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Food, growth and time: Elsie Widdowson's and Robert McCance's research into prenatal and early postnatal growth

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ABSTRACT

Cambridge scientists Robert McCance and Elsie Widdowson are best known for their work on the British food tables and wartime food rations, but it is their research on prenatal and early postnatal growth that is today seen as a foundation of the fields studying the impact of environment upon prenatal development and, consequently, adult disease. In this essay I situate McCance's and Widdowson's 1940s human and 1950s experimental studies in the context of pre-war concerns with fetal growth and development, especially within biochemistry, physiology and agriculture; and the Second World War and post-war focus on the effects of undernutrition during pregnancy upon the fetus. I relate Widdowson's and McCance's research on the long-term effects of early undernutrition to the concern with recovery from early trauma so pertinent in post-war Europe and with sensitive (critical) periods, a concept of high importance across different fields. Finally I discuss how, following a hiatus in which fetal physiology engaged with different questions and stressed fetal autonomy, interest in the impact of environment upon prenatal growth and development revived towards the end of the twentieth century. The new field of "developmental origins of health and disease", I suggest, has provided a context in which Widdowson's and McCance's work has regained importance.

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1. Introduction: food, growth and time

"Crystals grow, and children grow, but they do not grow in the same way" wrote Robert McCance in 1974 (McCance & Widdowson, 1974, p. 1). Crystals, he continued, increased in size by the steady, uniform deposition of material identical with the first "seed" but children's growth was much more complex. It begins quickly from a single fertilized cell, but then slows down, to pick up and slow down again and again; growth in size is accompanied by change of form, dimensions and chemical composition; and the organism can be highly sensitive to environmental influences at some stages, while remaining surprisingly robust at others.

McCance's musings on the nature of growth came out of decades of experimental and clinical studies that took him from London and Cambridge, via post-war Germany, to colonial Uganda. These studies were conducted with his loyal collaborator Elsie Widdowson; together, they attempted to establish the relationship

between nutritional variations (of the mother and the offspring) and growth of the offspring, from the fetal period to adolescence. Widdowson and McCance's work influenced various disciplines, such as nutrition, physiology and neonatology and, more recently, has been claimed as foundations of the growing field of "developmental origins of health and disease", known under the abbreviation DOHaD (Barker, 2012; Gluckman & Hanson, 2006). Starting with historical epidemiological observations in the 1980s, this field has expanded to incorporate clinical, experimental and epigenetic studies of the ways in which environmental influences in early development shape adult susceptibility to chronic disease (Gluckman & Hanson, 2006; Smith, 1997). Food has come to stand as the prime example of such environmental influences (Landecker, 2011). Widdowson and McCance are therefore part of a rich narrative that continues to inform current science, policy and public views of early human development. But historians have hitherto had little to say about Widdowson's and McCance's work, or the topic of fetal growth more generally.

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Historical scholarship on science and medical practice concerning human development in the twentieth century is diverse and growing. Much of it—and I reference here only a small subset of the literature—has arisen out of concerns around the status of the fetus in society and medicine in the rapidly changing context of the women's rights movement, the rise of visual technologies and the increased medical control of pregnancy (Casper, 1998; Dubow, 2011; Duden, 1993; Franklin, 1991; Mulkey, 1997; Rapp, 2000). But the sciences of human development that are not directly concerned with reproductive technologies, such as teratology and fetal physiology, have not received as much attention.¹ Yet they must be taken into account when considering the changing view of the fetus in the twentieth century. The focus on maternal nutrition, the nutritive role of the placenta, and fetal and child growth tell us much about anxieties of the period stretching from the 1930s Depression to post-Second World War reconstruction and the concerns around population explosion in the developing world in the 1970s. The rise of physiological research topics such as fetal breathing movements, fetal endocrine control over the timing and initiation of birth as well as the emergence of “fetal medicine” (Casper 1998; Gluckman & Buklijas 2013) supports the argument that has been made for obstetrics (Arney, 1982; Nicolson & Fleming, 2013) that from the mid-twentieth century onwards the fetus came increasingly to be seen as an autonomous organism. Just a year before Lennart Nilsson published his iconic floating “spaceman” fetus images in *Life* magazine,² Robert McCance spoke of the fetus as a “weightless astronaut in utero” (McCance, 1964, p. 307). It is no coincidence that in the introduction to the 1969 proceedings of the prestigious Ciba Foundation Symposium series—bearing the title of *Fetal autonomy*—the then leading contemporary fetal physiologist wrote that “it (the fetus) demonstrates its innate capacity for influencing its external and maintaining its internal environment—that is, its autonomy” (Wolstenholme & O'Connor, 1969, p. 1).

The study of changes in the approach to fetal growth illuminates this conceptual shift. Driven by agricultural, clinical and public health interests, in the mid-twentieth century fetal growth was established as a research topic of high importance. In the 1940s, the old argument that the fetal parasite will extract whatever nutrients necessary from the maternal body, even if it means incurring maternal poor health, was replaced by the view that fetal growth and development is sensitive to its (nutritional) environment. Birth weight was long considered an indicator of gestational age rather than maternal nutritional or health status: for instance, physicians studying the effects of starvation in pregnancy upon the offspring took a birth weight under 2250 g as the sign of prematurity (Smith, 1947a). The intense preoccupation with food and nutrition during and immediately after World War Two transformed the understanding of low birth weight, which came to be seen as a sign of pathological pregnancy or malnutrition. Finally, by the end of the 1960s the focus of the field shifted to fetal factors of growth control, especially the role of hormones (Gluckman & Liggins, 1984). While the importance of nutrition was recognized, most of this new research focused on the role of fetal growth hormone, insulin and insulin growth factors. The two approaches, endocrine and nutritional, only came together towards the end of the twentieth century.

In this essay, after briefly discussing McCance's and Widdowson's careers in London and Cambridge, I focus on their clinical and experimental projects studying the impact of nutrition upon growth, first in post-war Germany, where most of their human studies of undernutrition took place, and then back in Cambridge, the site of their experimental animal studies. I am interested in

their gradual move from postnatal to early postnatal and gestational studies and the strengthening of ties with the community of fetal physiology and neonatology. Finally I discuss how and why, following the period in which fetal physiology moved away from nutrition to deal with different questions and emphasize fetal autonomy, Widdowson's and McCance's work came to be incorporated into the narrative of a new field, developmental origins of health and disease.

2. The careers of Robert McCance and Elsie Widdowson in prewar London and Cambridge

Following a stint as a Royal Naval Air Service pilot at the end of the First World War, the Irish-born Robert McCance (1898–1993) read natural sciences at Cambridge and then obtained a PhD in biochemistry under Frederick Gowland Hopkins (Ashwell, 1993, p. 19) (Fig. 1: Robert McCance). In 1926, he moved to King's College Hospital in London to complete his medical qualifications and supported himself by working in the Departments of Biochemistry and Diabetes. McCance drew on his biochemical expertise to study the carbohydrate composition of cooked fruit and vegetables and so improve the diet of patients suffering from diabetes. Successfully completed and well received, this project was followed by a study of the composition of cooked meat and fish for which McCance received a Medical Research Council (MRC) grant. It was in the King's College Hospital kitchens that McCance met Elsie Widdowson (1906–2000) and forged a partnership that would last for 60 years.

Widdowson had completed her BSc in biochemistry at Imperial College (Ashwell, 1993, pp. 31–35) (Fig. 2: Elsie Widdowson). Her first post involved analysing changes in the carbohydrate content of apples but when the grant ran out, she could not get a new position and so came to King's College to study for a diploma in dietetics. Her career move was fairly typical: food and nutrition were seen as female domains so not only were women, as homemakers and mothers, chief consumers of nutrition science knowledge, but also female university students of chemistry and biochemistry were directed towards careers in nutrition, especially dietetics and home economics (Apple, 1995). Indeed, prior to studying growth, possibly the best known of Widdowson's contributions were her individual dietary surveys in which participants weighed all the food they consumed over the period of one week. These surveys were conducted to prepare the British food tables or comprehensive tables showing the composition of foods used in the contemporary British nutrition (Widdowson, 1936a, 1936b).

Widdowson and McCance immediately discovered many shared interests. Their early nutritional studies were brought together in *The chemical composition of foods* (1940; four editions by late 1960s) but by the mid-1930s their work had moved from hospital kitchens into the clinic and from the content of foods towards examining the ways in which foods changed the biochemical makeup of the body. Projects included a study of the regulation of iron levels through absorption, and of the effect of salt deficiency in humans. The studies into salt deficiency led McCance to develop a long-term interest in renal metabolism, of which the best known project was the wartime “Survival at sea” that, among other things, showed that drinking sea water—previously thought a reasonable option in such circumstances—was dangerous in any amount. More relevant to this essay were the studies of newborn kidney function, most of which were conducted in the aftermath of the Second World War (Dean & McCance, 1947a, 1947b, 1949). The key question was why newborns, in spite of their apparently

¹ An exception is literature that brings together teratology with the issues of disability rights, abortion politics and reproductive rights. See, for example, Reagan (2010).

² See e.g. Tatjana Buklijas and Nick Hopwood, ‘The lonesome space traveller’, Making Visible Embryos [http://www.hps.cam.ac.uk/visibleembryos/s7_4.html].

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