nathan Shock played a pivotal role in integrating gerontological research within the changing institutional organization of American medical research, and in aligning gerontology with the normative requirements of emergent biomedicine (see Achenbaum, 1995). This was encapsulated primarily in the design of the Baltimore Longitudinal Study of Aging (BLSA), which Shock began to develop in the mid 1950s to measure individual functional capacity over time (see Bookstein and Achenbaum, 1993). Although contemporary with the longitudinal studies which characterized American public health research during these years, such as the Framingham Heart Study (see Oppenheimer, 2005; Rothstein, 2003), the BLSA was distinctive insofar as it focused on 'healthy individuals' alone, to the exclusion of all those who contracted any illnesses. This was due to Shock's interest in disentangling 'pure ageing' from 'disease' and so providing the standard that would guide geriatricians in their diagnosis and management of old age illnesses (Shock, 1956, 1961). This concurred with the aims of geriatricians themselves. From the 1940s onward, American geriatrics aimed to establish itself within medical specialities, and, as Hirshbein (2000) has suggested, this was achieved by evoking a notion of normal ageing and then defining the expertise of the geriatrician as dealing with the prevention and treatment of diseases of old age. Gerontology, particularly the physiological and functional measurement provided by case-controlled or longitudinal studies such as those that Shock proposed, was construed as providing the requisite biological standards. Importantly, Shock's distinction between normal and pathological ageing served not only clinical, but also political goals when the plan to establish a national programme of research into the causes of the diseases commonly associated with old age finally moved onto the national political agenda and was constructed on this same distinction (Achenbaum,

1995). Equally importantly, while the distinction would appear to have enabled a hybrid understanding of normal ageing that was workable in the clinic and the laboratory, the development of gerontology was constrained by its institutional association with the Veterans' Administration (VA) (Achenbaum, 1995; Haber, 1986) such that it was only when the claims advanced by ever larger numbers of ageing veterans started to strain the VA's resources that the calls to establish a national programme of research into the causes of the diseases associated with old age gained any political support. In other words, the solidity of the alignment between Shock and the nascent NIA should not be overestimated and it is perhaps no surprise that, despite Shock's ambitions to create a national programme of research that might help to differentiate healthy from unhealthy ageing, the NIA only secured a firm political foothold when it began consistently to sponsor research on what, at least according to Robert Butler, has today become the defining disease of old age, AD (Anon., 2008; see also Ballenger, 2006).

In the United Kingdom, a different configuration of medicine, biology and old age not only distanced gerontology from biology altogether, but ultimately resulted in the significant weakening of gerontology as an autonomous discipline. Some of the reasons for this are most evident if a comparison is made of the disciplinary affiliations of the participants in the CIBA Foundation Colloquium and those of the Nuffield Trust conference on the 'biology of ageing'. While no social scientists appear to have been invited to attend the CIBA Foundation Symposium, other than in an honorary capacity, the conference funded by the Nuffield Trust was organized by, and attracted, a very diverse group of experts, some being zoologists or botanists and others being clinicians, psychologists or economists. The challenge was then to establish how their diverse expertise might be coordinated so as to address the social and political question posed by ageing. This situation is not surprising given that the Nuffield Foundation was renowned as the sponsor of the Survey Committee on the Problems of Ageing and the Care of People, and that, in the absence of any substantial, structured funding by the Medical Research Council (MRC) for research on the biology of ageing, the Nuffield Foundation supported a variety of academic programmes that relied on equally varied methods, though focusing primarily on the importance of social and economic conditions to the definition of 'normal' ageing. Furthermore, as Martin has observed, it was not through the laboratory but 'through the technique of the survey [that] doctors created a body of knowledge relating to the social, economic, and medical needs of the aged population in their own districts' (1995: 458). In the process, British geriatricians defined gerontology as the field, in Lord Amulree's words, concerned with 'those elderly sick *with social and economic problems*' (in Martin, 1995: 460, italics added). Importantly, this construction positioned gerontology outside the hospital, the main research platform of British biomedicine during the second half of the twentieth century (Stewart, 2008). Furthermore, the consequent association between old age and that peculiarly British disciplinary integration of social and medical science that went by the name of 'social medicine' was responsible for much uncertainty around the place of the elderly within the National Health Service (NHS). Under these circumstances, any funding for research on the medical problems posed by older people tended to be allocated to disease-specific programmes within the MRC because there seemed to be nothing so biologically and clinically distinctive and remarkable about the patients' chronological age as to deserve the attention of a specialist (see

also Ballenger, 2006). Finally, in the 1960s and 1970s, when social medicine lost its precarious institutional support within both the MRC and NHS (Porter, 1997), British gerontology lost all residual disciplinary legitimacy. Thus, despite the fact that at the time of the CIBA Foundation Colloquium the evolutionary perspective on ageing was a wholly British and very vibrant current, institutional and political factors had worked together to progressively disconnect biological explanations of ageing from any public debates and programmes to address the 'problem of old age', so that Peter Medawar could declare in 1977 that British gerontology was moribund and that 'those anxious about the possible malefactions of research on ageing should take comfort from the fact that the great public and private agencies are not competing with each other in their endeavours to support research on ageing' (Medawar and Medawar, 1977: 159).

In sum, if the 'problem of old age' emerged during the years between the late 1930s and early 1950s as a pressing political question and a variety of powerful institutions became interested in the biology of ageing, the successful alignment of ageing, biology and medicine was a highly contingent and unstable affair.

The trouble with the National Institute of Aging

It is widely acknowledged that the establishment of the NIA was a difficult and protracted matter. Importantly, while the difficulties have been portrayed as a matter of divergence between gerontologists and the medical establishment (Lockett, 1983), there also is evidence of divergence among gerontologists themselves over the framing of a coordinated programme of research on the biological origins of ageing.

Between 1963 and 1965, Leonard Hayflick, a cytologist working in the expansive domain of experimental oncology, challenged the notion that cell lines were potentially immortal by demonstrating that the number of replications cells could undergo was limited and that the limit was fixed by cellular mechanisms that were eventually located within the nucleus (Landecker, 2007). The challenge went unnoticed among oncologists because the notion that cell lines were potentially immortal was too solidly embedded in the material practices of experimental oncology, but it did not go unnoticed among gerontologists insofar as it offered scope to re-articulate and revitalize Edmund Cowdry's experimental approach to ageing. This interest peaked in 1973, when Hayflick received the Robert Kleemeier Award, which the Gerontological Society of America bestowed annually 'in recognition of outstanding research in the field of gerontology'. In his acceptance lecture, Hayflick, while admitting feeling 'somewhat uncomfortable in accepting an award for work which at the outset was undertaken with the biology of aging farthest from [his] mind' (1974: 37), was quick to propose the following:

> What are the implications to gerontologists of the notions that are emerging from cytogerontology? I believe that there are several important implications. The first is that the primary causes of age changes can no longer be thought of as resulting from events occurring at the supracellular level, i.e., at cell hierarchies from the tissue level and greater. *The cell is where the gerontological action lies*. I believe therefore that purely descriptive studies done at the tissue, organ and whole animal level, as they

> pertain to the biology of aging, are less likely to yield important information on mechanism than studies done at the cell and molecular level. (1974: 39, italics added)

In other words, according to Hayflick, investigations of ageing would be most productive when grounded in the methods of 'cytogerontology', the new field of research which Hayflick himself was busy trying to define and delineate; but he also seemed intent on challenging Shock's programme for the development of gerontology, first because Shock had justified his focus on individuals on the grounds that the cellular level concerned only a subset of the gerontological phenomena and, second, because the list of 'purely descriptive studies' of ageing presumably included the Baltimore Longitudinal Study of Aging (see also Achenbaum, 1995). There was more, however. If Shock's programme was underpinned by the need to distinguish between normal and pathological ageing, on Hayflick's vision this would become a problematic endeavour:

> One is forced to conclude that if all disease-related causes of death were to be resolved, then the aging processes would present some clear physical manifestations well in advance of death itself. The challenge, of course, is to separate disease-related changes from the basic biological changes that are a part of the aging process. Since fundamental aging processes most certainly contribute to or allow for the expression of pathology, then the two concepts may be so closely intertwined as to make any clear distinctions a futile exercise in semantics. (Hayflick, 1974: 43)

The question about the relationship between the normal and pathological which Hayflick thus posed rested explicitly on Alex Comfort's well-established evolutionary explanation of ageing (see Moreira and Palladino, 2008). Natural selection, Comfort argued, operated most forcefully on those phases of the life cycle which were related to reproduction, so that the expression of any deleterious mutations in these phases would be targeted more strongly than their expression in post-reproductive phases. This, according to Comfort, led to an accumulation of deleterious genes whose expression occurred in the later phases of the life cycle, eventually resulting in the genetic determination of the post-reproductive weakening of the organism commonly named 'ageing'. From this evolutionary perspective, seeking to 'separate disease-related changes from the basic biological changes that are a part of the aging process' was questionable, to say the least. Significantly, just two years after these critical declarations, Hayflick was mentioned as a possible first director of the NIA, thus illustrating the force of his criticism of Shock's programme, but Hayflick's accompanying ambition to totally reconfigure the organization of gerontological research may also have been the reason for its limited institutionalization. Thus, the first director of the NIA was not Hayflick, but Robert Butler, psychologist and author of the best-selling and prize-winning book *Why survive? Growing old in America* (1975; see also Ballenger, 2006).

One of the greatest challenges confronting Butler upon his appointment was the lack of research capacity and limited public interest in gerontology. Despite Butler's attempts to enrol policy makers and congressional committees, the NIA struggled to secure any steady stream of resources. Thus, when he suggested that 'research on aging has shifted from its exclusive disease orientation toward a more comprehensive investigation of the *normal, physiological changes with age*' (Butler, 1977: 8, italics added), the evocation of normality

was related more to the need to re-articulate how the American public viewed older people's role in society than to the needs of clinicians working with older people. The situation only changed with the emergence of what Butler called the 'health politics of anguish' (Fox, 1989: 82), an alliance of activists, clinicians and politicians who called public attention to the abandonment experienced by sufferers of senile dementia and those around them. This resulted in the prioritization of research into the causes and treatment of AD, particularly through the NIA's extramural research programme, which embodied emerging, competition-driven innovation policies that were based on both collaborations between universities and pharmaceutical companies, and ideals of 'rational' therapeutic development from bench to bedside (Moreira, 2009). It should be noted that, despite Butler's later disenchantment with the direction taken by the NIA, his own programme for the development of gerontology could be said to have facilitated the change insofar as it rested on the transformation of individual failures to adapt and age 'successfully' from a matter of psychic disposition into a matter of organic pathology (Ballenger, 2006). More importantly, however, with the support thus gained, the NIA experienced an extraordinary influx of researchers from other areas of biomedical research. This helped to transform the NIA's place in the American polity, but in the form of a highly visible disease-specific programme that eventually accounted for the majority of the NIA's budget. This caused considerable dissatisfaction among a number of gerontologists. As Richard Miller (2002) has noted, and plaintively so, 'senators' and voters' parents [die] of specific diseases' and are less likely to fund a general, 'basic' programme of research on ageing. In sum, AD firmly established the position of the NIA within the political and clinical worlds, but only by emphasizing the equation of ageing and illness. If gerontologists such as Butler, Hayflick and Miller felt that an opportunity had been missed, however, this situation also created the conditions for an unlikely alliance between programmes aiming to distinguish between normal and pathological ageing, on the one hand, and investigations of ageing at the cellular and sub-cellular level, on the other hand.

Biogerontology and the promise of health

During the 1990s, the alignment of evolutionary models and genetic research which Richard Dawkins's *The selfish gene* (1976) had by then popularized very successfully renewed gerontologists' interest in the evolutionary understanding of ageing, especially because it seemed to promise a new articulation of the problems of old age and how to address them (see also Nesse and Williams, 1996). This is powerfully illustrated by the increasing importance attached to Thomas Kirkwood's work.

Kirkwood (1977) re-articulated Alex Comfort's evolutionary explanation by combining molecular and demographic analyses to advance the notion that the organism should be understood as the product of a historical process involving the balancing of energetic investments in the somatic body, to enhance the chances of successful reproduction of the germinal line, and the cost of these investments to the continuity of the germinal line. On this understanding of ageing, attention is then directed toward the molecular mechanisms involved in the preservation of genomic integrity, or, as Kirkwood has put it, toward 'the evolved capacity of somatic cells to carry out effective maintenance and repair' (Kirkwood

and Austad, 2000: 235). Importantly, in this new vision, the business of gerontology is to enhance the ability of the individual to approximate the immortal germinal line, even if immortality itself is irretrievably denied by the evolutionary history of the human species. The hope is that this redefinition will at least result in maximizing the biological functionality of the individual up to the moment of death. Thus conceived, gerontology ceases to be a field of clinical specialization concerned with the diseases of a distinct population, the elderly, as these diseases are re-articulated as unfolding temporally on to antecedent risk factors and biomolecular pathways. Biomolecular and demographic pathways of individuals who might be 'at risk' of developing pathologies such as cardio-vascular disease, cancer and dementia are traced backward, to the earliest possible molecular, behavioural or clinical manifestations, aiming to develop multiple preventative interventions. These pathologies thus become part of a wider set of 'degenerative diseases' that are only connected contingently to the organism's chronological age. Within this framework, all degenerative diseases might be said to entail 'ageing', but in so expanding its domain of application the term 'ageing' no longer identifies a distinct biological process of its own kind. Equally importantly, because the domain of gerontology thus defined is resistive to any precise delimitation, it can become an object of interest for all clinical practitioners involved in managing degenerative diseases, from the primary care practitioners controlling middle-age hypertension to the specialized clinicians required to train these practitioners in the assessment of the earliest symptoms of cardio-vascular weakening. Furthermore, gerontology also offers opportunities of development to a great variety of actors in the market for health care as investigation of the mechanisms involved in the onset of these degenerative diseases greatly expands opportunities for pharmaceutical companies because the threshold of treatment moves ever backward to encompass a greater fraction of the population. This said, the investigation of these same mechanisms also offers opportunities to those providing the wherewithal and support to secure 'healthy lifestyles' from birth to death. In so doing, biogerontology promises to deliver a central expectation of private and public health care insurers, namely reducing the prevalence of degenerative diseases so as to reduce the aggregate cost of provision.

Importantly, by drawing on evolutionary biology to explore organisms' life histories in relation to the genome and the environment, the biogerontological programme enables links between the laboratory, preventative medicine and health maintenance programmes. One of the key changes in the organization of research, clinical practice and policy at the end of the twentieth century has been the shift from the 'problem of disease' to the 'problem of health'. This entails not only constructing an understanding of the molecular, individual and social dynamics that lead to illness, rather than just focusing on restoring health, but also reliance on preventative therapeutic strategies and health promotion programmes. These in turn are sustained by enhanced surveillance technologies which regulate access to therapies and programmes by identifying risk factors or states and supporting individuals' reorganization of their conduct in light of such risks (Clarke *et al.*, 2003; May *et al.*, 2006; Rose, 2007). Significantly, in so doing, biogerontologists differentiate themselves from the 'anti-ageing' movement and medicine (Olshansky *et al.*, 2002; see also Fishman *et al.*, 2008; Juengst *et al.*, 2003). While the latter argue for an interventionist approach to ageing, ageing being conceived in this case as a 'natural' but 'modifiable' process (Mykytyn, 2008), biogerontologists suggest that there is in fact nothing 'natural' about ageing. Instead, the plasticity of

the human organism, and in particular how first death and then ageing have been significantly postponed during the last few centuries, is where biogerontologists draw support to propose the expansion of public health measures to further this historical process. Consequently, in a recent public statement, a number of influential biogerontologists and representatives of non-governmental charitable organizations have argued that:

> ... the exploration of the mechanisms by which ageing can be postponed in laboratory models will yield new models of preventive medicine and health maintenance for people throughout life, and the same research will also inform a deeper understanding of how established interventions, such as exercise and healthy nutrition, contribute to lifelong wellbeing. (Butler *et al.*, 2008: 399)

In so doing, they call upon individuals identified through screening programmes and characterized through a variety of molecular and demographic markers to produce and maintain their own health. Such promises of health can only be realized, however, if research policies provide the means to focus on the basic biology of ageing and abandon biomedicine and its disease-driven business.

Conclusion

During the past decade, discontent with the organization of research into the causes and treatment of diseases associated with age has motivated highly visible public debates in both the United States and the United Kingdom. In this context, a number of influential biogerontologists have offered an alternative to disease-specific programmes which calls into question both biomedicine and the historical opposition between biomedicine and public health. Such proposals, as we have argued elsewhere, could be taken as evidence of a transformation of socio-political forms of management whereby:

> ... the individual of the 19th-century biopolitical imaginary, a human body whose biological constitution was irremediably fixed at birth, is giving way to an understanding of the human body as an assembly of biomolecular components that can be ... recombined so as to maximize the resultant unit's cultural, social and political productivity. (Moreira and Palladino, 2008: 21)

Whether and how the proposed link between the laboratory, preventative medicine and health maintenance programmes will work in practice, however, is a matter of empirical case studies of the development, mediation and use of emerging gerontological technologies. Furthermore, as we have argued in this article, such studies should not be underpinned by a critical appraisal of biogerontology as a 'biomedicalization of ageing', because biogerontology positions itself outside the institutions of biomedicine. In other words, the challenge for future studies will be to understand how the current uncertainties of the biogerontological programme play out in multiple social and political arenas.

Finally, some of the uncertainty involved in the future development of the biogerontological programme is evident in the reluctance with which the British government has greeted some of the recommendations advanced in the House of Lords report *Ageing: Scientific aspects* (2005). The Science and Technology Committee of the House of Lords was

particularly surprised that it was not the Science Secretary who responded to its report, a report on the '*scientific* aspects of ageing' (italics added), but the Minister for Work and Pensions, who argued that 'old age' had long been a major concern of the government and that it had already invested very heavily in the improvement of health and social care, as well as pensions. Citing a memorandum by one of the chief scientific advisers involved in the preparation of the report, Thomas Kirkwood, the Science and Technology Committee wrote:

> It is particularly disappointing that the Government seem to wish to 'pigeon-hole' ageing research, as if ageing were an isolated, discrete problem, and that research into ageing must necessarily compete with research into other areas. Thus the response reproduces the familiar mantra that 'given finite resources, there will always be a need to balance competing priorities for research'. As we sought to demonstrate in our Report—a point repeated by Professor Kirkwood in his written comments—ageing is a continuum, affecting all of us all the time. He also reiterates the point made in our Report, that generic research into the process of ageing, far from being in competition with research into specific conditions affecting older people, may be 'the most direct route to developing novel interventions and therapies'. There is no sign of such holistic thinking in the Government response. (House of Lords, 2006a)

The Science and Technology Committee's contrast between 'specific conditions affecting older people' and the notion that 'ageing is a continuum, affecting all of us all the time' was informed by Kirkwood's more specific observation that, 'there are scientific connections between birth, early years, childhood and adolescence that have major impacts on health and quality of life in middle and old age. These need much greater attention . . .' (House of Lords, 2006b). What might explain the Department of Work and Pensions' rejection of the House of Lords' recommendations may be that the department remains committed to the needs of a specific subset of the population, the chronologically aged and their distinctive social problems. If this surmise is correct, it indicates that there are significant obstacles to the biogerontological programme and that they stem from the coexistence of biopolitical and disciplinary modes of governance (Moreira and Palladino, 2005).

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