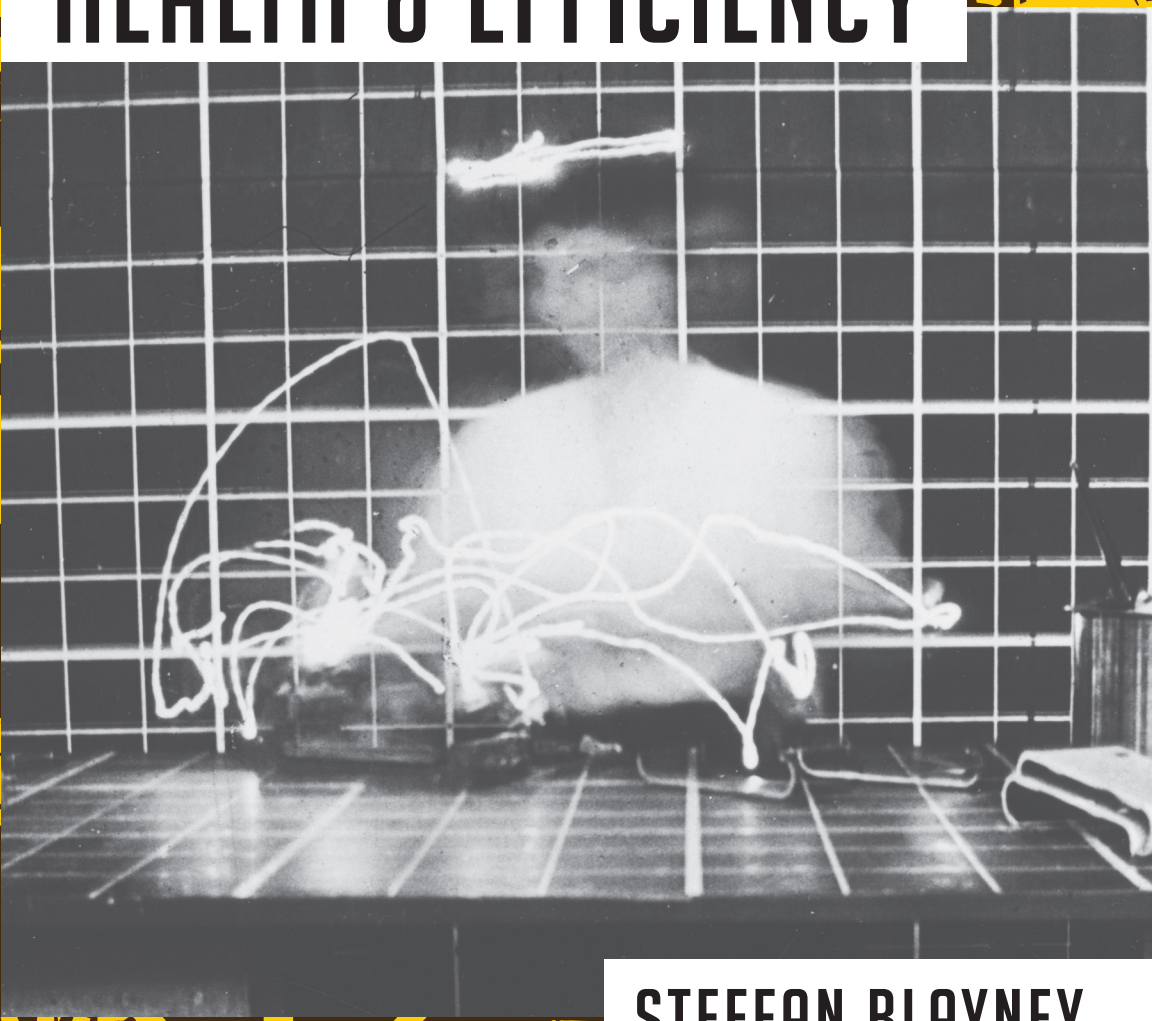
FATIGUE, THE SCIENCE OF WORK, AND THE MAKING OF THE WORKING-CLASS BODY

HEALTH & EFFICIENCY



STEFFAN BLAYNEY

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HEALTH & EFFICIENCY

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FATIGUE, THE SCIENCE OF WORK, AND THE MAKING OF THE WORKING-CLASS BODY

STEFFAN BLAYNEY

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HEALTH AND EFFICIENCY

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INTRODUCTION

Industry demands efficiency; efficiency demands health.
—E. L. Collis, "Health and Production"

The duty of us all is to make ourselves efficient and Healthy first.
—Bernard Bernard (editor of *Health & Efficiency* magazine),
The New Anatomy of Health (1921)

The years between 1870 and 1939 saw the emergence and consolidation of a new model of health in Britain, centered on the process of production and organized around the concept of efficiency. In the mid-nineteenth century, "efficiency" had been a word used chiefly by physicists and engineers, describing the ratio of useful work done to total energy expended by steam engines and other machines. Over the period in question, however, this narrowly mechanical term came increasingly to be applied both to political economy and to the human body, and especially to the relationship between the two. From the late nineteenth century onward, a new science of human labor advanced the proposition that the economic productivity of the nation could be maximized through physiological and psychological interventions aimed at the working population. At the core of this approach was the conviction, as a 1921 textbook of industrial medicine put it, that "the goal of the economist—output—can be best attained through the same agencies as allow the medical man to obtain his objective—health."[1] While articulated in most detail around the body of the industrial worker, the equation of health and efficiency promoted by the science of work would have wide-ranging consequences for medical and scientific understandings of the human body well beyond the context of the factory.

If efficiency was the ultimate goal of work science, its chief obstacle was the problem of fatigue: the declining capacity of the human body to perform continued physical or mental labor. While fatigue was barely

mentioned in scientific or medical textbooks before the 1860s, the last decades of the nineteenth century saw an extraordinary proliferation of attempts to define, describe, measure, and control it. New models of human physiology and psychology, drawing on developments in the physical sciences, conceived of body and mind as engines for transforming energy into work. Fatigue appeared as the corporeal manifestation of the second law of thermodynamics, expressing the inevitable waste associated with this process. With productive output increasingly understood to be the ultimate measure of health, fatigue in turn could emerge as the foremost pathology of industrial civilization.

In the first decades of the twentieth century, fatigue study entered the factory, and the science of work was born in earnest. Newly minted experts in *industrial physiology* and *industrial psychology*—sponsored by employers and the state—reimagined the working body in terms of its productive capacities and economic outputs, seeking to minimize *industrial fatigue* in the name of national efficiency.[2] At the same time, outside of the factory, workers—as consumers—were encouraged to see their bodies in the same terms and to dutifully participate in the optimization of their physical and mental capabilities through the purchase of energy-enhancing medical products and foodstuffs, through the adoption of "physical culture" regimes, and through various schemes and courses of popular psychology and "personal efficiency."

The science of work—and the cultures of health and efficiency that surrounded it—attempted to render the body measurable, governable, and intelligible. At its heart was a promise to produce docile and productive workers who could be fitted into the mechanism of industrial production. The threat of workers' resistance was a constant concern for work scientists, as it was for capital. Ordinary men and women found ways to resist the logics of productivity and efficiency imposed on them and to articulate alternative perspectives on work, health, and the body. For many, the physical and mental effects of work—and the embodied and emotional responses to its rationalization—formed the basis of an oppositional consciousness, which expressed itself in acts of rebellion, sabotage, or political organization. Whereas for some the working-class body was an object of control, for others it was a site of resistance.

FATIGUE, EFFICIENCY, AND HEALTH

In what is still the key text on the European "science of work" as it emerged in the late nineteenth century, the historian Anson Rabinbach described how revolutions in science and industry in mid-nineteenth-century Europe ushered in a new image of the body that brought the problem of fatigue to the center of debates about modernity and progress.[3] The twin industrial and scientific revolutions of the mid-nineteenth century—characterized respectively by the advent of the modern motor and the articulation of the laws of thermodynamics—allowed the development of a new cosmology based on the conservation and transformation of energy.[4] The metaphor of the "human motor" collapsed distinctions between the biological and the mechanical. Increasingly, it was possible to see the "human body and the industrial machine" as "both motors that converted energy into mechanical work," while fatigue—the inbuilt resistance of the human motor to continued work—emerged as "the permanent nemesis of an industrializing Europe."[5] Human labor was transformed into an object of scientific study, as an "international avant-garde of fatigue-experts, laboratory specialists, and social hygienists" sought to determine objective "laws" of energy and fatigue. Scientists and social reformers alike were motivated by the utopian goal of the "body without fatigue" and with it the elimination of the material and symbolic limits on efficiency, productivity, and social progress.[6]

While Rabinbach's account includes detailed discussions of developments in continental Europe (as well as the United States), its coverage of the British science of work is limited to a single paragraph in its final chapter, with only a brief description of late-Victorian medical anxieties concerning fatigue appearing in a separate essay.[7] While there had been "little development of a science of work" in Britain before 1914, Rabinbach states, by the end of the First World War the country had become "a leader in the development of industrial psychology and physiology in Europe."[8] Despite this acknowledgment, however, in the three decades since Rabinbach's book, there has been little study of the British contribution to the science of the working body. In recent

historiography, fatigue has received less interest that the later category of stress, which emerged as the dominant pathology of working life, and perhaps of society more broadly, in the decades following the Second World War and continues to structure understandings of health, work, and the body today.[9] While historians have shown how medical discussions of stress, much like earlier discussions of fatigue, have reflected a wide range of anxieties about the strain placed on the individual under the conditions of modern civilization, and in particular with the pressures of work, less attention has been paid to the period in which pressures first became a serious object of scientific study.[10]

Developing from the end of the nineteenth century, British work science came to prominence during the First World War, with the appointment of the Health of Munition Workers Committee (HMWC) by the British government, aimed at reducing fatigue and increasing efficiency in armaments factories. In the interwar period, the HMWC was superseded by the Industrial Fatigue Research Board (IFRB), which became the Industrial Health Research Board (IHRB) in 1928. These government institutions were joined in the interwar period by the private National Institute of Industrial Psychology (NIIP), established in 1921 by the psychologist Charles Samuel Myers, which conducted scientific investigations on behalf of businesses. While accounts of European work science have tended to focus on the ideas of a series of prominent scientists and researchers, in Britain the vast majority of research was carried out by these more anonymous and obscure institutions. In theoretical terms, while European work science continued to rely heavily on the mechanistic models of human physiology, British scientists, at least by the 1920s, characterized themselves as laying a greater emphasis on what became known as the *human factor* in work—a holistic approach to the study of industrial processes that encompassed not only the physical effort of labor but considerations of working environment, diet, and the psychological and emotional life of the worker as well.

For some historians, such an approach has been taken as evidence of a growing concern with the well-being of the working population, which can be situated within a broader contemporary health movement. In the interwar period, the medical historian Vicky Long argues, the factory emerged for the first time as a "site of health production" as well as a "site of economic production." Underpinning this movement

was the "belief that the efficiency of the industrial machine was directly related to the physical and mental health and efficiency of the individual worker." Employers and government became convinced that due care and attention to the health of the workforce would increase industrial output: that by creating healthy workers, they would create productive workers. What accounts like this miss, however, is the extent to which these interventions—rather than simply promoting and extending health to the working population—were reshaping conceptions of *health* itself according to the demands of industry. If institutions like the Health of Munition Workers Committee began promoting a "broadly conceived model of health which embraced physical and mental well-being in all spheres of life," the corollary of this was that all spheres of life were to be brought within the scope of the science of work.[11] Individual well-being was increasingly inseparable from industrial output. For the science of work, health and efficiency were not merely complementary: increasingly, they were taken to be identical. In this context, any suggestion that greater efficiency could be won *at the expense* of workers' health would come be seen as a contradiction in terms.

PRODUCTIVE BODIES

In its equation of health and efficiency, I argue, the British science of work, and the cultures of efficiency that developed around it, are best understood as technologies of what François Guéry and Didier Deleule have called the "productive body."[12] While their vocabulary was biological and medical, the new specialisms of "industrial physiology" and "industrial psychology" that emerged between the end of the nineteenth century and the start of the Second World War began to conceive of the human body primarily in terms of its economic attributes. The worker's physical capabilities were reduced to productive capacities. The individual body of the worker was important only inasmuch as it represented, in microcosm and as constituent part, the productive powers of the working population as a whole. In this context, fatigue—the body's resistance to productive work—emerged as the chief obstacle to the continued generation and expansion of surplus value.

First published in French as *Le corps productif* in 1972, but only appearing in a complete English translation for the first time in 2014,

Guéry and Deleule's *Productive Body* is concerned with the ways in which the "biological body" becomes "incorporated" into a "social body" through successive stages of capitalist development and the role played by scientific and managerial knowledge in mediating and reproducing these arrangements. Building on Karl Marx's idea of the "collective worker," the organic entity created through the division and specialization of labor and through cooperation in manufacturing, Guéry and Deleule's "social body" represents the historical "interweaving of body and society" that emerges from the organization of production. The "productive body" in this schema is the socialization of the body that becomes hegemonic with the development of industrial capitalism. It is, as Justin Edwards has put it, "a body that is regulated and re-engineered within an economic system based on consuming and consumption, supply and demand, labor and discipline": a social body that is organized for the production of profit.[13]

For Guéry and Deleule, following Marx, "productivity" refers not simply to the capacity for creative labor or the production of goods but specifically to the production of surplus value for a capitalist employer in exchange for a wage. Since, in Marx's terms, the rate of surplus value is equivalent to the rate of exploitation—the greater the value produced by the worker, the less they receive as a proportion in wages—the more productive a worker becomes, the more they are exploited. To be a "productive worker," as Marx concludes, "is therefore not a piece of luck, but a misfortune." Under capitalism, Guéry and Deleule argue, "there is a tendency . . . toward the conversion of human material into productive-form." With the rise of modern industry, as work is reorganized in order to obtain the maximum possible surplus, individual bodies are in turn reorganized according to their economic potentials and integrated "within the productive body as elements of production." The result is "a representation of living beings in which work's production is constitutive of the perceived being," such that the human body appears as a "pure work machine."[14]

The making of the productive body, as Philip Barnard and Stephen Shapiro explain in the introduction to their English translation of Guéry and Deleule's book, is made possible by "squeezing out the awareness of the social nature of work, the social body, in favor of a sense of an individualized 'biological body,'" which is in turn reimagined as

analogous to the machine.[15] Medical and scientific discourses play a crucial role in this process, as the increasingly sophisticated techniques developed by the human sciences for understanding, measuring, and categorizing individuals make possible the adaptation of "the living machine to the dead one": "to make the living machine function like a dead machine—without problems, without qualms, and above all without wasting time—to transform the living machine entirely into efficacious motion."[16] In the sphere of consumption, the worker is addressed not as part of a social body but as a private individual. The marketplace fosters individualism and competition rather than collective solidarity. This has the double effect of militating against resistance to capitalist exploitation, while at the same time fostering an ethic conducive to increased productivity. The worker is encouraged to consume productively: to enhance their own capacity, and therefore their earning power.

THE SCIENTIST AND THE ENGINEER

A distinction needs to be made between what I am calling here the *science of work* and the various forms of *scientific management* that emerged in the same period, associated with the organizational theories of Frederick Winslow Taylor (1856–1915). While less influential in Britain than elsewhere, from the late nineteenth century a small number of British firms were beginning to adopt elements of Taylor-inspired scientific management systems, the most popular being the "Bedaux system" designed by the French engineer Charles Eugene Bedaux (1886–1944). In 1937 the Bedaux Company listed 225 British clients, including a number of industry-leading employers.[17] By 1945 this number had doubled, in addition to the increasing number of firms implementing the systems of one or another of Bedaux's competitors.[18]

Like the work scientists discussed in this book, the purveyors of these systems claimed to apply scientific principles to the organization of labor. Central to the philosophy laid out in Taylor's 1911 *Principles of Scientific Management,* and later adapted by Bedaux and others, was the "separation of conception from execution."[19] In the ideal of the scientifically managed factory, the planning and organization of the labor process would be removed from the shop floor, becoming instead

the responsibility of the expert "efficiency engineer." Where previously workers' accumulated skills and knowledge would allow them greater control over the work process (and, in Taylor's view, more leeway to "soldier," or restrict production), now knowledge would be stripped from workers and concentrated in the hands of management. Each step of production—down to the individual physical movements of the working body—could be rigorously and systematically controlled and preplanned.

Scientific management in practice—as it was experienced by workers in the early twentieth century—consisted of three main processes: job analysis (the subdivision of a task into its discrete constituent parts), work measurement (for example, through time and motion studies), and wage-incentive systems (such as the premium bonus).[20] In each of these areas, the science of work straightforwardly borrowed—or adapted—the techniques of the Taylorist "efficiency engineer" and with broadly the same ends: to increase the control of management and to maximize output and productivity. For a number of reasons, however, the science of work was always keen to distance itself from scientific management, carving out instead its own particular sphere of authority and expertise.

Whereas the purveyors of scientific management systems most often came from engineering or commercial backgrounds—in some cases working their way up from the factory floor—representatives of the science of work were generally (though not exclusively) qualified in medicine, physiology, or psychology. Many held university posts. As a result, while the "scientific" credentials of the efficiency engineers were always vulnerable to attack, those of work scientists (if often marginal within the wider scientific community) were comparatively secure. Whereas scientific management was predominantly the domain of the entrepreneur, the institutions of the science of work were in general nonprofit enterprises. Crucially, the science of work always framed its objective as the improvement and promotion of *health* and justified its work on these grounds. Where the efficiency engineer was concerned only with "speeding up" work, no matter the physical and mental cost, work scientists argued, only their *truly* scientific approach to work would safeguard the physical and mental welfare of the worker, with increased productivity a happy coincidence. While historians have

tended to use Taylor as a benchmark against which to evaluate other forms of labor rationalization—thus reducing the science of work to a derivative species or "school" of scientific management—the science of work embodied by industrial physiology and industrial psychology, I will argue, had a status and an influence in Britain that often reached far beyond the ambitions of scientific management in articulating a model of the body and of health in relation to work.[21]

While the efficiency engineer was consistently viewed as being on the side of management and against labor, or denigrated as a charlatan or profiteer, the claims of the work scientist were sanctified by the supposedly objective and impartial character of scientific research. With the increased involvement of the British government in sponsoring and directing industrial research over the period in question, the legitimacy of the state was added to the authority of science. As such, even when they were saying the same things, the pronouncements of work scientists carried more weight than those of efficiency engineers. What is more, given the institutional positions held by its proponents, the concepts and the conclusions of work science could be readily assimilated into mainstream scientific knowledge. Particularly in the case of psychology, the development of the academic discipline—its conceptual frameworks and models of human nature—was inseparable from its practical uses as a means to increase labor productivity. While more people might have worked in a Bedaux-engineered factory than one reorganized by the National Institute of Industrial Psychology or the Industrial Health Research Board then, the long-term effect of the science of work—its influence on understandings of health and the body—is arguably more significant. If Taylorism, as Harry Braverman has claimed, was "nothing less than the explicit verbalization of the capitalist mode of production," then the science of work represented its scientific legitimation.[22] Where scientific management sought to strip knowledge of the labor process from workers, making it instead the property of management, the science of work added a further dispossession, whereby legitimate knowledge of the working-class body—including definitions of health and well-being—was taken from the worker and placed exclusively into the hands of the scientific expert. Through industrial physiology and psychology, the human body was remade according to the demands of capital.

UNHEALTHY CRITIQUE

At the core of this book is an argument that the ways in which we view our bodies, and the norms (social, cultural, scientific) by which we judge health, are inherently political. Health, as Jonathan Metzl has argued, "is a term replete with value judgements, hierarchies, and blind assumptions that speak as much about power and privilege as they do about well-being." Health, as such, should be seen as "a condition of ideology as well as longevity."[23] While histories of health care, welfare, and public health provision have traditionally regarded health as a neutral or fixed concept, it is a central aim of this book to destabilize these assumptions.[24] In evaluating the science of work, I argue, the important question is not whether it made workers more or less healthy, but how it remade the concept of health itself.[25]

As such, I situate *Health and Efficiency* within a body of work that seeks to emphasize not only the social and economic determinants of health *outcomes* but the genealogy of health itself as a historical and political formation, fundamentally influenced by forces external to medicine.[26] By showing how twentieth-century concepts of physical and mental health have been shaped by the demands of work and capitalist ideology, my aim is to question fixed understandings of health in the present day and to challenge the authority of both scientific and commercialized understandings of well-being. As Anna Kirkland argues in her conclusion to a collection of essays titled *Against Health,* "The way one thinks about something like health really makes a difference to what it is and what it becomes."[27] By placing the scientific texts of the science of work alongside popular cultural sources and the writings of workers themselves, I aim to decenter the authority of science and medicine as guarantors of value-free expertise about work and the body and to open up new avenues for thinking about health outside of the confines of an individualized and commodified capitalist economic rationality.

OUTLINE

While the industrial health doctrines of work science were not fully articulated in Britain until the early years of the twentieth century, and

had little institutional basis before the First World War, they were made possible by developments in the final decades of the nineteenth century. Chapter 1 describes how developments in the physical sciences in the mid-nineteenth century transformed thinking about human biology. As the laws of thermodynamics were applied to the mechanics of the body, fatigue appeared as the inevitable dissipation accompanying the conversion of energy into work. Medical and lay commentators became convinced that the energies of the British population were being depleted, and new disease entities—chief among them neurasthenia—multiplied to describe the exhausting effects of modernity. In research laboratories, physiologists and psychologists sought to determine the scientific laws governing the human machine, seeking to find ways to describe, measure, and control fatigue as an objective and quantifiable phenomenon.

The first decades of the twentieth century saw the results of this experimental work applied directly in an industrial context. Following the movement of fatigue research from the laboratory to the factory, chapters 2 and 3 focus respectively on "industrial physiology" and "industrial psychology." These new sciences—given shape in the First World War and interwar period through government- and employer-sponsored research institutions—were articulated as sciences of the "productive body," promising to boost national efficiency and maximize Britain's competitiveness on the world stage. From an initially narrow focus on muscular fatigue, the science of the work progressively extended its horizons to articulate an increasingly expansive understanding of industrial health, bringing ever-greater spheres of working-class life within the scope of its expertise.

Chapter 4 moves from the sphere of production to that of consumption, looking at the ways in which the ideals of productivity were commodified and sold back to the working population. In Britain, from the late nineteenth century onward, an increasing number of products were marketed and sold to the working-class consumers on the basis of their purported ability to reduce fatigue, secure health, and promote efficiency. An expanded market in medical commodities and processed foodstuffs tapped into anxieties about overwork and fatigue and promoted an individualized model of the body as an object of improvement and optimization. At the same time, commodified cultures of bodily exercise ("physical culture") and popular psychology ("personal

efficiency") encouraged physical and mental enhancement as a means by which to secure a competitive advantage in the workplace. Through these means, working-class consumers were provided with a repertoire of "technologies of the self" through which to remake themselves in the image of the productive body.[28] While some manufacturers and advertisers drew explicitly on the ideas or results of the science of work, others participated in a looser exchange of language and concepts. Alongside the scientific discourses of industrial physiology and psychology, these commercial and popular forms helped to consolidate a hegemonic view of the body as an individualized, productive unit, in which health and efficiency were equated.

Chapter 5, finally, focuses on the ways in which productivist ideologies of health and efficiency were experienced, contested, and resisted at the level of the worker and the working body, complementing a story of discipline and control with one of agency and opposition. It attempts to uncover a workers perspective on work science in the writings of work scientists, in trade-union archives, and through the autobiographical writing of working-class men and women. Drawing on critical theories of affect, it explores how workers' emotional and embodied responses to the pressures of work—and to the scientific rationalization of the body—were translated, in some cases, into conscious political opposition and to the articulation of alternative models of health and efficiency. While the science of work endeavored to impose totalizing logics of productivity and efficiency on the working body, the workers discussed in this final chapter demonstrate that its effects were never comprehensive. Today, as a number of critics argue that "capitalist economic rationality has left the factory and offices to become the template for all facets of society," such that "the real fault-line today is not between capital and labor [but] between *capital and life,*" a historical analysis of the ways in which bodies have been made productive, and the ways in which this has been resisted, is of crucial importance.[29]

CHAPTER 1

THE DISCOVERY OF FATIGUE

In the second half of the nineteenth century, fatigue was discovered by medical science. While physical and mental fatigue was virtually absent from the pages of medical or scientific journals and textbooks before the late 1860s, the last three decades of the nineteenth century saw a proliferation of attempts to define, describe, measure, and control it. At the same time, the question of the limits to the body's powers of action was widely discussed by a range of commentators as one of the key problems of the modern age. Rarely a subject of discussion in the first half of the nineteenth century, by the time of its conclusion, contemporaries were certain that they lived in an "age of fatigue," with medical professionals concerned that their era would be remembered by posterity as "the Tired Age."[1]

The discourse on fatigue expressed a variety of concerns about modernity and its limits and about social, political, and cultural decline.[2] It did so in a language that drew on a range of scientific and cultural tropes. Crucially, it relied on a new scientific understanding of the material world and of the body, based around the concepts of *energy* and *work*. This new paradigm, inaugurated by the "discovery" of the laws of thermodynamics, was influential across Europe in the second half of the nineteenth century. At its center was the metaphor of the "human motor": the notion that the body operated in the same way as a thermodynamic engine, converting nature's "energies" into productive "work." In this context, older moral proscriptions against sloth and idleness were superseded by materialist concerns about the limits to bodily efficiency. Fatigue—understood as the body's inbuilt resistance to work—emerged as the chief obstacle to human productivity and social progress, "the endemic disorder of industrial society," coming to embody a vast range of anxieties about social, economic, political, and cultural decline.[3]

The canonical account of these developments, in Anson Rabinbach's *The Human Motor,* barely mentions developments in Britain. Yet for a number of British scientific writers and cultural commentators in the late nineteenth century, energy and fatigue were central preoccupations. Perhaps more in Britain than elsewhere, the exploration of the limits to the body's productivity proved particularly compelling. Particularly after 1870—with Britain's long-held status as the single global dominant economic power increasingly threatened by the rise of international competitors such as Germany and the United States—bodily exhaustion became a focus for a wide range of concerns about economic and political decline, cultural stagnation, and the pressures of modernity.[4] Fatigue took its place alongside those other familiar fin de siècle signifiers—decline, degeneration, and decadence—gaining currency at the turn of the century. For a nation with so much of its self-image tied up with the ideal of progress, fatigue was a particularly disturbing symptom of modernity.

Across a range of texts, metaphors of fatigue were used to signify political decline, social regression, and cultural deterioration. In 1871 the editor of *Fraser's Magazine* painted a picture of a nation overcome by "lethargy," the political and racial "vigor" of its people teetering on the brink of "exhaustion."[5] By the end of the century, one politician lamented, Britain had become a "Weary Titan," overburdened by its vast empire and struggling to match the energy and dynamism of its international rivals.[6] For the literary critic John Addington Symonds, late-nineteenth-century British culture was pervaded by a "world-fatigue," which had "penetrated deep into our spirit," while the satirist H. D. Traill personified the nineteenth century itself as a tired old man lying on his deathbed, his hundred-year life coming to an end in "an age of exhaustion and delusion, and failure, and emptiness, and weariness."[7]

Medical writers were likewise concerned that the British population was "drooping with the century."[8] New medical labels, such as neurasthenia, emerged to describe the exhausting effects of modern life on body and mind. The "working powers of the community at large," it was argued, were undergoing depletion as a result of the vast and rapid social and technological changes that had characterized the nineteenth century.[9] The spread of industrialization, urbanization, education, and new technologies such as the railway and the telegraph had increased

the pace and intensity of modern life to such a degree that the body was unable to muster the energy to withstand its constant pressures and demands.

While it is possible to emphasize the pessimistic overtones of these writers, the status of fatigue in medical discourse—and its relationship to modernity in particular—was always ambiguous.[10] While the specter of exhaustion produced anxieties about the detrimental consequences of civilization, the limits to progress, and the inevitability of degeneration, scientific investigation of the body's energies at the same time held out the hope of revitalized and reinvigorated bodies, increased productivity, and social efficiency. By discovering the objective scientific laws of fatigue, it was hoped, the limits on the productive powers of the body could be extended or overcome.

Notions of energy and fatigue were shaped at the intersection of various nineteenth-century discourses, from physics and chemistry, to biology and medicine, to philosophy and literature. No simple straight line of influence can be drawn, say, from William Thomson's writings on thermodynamics to the philosophy of Herbert Spencer to medical writing on neurasthenia. Ideas from a variety of discursive arenas were adopted, modified, and reincorporated in a continual and reciprocal process, in which "not only *ideas* but metaphors, myths and narrative patterns could move rapidly and freely between scientists and non-scientists."[11] The "discovery" of fatigue should be understood in these terms: not simply as the consequence of certain scientific ideas or empirical findings, nor as an isolated cultural phenomenon, but as the result of a complex exchange of ideas and concepts.

This chapter traces the emergence of fatigue in British scientific and medical discourse through some of these exchanges. It starts with an examination of how the concepts of energy, work, and fatigue emerged in the mid-nineteenth-century scientific vocabulary, looking at the way the laws of thermodynamics were articulated and applied to the body. It then turns to explore how these concepts were developed and refined in debates about "overwork" in the 1870s and 1880s, tracing the emergence of new medical categories through which the relations between modernity and the body were understood. This was a deeply ambivalent discourse, in which fatigue sat uneasily between notions of, on the one hand, civilization and progress and, on the other, decline and

degeneration. The final two sections of the chapter look at attempts to submit physical and mental fatigue to measurement and quantification, to define its scientific laws, and to bring it under scientific control.

ENERGY, WORK, AND WASTE

In broad terms, the two faces of the late-nineteenth-century discourse on fatigue can be mapped onto the first and second laws of thermodynamics, which in turn formed the basis of a new scientific understanding of the human body in the second half of the nineteenth century. The first law—originally theorized by Hermann von Helmholtz in 1847 and variously developed and elaborated by a number of physicists from the mid-nineteenth century onward—asserted that all of the different physical forces observable in the universe were in fact manifestations of a single and universal "force" or "*energy*." This energy could be neither created nor destroyed but was capable of infinite interconversion into its different forms.

As the physicist James Clerk Maxwell—an early champion of Helmholtz's ideas in Britain—explained, the principle of the conservation of energy enabled a radical unification of scientific inquiry in areas hitherto assumed to be unconnected: "It gives us a scheme by which we may arrange the facts of any physical science as instances of the transformation of energy from one form to another. It also indicates that in study of any new phenomenon our first enquiry must be, How can this phenomenon be explained as a transformation of energy? What is the original form of the energy? What is its final form? and What are the conditions of the transformation?"[12] The first law seemed to answer a long-held philosophical desire for a single unifying principle behind the material universe.[13] The conservation of energy, as the physicists William Thomson and P. G. Tait wrote, was "the ONE GREAT LAW of physical science."[14] All physical phenomena could be reduced to energy.[15]

The study of thermodynamics had its origins in the Industrial Revolution of the late eighteenth century, where the steam engine symbolized the productive possibilities of the science of energy.[16] The central problematic for the engineers and scientists at the birth of thermodynamics was the efficient conversion of nature's reserves of

energy into "mechanical effect," or useful "work." In this context, the concept of *work* took on a new, universal, signification.[17] Work as a physical quantity and work as a category of political economy were elided, serving simultaneously to naturalize industry and to industrialize nature.[18] In the universe of thermodynamics, the "cosmos was essentially a system of production whose product was the universal [energy] necessary to power the engines of nature and society, a vast and protean reservoir of labor power awaiting its conversion to work."[19] In the words of one Victorian writer, "Work is . . . the only motive power that keeps not only men, but the solar system, and all the countless orbs of the boundless universe which God has made in a condition of healthy and progressive perpetuity."[20]

The concept of energy as the single unifying principle animating the material universe challenged distinctions between organic and inorganic nature, the human body, and the rest of the physical world. In a series of lectures delivered at the Royal Institution in 1862, the physicist John Tyndall explained that the implication of the first law of thermodynamics was that the forces behind "animal power" were "the same, in kind, as those which operate in organic nature."[21] The concept of "Life" itself, the chemist H. A. Huntley went so far as to suggest, should, "scientifically speaking," be referred to under the term "Thermo Dynamical Phenomena."[22] If some dissenters lamented the fact that "Biology and Physiology are in fact now taught by men who ought to be teaching us physics," increasingly from the 1860s writers in the life sciences could not avoid speaking in the vocabulary of physicists.[23] Increasingly, physicians and physiologists began their inquiries with Maxwell's fundamental question: "How can this phenomenon be explained as a transformation of energy?"

Applied to the human body, an article in the *British Medical Journal* enthused in 1870, the "law of the conservation of energy" was of "immense importance in its bearing on the subject of physiology." It was now possible to understand the "vital energy" of animals and human beings to be "merely a form of physical energy, and convertible with it."[24] For the biologist Thomas Huxley, writing in 1874, "The idea that the physical processes of life are capable of being explained in the same way as other physical phenomena" was no less than "the expressed or implied fundamental proposition of the whole doctrine

of scientific Physiology."[25] From the principle of the conservation of energy it followed that "the total quantity of work of which a healthy man was capable . . . [was] constant, no matter in what description of labor he was employed."[26] The human body could be seen—like the productive machines of the Victorian factory—as simply another arena for the conversion of an abstract and universal labor-power into useful "work." Medical textbooks envisioned the human body as a "physical machine": an "engine furnace . . . convert[ing] energy into work."[27]

However, the reassuring picture of a constant supply of universal energy ripe for conversion into useful "work" offered by the first law of thermodynamics was almost immediately undercut by the arrival of the second. As Thomson explained in 1851, in any transfer of energy from a warm body to a cold one, only a small fraction of the heat generated could actually be harnessed for useful "work," with "the remainder being irrecoverably lost to man."[28] In 1865 the German physicist Rudolf Clausius coined the term "entropy" to describe the result of this irreversible loss of energy that accompanied any real-life process of energy conversion.[29] Followed to its conclusion, the second law implied "a universal tendency to the dissipation of mechanical energy": the universe was gradually tending toward an equilibrium point at which human life, let alone useful work, would, "within a finite amount of time," be impossible.[30] In the fin de siècle imagination, the image of a universe slowly, but inexorably, running out of energy both reinforced and further fueled contemporary notions of decline and cultural pessimism. If the principle of the conservation of energy opened a space for utopian dreams of a society engineered so as to best exploit the infinite productive potentials of nature, the notion of entropy brought shadows of "deterioration, decay, and dissolution."[31]

The upshot of the second law was that "all work implies waste" and, further, that "the work of life" was no exception.[32] From the very beginning, discussion of "energy" in British medical and scientific discourse was characterized by a preoccupation with its dissipation. Rather than being a boundless productive resource, "the energy of a human body" was "a definite and not inexhaustible quantity."[33] It was in this context that fatigue—the body's inbuilt "resistance to effort" or "to the conversion of latent energy into active motion"—emerged as a distinct phenomenon and object of concern.[34] If degeneration, in the words of

Stephen G. Brush, was the "cultural counterpart of the second law of thermodynamics," then fatigue appeared as its bodily expression.[35]

From the end of the 1860s, both lay and medical writers began to voice concerns that the energies of the population were being depleted as a result of the vast and rapid social and technological changes that had characterized the nineteenth century. An epidemic of exhaustion, it was argued, was the price to be paid for the advance of civilization. "Living, as we do, in age of progress and intellectual competition," one doctor wrote, "there is little cause for wonder, that, of the thousand who join the ranks of those engaged in emulation and strife, some portion of that number should fall out disabled."[36] Increasingly, commentators complained that the modern age demanded "more strenuous and exhausting toil" and "a greater strain upon both bodily and mental powers" than at any previous point in history.[37] As one physician speculated, "If one of our ancestors but of 100 years ago were suddenly resuscitated and made to undergo the toil and mental labor of our days, he could not endure it."[38]

In the mid-1870s, the question of "overwork" became a locus for medical negotiations of energy and fatigue, the body and modernity. An 1874 article in the *Contemporary Review* argued that the late nineteenth century was characterized by "life at high pressure," with the "severity of exertion" and "incessant strain" demanded by modern industrial and commercial life leaving large numbers "shattered, paralyzed, reduced to premature inaction or senility."[39] From 1875 a series of articles and letters in the *Lancet* and the *Journal of Mental Science* debated the extent to which "society at large is really suffering from an amount of work, physical and mental, which is injurious to the individual, and therefore to the human race."[40] Doctors mobilized the language of the physical sciences to argue that the natural "energies" and "nervous power" of patients were being depleted through overuse.[41]

While fatigue had rarely before been considered a medical issue, now it was increasingly associated with pain, disease, or even death. For the esteemed surgeon Sir James Paget, writing in 1871, fatigue had "a larger share in the promotion or permission of disease than any other single causal condition you can name."[42] By 1875 the physician George Poore was able to elevate fatigue from a predisposing factor in illness to a medical condition in its own right, further subdivided into its "general" and

"local," "acute" and "chronic" forms.[43] Increasingly, distinctions were drawn between normal and pathological states of fatigue, or "between fatigue and over-fatigue."[44] By the early twentieth century the "pathology of fatigue" was supplemented by a proliferation of related conditions, from "fatigue dyspepsia" to "exhaustion psychosis."[45]

Perhaps the most noteworthy form of pathological exhaustion to emerge in the late nineteenth century—certainly the one to attract most attention from historians—was neurasthenia.[46] Introduced into the medical vocabulary by the American physician George Miller Beard in 1869, the diagnosis gained widespread currency internationally from the late 1870s.[47] Translated by Beard as "nervous exhaustion," neurasthenia referred to a syndrome consisting of a wide range of symptoms but defined most prominently and consistently by chronic fatigue. Characterized as a specifically modern (and, for Beard, specifically American) disorder, neurasthenia is arguably the archetypal "disease of modern civilization."[48] In a notorious passage in his 1883 book *American Nervousness,* Beard attributed responsibility for an increase in nervous debility in the United States to a "modern civilization" characterized by "steam power, the periodical press, the telegraph, the sciences, and the mental activity of women."[49] While the diagnosis was never as popular in Britain as elsewhere (notably in the United States, France, and Germany), a steady flow of publications on the subject began to emerge from the 1880s onward, and neurasthenia, often in combination with earlier concepts of "nervous exhaustion," became an increasingly common framework for interpreting the problems of life at high pressure.

Like fatigue from overwork, neurasthenia was interpreted as a special case of the second law of thermodynamics. Its explanation in terms of the dissipation of "nervous energy" was ubiquitous. "It is a general principle in physics that energy in performing work is expended and finally exhausted," wrote Thomas Stretch Dowse, one of the first British physicians to adopt the diagnosis. For Dowse, biologists and physicians could "account for the exhaustion of nervous energy in very much the same way as the physicist." Neurasthenia was a pathology of energy conservation. In the healthy individual, fatigue was the "natural consequence of some accomplished muscular or mental work," after which "the store of our latent forces" could be "readily and easily

replenished." For the neurasthenic, however, "fatigue means that such a demand has been made upon the already inefficient reserve forces that they cannot be well repaired, and nervous exhaustion is thus increased."[50] Or, as another expert on neurasthenia put it, "instead of fatigue the result is exhaustion."[51] While a certain amount of fatigue was the natural consequence of normal work, continued overexertion put body and mind at risk of severe, or even permanent, debility. Behind every discussion of fatigue lay the dark entropic specter of "total collapse" or "irrecoverable degeneration."[52]

TIREDNESS AND CIVILIZATION

While some discussions of pathological exhaustion emphasized the dangers of pushing the body beyond its physiological limits, for some medical writers, the idea of fatigue as a naturally set limit on working capacity seemed to provide the key to a healthy accommodation between the body and modern civilization. As the frenetic pace of late-Victorian society placed increasing demands on bodies and minds, these writers argued, fatigue acted as a kind of biological safety mechanism, alerting the subject to the dangers of overexertion and preventing any permanent damage to the body's tissues. Fatigue was a "warning illness," ignored at one's peril.[53] The authority of nature was placed in opposition to the pressures of modernity: in contrast to a "primitive life" in which humans lived in harmony with nature and with their bodies, the demands of modern life were "opposed to all biological laws."[54] It was the task of the physician "to see that Nature is not thwarted."[55]

Similar appeals to nature—and further claims of fatigue's beneficial qualities—can be found in medical and physiological discussions of the body's inbuilt "rhythms," which were supposed to govern both voluntary movements and automatic biological functions. Like the idea of a single motive force behind the material universe, the unifying concept of natural rhythms, with its implication of universal balance, had a preexisting philosophical pedigree. For the philosopher Herbert Spencer, writing in 1862, rhythm was a law of nature: "a necessary characteristic of all motion" uniting phenomena as diverse as the movement of the tides and the vibrations of a violin string. Perhaps nowhere, though, Spencer speculated, were "the illustrations of rhythm so numerous

and so manifest as among the phenomena of life."[56] The beating of the heart, the rhythms of digestion, and the breathing cycle were all undeniable evidence of the body's innate periodicities.

For medical writers in the second half of the nineteenth century, the concept of rhythm was key to understanding how the body conserved its energies. Periods of action, in which work was done, alternated with periods of rest, during which nutrition could take place and the body's energies be restored. "Every living structure," as one author claimed, "passes through alternating conditions of repose and activity: when active, the tissue is consumed; when at rest, the tissue is nourished, and the waste repaired."[57] Rest, it followed, was not truly inaction but an active process of "re-creation."[58] In this context, fatigue was seen to play a crucial role in regulating the body's rhythms of work and rest. In a state of nature, the physical and mental sensations of weariness had the protective function of compelling rest at regular intervals and so preventing the body's rhythms from becoming dangerously syncopated.

Here again, the problem of fatigue was understood less as the inevitable consequence of modern progress than as a failure of adaptation.[59] Biological and social rhythms had fallen out of step. The natural synchronization of human beings with their environment had been disrupted. The unnatural rhythms of economic and industrial life, of motors and machines, had not been designed with the natural tempos of body or society in mind, and fatigue was the price paid by bodies—both individually and socially. As George Poore explained in his article on the subject, "Fatigue occurs directly we attempt to alter the rhythm of our vital vibrations," while the key to health was "the restoration of . . . proper rhythm'.[60]

For the physician Joseph Mortimer Granville, neurasthenia likewise consisted "in the disturbance of the rhythm of the vibration of the nerve elements," caused, for example, by the body's exposure to the artificial and mechanically driven rhythms of a railway carriage.[61] Such malign rhythms, Granville and others proposed, could be corrected via the application of electronic vibrating instruments, specially designed—it was claimed—to "control and rectify the disorderly vibrations."[62] Thus, the fatigue wrought on modern bodies as a result of technological changes could be palliated or prevented through technological means, reconfiguring the challenges of modernity as solutions.

In late-nineteenth-century medical discourse then, nature and civilization participated in an unstable dialectic. While modern industrial life was often opposed to a supposedly "natural" order, governed by the rhythms of the body, at other times biological language functioned to naturalize the rhythms of modernity. The metaphors used to describe energy and fatigue commonly aligned the body either with the technologies of industrial machinery (the "human motor") or with the economic logic of the market. Susan Sontag is one of a number of theorists to have observed, for example, that nineteenth-century anxieties about the waste of energy often "echo[ed] the attitudes of early capitalist accumulation. One has a limited amount of energy, which must be properly spent. . . . Energy, like savings, can be depleted, can run out or be used up, through reckless expenditure."[63] For health to be maintained and exhaustion avoided, fin de siècle doctors argued, the "economy of the body" needed to be properly balanced.[64] If the "daily out-goings" of "bodily expenditure" exceeded the "body-income . . . paid in daily from the food we eat," the inevitable result would be "the exhaustion of the body-capital" and "physiological bankruptcy."[65] As Chandak Sengoopta has observed, neurasthenia in particular was often presented as a pathology of economic efficiency, striking down "the most productive section of society in the most productive years of their life."[66]

Anson Rabinbach attributes an intensified focus on "the wasteful expenditure of energy" in 1870s Britain to concerns about the rising costs of labor and the accompanying recognition that "the costs of reproducing labor power could be turned into profit" through the development of a lucrative working-class consumer market.[67] However—in contrast to much of the early discourse on fatigue in continental Europe—the object of medical concern in Britain in the late nineteenth century was not, at least at first, the industrial working class. While the British science of work that developed in the twentieth century centered heavily on the factory, the nineteenth-century study of exhaustion was notable for its thoroughly bourgeois preoccupations. In almost every article on the subject, overwork, fatigue, and neurasthenia were problems said, for the most part, to affect "the official, the professional, the commercial, and the literary classes."[68] It was not the manual worker but "the eminent lawyer, the physician in full practice, the minister, and the politician who aspires to be a minister . . . the literary workman, or the eager man

of science" who were the archetypal subjects of fatigue.[69] In general, concerns about overwork focused on the "excessive mental labour" that many saw as being increasingly demanded of a swelling class of so-called brain workers.[70] As one article on neurasthenia categorically put it, "It is not among the working classes that we meet with examples of nerve exhaustion."[71]

Both men and women were seen as susceptible to pathological fatigue, although the supposed causes attributed to each, as well as the suggested treatments, were often heavily gendered.[72] As Elaine Showalter has argued, psychiatric diagnoses for female patients at the end of the nineteenth century were often implicated in a conservative reaction against challenges posed by women to the existing social order. As women began to enter higher education and the professions, to assert their independence and sexual freedoms, and to organize for their political rights, a largely male medical establishment looked to designate "women's efforts to change the conditions of their lives" as psychologically deviant.[73] In male cases of neurasthenia, doctors tended to emphasize overwork and the demands of professional life. For women, it was more common to stress the constitutional weakness of the female body and the moral degradation caused by the crossing of social boundaries. Advertising the notorious "rest cure" made famous by Silas Weir Mitchell and his female patients in the United States, for example, the London physician William Smoult Playfair stressed the benefit of removing "the patient from the unwholesome moral atmosphere in which she has been living."[74] Often, in the case of women, neurasthenia was—like hysteria—linked to dysfunctions of the uterus, with attention focused less on the stresses of overwork than on the innate biological or emotional weaknesses of the female sex.[75] The question of unpaid domestic "work" was rarely considered.[76]

What linked both male and female neurasthenics, however, was their inextricable and active association with modernity. Sufferers from pathological exhaustion were less the discontents of modern civilization than they were its agents. While fatigue was associated with weakness and degeneration, it was, at the same time, an affliction of progress. If it could be called on to explain Britain's decline, it could also be used as evidence of its social and cultural preeminence and imperial dominance—in a word, its modernity. "The more advanced a nation

becomes," wrote one physician, "the more prevalent have nervous diseases been amongst its people."[77] The tendency to exhaustion, wrote another, was "characteristic of high states of civilization."[78]

Late-Victorian doctors were thus faced with an uncomfortable paradox. Fatigue represented the failure of the human body to meet the demands of modern life—or its punishment for overstepping natural boundaries—yet, at the same time, its increasing incidence was the best possible evidence of a society's modernity. An epidemic of pathological exhaustion, if alarming, at least proved that the British nation—and particularly its "strenuous" middle classes—stood at the forefront of human progress.[79] The problem that preoccupied medical and scientific writers, therefore, was to reconcile immutable constraints on the powers of the body with continuing social and economic progress. Did fatigue represent the impassable boundary of modernity or an obstacle that it was possible to overcome?

THE LAWS OF FATIGUE

As Catherine Oakley has recently argued, while scholarship on the Victorian fin de siècle has often stressed fears surrounding "the dissipation or curtailment of human capacity," less attention has been paid to "the ways in which these anxieties about biological, moral and racial decline were counterbalanced by a more optimistic interest in the physical potential of the human body." While the specters of physical and social degeneration provoked anxiety, Oakley argues, they also offered a rationale for new "interventionist strategies of corporeal '*re*generation'" that aimed to recuperate, augment, or maximize bodily energy.[80] If concerns about overwork, exhaustion, and neurasthenia were frequently implicated in pessimistic narratives at the end of the nineteenth century, medical and physiological writing on human energy was at the same time often characterized by an optimistic—or even utopian—confidence that fatigue and inefficiency could be conquered. Through the discovery of the scientific "laws" of human effort, it was argued, fatigue, the body's inbuilt resistance to work, could be understood, controlled, or even eliminated.

In his essay on "metaphors of human biology," Owsei Temkin argues that the elaboration of mechanical models of human physiology allowed

the development of "a more active attitude toward the body" than was previously possible. Whereas older notions of the body as a divine creation "imagined the human organism to be so perfectly constructed that an improvement was not even thinkable," the idea of the body as a machine or motor implied that improvements were both possible and desirable.[81] While mechanical models of animal and human physiology had been articulated since at least the seventeenth century, the development of thermodynamics from the middle of the nineteenth century effectively closed the gap between animate and inanimate mechanisms. For those who insisted on the "physical doctrine of life," the "human motor" was more than just a metaphor: the human body was, in its essential properties, *no different* from any other heat engine, motor, or industrial machine converting energy (or "force") into useful work.[82] Increasingly, physiologists and physicians viewed themselves as engineers, tasked with maintaining and increasing the efficiency of the body, optimizing its potentials, and expanding its capacity to convert energy into work.

In this context, fatigue—the body's inbuilt resistance to continued effort—was viewed less as an absolute barrier to the expansion of the body's productive powers than as a contingent and surmountable inefficiency: an engineering problem that could be rationally solved. The "power, and hence the usefulness, of the machine we call the human body is limited by two shortcomings prominent among others," the physiologist Michael Foster proclaimed in 1893: "by the inertia, the sluggishness which makes it so hard to set agoing, and the readiness with which it wearies, so that its work is stopped before its task is done." For Foster, the scientific study of fatigue would indicate how both the individual and society as a whole might "extend [the] limits" of working capacity and productivity.[83] While fatigue might be the "inevitable" consequence of work, others argued, the "suitable management" of the body would make it possible "to secure the maximum efficiency for the human machine."[84]

Such developments were not unique to Britain. The laws of thermodynamics motivated new research into the mechanics of the human body across continental Europe. The Italian physiologist Angelo Mosso—whose *La Fatica* was published in 1891—was a central figure in developing methods by which to study and measure muscular

fatigue.[85] In the 1880s, Mosso developed "the first efficient and accurate measure of fatigue." This new apparatus, the "ergograph" (register of work), was first used in 1884 (fig. 1). The subject's wrist and index and ring fingers were held in place by metal clamps, so that only the middle finger was able to move freely. By means of a cord attached to the unconstrained finger, the subject was able to raise and lower a weight, which in turn set in motion a registering apparatus, recording the height and duration of each muscular contraction. The apparatus isolated the forearm muscles of the subject such that, by repeatedly raising the weight, they were quickly fatigued, establishing a tracing of the diminishing power of each contraction. By this means, Mosso was able to graphically represent the onset and course of muscular fatigue. He concluded that while individuals fatigued at different rates, the "fatigue curve" for each individual was unique, regardless of the intensity or nature of the work performed (fig. 2). By studying the conditions governing muscular exertion, Mosso believed, "the conservation of the internal energy of the muscles" could be enhanced, increasing the body's capacity for physical work. The discovery of objective "laws of fatigue," he posited, "would lead directly . . . to its more efficient control, if not its ultimate conquest."[86]

Mosso's ideas and methods proved influential, both in Europe and to an extent—after the translation of *La Fatica* into English, as *Fatigue,* in 1904—in Britain as well. However, Mosso's intervention was by no means the spark that ignited British research into the mechanics of the human body or into the physiology of fatigue. From as early as the 1860s, British physiologists were investigating the energy of the human body, its conservation and efficient use. As concerns mounted about the dissipation of the nation's energetic resources toward the end of the nineteenth century, scientific research into the physiology of fatigue gained increased sociocultural significance. As Richard Gillespie has argued, the problem of fatigue enabled physiology, as a distinct branch of medical science and as a profession, to forge for itself a "social role" in the application of laboratory research to questions of supposedly national importance: systematic knowledge of the body's mechanisms, physiologists argued, could provide the key to industrial and social efficiency.[87] This was a period that saw the creation of Britain's first professional association for physiologists, the Physiological Society,

in 1876, and the early issues of the society's journal carried numerous articles on the origins and nature of the body's energies, the biochemical mechanisms of fatigue, the optimal rhythms of muscular contractions, the effects of different foods and drugs on bodily efficiency, and different means to measure the extent of fatigue.[88]

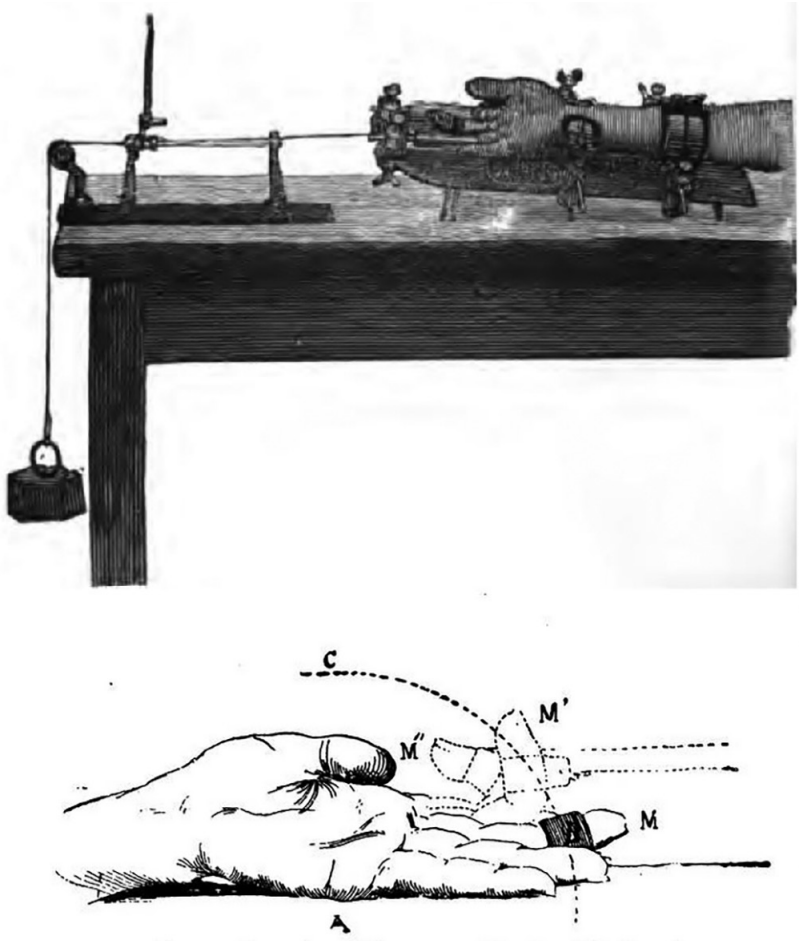


FIGURE 1. Measuring fatigue. Illustrations showing Mosso's ergograph in use and the successive positions assumed by the finger in raising the attached weight. From A. Mosso, *Fatigue,* trans. Margaret Drummond and W. B. Drummond (New York: G. P. Putnam's Sons, 1904), 88 and 97, courtesy of Cornell University Library, https://archive.org/details/cu31924000889091.

A central question for early research into the thermodynamics of the body was that of the origin and nature of the body's energies. In the 1860s, the Irish physiologist Samuel Haughton calculated that an "enormous force" was required simply for the "effort necessary to live"—that is, for the performance of normal biological functions—on top of which yet further energy was required for the physical and mental work done by the body, as well as losses in the form of body heat.[89] Clearly, the first law of thermodynamics did not allow for the creation of energy ex nihilo. The human body could "no more *generate* an amount of force capable of moving a grain of sand, than a stone can fall upwards or a locomotive train drive without fuel."[90] The most obvious answer for the source of human energy was food. As early as the 1840s, James Prescott Joule (a brewer and amateur physicist whose work on the "mechanical equivalent of heat" was an important breakthrough in the development of thermodynamics) had suggested that, just as coal was burned in a steam engine to produce mechanical work, the oxidation or combustion of food in the body provided the impetus for muscular power.[91] By midcentury there was general agreement "that food, and food alone, is the ultimate source from which muscular power is derived," yet there remained disagreements over which substances *within* food were the chief source of energy.[92] The prevailing opinion was that of the German chemist Justus von Liebig (1803–73), who asserted that energy was generated in the muscles through the decomposition of the nitrogenous substances (and particularly proteins) from

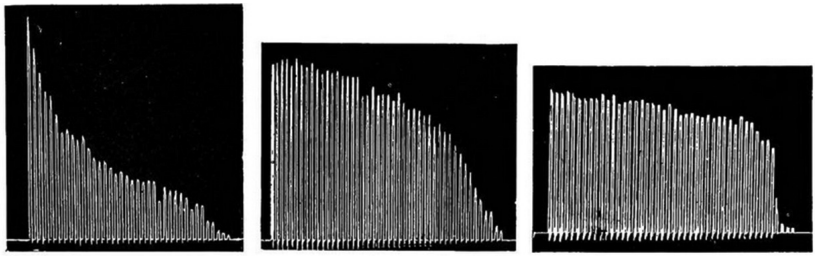


FIGURE 2. Ergograph tracings taken by Mosso showing different "fatigue curves" for three individuals. From A. Mosso, *Fatigue,* trans. Margaret Drummond and W. B. Drummond (New York: G. P. Putnam's Sons, 1904), 89, 90, and 93, courtesy of Cornell University Library, https://archive.org/details/cu31924000889091.

which they were constituted. In Britain this view was represented by the chemist and industrialist Lyon Playfair, a student of Liebig and also an associate of Joule.[93] For Playfair, the "nitrogenous ingredients of food" provided "a magazine of force for the production of dynamical effects in the animal."[94]

In 1865 the English chemist Edward Frankland, along with the German chemists Adolf Fick and Johannes Wislicenus (both relatives of Frankland by marriage), formulated an experiment "to submit to a crucial test the theory which assigns the source of muscular power to the oxidation and destruction of the muscles themselves."[95] Eliminating protein from their diets, Fick and Wislicenus embarked on an ascent of the Faulhorn mountain in Switzerland (Frankland having been prevented from participating due to poor weather on the date originally set). By measuring the quantity of nitrogen excreted in their urine during the climb, Fick and Wislicenus calculated that the total energy required for the ascent could not be sufficiently accounted for by the breakdown of proteins. In further laboratory experiments, Frankland showed that, in fact, nitrogenous substances provided only a small amount of muscular energy even under normal conditions.[96] While proteins provided the substance from which muscles were built, it was nonnitrogenous elements, such as fats and carbohydrates, that were "the chief sources of the actual energy, which becomes partially transformed into muscular work." Further, Frankland showed, there was no need for food to become "organized tissue" within the body to transfer its energy, with the muscles taking their energy directly from the blood. Typically, he explained his results by way of a mechanical analogy: "Like the piston and cylinder of a steam engine, the muscle itself is only a machine for the transformation of heat into motion; both are subject to wear and tear and require renewal, but neither contributes in any important degree by its own oxydation to the actual product of the muscular power which it exerts." Just as the components of an engine were not substantially destroyed in the burning of its fuel, the muscles remained intact during the combustion of the food supplied by the blood. Also like the steam engine, Frankland observed, the conversion of "potential energy" in the body's fuel was accompanied by losses in the form of heat.[97] In accordance with the second law of thermodynamics, only a small amount of the energy contained in food could be converted into useful work.

In 1873, explicitly framing the study of physiology within the language of physics, Samuel Haughton published a treatise titled *Principles of Animal Mechanics*. The central principle governing the laws of the body, Haughton argued, was the "principle of least action." Originating in the eighteenth century, and at first applied to physics, this was the idea, as formulated by the French mathematician and philosopher Pierre Louis Maupertuis, that "nature is thrifty in all her actions." In the performance of muscular work, Haughton claimed, "the work to be done is effected by means of the existing arrangement of the muscles, bones, and joints, with a less expenditure of force than would be possible under any other arrangement."[98] The pain caused by fatigue, it was argued, forced the limbs "to seek a position in which the parts of them are in a state of least tension and of least pressure," thus minimizing the waste of energy.[99] In this view, fatigue was not necessarily pathological but, on the contrary, was essential in ensuring that the work of the body was carried out at optimum efficiency. "The framer of the universe," wrote Haughton, "has constructed all muscles on the principle that each shall perform the maximum of work possible for it under the given conditions."[100]

By discovering the precise laws of governing the performance of muscular work, Haughton argued, it would be possible to determine the conditions for achieving the maximum output and the precise point of optimal efficiency before fatigue set in. Through his experiments into the mechanics of muscular work, conducted through the 1860s and 1870s, Haughton formulated what he came to call the "Law of Fatigue." This was less concerned with the causes of fatigue than with the amount of work that could be done by a muscle before it succumbed to its effects. Haughton stated the law as follows: "When the same muscle (or group of muscles) is kept in constant action until fatigue sets in, the total work done, multiplied by the rate of work, is constant." In other words, for any given muscle, there was a precise point during work at which fatigue would inevitably set in, which could be determined experimentally and remained constant. At this limit point, "fatigue sets in, and the muscles become incapable of giving out more work."[101] In the mid-1870s, Haughton's "Law of Fatigue" was the subject of much debate among physiologists, yet the principle that muscular work could be quantified, mathematically regulated, and optimized was widely accepted.[102]

The idea of fatigue as a limit on working capacity—and the notion that this limit could be arrived at by a formula with predictive power—also proved attractive to the political economist (and polymath) W. Stanley Jevons. Independently of Haughton, Jevons conducted his own physiological experiments into "the natural laws of muscular exertion." "By the natural constitution of the muscles," he reported, "they can only develop a limited amount of force in a given time, and the fatigue rapidly increases with the intensity and rapidity of exertion. Hence there is in every kind of work a point of maximum efficiency, which is in practice ascertained more or less exactly by frequent trial." Making explicit the link between mechanical and industrial "work," Jevons speculated that, through such physiological experiments, "definiteness might be possibly be given by degrees to some of the principles and laws which form the basis of the science of political economy."[103]

If Jevons's and Haughton's work focused primarily on fatigue as a point or limit, there was, at the same time, a growing interest in fatigue as a *process,* through research into its internal physiological mechanisms. While experiments into nutrition in the mid-nineteenth century had helped to establish the source of the body's energies, the internal physiological mechanism by which the muscles became fatigued remained unclear, and laboratory experiments threw up a number of questions. Fatigue, it seemed, consisted of more than simply the consumption and exhaustion of either "contractile material" in the muscle or of those "substances available for the supply of potential energy."[104] Mosso and others suggested that fatigue was in fact a form of poisoning, caused by the buildup of toxic by-products of work, such as lactic acid and carbon dioxide. In a famous experiment, Mosso injected the blood of a fatigued dog into the veins of a rested one, immediately inducing exhaustion in the latter.[105] Further experiments, described by the English physiologist Ernest Starling, showed that fatigue could be artificially induced in a muscle by "feeding" it with a weak solution of lactic acid or the effects of fatigue reduced by "washing out" the muscle with saline solution.[106]

In reviewing the English translation of Mosso's *Fatigue* in the *Quarterly Review,* the neurologist William Gowers drew on a familiar analogy to explain the process: "The carbonic acid formed in the gas-engine would extinguish any other light placed in it," he wrote, and "through it no spark could pass." Likewise, "The combination of atoms in the

muscle which releases energy produces substances that interfere with a repetition of the process. They are toxic to the muscle in so far as they hinder its contraction."[107] In the 1890s and 1900s, countless articles on the chemical basis of fatigue appeared in the British medical and scientific press.[108] If the "toxins" responsible for muscular fatigue could be eliminated, it was suggested, it might be possible to alleviate, or even eliminate, its effects. In 1909 an article reporting on the attempts of the German physiologist Wilhelm Weichardt to find a "fatigue anti-toxin" went so far as to suggest that "some day we may have a form of immunisation against fatigue that will be effective as the present vaccination against smallpox."[109]

In the 1890s, attention increasingly turned from the physical causes of fatigue in the muscles to its relationship with the brain and nervous system. Experiments conducted by Michael Foster, with the use of Mosso's ergograph, demonstrated that muscles that had been worked to the point of exhaustion, such that contraction was no longer possible by means of the voluntary effort of the subject, could nonetheless continue to work if artificially stimulated. For Foster, this seemed to correspond to the "common experience that when we are weary almost, it may be to death, some sudden emotion, some great joy or fear, may spur us on to an effort which just before seemed impossible." This indicated that it was not only, or even chiefly, the muscles themselves that underwent fatigue through work but rather that the nervous system (brain, spinal cord, and nerves) became unable to supply them with energy. It could be shown by experiment that the nervous fibers themselves "never tired": if prevented from communicating with a muscle, a nerve could be stimulated for hours by an electrical current and still be capable of producing work in the muscle when reconnected. The conclusion this implied was that, while sensations of fatigue were felt in the muscle, "much of the weariness, we may even say the greater part at least of the weariness, is begotten not in muscle but in the brain" (or central nervous system).[110] While direct experimentation on the nervous system was much more difficult than on the muscles, it was generally assumed "that nervous fatigue is produced in an analogous manner," that is, through the toxic products of work.[111]

In the early years of the twentieth century, the neurophysiology of Charles Scott Sherrington helped to locate the "place of incidence" of nervous fatigue at the "synapses," or junction points between nerve

cells. Once again evoking the principle of least action, Sherrington argued that nervous fatigue played a crucial role in "canalizing" the body's energy. By increasing the "resistance" along certain nervous paths when overworked, fatigue prevented permanent damage to the nerves or muscles. Fatigue, Sherrington argued, was "a process elaborated and preserved in the selective evolution of the neural machinery." The regulative role played by nervous fatigue was crucial for the evolution of complex species: "The organism, to be successful in a million-sided environment, must in its reactions be many-sided. Were it not for such so-called 'fatigue,' an organism might, in regard to its receptivity, develop an eye, or an ear, or a mouth, or a hand, or a leg, but it would hardly develop the marvellous congeries of all those various sense-organs which it actually does." For Sherrington then, fatigue was not a pathological condition, nor even simply a normal part of healthy physiology, but a crucial factor in the evolutionary success of humankind.[112]

The physiological discourse on muscular fatigue thus mirrored the ambivalence of medical and cultural discourses surrounding overwork and neurasthenia. Fatigue was a sign both of advancement in the organism and of its degeneration. It represented an apparently impassable limit on the work that could be done by the muscles, yet, at the same time, there was a powerful—almost utopian—conviction that through the observation and measurement of fatigue, through the discovery of its objective physical laws, it could be scientifically understood, controlled, or even eliminated.

MEASURING MENTAL FATIGUE

The realization that physical fatigue was in large part nervous in origin led to increased scientific attention being paid to the subject of mental fatigue. While the mental aspect of fatigue had been acknowledged as a problem by physiological researchers, it seemed, in comparison to its muscular side, a much more difficult problem for scientific research. "The facts of fatigue in the brain are less simple and far more difficult to investigate and understand," wrote William Gowers. "We cannot measure and record the power of the brain as we can that of the muscles."[113] While the discourse on overwork that grew up in the 1870s

was concerned with "brain work" and mental overstrain, few offered a means by which to quantitatively measure the effects of intellectual effort. While many drew on the imagery of "mental energy" and "nerve force," there was little speculation on the physical relationships between these and other forms of energy. Compared with the muscles, it was difficult to imagine the mind as a steam engine, and the metaphorical attempts of some doctors to bring the mental processes within the domain of the laws of thermodynamics were notably less precise: "Mind is an abstract conception, like heat or motion," wrote the physician George Johnson in 1875, "and it is conveniently used to designate a set of complex psychological energies."[114] While theoretically, and philosophically, the idea that the energy of the mind was just a particular form of the constant and universal energy that animated the material universe was attractive, the "mechanical equivalent of thought" proved elusive.[115] Toward the end of the nineteenth century, however, there were a number of attempts to submit to quantification the "unknown, and hitherto unmeasured, work done by the mind."[116]

Even as physiologists were attempting to determine the objective laws of muscular fatigue, it was not uncommon for both medical and nonscientific writers to offer largely subjective accounts of the phenomenology of fatigue. Medical writers frequently appealed to "common experience," or to anecdotal or autobiographical evidence, in evoking the sensations of weariness to their readers.[117] Some descriptions, like the one anonymously published in the *Pall Mall Gazette* under the austerely scientific title of "The Physiology of Fatigue" bordered on the poetic:

> It is as if day and night approached and retired with the ceaseless pulsation of nature. In this daytime, the mind is fresher than in its normal condition: the faculties are brighter, thoughts are quicker, while a curious dreamlight seems to steep all this alert sense with some unnatural colour. And it fades away quickly and horribly, leaving the mind in profound darkness, the body listless and indolent, the brain acting, with only the indomitable will battling against the cohorts of sleep. . . . [T]he darkness finally clears away, first into silver mists, then into a strong and almost insupportable brain-light, like the shining of planets in a dream.[118]

Increasingly toward the end of the century, however, descriptive or qualitative accounts of the sensations of fatigue became less common. There was instead a concerted effort to redefine mental fatigue as an objective quantity, as a purely scientific phenomenon with its own laws and regularities, which, crucially, would be capable of precise measurement.

At the forefront of this approach to fatigue was a new brand of self-consciously scientific experimental psychologists. For most of the nineteenth century, "psychology" in Britain had remained largely the prerogative of philosophers, not of scientists.[119] By the turn of the century, however, this hegemony was being challenged. The year 1901 saw the foundation of the British Psychological Society (consciously modeled after the Physiological Society).[120] The first edition of the *British Journal of Psychology,* published in 1904 (and taken over by the society in 1914), claimed that the subject had at last "attained the position of a positive science . . . possessing its own methods, its own specific problems and a distinct standpoint altogether its own."[121] Just as the physiologists had seized on the question of muscular fatigue as a means by which to assert the relevance of their discipline to society, mental fatigue was seen as a subject in which the methods of the new scientific psychology might provide solutions to important "practical questions."[122]

One arena in which the measurement of fatigue was seen to be of practical social performance was the education of children.[123] From 1870 elementary education was compulsory for children between the ages of five and thirteen, and in the overwork panic of the following decades the underdeveloped bodies and minds of the young were seen as particularly susceptible to the damaging effects of life at high pressure. "Seeing the delicate organization of the child who is placed under the teacher's influence for the purpose of education," wrote the physician of Rugby School in 1893, "it is incumbent upon us to be on our guard, that even the borderland of overwork is not reached; since it is easy to overstep the line of safety, and cause lasting injury to the nascent brain."[124] By the end of the century, it was increasingly argued that a proper measure of mental fatigue was essential for ensuring that children were not pushed beyond their physiological and psychological limits. "If the method employed in ascertaining the facts afforded a certain index of cortical exhaustion," suggested a 1902 editorial in the *Lancet,* "results might be obtained of great value in

scientific education." "The difficulty of investigating mental fatigue," it continued, "arises chiefly from the want of a quantitative standard of mental work."[125] When Mosso's *Fatigue* appeared in English, in 1904, it was the physician and educational theorist William Blackley Drummond and his wife, Margaret, who undertook the translation. In their preface, the Drummonds asserted that fatigue was a subject "of special importance to educationists." Criticizing a merely "empirical" approach to educational theory, they praised the "application of modern methods of scientific research to the problems of physiology and psychology." For any science to achieve legitimacy, they argued, "the phenomena considered" had to be "compelled to submit themselves to measurement."[126]

Like the physiology of the late nineteenth century, the new experimental psychology carried with it an underlying assumption that scientific knowledge could help to perfect or optimize the human species. For Francis Galton, the measurement and development of mental "energy" was central to a project of racial improvement. In the work in which he introduced the term "eugenics," in 1883, Galton proclaimed that energy—"the capacity for labour"—was "an attribute of the higher races." "In any scheme of eugenics," he argued, "energy is the most important quality to favour."[127] While some human beings were born with "large powers of endurance," others were naturally "quickly fatigued," and it was essential to be able to distinguish between the two.[128] Particularly under "the strain and exhausting calls of modern civilised life," Galton contended, the need for a "measure of fatigue" was essential. In an 1889 research article, Galton attempted to apply his "psychometric" methods "to determine the signs and effects of incipient fatigue in as *measurable* a form as possible."[129] He distributed questionnaires to schoolteachers, asking them to record the effects of fatigue on themselves and their pupils. By comparing the answers, he was able to produce a catalog of the most common "warning signs" of incipient fatigue, although his attempts to provide a fail-safe test or quantitative measure of the extent of mental fatigue were at best, he admitted, inconclusive.

For many writers, the easiest way to conceptualize mental energy and fatigue in scientific terms was by analogy with muscular energy and fatigue. Indeed, for those writers who held dogmatically to the

"physical doctrine of life," mental energy was necessarily just another form of, and convertible with, the same universal energy that powered the muscles. "Like muscular motions," wrote Henry Maudsley in his *Physiology and Pathology of Mind,* "ideas . . . are excited into action by an appropriate stimulus; like them . . . they are fatigued by prolonged exercise."[130] Likewise, for his fellow alienist Thomas Clouston, the mind was a muscle that could not be overworked without leading to fatigue or even mental collapse.[131] While it was relatively simple to compare physical and mental fatigue in theoretical terms, however, measuring the latter seemed more of a challenge. Mental fatigue, after all, was primarily a *feeling* and as such apparently entirely subjective. For the archmaterialist Thomas Huxley, writing in 1866, mental fatigue would always be "vague and undefinable" for the scientist: "However real these sensations may be," he wrote, "and however largely they enter into the sum of our pleasures and pains, they tell us absolutely nothing of the external world." While such "subjective sensations" were not denied an existence, for Huxley they were nonetheless beyond the domain of scientific observation or measurement.[132] Given their subjective nature, scientists argued, the sensations or feelings of fatigue could be measured only indirectly, through the observation of its supposed effects.[133]

Despite such doubts, however, the final decades of the nineteenth century saw a series of attempts to quantify mental fatigue. Many of these originated overseas. As the Drummonds reported in their preface to Mosso's *Fatigue,* "scores of instruments" were being invented on the Continent "to record and measure the vital and mental processes." Of these, undoubtedly "the most interesting and important" was "Professor Mosso's ergograph or fatigue-recorder."[134] While the ergograph did not measure mental fatigue directly, Mosso had argued that, physical and mental energy being essentially interchangeable, excessive intellectual work resulted in diminished muscular power and therefore that ergographic tracings could be used as an index of mental fatigue. In the 1890s, the German physiologist Hermann Griesbach developed a new instrument, the "aesthesiometer," that measured the effects of fatigue in terms of decreased tactile sensitivity. Experimenting on schoolchildren, he showed that, over the course of difficult intellectual activity, students were less able to determine the distance between two impressions made close together on the surface of the skin.[135]

Both the ergograph and the aesthesiometer were used by British researchers to assess the effects of mental fatigue, along with tests of other physical indications such as blood pressure and the rate of respiration, yet these tests remained only indirect measures of mental fatigue.[136] In the first decade of the twentieth century, the German psychiatrist Emil Kraepelin attempted to devise methods by which mental fatigue could be measured in purely psychological terms. He made an important distinction between the subjective "tiredness" (*Müdigkeit*) and objective "fatigue" (*Ermüdung*). While the sensations of tiredness might evade scientific measurement, mental fatigue was nonetheless still an objective phenomenon that could be measured—like muscular fatigue—in terms of declining capacity for work. Kraepelin's fatigue tests consisted of the repeated performance of some simple form of mental work (for example, adding columns of figures or memorizing lists of nonsense syllables). By plotting the speed and accuracy with which the tasks were completed, he was able to produce "work curves," which he claimed showed the course of fatigue for different individuals.[137]

One student of Kraepelin was the English psychologist W. H. R. Rivers. During the summer of 1893, Rivers went to Heidelberg to work with Kraepelin on his experiments into mental fatigue. In 1896 they jointly published a paper "on fatigue and recovery" in Kraepelin's journal of experimental psychology, with Rivers reporting back on their results to the *Journal of Mental Science*.[138] In 1897 Rivers was made university lecturer in psychology at Cambridge, where he began conducting psychological experiments (though without a proper laboratory at his disposal until 1907). One of his research students was William McDougall, and the two formed a lasting intellectual connection. Both joined the Cambridge Anthropological Expedition to the Torres Strait in 1898 under Alfred Cort Haddon. More important, both were founding members of the British Psychological Society and vocal supporters of "the experimental movement in psychology." This new scientific approach, as Rivers explained, was "directed chiefly to the study of methods by which mental phenomena may be subjected to exact investigation, and by which they may receive for the purposes of comparison some kind of quantitative expression."[139]

After leaving Cambridge, McDougall, like Rivers had before him, went to study in Germany, at the Göttingen laboratory of the experimental

psychologist Georg Elias Müller. He returned to England in 1901 as a reader in experimental psychology at University College London and then, from 1904, as the Wilde reader in mental philosophy at Oxford. Despite the terms of the readership specifically prohibiting experimental research, McDougall was able—with the assistance of Charles Sherrington and fellow physiologist Francis Gotch—to obtain a room in the basement of the Physiology Laboratory for clandestine research.[140] McDougall devoted himself to the study of attention and, as its limit, mental fatigue. "Perhaps no other problem presented by the mind," he wrote, "so well illustrates the limitations of the purely psychological methods."[141]

To fully understand the mind, McDougall argued, "the pure psychologist must cease to be content with a one-sided and partial study of mental processes" and be prepared to "descend into the dark places of physiology."[142] The task of "physiological psychology," as McDougall termed his enterprise, was "to render a complete account of the laws that govern conduct." Of the laws he looked to for inspiration, none impressed him more than the law of conservation of energy: "the best-founded generalization of physical science." Indeed, for McDougall, the relationship between mind and body could be understood as a complex economy of energy exchange. The "will" was an instrument for controlling the flow of energy around the body, and fatigue was the ever-present resistance to the full conversion of potential energy into useful work.[143] "The study of fatigue," he wrote, "must always be of the deepest interest from the point of view of pure science, because in studying fatigue we are studying the source of human energies, the modes and conditions of their operations, and, above all, their limitations."[144]

For McDougall, the discovery of a reliable measure of fatigue was thus "one of the most important problems" for experimental psychology.[145] While he did not deny the value of "the refinements and subtleties of the introspective psychologists," he nonetheless became convinced, like Kraepelin before him, that the experiential and phenomenological side of fatigue would have to be sacrificed if "objective" mental fatigue was to be accurately measured.[146] While acknowledging that of "all the manifestations of fatigue the most familiar are the *subjective,*" he maintained that feelings of tiredness bore no direct relation to the capacity of the body or mind for exertion.[147] Rivers expressed a

similar point of view: "In the performance of mental work especially, decided sensations of fatigue may be experienced when the objective record shows that increasing and not decreasing amounts of work are being done; and there may be complete absence of any sensations of fatigue when the objective record shows that the work is falling off in quantity, or in quality, or in both." A proper test would have to eliminate as far as possible the influence of subjective factors that might affect a subject's "work curve" independently of their fatigue. The most important of these were "practice" (whereby a subject's capability for work improved with its performance), "warming to work" (whereby the subject's capability for work improved by their getting into the particular rhythm of the task), "loss of interest" (whereby the subject's work rate declined because of diminished attention), and "spurt" (the subject's concerted increase of attention or application common toward the end of a task).[148]

In 1905 McDougall presented his own new method for the measurement of mental fatigue.[149] The "McDougall dotter" (fig. 3) consisted of a rotating cylinder, of variable speed, on which was carried a piece of white paper with eight parallel rows of irregular, zigzagging red dots.[150] The cylinder was covered by a screen with a horizontal slit of variable width. The experimental subject sat in front of the screen, marking each dot with a black pen as they appeared through the slit. The subject's level of attention was measured by their accuracy in pinpointing each dot, with the incidence of mistakes indicating the onset of fatigue. A key benefit of this method was that the pace and rhythm of the work involved could be controlled by the experimenter with mechanical precision (by varying the speed of the cylinder), thus eliminating any conscious or unconscious attempts by the subject to limit their rate of work. Unlike the addition of numbers, or the memorizing of syllables (in which some tasks might be more difficult than others), the work required by the dotter was of a more obviously uniform kind, and thus, thought McDougall, the accuracy of the subject's responses could be relied on as an objective index of mental fatigue.

The dotter underwent several revisions by McDougall, Rivers, and other researchers, all aimed at diminishing the subjective element in the test (for example, having the dots moved on a continuous tape rather than in rows on a cylinder to avoid the subject having to move

between rows, potentially causing distraction or "incentive to spurt"). In 1908 Rivers made extensive use of the dotter—as well as a modified ergograph—in a study on the effects of alcohol and other drugs on physical and mental fatigue. Compared to other methods of measuring mental fatigue, he noted approvingly, the McDougall apparatus had the advantage of being "in many ways more nearly comparable with the methods of measuring muscular work," in that "the measure of fatigue is the quality of work" and nothing to do with the feelings of the experimental subject.[151]

If Rivers and McDougall achieved their aim of finding a quantitative measure of mental fatigue, then it came at the cost of a conceptual shift—and an important limitation—in what mental fatigue was understood to *be*. For the majority of both scientific and lay writers in the late nineteenth century (and before), fatigue was primarily a sensation. While scientists despaired of finding a way to measure human feeling,

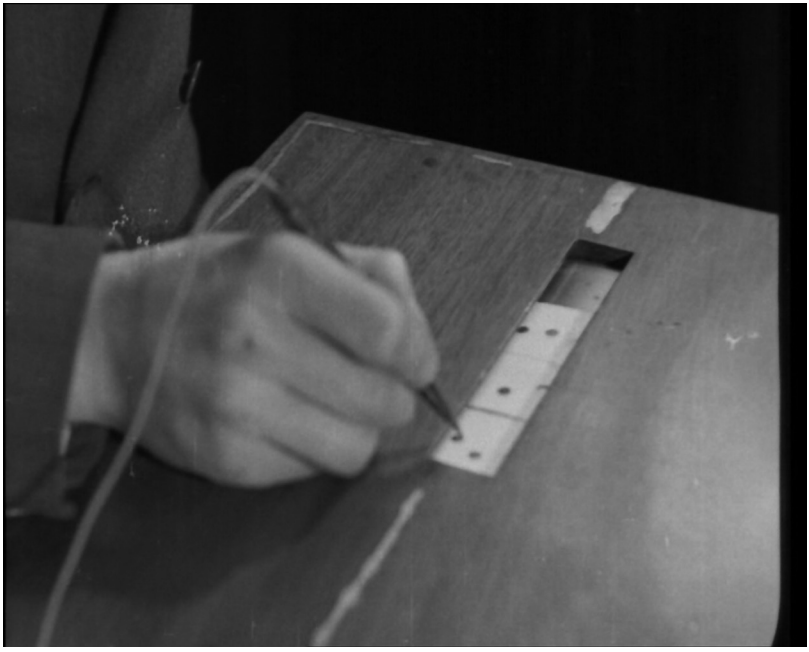


FIGURE 3. A version of the "McDougall dotter" in use at the National Institute of Industrial Psychology, 1934. © British Pathé.

the introspective and sensory aspects of fatigue were nonetheless a crucial—indeed, as some saw it, the most crucial—feature of its existence. The question of fatigue's subjective side was left open. Instead of confronting the problem, however, the late-nineteenth-century experimental psychologists effectively ignored it. In Rivers and McDougall's ontology, only what could be quantitatively measured could be meaningfully said to exist. Anything else was beyond the realm of scientific comprehension (the only kind that mattered). There was no place in serious research for the "curious dreamlight" and "silver mists" that had enchanted descriptions of fatigue in the late nineteenth century. In order to measure "objective" fatigue, the subjective elements of tiredness had to be ruthlessly dispensed with. Instead of seeking to understand the psychology of fatigue from the internal perspective of the individual, mental fatigue was externalized and objectified. It could be measured without reference to any feelings of tiredness, purely in terms of the amount of "work" that a subject was able to produce in the course of a laboratory experiment.

CONCLUSION

In the final decades of the nineteenth century, fatigue—rarely discussed before the late 1860s—became an object of scientific study and of social anxiety. A new science of energy inaugurated by the articulation of the first and second laws of thermodynamics transformed physiological and psychological knowledge, enabling the body to be reconceptualized as a "human motor." Fatigue—increasingly narrowly defined as declining "capacity for work"—emerged as the central obstacle to the effective use of the human machine.

Far from resigning themselves to the march of entropy or relapsing into a gloomy therapeutic pessimism, however, a significant number of doctors, scientists, and thinkers expressed—implicitly or explicitly—the confident conviction that, if fatigue could not be eliminated altogether, the accumulation of scientific knowledge of the body's energies would create the potential for an increase in the efficiency and productivity of bodies both biological and social. If fatigue had seemed to some late-nineteenth-century observers to be a pathology caused by modern life, for others, as Rabinbach has argued, the science of fatigue itself

became "part of a broader strategy of social modernity," in which social problems would be overcome through technical knowledge, empirical investigation, and scientific and industrial progress.[152] In the first decades of the twentieth century—as concerns mounted about the physical deterioration of the working population—these convictions would form the basis of a new scientific approach to industrial work and to the working body. With the support of government and employers, fatigue study migrated from the laboratory to the factory.

CHAPTER 2

INDUSTRIAL PHYSIOLOGY AND THE PRODUCTIVE BODY

"'So tired!' is the cry of thousands of men, women and young persons at the close of the working day. How to meet the complaint and to remove its cause are among the problems of the present age. It would seem as if the stress of modern times was becoming too great, and as if the strain of industrial methods through improved machinery was becoming more than human strength can bear." With this warning, the distinguished physician and professor of physiology Sir Thomas Oliver began a 1914 article titled "Occupational Fatigue."[1] While in part echoing Victorian anxieties linking the pressures of modernity with bodily, social, and cultural exhaustion, the exclusive focus of Oliver's article on the factory and on the industrial working class represents an important shift in scientific and political discussions of fatigue at the turn of the twentieth century. While the concept of fatigue, understood as the exhaustion of the body's capabilities for effort and exertion, entered British scientific and medical discourse in the second half of the nineteenth century, the specific construction of Oliver's title—or its far more common variant, *industrial* fatigue—cannot be found prior to the twentieth.

In the early years of the twentieth century, the category of industrial fatigue became the basis of an eclectic but coherent field of medicoscientific inquiry, which I will refer to as "industrial physiology." It took shape in a handful of scientific texts, research committees, and government-sponsored investigations in the years before the First World War and played an important role in debates about hours and conditions of work across a number of industries. During the war, it was catapulted to prominence with the formation of the Health of Munition Workers Committee appointed by the government to "consider and advise on questions of industrial fatigue." By 1918, with the conversion of this wartime body into a permanent Industrial Fatigue Research Board, it had become firmly established within scientific and political discourse.

While the term "industrial physiology" was not widely used in Britain in the period, I have taken my lead from the contemporary American physiologist Frederic S. Lee, who, in a 1919 article, suggested its use to denote a new scientific approach to work, which he saw as having risen to prominence during the First World War. For Lee, the British pioneers of work science were exemplary figures in this new approach, and his broad definition corresponds to the way in which I wish to use the term. "I have called this new science 'industrial physiology,'" he wrote, "because this term seems to me to be the most appropriate single term to use in discussing this new phase of the application of scientific method to the solution of human problems. By it I mean to designate the sum of knowledge pertaining to the working of the human mechanism in industrial activity."[2]

While by no means a formal grouping, the individuals who formed the constituency of industrial physiology nonetheless developed a shared conceptual apparatus that justifies their being discussed as a coherent group, with many, in addition, sharing institutional affiliations. While not all were academic physiologists (industrial physiology's spokespeople also included physicians, economists, social reformers, politicians, government officials, industrialists, and trade unionists), all were united by the conviction that industrial work should be understood primarily in physiological terms. They sought to apply the science of the human body to the problems of industrial civilization. Through research into the physiological laws governing industrial work and fatigue, they argued, labor could be organized so as to maximize the productivity of the worker and the prosperity of the nation.

As Richard Gillespie has argued, in one of the only articles to address the subject directly, industrial fatigue was a central locus for negotiations of expertise and professional authority in the early twentieth century. For laboratory scientists, it represented a chance to "define a new social role for physiology," to expand disciplinary boundaries and claim legitimacy to comment on social and political issues.[3] In turn, through the adoption of a physiological vocabulary, social reformers could claim authority for their various proposals in an era in which policy was increasingly being dictated by scientific expertise. Likewise, for employers and the state, the discourse of industrial physiology could be used to justify the implementation of means by which to increase

profits and productivity, all the while appealing to the objective authority of scientific knowledge.

The scientific approach to the labor process that characterized industrial physiology in Britain had much in common with the contemporary "science of work" emerging in continental Europe, the history of which has been detailed by Anson Rabinbach. British researchers were familiar with, and often cited, works by continental authorities on fatigue, in particular Angelo Mosso, after *La Fatica* was translated into English in 1904. At the same time, however, the British science of industrial fatigue was significantly shaped by domestic political culture. In particular it can be seen as influenced by discourses of "national efficiency," which the historian Geoffrey Searle has identified as rising to prominence in the period from 1899 to 1914.[4] If "efficiency," as Searle has argued, was the "political catchcry" of early-twentieth-century Britain, then industrial fatigue was its dark and disturbing underside.[5] Behind optimistic visions of a scientifically ordered society, economic progress, national prosperity, and imperial dominance lurked the shadow of an industrial workforce dogged by chronic exhaustion and unable to sustain its capacity for work.

Like other discourses associated with the national efficiency movement, such as eugenics and social hygiene, industrial physiology was predicated on a powerful homology between the biological and the social. Indeed, the construction "industrial fatigue"—affixing a socioeconomic descriptor to a medical category—collapsed the two in a single stroke. National efficiency, argued the industrial physiologists, began with the body of the worker. By eliminating fatigue at a biological level, the social, political, and economic energies of the nation as a whole could be channeled to their maximum efficacy. As such, its proponents claimed authority not so much as guardians of the flesh-and-blood body of the individual worker but as technicians of what François Guéry and Didier Deleule have called "the productive body."[6]

If physiology is the scientific study of the human body, then *industrial* physiology, as it emerged in Britain in the early twentieth century, was explicitly articulated as a science of the *productive* body. Its proponents recast biology in terms of economy, health in terms of efficiency. In the experiments of the fatigue committees that proliferated in the early twentieth century, workers' physical capabilities were reduced

to productive capacities. The worker was an object for medical and scientific intervention only insofar as he or she represented a constituent part of the machinery of industrial labor, while the individual body was, in turn, reimagined as a productive system in microcosm.[7] In this context, fatigue emerged as the symbolic pathology of modern industrial civilization: a problem not only, or even primarily, of biology but of productivity.

This chapter traces the emergence of the discourse of industrial physiology through the development of its central category: industrial fatigue. In the early twentieth century, I argue, concepts of energy and fatigue developed in nineteenth-century physics and physiology were applied to the context of industrial work. Fatigue became increasingly seen as a condition of the urban working class: the emblematic pathology of the productive body, threatening to put at risk economic growth, national prosperity, and social stability. The concept of industrial fatigue was mobilized to legitimate an extension of physiological knowledge from the laboratory into society and to justify interventions into the organization of the workplace by a new breed of industrial experts, placing scientific knowledge at the center of debates about management and the organization of work. By the end of the First World War, it had become the central category in the scientific articulation of a new conception of the body in which health was equated squarely with productive capacity.

THE EMERGENCE OF A SCIENTIFIC OBJECT

To the extent that historians have taken account of the rise of industrial physiology, it has usually been seen as a well-intentioned—if perhaps long-overdue or insufficient—attempt to address a self-evident and preexisting problem. In this context, the development of a science of work has been viewed as merely the accumulation of empirical knowledge and its application to the problem of "industrial fatigue."[8] As historians and philosophers Bruno Latour and others have emphasized, however, a "scientific object" (such as industrial fatigue) cannot be simply "extended into the past" at no cost to our historical analysis. Objects of scientific study should be seen not as a preexisting entities, lying in wait for scientists to discover them, but as historical formations, fundamentally

tied to the contexts in which knowledge about them is produced and put to use. From this perspective, to state—as Arthur McIvor does—that "industrial fatigue . . . was widely prevalent in nineteenth-century industry" is therefore potentially misleading.[9] It is not simply that the term "industrial fatigue" was not used before the twentieth century but that its introduction represented the arrival of a new way of conceptualizing the working body that was previously unavailable.

Whether workers in nineteenth-century factories suffered the effects of long hours and poor conditions or not, it was not until the twentieth century that the concept of "industrial fatigue" was deployed as a means to describe this state of affairs or to justify interventions into the workplace. Nineteenth-century reformers who sought to address questions of long hours and overwork conceived of the problem in different terms. In 1893, for example, a reduced forty-eight-hour working week was trialed by William Mather at the Salford Iron Works, demonstrating that a cut in hours did not lead to a corresponding fall in production.[10] While his conclusions were often cited by proponents of industrial physiology in the twentieth century, Mather did not justify his own experiments in the scientific vocabulary that would come to dominate debates about overwork after 1900. In his published account of the experiment, Mather stressed "the moral, as much as the physical, effect" of shorter hours. He made no attempt to ground his results in physiology and did not draw on any scientific sources to back up his conclusions. The words "fatigue" and "efficiency" do not appear anywhere in the text. For other "enlightened employers" of the late nineteenth and early twentieth centuries who advocated shorter hours, the rhetoric was also philanthropic rather than physiological. Edward Cadbury, for example, despite later adopting the language of physiological efficiency, was, as late as 1912, still advocating shorter hours for young workers, combined with the provision of educational facilities, on the basis "that they may have as varied and full a social life as possible."[11]

The political context of the early twentieth century provided the conditions for concerns about overwork to be translated into the language of industrial physiology, that is, to be explicitly, and increasingly exclusively, applied to the working-class body. The period from the beginning of the twentieth century to the start of the First World

War saw the development of new discourses about the working-class body, with Social Darwinist–inspired movements of eugenics, "social hygiene," and "national efficiency" influencing public debate across the political spectrum.[12] Revelations about the poor physical condition of army recruits during the Boer War (1899–1902) provoked widespread anxieties about the "physical deterioration" of the urban working class. Increasingly, British national and imperial greatness, as well as economic prosperity and productivity, was seen to turn on the physique of its citizens. As one author put it in 1907, "The health of the people of a country stands foremost in the rank of national considerations. Upon their health depends their physical strength and energy, upon it their mental vigour, their individual happiness, and, in a great degree, their moral character. Upon it, moreover, depends the productivity of their labour, and the material prosperity and commercial success of their country. Ultimately, upon it depends the very existence of the nation and of the Empire." The development of industrial physiology—collapsing, as it did, the distance between the biological body and the productive body—was shaped by such concerns. If governments were sincere in their concerns for the "physical condition of our people," argued the educationist Margaret Drummond in 1905, then there was a "pressing need for a science of fatigue."[13]

The scientific elaboration of the concept of industrial fatigue was, from the start, inseparable from calls for its practical application as a tool of industry and of the state. Indeed, the first use of the phrase in a British context occurred in the context of a call for state intervention. At the Thirteenth International Congress of Hygiene and Demography, held in Brussels in September 1903, the section "Industrial and Professional Hygiene" resolved that governments should facilitate research on "the problem of overwork as a result of industrial labour."[14] Reporting back to Parliament, British delegates Adelaide Anderson and Thomas Legge (both Home Office factory inspectors) testified that the congress had called for "investigations on the subject of industrial fatigue."[15]

Giving the proposals their full approval, Anderson and Legge stressed the potential practical utility of fatigue research for the state. If it became "possible to estimate with some degree of precision the amount of fatigue employed in manufacturing processes," they argued, "positive data on which to base legislation would be available." Anderson expressed

similar sentiments in her evidence to the Inter-departmental Committee on Physical Deterioration, and in its report of 1904, the committee deemed it "highly desirable that there should be a strictly scientific enquiry into the physiological condition and effects of over-fatigue, as recommended by the Brussels Congress."[16]

INSTITUTIONALIZING FATIGUE RESEARCH

While it would be almost a decade before a government-led study of industrial fatigue was put in place, the early years of the twentieth century saw the nascent science of work becoming more organized, both in Britain and internationally. Industrial fatigue was again discussed at the International Congresses of 1907 and 1912, in Berlin and Washington, DC, respectively. Among those delivering papers at the latter event was the American campaigner for labor reform Josephine Goldmark, whose *Fatigue and Efficiency* was published in the same year. Goldmark's book, which aimed to "explain the phenomena of overwork in working people," and thus provide "a scientific basis of legislation," was widely read in Britain and influenced a number of reformers. In the *Sociological Review,* the social investigator, feminist, and Fabian socialist Bessie Hutchins praised it as "the first systematic treatise on the dynamic relation of the worker to the work" and welcomed Goldmark's proposals for a harmonious—and productive—marriage of scientific expertise and factory legislation. Whereas previously reformers could rely only on the "mercy" or "pure philanthropy" of lawmakers and employers, Hutchins reasoned, a scientific investigation of work would place at their disposal "detailed facts and figures" and "a considerable body of scientific observation" to show that a reduction in the hours of work would be beneficial not only to workers but to employers' profit margins. With the development of a science of fatigue, Hutchins posited, previously intractable problems of industrial relations could be settled by an appeal to pure science. "The relation of output to effort is fast coming well within the range of scientific measurement," she declared, optimistically predicting that "eventually a scientific formula will be found for the relation of productivity to effort, and that it will involve something like another industrial revolution."[17]

The development of a scientific formula for the relationship between work and fatigue, and of a reliable means by which the latter could be quantified and measured, was the key desideratum of early research into industrial fatigue and was the goal of the first major foray into fatigue research by the British state. In 1912 Albert Stanley Kent, professor of physiology at the University of Bristol, was appointed by the Home Office to conduct an "investigation of industrial fatigue by physiological methods." His brief was "to discover a test for recognizing the presence, and a gauge for estimating the degree, of fatigue as met with under factory conditions," which could then be applied by the Factory Inspectorate as a means by which to judge the effects of long hours and overwork. The science of industrial fatigue, as Kent explained in his first report, was largely a practical, rather than theoretical, endeavor. From "the industrial point of view," it was less important to understand the physiological nature of fatigue than to determine the extent to which productivity was affected by overwork.[18] Through careful surveillance and control of the factory environment and hours of work, the conditions for "the attainment of maximum output" could be scientifically arrived at.[19]

The increasingly business-minded nature of fatigue research in the first decades of the twentieth century is neatly captured in a comparison of two research committees on the subject, formed within a few years of each other by the British Association for the Advancement of Science. The first, established in 1908 and chaired by Charles Sherrington, was organized under the association's physiology section and preoccupied itself largely with laboratory experiments into muscular and mental performance.[20] The second, established in 1913, was established not under the physiology section but under that of "economic science and statistics." Chaired by the philosopher and professor of political economy John Henry Muirhead, it took as its object of investigation "fatigue from the economic standpoint."[21] In actuality, the second committee was eclectic in composition, comprising not only economists and statisticians but also physiologists, psychologists, physicians, and other miscellaneous experts and enthusiasts in the burgeoning field of fatigue and efficiency.[22] The factory inspector and veteran of the Brussels Congress Adelaide Anderson was a member, as was the "progressive" industrialist Edward Cadbury, while its energetic organizing secretary was the

same Bessie Hutchins who had enthused over Goldmark's vision of a scientifically ordered and maximally efficient factory in the *Sociological Review*. Kent too collaborated with the association committee in tandem with his physiological investigations for the Home Office.

In truth, the science represented by the British Association Committee on Fatigue from the Economic Standpoint—as well as by Kent's *Investigation of Industrial Fatigue by Physiological Methods*—was neither physiology nor economics but a novel combination of the two: the emerging hybrid discipline I have referred to as industrial physiology. In terms of its scientific foundations, industrial physiology did not significantly depart from the explanatory frameworks and vocabulary of late-nineteenth-century physiology. However, it can be differentiated from earlier writings on fatigue both by its exclusive focus on industrial work and the working-class body and by a broad shift in emphasis from the theoretical to the practical, from the internal, biochemical workings of fatigue to its external, economic effects.

While the nineteenth-century science of fatigue reflected a broad range of anxieties about the toll taken by the advances of modern civilization and technology on body and mind, by the twentieth century concerns about the relationship between fatigue and modernity tended to focus more exclusively on the modern industrial factory and on the relationship of the human body to the machine. "Now in these days of huge factories," as one commentator asked in 1905, "is it not of importance that the laws of wear and tear which regulate the movements of our human machines should be sought as carefully and respected as religiously as those which govern the motion of our monster master-servants of steel and iron?" Thomas Oliver, in his 1914 article on "occupational fatigue," argued that the growth of the factory system, and in particular the technological developments of the second half of the nineteenth century, had imposed on the working population "a sense of fatigue of a deeper type than that which followed the hard manual labour of a bygone age." Whereas in the nineteenth century, as one writer on neurasthenia put it in 1889, it was not machine operators but "the inventors of machines" who were viewed as at risk of pathological exhaustion, in the twentieth century it was the working-class body that became the primary object of concerns about the new entity of industrial fatigue.[23]

In the 1908 paper that had inspired the formation of the earlier of the two British Association fatigue committees, the psychologist William McDougall had described fatigue as a pathology "which affects all classes at all ages." By contrast, in the first interim report Kent produced for the Home Office, published in 1915, he referred to "industrial fatigue" as "that exhaustion of the *working class* population."[24] The Anglo-American economist Philip Sargant Florence—who had served as chief investigator to the second British Association committee (and who would later work as an investigator for the Health of Munition Workers Committee)—in his 1918 PhD dissertation on the subject of industrial fatigue was careful to distinguish between simple "fatigue" and his own particular area of expertise. While fatigue, unqualified, referred to "a diminution of working capacity, often accompanied by some feelings of weariness, caused in the human organism by the length or intensity of some activity," *industrial* fatigue was defined as

> a diminution of working capacity, often accompanied by some feelings of weariness, caused in the human organism by the length or intensity of some activity *at a "gainful occupation*." Under the industrial system of today such occupation is usually carried on within a factory. . . . Moreover, in the parlance gradually being adopted from the social worker, the adjective "industrial" is applied only where the gain is comparatively a small one. Industrial life insurance, for instance, refers only to the lives of the *poorer* classes. Industrial fatigue may be defined roughly, therefore, as the fatigue occurring mostly in the factory among those gaining a bare living by their work.[25]

Industrial fatigue was not simply defined by the context of work but was specifically bounded by social class. The new science of work was also a science of the working-class body.

Industrial fatigue was also differentiated from older conceptions of physical exhaustion by the method of inquiry appropriate to its study. In a *Lancet* article of 1917, Kent contrasted "the multiple origin of industrial fatigue on the one hand," with "the simpler condition of physiological fatigue as studied in the laboratory on the other."[26] While the laws of "physiological" fatigue presented a fairly straightforward

problem for the scientist and could easily be measured by traditional laboratory experiments, *industrial* fatigue—involving as it did the complex interactions of body and machine, worker and environment—was a phenomenon of far greater complexity, requiring altogether new means of investigation. Rather than relying entirely on the artificial conditions of the laboratory, both Kent and the British Association committee argued, researchers needed to study the industrial laborer in the factory, either (in Kent's work) by devising tests of fatigue that could be applied before and after a spell of work or (for both Kent and the British Association committee) by the collection and analysis of statistical data relating to the speed, quantity, and quality of work produced.

As Richard Gillespie has argued, "Physiologists attempted to use industrial fatigue as a tactic to extend their expertise and authority from the laboratory into society." It was an explicit premise of industrial physiology that scientific research into work should produce results that not only were of interest to academics but could also be made practical use of by employers and by the government. If the "chaos of legislative regulation" governing hours and conditions of work was to be put on a rational scientific footing, industrial physiologists argued, research into fatigue needed to move beyond the abstract and narrow investigations of the laboratory scientist. "The truth is that at present we have practically no scientifically ascertained and authentic knowledge as to the nature, causation, and effects of industrial fatigue," wrote the British Association committee's J. W. Ramsbottom in 1914, "for though considerable work has been done on various aspects of fatigue, there has been no attempt to co-ordinate this knowledge and apply it to industry." Laboratory scientists, as the committee expressed it in their final report, had been "too apt to work under conditions which in the case of fatigue practically *exclude the production of any true fatigue as we meet with it in industry*." It was only as an applied science, taking as its experimental material the concrete and complex processes of actual factory work, that industrial physiology would be able to meet its "definite practical aim of influencing industrial organisation."[27]

Above all, the industrial physiology articulated in the years before the First World War was characterized by a conviction that fatigue was an entirely *objective* phenomenon, subject to precise measurement

and quantification. While the article on "occupational fatigue" that opened this chapter began with the anguished cry of the exhausted worker—"So tired!"—such a focus on subjective suffering was in fact, by 1914, extremely uncommon. Drawing on the laboratory work of W. H. R. Rivers and William McDougall, industrial physiologists insisted that the sensations of the worker were irrelevant to the scientific study of fatigue. One worker might complain of fatigue while displaying no measurable decline in work performance, experiments recorded, whereas another's work may drop off without their noticing any sensations of tiredness. Knowledge of the working body was the exclusive property of the scientific expert. Moreover, for all practical purposes, as the reports of both investigations made clear, fatigue was to be understood as "a lessened capacity for work" and measured in terms of declining "output."[28]

WAR AND INDUSTRIAL FATIGUE

In Kent's investigations for the Home Office, and in the work of the British Association's Committee on Fatigue from the Economic Standpoint, the concept of industrial fatigue that had been developing from the start of the twentieth century was beginning to solidify. In these institutional settings, the hybrid discipline of industrial physiology was taking shape. Broad agreement was reached about how industrial fatigue was to be defined and how the work of industrial physiology was to be carried out. Specifically, industrial fatigue was an objective physiological condition caused by industrial work and affecting the working-class body. It was defined as the diminished capacity for work, and, through analysis of empirical or statistical data relating to factory work, it could be measured in terms of declining work performance.

By 1914, however, industrial fatigue was still a relatively minor issue. Its emergence as an object of scientific inquiry and the proliferation of experimental research had not been matched by a similar level of political attention. While government departments and a few employers were, in the first two decades of the twentieth century, beginning to show an interest in the optimization of the working body, discussions of fatigue were still largely limited to the small circle of physiologists, economists, and factory reformers who made up the core constituency

of industrial physiology. In addition, as Arthur McIvor has shown, the impact of shorter-hours experiments and scientific fatigue research on the organization of British industry before 1914 was minimal.[29] By the time the first interim reports of Kent and the British Association committee were published, however, international events had made industrial fatigue an urgent matter of public debate. Britain's entry into the First World War, and the demands it placed on domestic industry, made the question of the limits to the body's productivity a question of national political—perhaps even existential—significance and provided the conditions for the first large-scale intervention on the part of the state.

The motivation to action was a crisis, not of workers' health or welfare but of production. The "shell crisis" of May 1915, in which the lack of artillery shells being provided to the front line was exposed, caused a national scandal and played a large role in the fall of the Liberal government.[30] One of the first items of business for the new coalition government, formed by Prime Minister Herbert Henry Asquith in the same month, was the creation of a new Ministry of Munitions, specifically to manage the production and distribution of munitions for the war effort. David Lloyd George, who had made the shell crisis his personal cause, resigned his post as chancellor of the exchequer to head the new department.[31] The express purpose of the ministry was to increase production. It organized the building of new government factories and the conversion of existing engineering workshops for the production of armaments. The Munitions of War Act of July 1915 empowered the minister to declare any private munitions factory a "controlled establishment," bringing it under the direct control of the ministry, with powers to control profits and wages, and requiring employers to provide detailed information about numbers of workers employed, the conditions of work, and the hours of labor.[32]

In addition to the expansion of production and the mobilization of new labor, the ministry was also concerned with increasing the productivity of those workers already employed in its factories, and the emergency powers granted to it by the Munitions of War Act—as well as the extreme conditions of overcrowding, poor sanitation, and long hours brought on by the pressure of munitions work in the early years of the war—provided an unprecedented opportunity for the state to

implement a large-scale investigation into the efficiency of the working body. In September 1915, Lloyd George appointed the Health of Munition Workers Committee to "consider and advise on questions of industrial fatigue, hours of labor, and other matters affecting the personal health and physical efficiency of workers in munitions factories and workshops."[33]

While the appointment of the HMWC has often been viewed as part of a top-down response to the crisis of the early years of the war—as it was, for example, in Lloyd George's own war memoirs—the new attention paid by the British government to the question of "industrial fatigue" also owed much to the scientists and reformers who had been formulating the concept in the years before the war and who, even before the outbreak of war, were putting pressure on the government to devote resources to the study of the limits of the working body. On July 29, 1914, just days before Britain's declaration of war on Germany, John Henry Muirhead, Bessie Hutchins, and J. W. Ramsbottom of the British Association Committee on Fatigue from the Economic Standpoint wrote to the National Health Insurance Commission (established under the National Insurance Act of 1911), enclosing a copy of their unpublished first interim report and requesting a monetary grant to support the expansion of their research. The request was forwarded to Walter Fletcher, secretary of the Medical Research Committee (created in 1913 under the terms of the 1911 act and responsible for the direction of funds for medical research), himself a physiologist who had made a number of important contributions to the study of muscular fatigue from the late 1890s onward, in particular through his work with Frederick Gowland Hopkins on the production of lactic acid.[34] While unable to help with the requested grant, Fletcher made provisions for investigations into fatigue and factory conditions to be undertaken by the MRC, which would take place alongside the work of the British Association committee and expressed interest in pursuing a "much more ambitious scheme" of research.[35]

Fletcher approached the Home Office (for whom Kent was in the process of writing his first interim report) about the possibility of a larger investigation into industrial fatigue but was unable to gain approval. In the wake of the shell crisis, Fletcher, in his new (additional) role as secretary to the Royal Society's wartime Committee on

Physiology, turned his attention to the new Ministry of Munitions.[36] In July 1915, Fletcher wrote to Christopher Addison, himself a former physiologist and physician, and now Lloyd George's undersecretary, informing him of the Royal Society committee's recommendation that the minister of munitions appoint a special committee to investigate "the best means of securing the maximum efficiency from munition factory workers."[37] In the opinion of the Royal Society committee, wrote Fletcher, "the efficiency and output of munition workers could be increased by applying existing knowledge upon ventilation, clothing, diet and especially upon industrial fatigue."[38] The new committee, he advised, echoing the hybrid approach of the British Association, should contain a minimum of two physiologists and "at least one experienced economist."[39]

While the committee appointed in September 1915 did not include a professional economist, it was nonetheless a mixture of scientific, medical, and industrial expertise similar to that which had characterized the British Association committee appointed two years previously. Fletcher was joined on the new committee by his fellow physiologist and MRC colleague Leonard Hill. Medical expertise was provided by Thomas Barlow, formerly the personal physician of Queen Victoria, along with Arthur Boycott, a professor of pathology at the University of Manchester. The interests of employers were represented by Samuel Osborn, of the engineering firm Samuel Osborn & Co., and those of workers, nominally, by the trade unionist, Labour member of Parliament, and efficiency enthusiast John Robert Clynes. The Factory Department supplied medical inspector Edgar Collis and senior lady inspector Rose Squire, while further female representation was provided by the former factory inspector May Tennant. The position of chairman was taken by Sir George Newman, medical officer to the Board of Education. E. H. Pelham, also from the medical department of the Board of Education, was recruited as secretary.[40]

As well as this permanent core, the HMWC also employed the services of a number of other experts to conduct a series of investigations into fatigue, hours of work, and factory conditions in government-controlled factories. The eclectic range of investigators included the economist Philip Sargant Florence (who had conducted the bulk of the research for the British Association committee on fatigue), the

medical statistician Major Greenwood, and the philosopher Thomas Loveday. The most energetic researcher, personally authoring three of the HMWC's memoranda, was the Oxford physiologist Horace Vernon, who offered his services to the committee after volunteering at a Birmingham munitions factory during the university vacation, experiencing firsthand the effects of a 74.5-hour nominal week plus overtime.[41] The results of the HMWC's research formed the basis of twenty-one memoranda on a variety of subjects produced between 1915 and 1918 (all but one of which were published), as well as two larger published reports, and a specially prepared handbook for factory managers.

Historians have rightly stressed the importance of the First World War in bringing the question of industrial health, and fatigue in particular, to national attention in Britain.[42] As one commentator remarked in 1917, "The war has caused us to give more attention to fatigue during the past two years than it has received from us during the preceding half century."[43] In the work of the HMWC, the discourse of industrial physiology that had been developing in Britain over the previous decade or so would receive its fullest, and most influential, articulation. In theoretical terms—that is, in the scientific definitions and explanations of fatigue they advanced—the HMWC made few innovations. However, the problems established by industrial physiology were given new salience in a transformed political context.

If early-twentieth-century concerns about the physical deterioration of working-class bodies, encapsulated in the new concept of industrial fatigue, had collapsed the physiological with the social, the effect of the war was to invest the metonymic relation between biological body and productive body with a new patriotic significance. As Britain's collective industrial power was mobilized for an imperialist war, the body of the factory worker—and the munition worker in particular—became a physical embodiment of national strength. The productive body became a military-industrial complex. A 1916 article in the magazine *Health & Strength* characterized munition workers as "a vast industrial army no less essential to victory than the lads in the firing line." For "his own sake and for his Country's sake," the author argued, "the munitionist must keep fit. The better his health the greater his efficiency, and the greater his efficiency the bigger his output." In this context,

fatigue became an "urgent national problem," potentially representing not simply the decline of profits but the difference between winning and losing the war.[44] "The health of the munition worker," as HMWC chairman George Newman put it, was "just as important to the Nation as the health of the soldier."[45] The elimination of fatigue was central to "the vigour, strength and vitality of the nation."[46]

Just as early industrial physiology had predicated its social utility on providing scientific answers to practical questions of industrial organization, the HMWC conceived of its work as an applied science: "a cross breed," as Newman described it, "between research and administration."[47] While the members of the HMWC—along with the ministry's Welfare Department, established in December 1915 on the basis of an HMWC investigation into welfare supervision and headed by the Quaker industrialist Benjamin Seebohm Rowntree—often couched their work in terms of workers' welfare, their primary purpose was unambiguously the maximization of productivity in service of the war effort.[48] The HMWC, as the Ministry of Munitions' Christopher Addison reminded one committee member in September 1915, was appointed by the ministry "with a view to securing an improved output of munitions of war."[49]

The discourse of industrial physiology—defining fatigue precisely as an objective decline in output—fitted such imperatives perfectly. In a memorandum titled "Industrial Fatigue and Its Causes," the HMWC defined fatigue as "the sum of the results of activity which show themselves in a diminished capacity for doing work." Subjective manifestations of fatigue were irrelevant to its objective course and were not worthy of scientific consideration. The memo continued:

> In ordinary language fatigue is generally associated with familiar bodily sensations, and these sensations are often taken to be its measure. It is of vital importance for the proper study of industrial fatigue, however, to recognise not only that bodily sensations are a fallacious guide to the true state of fatigue which may be present, and a wholly inadequate measure of it, but also that fatigue in its true meaning advances progressively, and must be measurable at any stage by a diminished capacity for work, before its signs appear plainly, or at all, in sensation.[50]

While the committee's chief researcher, Horace Vernon, may have been able to draw on his own experience of subjective fatigue as a volunteer munitions worker, he was careful not to let such considerations influence his work for the HMWC. If working capacity was not diminished, as he would later clarify, then any apparent fatigue, even though it might produce "severe subjective sensations in the worker," was neither "abnormal" nor "pathological," and "serious objection could not be taken to it on the ground of the sensations produced." Practically, as Alan Derickson has argued, "it was only a short step to defining fatigue as diminished output," with the crucial implication that "if tired employees could be driven by threats, stimulants, financial incentives, nationalistic appeals, or machine pacing to maintain output throughout their work shifts, no fatigue existed." As a later memo on hours of work confirmed, if efficiency could be maintained, the HMWC would "raise no *a priori* objections to any given number of hours, however long."[51]

"The true sign of fatigue is diminished capacity," explained the HMWC's memo on industrial fatigue, "and it follows from what has been said that measurement of output in work will give the most direct test of fatigue."[52] It is worth emphasizing the circular, reifying logic of such claims. Industrial fatigue was posited as an explanation for declining productivity, then measured in terms of the very decline it was supposed to explain. As a result, fatigue appeared not as an internal physiological condition experienced by the worker but as an externalized pathology of the productive body, defined completely in economic terms and quantified in the number of units a worker could produce in a given period of time.

As well as the so-called direct measure of output, the memorandum on fatigue detailed a number of "secondary" methods by which a measurement of fatigue could be obtained—foremost among them the incidence of "accidents" and of "spoiled work"—again corresponding to productivity rather than biology. Ideally, the committee explained, measurements should be taken without the workers being aware of it, so as minimize any subjective influence on the results.[53] This was a physiology, then, that had no need of bodies. Direct experimental research on workers (in the form, for example, of tests of muscular strength or reaction time) was rare. Instead, as numerous reports and

research manuals set out, it was preferable to rely on statistical data collected from records kept by factory management.[54]

Rather than focusing on the biological body (which was always kept at a distance), industrial physiology sought to isolate and measure the *productive* body in its pure form—as a statistical composite and mathematical average—at once derived from, yet radically divorced from, the flesh-and-blood bodies of the workers themselves. For industrial physiology, the most direct way to observe the working body was not to observe it at all, instead relying almost exclusively on abstract representations of pure productivity. The subjective sensations of the body entered into the work of the HMWC only as a disruptive influence, the effects of which needed to be minimized in the practice of proper scientific methodology. Indeed, the purpose of the scientific method was to render such subjective feelings invisible.

PHYSIOLOGICAL MANAGEMENT

In the terms of Guéry and Deleule, then, industrial physiology was predicated on "the eviction of bodily experience from the epistemological field." When it came to the practical recommendations of the HMWC, such a conceptual framework had significant implications. If workers were unable to accurately recognize their own fatigue, then their opinions as to the effects of work on their own bodies could have no legitimate bearing on industrial questions, such as factory conditions or hours of work. As the memorandum on fatigue explained: "During the continued performance of work the objective results of nervous fatigue precede in their onset the subjective symptoms of fatigue. Without obvious sign and without his knowing it himself, a man's capacity for work may diminish owing to his unrecognised fatigue." After a certain point, the memo argued, the workers' time "begins to be uneconomically spent." It was the responsibility of "scientific management"—and not the worker—to determine this point and to "determine further the arrangement of periods of rest in relation to spells of work that will give the best development . . . of the worker's capacity." "If the operatives are left to themselves," recorded another memorandum, on the subject of hours of work, "they take rests at irregular and often unsuitable times. Hence it would be much better if the rest pauses were chosen

for them."[55] The organization of work was a purely technical question. Questions of hours of work, the intensity of labor, and distribution of rest spells were not to be negotiated between management and labor but determined by objective scientific knowledge and the expertise of industrial physiology.

In making such recommendations, the HMWC was keen to distance itself from the contemporary systems of workshop rationalization that went by the name "scientific management." While, as the above-quoted passage shows, they were not always shy about using the term, the proponents of industrial physiology were always careful to distinguish their own work from the "American" forms of scientific management associated with Frederick Winslow Taylor and his followers.[56] In part, this was due to an awareness of the widespread suspicion among workers and unions, who broadly viewed scientific management and its methods (particularly time and motion study) as little more than means for employers to extort a greater intensity of work from employees.[57] However, the rejection of "American" scientific management also provided an important point of contradistinction by which industrial physiology could define its own particular expertise.

The British advocates of industrial physiology characterized the American-inspired "efficiency engineers" as presenting a simplistic, reductive, mechanical view of the worker. Rather than attempting to determine the true scientific principles and physiological laws that would ensure the maximum of efficiency over time, efficiency engineers offered crude one-size-fits-all solutions, increasing profits in the short term through "driving" labor to the breaking point. In short, as the British Association Committee on Fatigue from the Economic Standpoint concluded, in failing to recognize the true physiological basis of the labor process, the problem was that "scientific management" was simply not scientific enough: "Scientific Management has perhaps not spent enough time searching scientifically for the laws of fatigue before setting its standard intensity of work," the committee protested, "yet, if once these laws are discovered, then it is only to *a really scientific management* that we can look for the application of the discovery." While acknowledging research by Taylor and others on the relation of the distribution of breaks in work to output, the HMWC's

final report likewise concluded that this was "another problem which has never yet been *scientifically* explored."[58]

For the proponents of industrial physiology, it was not that the working body could not be thought of in mechanical terms but only that previous researchers had failed to appreciate the complexity of the machine they were dealing with, the sheer number of variables that affected the performance of its work. "The human machine," wrote Kent in 1917, "infinitely more complex and highly tuned than any work of man, is correspondingly delicate and dependent for its efficiency upon suitable surroundings."[59] In principle, the working body obeyed strictly predictable physical and physiological laws, yet these were often hard to determine in practice due to complex and interconnected influences of psychology and the environment. In the interwar period, consideration of these complicating factors would lead to a greater focus on the worker's psychology and the "human factor in industry."[60] In the HMWC, tensions between the view of the worker as a complex human being and a simple instrument of production led to sometimes paradoxical statements, such as chairman George Newman's caution that "the worker is not a machine, and cannot be so treated without grave loss of efficiency."[61]

Despite adorning criticisms of scientific management with references to workers' well-being, industrial physiology made it explicit that the problem of scientific management wasn't that it increased output to the detriment of workers' physical and mental health but that, in the long run, it *failed* to increase output. And, further, only a properly scientific application of the principles of industrial physiology could secure a permanent increase in productivity. While the object of American so-called scientific management was simply a direct increase of output in the short term, explained the HMWC's Walter Fletcher in an early memorandum to the Ministry of Munitions, the "object of scientific *physiological* management is to secure the optimum physiological efficiency and the maximum output" over long periods of time.[62] The characteristic innovation of industrial physiology—which reached its apogee in Britain with the work of the HMWC—was to insist that the two were in fact identical: that health and productivity were one and the same. It is not so much the case that work scientists prioritized output over health but that the science of work collapsed any distinction between the two.

This conceptual elision had important consequences for the organization of work and industrial relations. If the protection of workers' health and safety and the enhancement of their productivity were one and the same, then the interests of capital and labor were essentially identical. Disputes over working conditions or the length of the working day were technical problems rather than political ones and could be satisfactorily resolved in the best interests of all parties by the mediation of scientific expertise.

"The problem of scientific industrial management," as the HMWC repeatedly asserted, "dealing as it must with the human machine, is fundamentally a problem in industrial fatigue." Conflicts between workers and employers had arisen in the past due to work being organized in contravention of "physiological law," and industrial physiology promised "a hearty co-operation between employers and employed, in the task of finding the optimum conditions of work for the benefit of both." As Kent reflected in 1920: "Yet it may be said with certainty that the best result, in the sense of greatest output with least fatigue, can only be obtained by a careful adjustment of hours of work to the conditions of the operation concerned, and that the real interests of capital and labour, which indeed, in this respect are almost identical, should be secured through such an arrangement based on scientific principles." Even John Clynes—representing the interests of organized labor on the HMWC—was personally committed to the development of a scientifically managed labor process, in which technocratic expertise and corporatism would replace collective bargaining and class struggle as the basis of industrial politics.[63]

THE HEALTH OF THE WORKER

Viewed within a wider context of state interventions into the health of the population around the start of the twentieth century, the science of work begins to look less like a specific discourse of industrial medicine, confined within the factory, and more like a—perhaps unusually explicit—articulation of the ideological foundations for a much broader discourse of the working-class body. In the science of industrial physiology, the equivalence of health and productive capacity (often latent in discussions of "physical deterioration") was made unambiguously

plain.[64] When industrial physiology referred to the health of the worker—as in the title of the handbook prepared by the HMWC for munition factory owners, *The Health of the Munition Worker*—it was usually explicit that this meant the health of the worker only insofar as they *were* a worker: that is, as far as he or she could meet the minimum bodily requirements to maintain productive efficiency. Industrial health—a term only just coming into use in the early twentieth century—likewise referred to health only insofar as it was relevant to industrial production. Indeed, as in the title of the HMWC's final report, it usually came as part of a dyad: *Industrial Health and Efficiency*.

For the HMWC investigator Philip Sargant Florence, health could be defined as "the actual seat of working capacity." "Without health," a committee publication began, "there is no energy, without energy there is no output."[65] It was in this context that fatigue—defined as "diminished capacity for work"—was able to emerge as the all-encompassing pathology of industrial work, effectively describing any impediment that might possibly befall a worker. The opposition between health and infirmity (at least for the working-class body) was resolved into the binary of efficiency and fatigue. While only one of the HMWC's memoranda was specifically dedicated to the subject of fatigue, it was a constant presence, both symbolically and literally, throughout their reports.[66] "Special industrial diseases" such as lead or TNT poisoning were an issue only insofar as they might result in "interference with output" (indeed, as Antonia Ineson and Deborah Thom have shown, the HMWC was happy to collude with management to downplay the harmful effects of TNT in order to maintain levels of shell production), while general "sickness and injury" were considered to the extent that they were harmful to "industrial efficiency and output."[67] Not only fatigue but health itself could now be measured directly in terms of productivity.

While some historians have emphasized the broad scope of the HMWC's investigations—taking into account not only the workplace but also a wide range of external considerations such as diet, leisure, and home life—it is important to stress the extent to which the unambiguous object of all such investigations was the maximization of working efficiency.[68] The conceptual opposition between health (as capacity for work) and fatigue (as its absence) enabled the logic of productivity

to take on a comprehensive scope with regard to the body. The body was reimagined as in its very essence productive. "The inclination to work rather than to be idle," as the HMWC concluded, "is a deep-seated natural phenomenon."[69] Work became the fundamental telos of the body. As such, even those parts of life apparently unconnected with work—indeed, even those ostensibly diametrically opposed to work, such as rest and recreation—could be incorporated within the body's greater purpose. Inactivity itself was colonized by the logic of productivity, reimagined only as the maintenance and enhancement of the body's immanent productive capacities. "Rest after activity is not a passive state," stressed the HMWC, "but is itself an active process, or a series of active processes, leading to a restoration of the normal capacity for work." The worker was not a worker only while "at" work but was—by virtue of a body whose guiding purpose was to produce output—perpetually caught within a constant "rhythm of action and rest," which could in turn be finely tuned to a state of maximal efficiency.[70] The study of fatigue and efficiency, argued the HMWC, needed to consider not simply "the individual, taken at any one moment" but "his life history, his heredity, his family, his domestic life, his personal habits and customs, his home as well as his workshop." Not only workers' bodies but their whole lives had to be viewed from the point of view of optimizing their productivity, taking into account, as another advocate of "industrial medicine" put it in 1919, "every human equation in this problem which affects the health and efficiency of the individual or of the entire group of employees."[71]

Echoing the rhetoric of eugenics—and other contemporary discourses aimed at the working-class body—the HMWC and other proponents of industrial physiology linked industrial health and fatigue to a number of moral, social, and political concerns. Industrial physiology aligned productivity with racial hygiene. The physical exhaustion caused by overwork, it was argued, left workers weak and susceptible to the temptations of "racial poisons" such as alcohol, putting at risk not only their own bodies but the productive stock of the nation. Fatigue, the HMWC reported, "increases the temptation to men to indulge in the consumption of alcohol; they are too tired to eat, and seek a stimulant." Kent likewise concluded that "fatigue lies at the very root of chronic alcoholism" and stressed "its greatest potency for

evil—viz., its influence on the health of the stock." If fatigue was left to progress unchecked, warned the HMWC, the worker's productive potential would be wasted, leaving him or her "a liability and even a charge on the State."[72]

The specters of irreversible exhaustion and degeneration—the bodily expressions of the principle of entropy—that had haunted the science of fatigue in the late nineteenth century resurfaced in the twentieth in references to "permanent" or "accumulated" fatigue. Directly borrowing from the language of thermodynamics, Kent wrote in 1916 that, where insufficient time was allowed for rest, "permanent fatigue" would develop, until either "the worker breaks down under the strain" or "equilibrium is brought down" as workers conserved energy by producing less output.[73]

Chronic physical fatigue, warned the industrial physiologists, not only would damage workers' bodies but could also poison their minds, weakening their defenses against dangerous social and political creeds and risking disruption to their continued productivity. "The overworked and tired man," commented a *Lancet* editorial, "must become irritable, and is the ready material for any agitator to set alight whatever be his special gospel." A government investigation into industrial unrest in war factories in 1917 similarly pointed to "ample evidence to show that the continuous labour and unduly extended hours during the War have caused a state of nervous exhaustion in large numbers of workers which has made them more susceptible to influences contributing to unrest."[74] In the conceptual framework of industrial physiology, the political beliefs and demands of workers were little more than subjective expressions of objective pathological states, which would disappear once labor was organized according to properly physiological principles.

THE (RE)PRODUCTIVE BODY

The social and moral panic associated with the science of fatigue was nowhere more emphasized than in the HMWC's discussion of the influx of juvenile and, especially, female labor into munition factories during the war. It was here also that the adoption of eugenic rhetoric—though again with a decidedly productivist inflection—was most explicit. As the war progressed, with large numbers of men of working age being

killed, eugenic anxieties about the "future of the race" were intensified, with a decided shift in emphasis toward children (as the next generation of workers) and toward women (as the "mothers of the race"). In the discourse of the science of work, racial and eugenic arguments were fundamentally connected to concerns for the productive body: the maintenance of national efficiency depended on the reproduction of a healthy and productive labor force. In this context, industrial fatigue presented itself as a problem not just of the current industrial population's ability to work but as a threat to the preservation of national productivity in generations to come.

"At the present time when the war is destroying so much of its best manhood, the nation is under special obligation to secure that the rising generation grows up strong and hardy both in body and character," declared the HMWC's memorandum on juvenile labor. "It is necessary to guard not only against immediate breakdown," the report continued, "but also against the imposition of strains which may stunt future growth and development."[75] Young workers needed to be protected from overwork, not so much for their own welfare but for the benefit of the nation, to preserve their productive energies into adulthood.[76] "A length and intensity of activity that will do adults no harm may permanently stunt the rising generation," warned Florence, who dedicated a chapter of his 1918 thesis to the varying effects of fatigue on workers of different ages, sexes, and races.[77]

When it came to discussing female labor, it was not so much the productive body but the *re*productive body that came to the fore.[78] Whereas men's physiology was in general reduced to capacity for manual work, women's was routinely reduced to capacity for childbirth. The responsibility for the regeneration of the race after the devastations of the war was seen as falling on British women—viewed primarily as "mothers" or "prospective mothers"—with debates about women workers' welfare tending to make this their central theme. "More than ever in the past should consideration now be given to the well-being of young girls fresh from school, of the prospective mother, and of the mother whose care is especially claimed by her infant during the first months of its life," proclaimed the HMWC's memorandum on the employment of women, "for more than ever is their welfare of importance to the State, and much more than ordinarily is it threatened by

conditions of employment."[79] The reproductive body, then, was an integral component of the productive body, fundamentally linked, though hierarchically subordinate. Women had to be protected from overwork and fatigue, not so much for their own benefit but to ensure that they were fit to give birth to and nurture future generations of workers and soldiers.[80] "Upon the womanhood of the country most largely rests the privilege first of creating and maintaining a wholesome family life, and secondly, of developing the higher influences of social life," asserted the HMWC memo on women.[81] The question of female labor was "a matter of vital importance to the future of the British race."[82]

Physiological differences between the sexes were a preoccupation in the work of the HMWC and in the conceptions of fatigue advanced in their reports. "Woman," as the committee's chairman, George Newman, reflected in 1918, represented "a peculiar and particular physiological instrument."[83] Women were consistently portrayed as constitutionally weaker than men and thus more subject to physical fatigue. "There is a general consensus (it is indeed beyond dispute)," reported one memo, "that women are unable to bear the strain of long hours so well as men."[84] While perhaps better able to bear mental fatigue in some cases (the female temperament being more suited to unskilled and monotonous work), "conditions of muscular strain well borne by the ordinary boy" would be "highly detrimental to the girl of corresponding vigour and physique."[85] Moreover, women were subject to further biological constraints that did not affect men—for example, being, as Florence indelicately put it, "subject each month to a period of sickness."[86] Under the banner of welfare, women workers were subjected to a regime of medical inspection, surveillance, and supervision far more intense than anything imposed on their male counterparts.[87]

While some discussions of female fatigue acknowledged women's further burden of domestic work outside their paid hours, in general anxieties about "women's work" and its effects focused on the factory.[88] These concerns were often as much moral as they were purely physiological.[89] Indeed, as the HMWC wrote, especially in the case of women, problems of physiology were inseparable from those of "social relationship or morals, and of human conduct." The task of industrial physiology was to "secure the inestimable advantages of woman's skill and energy without those irremediable and far-reaching evils which

will inevitably arise if her contribution be not wisely and effectually safeguarded."[90] Such evils included the improper spending of wages, unwholesome use of leisure time and recreation, inappropriate interaction with male workers, and, crucially, the abandonment of domestic duties and the deterioration of family life and moral values as a result of mothers' absence.[91] (This in turn was linked to further social evils, such as alcoholism: the deserted husband, wrote Kent—deprived of a well-cooked meal—was impelled "to spend his free time in the public house and to look upon alcohol as a necessary condiment with his tasteless and indigestible diet.")[92]

As Gail Braybon has shown, in debates about women's welfare during the First World War, the question of the effect of munitions work on women's health was often subordinated to the problem of whether their participation in paid work at all was luring women away from their "true role" as mothers and homemakers and, if so, what effects this might have on the future of the nation and of the "race."[93] Scientific knowledge was called on to justify preexisting conservative attitudes to female labor, and commentators from across the political spectrum drew on the language of industrial physiology to support the view that women were particularly unsuited to industrial work. If allowed to work themselves to fatigue, it was argued, they would have no energy left for their reproductive and maternal duties. The eugenicist Caleb Saleeby, for example, claimed that if a woman worked while pregnant, "the mother puts into the products of her external work the energy which should have gone into the internal work which she alone could do, of creating and saving the future."[94] "It has been said that we are financing this war by borrowing from future generations," the trade unionist Mary Macarthur likewise wrote. "In nothing is this more true than in the case of women workers. We are, in fact, borrowing the health and efficiency of generations unborn."[95]

Patriarchal discourses about women's work obviously had a long pedigree, and wartime fears about the future of the race extended far beyond the work of the HMWC. As with the Brussels Congress and the Committee on Physical Deterioration earlier in the century, however, the concerns of eugenics and industrial physiology were often compatible. Both discourses relied on a powerful homology between the biological and the social, and both sought to influence legislation in order to effect reorganizations of the body and of society according to

rational scientific principles. For the HMWC, and for the government that appointed it, moral concerns were always secondary to those of productivity. However, more often than not the two spheres were seen as inseparable. Prescriptions on behavior (particularly for women) were justified in terms of economic benefit. The future of the race and the fitness of the population were concerns for industrial physiology because they also represented the future of the nation's industrial power and of the continued efficiency of the productive body.

CONCLUSION

While acknowledging that in their wartime work they were "solely concerned with the factors which are of importance during the present emergency," and, obviously, only with munitions work, the HMWC and its investigators nonetheless always emphasized that the science of the working body they advanced had a far broader applicability. As the HMWC's final report, published in 1918, put it, "The fact is that this Report of the Committee's work, though concerned primarily with the munition worker, deals also with vital principles and practical methods affecting all forms of industry." By the end of 1917, members of the HMWC were in discussions with government departments about establishing a permanent peacetime body through which their research into fatigue and the working body could be continued and expanded beyond munitions factories. In July 1918, this ambition was realized with the appointment of the Industrial Fatigue Research Board. Established under the joint auspices of the Medical Research Committee and the Department of Scientific and Industrial Research, and with the backing of the Home Office, the brief of the new board was "to consider and investigate the relations of the hours of labor and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers."[96]

Industrial fatigue—an entity that twenty years previously was absent from British scientific or political discourse—was now firmly established within physiological and medical vocabulary and enshrined in the name of a government institution. While historians have debated the extent to which the HMWC's recommendations made a significant impact on factory organization or hours of work during the war, the

acceptance of the language of industrial physiology, by the scientific community and by the state, is nonetheless testament to its discursive impact by 1918.[97] Moreover, in giving shape to an emerging coalition of efficiency reformers, trade unionists, and government officials, and bestowing scientific legitimacy on demands for reduced working hours, the HMWC and industrial physiology played an important role in laying the groundwork for postwar reforms.

The development of industrial physiology was never separate from its practical application or from the interests of the various groups by whom it was articulated and contested. The science of fatigue and the working body was shaped in response to economic, political, and institutional imperatives. For the discipline of physiology, the problem of industrial fatigue provided a point around which claims of expertise, authority, and social utility could be enunciated. By drawing on contemporary rhetorics of eugenics and national efficiency, physiologists presented their discipline as a form of social hygiene, necessary to the continued health of the nation and of the race. For a range of social reformers, the scientific language of physiology and the authority of statistical evidence lent credibility to demands for changes in the organization of work and working conditions. For industry and government, industrial physiology could legitimate attempts to introduce programs of scientific management and rationalization of the body aimed at maximizing productivity, all while claiming to act in the interest of workers' welfare.

The emergence of the discourse of industrial physiology represented the articulation of a science of what François Guéry and Didier Deleule have termed the productive body. The category of industrial fatigue, collapsing the distance between the biological and the social, placed the body at the center of debates about work. At the same time, however, it entailed a radically limited understanding of the body as a cog in the industrial machine, far removed from the embodied experience of work. In the final instance, fatigue was a disease not of the worker but of production. Symptoms were read not from the body but from its output. For industrial physiology's proponents, the individual worker was important only insofar as he or she represented a constituent element of the nation's productive potential, while health itself was reduced to an index of productive capacity.

CHAPTER 3

INDUSTRIAL PSYCHOLOGY AND THE HUMAN FACTOR

In the interwar period, the science of work became psychological. Concerns about the physical consequences of overwork gave way to the study of the mental effects of factory life. While the new experimental psychology of the late nineteenth century had established mental fatigue as a topic of laboratory research, psychological questions had played only a small part in the science of work up to the First World War. The memoranda of the wartime Health of Munition Workers Committee, while beginning to expand the scope of fatigue study beyond the question of physical overwork, only rarely addressed questions of behavior, personality, or emotion.[1] Increasingly during the 1920s and 1930s, however, psychological questions came to dominate a science of work that defined its central topic as "the human factor in industry." As the psychological profession sought to assert its corporate identity and social utility through the application of its methods to industry, the science of work expanded its scope and influence. New institutions were established for the psychological study of work, and firms increasingly employed the services of psychologists to select, train, and rationalize their workforces.

The growth in influence of the science of work during the interwar period can be explained in part by changing economic conditions. As Harry Braverman has argued, the adoption of various "scientific management" techniques in the late nineteenth and early twentieth centuries was linked to the parallel rise of "monopoly capitalism" through economic concentration. Large conglomerate firms experienced new problems of coordination and control and were able to bear the initial costs of introducing large-scale schemes of rationalization.[2] In Britain concentration did not take place on a significant scale until the interwar period, when it accelerated rapidly, and the very largest firms of the interwar period made up the most significant market for the new institutions of industrial psychology.[3]

The shift in focus from the physiological to the psychological can also be explained, in part, by large-scale economic, political, and industrial developments. The interwar period saw significant reductions in working hours in most industries—not only from wartime peaks but from pre-1914 norms. In the aftermath of the Armistice, faced with widespread strikes at home and the specter of Bolshevik revolution internationally—but also reassured by scientific promises of increased efficiency at shorter hours—employers (and government) rapidly conceded on work-time demands that the First World War had temporarily stalled.[4] The average weekly hours of a full-time industrial worker in Britain fell from fifty-six before 1914 to forty-eight in the interwar period, with an eight-hour day becoming widely accepted as standard.[5] This fact, combined with the increasing mechanization of industrial processes in the 1920s and 1930s, saw attention shift from the effects of extreme physical labor to the mental effects of monotony and repetitive work. As wartime conditions of high demand and short supply of labor were (after a brief postwar boom) reversed in an interwar period characterized by high unemployment and long periods of recession, attention shifted from extracting the highest possible quantum of output from a limited workforce to questions concerning the selection of the most efficient workers from a large supply. At the same time, continuing concerns over industrial unrest in the interwar period only increased the appeal of psychological expertise in the administration and control of the factory.[6]

It was in these conditions that psychologists placed themselves at the service of industry. In the terms of sociologist Loren Baritz, they made themselves "servants of power."[7] Dependent for the survival of their discipline on the benevolence of their sponsors, they tailored their science to suit the needs of industry and the state. The result was a model of human behavior and mental health grounded firmly in the ideological assumptions and practical requirements of industrial capitalism.[8] Despite the claims of many of its practitioners, industrial psychology, like industrial physiology before it, was in practical terms concerned not with the welfare of the worker but with the health and efficiency of the productive body.

THE EMERGENCE OF INDUSTRIAL PSYCHOLOGY

In the interwar period, psychology was still a marginal academic discipline. When the Second World War broke out in 1939, there were only six chairs of psychology in British universities—three of which were in London—and the total lecturing staff in departments of psychology across the country numbered "only around thirty."[9] As a number of historians of the subject have argued, psychology in this period subsisted chiefly as a practical science, "saved by its applications, educational, industrial and medical."[10] Indeed, as Nikolas Rose has argued, the status of psychology as a form of knowledge cannot be seen as independent from these concrete "applications." Developments in psychological knowledge, Rose argues, did not take place in a "pure theoretical space," whence they could be usefully applied to practical problems. Rather, the conditions of possibility for the emergence of modern psychology, its institutional frameworks and conceptual apparatuses, were formed in and through its practical work, shaped in turn by the social, political, and administrative demands of the state.[11] While Rose emphasizes techniques developed to regulate abnormal conduct and to identify and classify the deviant or pathological individual—in particular in the schools and courts—he overlooks another crucial motor for the development of psychology in the early twentieth century: the desire (of capital and the state) to transform the individual, and the working population as a whole, into a productive force.[12]

From the late nineteenth century, representatives of the new scientifically minded experimental psychology—aware of their own marginality—had sought to assert the social utility of their expertise. William McDougall (whose work on the measurement of mental fatigue was examined in chapter 1) was a prominent early example.[13] In his *Social Psychology,* published in 1908, McDougall argued that psychology was not simply relevant to other forms of sociological discourse but in fact "the essential foundation on which *all* the social sciences . . . must be built up." Since all social sciences were at base rooted in the study of human behavior, McDougall argued, there could be no adequate conception

of "ethics, economics, political science, philosophy of history, sociology, cultural anthropology" or of "the sciences of religion, of law, of education, [or] of art" that was not grounded in a robust theory of the human mind. McDougall set out a model of human behavior based not on the rational calculation of *Homo economicus* but on the primitive drives of innate or inherited instinct, often acting without the conscious knowledge of individuals. Comparing society to a great thermodynamic motor, McDougall argued that these "mental forces" were the "sources of energy, which set the ends and sustain the course of all human activity." To attempt a theory of psychology or of society without an understanding of this "native basis of mind," he wrote, would be like "describing steam-engines while ignoring the fact of the presence and fundamental role of the fire or other source of heat."[14]

Throughout the interwar period, psychologists asserted the centrality of their expertise to all forms of political, economic, and social inquiry.[15] Human society, wrote the psychologist Cyril Burt in 1926, should be seen as essentially an aggregate of "human minds": "Hence, it follows at once that psychology must have an intimate bearing upon social questions of whatever sort." Over the previous fifty years, Burt argued, psychologists had set aside their "books and papers" and made their way "into the classroom, the factory, and the prison," establishing psychology as an applied science, providing useful answers to practical questions.[16] Of the sites mentioned by Burt, the factory was unquestionably the most important for the advancement of psychology in the interwar period.[17] Showing that psychological methods could increase the efficiency of industry, make the bodies and minds of workers more productive, decrease fatigue, and increase output was the clearest way, psychologists judged, to prove the social—and economic—worth of their discipline. In so doing, it also became the most effective means of securing funding—from government and from employers—for psychological research.

British psychologists were not the first to make the link between psychological knowledge and productivity. In 1913 the German American psychologist Hugo Münsterberg had published his *Psychology and Industrial Efficiency*. His aim was to create an applied psychology, or "psychotechnics," in which the techniques of experimental psychology could be "placed at the service of commerce and industry." In the

industrial context, Münsterberg argued, applied psychology would play an impartial, technical role: just as an engineer had the expertise to build a bridge if one was desired yet was not concerned with the question of its desirability, the psychologist would simply provide technical solutions to industrial problems without commenting on their moral or political implications. In effect, of course, this meant making the industrial psychologist a willing "servant of power," the compliant executive of capital's demands for increased productivity. "Economic psychology," as Münsterberg termed his new enterprise, would aim at creating the "best possible man" from the point of view of production.[18]

While Münsterberg's work was briefly cited by the British Association Committee on Fatigue from the Economic Standpoint, more significant for the rise of "industrial psychology" as a self-conscious specialism in Britain was the publication, in 1917, of Bernard Muscio's *Lectures on Industrial Psychology*.[19] Born in Australia in 1887, Muscio had come to England in 1912 to study philosophy and psychology at Cambridge, where he served as a demonstrator in experimental psychology from 1914 to 1916, before returning to the University of Sydney. One consequence of the First World War, Muscio argued, was to illustrate the great advantages to be gained from "the systematic application of science to industry." While this was widely recognized in the physical and chemical sciences, however, there was as yet "scarcely any conception of applied psychology, or of the results which might be obtained from the application of psychology to industry." There was a clear line from the industrial physiology of the early twentieth century to Muscio's conception of industrial psychology. Praising the pioneering fatigue research of the British Association and the HMWC, Muscio argued that it was now necessary for psychologists to prove their usefulness to society through the application of their own specialist knowledge to industrial questions. Crucially, like Münsterberg, Muscio imagined for psychology a wholly technical role. It was not for psychologists to determine the aims of industrial enterprise, only to provide expert knowledge when called on to address industrial questions. "All that the application of psychology means essentially," he stated, "is that the aim of industry, *whatever this is,* may be effected more easily."[20]

In theoretical terms, the psychology set out by Muscio in 1917 was firmly grounded in the conceptions of human energy that had defined

the science of work from the start of the twentieth century and, in practical terms, remained explicitly directed at increasing productivity. It was the task of industrial psychology, Muscio argued, to obtain the maximum output from the worker with the minimum expenditure of energy. With this in mind, the psychologist could help industry to achieve its goals in two main ways: first, by devising means to select workers for particular tasks "on the basis of natural fitness" and, second, by constructing methods of work that would conserve the energies of the worker, reduce fatigue, and maximize productivity.[21]

Of the readers of Muscio's *Lectures in Industrial Psychology,* none was more influential than his former Cambridge tutor, Charles Samuel Myers, "undoubtedly," the historian Geoffrey Bunn has argued, "the most important British psychologist of the first half of the twentieth century."[22] While himself a student at Cambridge in the 1890s, Myers had become attracted to the experimental psychology taught by W. H. R. Rivers.[23] In 1898 Myers (along with his fellow student William McDougall) accompanied Rivers on an expedition to the Torres Strait organized by the Cambridge anthropologist Alfred Cort Haddon, where he helped to conduct psychological investigations into the Indigenous population.[24] Shortly after their return, Myers was invited to assist Rivers as university demonstrator in experimental psychology, becoming a lecturer in 1909 and director of a new purpose-built psychological laboratory (which he had personally helped to fund) by 1912.[25] From 1913 he served on the British Association Committee on Fatigue from the Economic Standpoint.[26] During the First World War, Myers served with the Royal Army Medical Corps in France and then at Maghull Military Hospital in Lancashire, becoming influential in the recognition and treatment of "shell shock" as a psychological condition, writing the first paper on the subject to be published in a recognized medical journal.[27] In the interwar period, Myers was to become the leading figure in the development of a psychological science of work.

Myers returned to Cambridge at the end of war "fired with the desire" to apply psychology to practical questions.[28] After reading Muscio's 1917 lectures, he turned his attention to psychology's industrial applications.[29] In 1919 the two men organized a conference at Cambridge "for the study of certain industrial management problems, chiefly from the psychological point of view," resulting in a published collection

of lectures.[30] In the modern world, Myers argued, "the psychological factor" was "by far most important and fundamental" determinant of "industrial and commercial efficiency."[31] As he explained, however, this "psychological factor" embraced a wide range of influences. Since in practical terms it was impossible to isolate mental from bodily activity, so in theoretical terms psychology could not be separated from physiology or from any of the other sciences that dealt with the operation of the human body: "Just as physics involves mathematics, just as physiology—the study of the living body—involves chemistry and physics, so psychology—the study of the living mind—must involve physiology. The higher sciences involve the lower; and in this respect psychology, the most recent and the most complex of all the biological sciences, is the highest of them all."[32] Likewise, in the context of applied industrial research, the psychologist had to take into account "the ethical or the economic aspects of the operations on which they were asked to advise." In the eclectic tradition of the science of work developed before the First World War, then, industrial psychology—as conceived by Myers—was to be a hybrid discipline: "a hotch-potch," as one commentator put it in 1932, "of physiology, psychology, sociology and one or two other sciences."[33] Its coherence as a specialism came less from a unified theoretical approach than a unified purpose: the improvement of "human power and efficiency" and the maximization of industrial output.[34]

INSTITUTIONALIZING INDUSTRIAL PSYCHOLOGY

In April 1918, Myers delivered two lectures at the Royal Institution, published the same year under the title *Present-Day Applications of Psychology with Special Reference to Industry, Education and Nervous Breakdown*. The book was effectively a manifesto for applied psychology in the twentieth century, an era in which—according to Myers—the science of the mind was "bound to play an increasing part alike in industry, jurisprudence, education, aesthetics and medicine." Crucially, Myers argued, psychology required institutional settings, so that the expert knowledge of its practitioners could be organized and made available to politicians, businesses, and the public in a systematic way: "The urgent need now is for institutes of applied psychology in

each of our largest cities, which may serve as centres for attacking these practical problems with the help of experts trained both in psychology and in the particular branch in which its help is needed, and with the active, enlightened sympathy of the general public." With respect to industry, he argued, the "time seems ripe for the formation of a society, composed of employers, employees, and scientists," working together to reduce industrial fatigue and increase productive efficiency.[35] In October of the same year, Myers was approached by Henry J. Welch, director of the importing firm Harrisons & Crosfield, and throughout 1919 and 1920 the two were active in gathering support from academia and from business for the establishment of such an institute.[36] The result was the National Institute of Industrial Psychology, formally incorporated on February 11, 1921.

Together, the NIIP and the Industrial Fatigue Research Board (established in 1918 as the successor to the HMWC) constituted the "twin pillars" of industrial psychology and fatigue research in the interwar period.[37] In fact, to a very large extent, the two organizations overlapped. Although proposals for amalgamation failed to come to fruition, there would be close cooperation between the two bodies throughout the interwar period.[38] The composition of each was similar, comprising an executive board made up of "academic, governmental and business elites" and a staff of scientific investigators.[39] There was also significant overlap in terms of personnel, with a high proportion of board members and investigators from each institution lending their services at one time or another to both. The theoretical perspectives and conceptual apparatus of each institution were essentially identical. The two often conducted a number of joint investigations and published several joint reports, and the relationship was described by Myers as "intimate and harmonious."[40]

At the same time, however, there were a number of important differences in the organization and purpose of the two institutions. The IFRB was established to continue the wartime work of the HMWC, with a number of the latter's investigators transferring to the new board. It was a government department, appointed by the Department for Scientific and Industrial Research (DSIR) and the Medical Research Committee and supported by the Home Office. The IFRB's original terms of reference were "to consider and investigate the relations of

the hours of labour and conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers." Threatened by government cuts during the recession of 1921, the board was reorganized under the sole control of the MRC.[41] The work of the IFRB involved a mixture of laboratory research and workplace investigations, sometimes at the invitation of specific firms or industries. The board published an annual summary of research, as well as regular stand-alone reports on more specific topics.[42] While the board continued to conduct research into the physical effects of work in the vein of the HMWC, its outlook became increasingly psychological throughout the interwar period, with a dedicated psychological committee established in 1921.[43]

In contrast to the government-sponsored IFRB, the NIIP had to raise its own funds. It was helped by large grants from the Rockefeller Foundation, the Carnegie United Kingdom Trust, as well as firms and individuals. The vast majority of the NIIP's income, however, came from fees it charged for its industrial investigations. The services of the NIIP were hired at a price, with the institute's records listing clients as varied as government departments, tea shops, chocolate factories, and hotels.[44] As D. C. Doyle has observed in a PhD thesis on the institute, however, a large proportion of the NIIP's investigations were carried out for very large employers—the result of the mergers and concentration that characterized British industry in the 1920s and 1930s—who were tackling problems of large-scale coordination and rationalization.[45] In addition to its factory investigations, the NIIP was active in promoting the interests of industrial psychology: through its own journal from 1922, through public lectures and radio broadcasts, and through the funding and teaching of university courses and academic positions.

To avoid unnecessary overlap, or unwanted competition, between the two institutions, an informal arrangement was agreed regarding the roles of each, defined in part by their respective sources of funding. The government-sponsored IFRB would deal with general principles, conducting "pure" research into general industrial problems. The NIIP would be concerned with research for individual firms, the application of results, and the training of practitioners.[46] In the context of

psychology's professional marginality in the early twentieth century, the IFRB and NIIP were crucial in the "institutionalization" of psychology as a discipline.[47] As Leslie Hearnshaw has argued, "In the years between the wars, when university departments were small and posts in educational and clinical psychology few and far between, [the NIIP] was the most considerable avenue of employment for psychologists." Without the work of research institutions such as the IFRB and NIIP, Hearnshaw goes on to argue, "the expansion of psychology in the Second World War and after would have been virtually impossible."[48]

The paths taken by the research of the IFRB and NIIP—and the concepts around which industrial psychology crystallized—were determined by the needs of those who funded and directed their work: in the case of the NIIP, the firms that hired their services, and in the case of the IFRB, the British government. Despite professions by the experts involved that they were working in the interests of workers' welfare, or that they occupied an impartial position above any class antagonisms, in the final instance the very existence of these institutions depended on proving their utility to capital and the state. As Doyle's detailed analysis of the work of the NIIP has shown, sponsors' interests were deeply embedded in the institute's practice: the "rhetoric, scientific orientation and specific techniques" of its investigators reflected the specific needs, and the broader ideologies, of the directors and managers who employed its services.[49] As Loren Baritz has argued (in the American context), industrial psychology was of value to employers only to the extent that it served their business interests, and consequently the scope of scientific research was severely limited: the "financial condition of the firm was the ubiquitous criterion of . . . success." While the IFRB was not funded directly by employers, its investigations were likewise limited by the aims of a government whose main preoccupation was, as the board's terms of reference specified, the maximization of industrial and national efficiency. If the sponsors of the NIIP aimed at increasing the output of the firm, the government's aim was to increase the productivity of the nation. The well-being of the individual worker was important only insofar as it constituted part of the productive body. As the Home Office's Malcolm Delevingne wrote to the DSIR concerning the establishment of the IFRB, the concern of the government was less the "efficiency of the worker" than the "efficiency of industry."[50]

Given the importance of these institutions in the development in Britain of psychology in general, these conditions on the scope of industrial psychology were to have important consequences. Industrial psychology would be a training arena for many of the most influential psychologists of the twentieth century. The models of mind and behavior formed in the course of factory research viewed human psychology in the context of capitalist production. Concepts such as "intelligence," "attention," and "personality" were shaped by psychologists' workplace investigations in service of government and employers. The psychologically healthy or normal worker was obedient, compliant, and above all productive.[51] In a very important sense then, the "pure" psychology of the twentieth and twenty-first centuries was itself produced in the factory.

THE PSYCHOLOGIST, THE ENGINEER, AND THE "HUMAN FACTOR"

Like the industrial physiologists of the prewar period and the HMWC, the industrial psychologists of the IFRB and NIIP were keen to distinguish their own work in pursuit of efficiency from the various schools of "scientific management" and "efficiency engineering" deriving from the ideas of Frederick Winslow Taylor. While some of industrial psychology's earlier proponents approvingly cited the works of Taylor and his disciples in their work—even going so far as to advocate a form of "neo-Taylorism"—an awareness of workers' and organized labor's hostility to any scheme associated with "speeding up" meant that industrial psychology would increasingly distance itself from these links.[52]

In private communications, members of the IFRB and NIIP were clear about the need to play down any similarities between their own work and scientific management. In an early meeting of the provisional NIIP committee, for example, Myers shared a piece of advice given to him by a Sheffield industrialist: "For heaven's sake, keep Scientific Management out of it, or you'll offend labour."[53] In choosing the name for the organization, Myers and Welch deliberately excluded the terms "human efficiency" and "scientific management" so as to avoid arousing the suspicions of workers.[54] Correspondence between the MRC's Walter Fletcher and the DSIR from 1918 discussed similar concerns regarding the successor institution to the HMWC. It was crucial, Fletcher

argued, "to wash away any taint of Taylorism" that the term "industrial efficiency" might suggest.[55] Researchers, he informed IFRB members, would "certainly have to go 'canny' for some time at the beginning" to avoid provoking hostility.[56] Industrial psychologists repeatedly emphasized the need for research to be carried out with the "full consent and co-operation" of the workers.[57] While the techniques they used were often the same as those employed by American efficiency engineers, and while both shared the ultimate goal of maximizing output, industrial psychologists knew it was imperative that they should not be seen by workers as representatives of management or as agents for the "speeding up" or "sweating" of labor.[58]

Publicly, too, industrial psychologists sought to distance their work from American-style scientific management. While praising the efficiency engineer's aims of "eliminating the wasteful expenditure of human energy," industrial psychologists (like the representatives of industrial physiology before them) continued to argue that the problem of scientific management was simply that it was not scientific enough.[59] In the view of the Scottish economist James Alexander Bowie, an advocate of the industrial application of scientific expertise, Taylorist management had the same relation to industrial psychology as the search for the philosopher's stone did to modern chemistry, exhibiting "the youthful stage and extravagant claims" of a science now deserving of respect.[60] Whereas scientific management was on the side of management, industrial psychology would be "strictly impartial."[61] Whereas the efficiency engineer targeted short-term gains, the industrial psychologist strove for long-term efficiency.[62] In Myers's view, while scientific management and industrial psychology shared a common purpose, the methods employed by each were different, even opposite. While the engineer looked to "press the worker from behind," the psychologist instead "aimed at removing the obstacles which prevent the worker from giving his best to the work."[63] Naturally, however, Myers reassured his readers, "when such obstacles . . . are removed, increased output has invariably been found to follow."[64]

Industrial psychologists defined their central problematic as the relationship between man and machine: how best to harness the physical and mental energies of the workforce in an increasingly mechanized system of production, which had revolutionized the labor process at every level. As a report of the IFRB put it:

> The mechanization of industrial processes is developing more rapidly than the knowledge of its effects. While much thought and skill have been given to the invention and construction of machines, less attention has been given to the study of their effects on the workers. Thus, whilst the material gains of mechanization . . . are plainly obvious, the strains and stresses experienced by the individuals who operate the machines are often so much less obvious as to be ignored.[65]

What separated industrial psychology from scientific management, the psychologists argued, was its systematic consideration of the "human factor" in this machine-driven industrial universe. The labor process, it was argued, could be viewed in terms of "mechanical factors" and "human factors," the former covering the machines and tools used and the latter describing all the variables that the worker brought to the process.[66] Depending on the kind of work, the proportion of each factor varied: in a completely manual task, the human factor would predominate exclusively, while in a completely mechanized process, it would be absent.[67]

Since the Industrial Revolution, psychologists argued, attempts to improve productivity had been focused nearly entirely on the mechanical side of industry, to the detriment of workers' health and efficiency. "We have perfected the machine in industry," wrote the trade unionist Arthur Pugh, who served on both the NIIP executive committee and the IFRB in the 1920s, "but it has been at the expense of the human factor. . . . We have applied Science to Industry but it has been in relation only to the process of production, not in relation to the human producer."[68] Mechanization, and the resulting antagonism between machine and worker, was presented as a purely technical problem that could be overcome through the systematic application of psychological knowledge to the labor process.

While scientific management (and to a large extent industrial physiology) had treated the worker as merely another kind of machine, which could be driven indefinitely to greater speed and greater output, industrial psychology would treat the worker as a human being, "acting under the influence of human impulses, emotions, and passions, arising out of fundamental human needs."[69] Maximizing the efficiency

of machines and increasing the productivity of humans, psychologists argued, required different kinds of expertise: "The human being . . . cannot be redesigned, and improvements in his method of working can only come about after consideration of the mental and physical principles by which he is governed. In other words, the study of the human side of industry is the work of the trained physiologist and the psychologist, not of the engineer."[70] Increasingly throughout the interwar period, the term "human factor" took on a totemic significance, signifying the industrial psychologist's compassionate and holistic view of the worker as "a complete human being" whose welfare was of paramount concern. While the term had not appeared in any of the published reports of the HMWC, between the wars it was to be found in the titles of numerous books and articles, with the *Journal of the National Institute of Industrial Psychology* changing its name in 1932 to the *Human Factor*. Its scope was expansive—covering "the whole problem of human nature in industry," from diet to industrial relations.[71] The sixth annual report of the IFRB in 1926 declared with utopian enthusiasm that "the time is fast approaching when the scientific study of the human factor in industry . . . will be accepted as the beginning of a movement with limitless possibilities."[72] To maximize the productive potential of human energy, psychologists argued, it was necessary to study not simply the worker as a worker but "the whole man—his wants, his ideas, and his ideals."[73] The rhetoric of the human factor was used to legitimate calls for increasingly comprehensive psychological surveillance. The psychologist's potential field of action was expanded to include the measurement not simply of output and fatigue but of feelings, desires, political opinions, and more, intervening not only inside but outside of the factory.

In the apparently humanist turn of the interwar science of work, the question of control remained central. For the industrialist Benjamin Seebohm Rowntree, who had been an important early supporter and sponsor of the NIIP, the study of the "human factor in business" was chiefly of importance in tackling problems of industrial unrest, particularly in the tense conditions of British postwar industrial relations.[74] In turn, psychologists, drawing on McDougall's "social psychology," argued that their specific expertise was required to tackle problems of unrest.[75] Workers' grievances with employers were routinely psychologized and

pathologized. Industrial psychologists argued that pressures of fatigue and overstrain made the worker psychologically susceptible to "the spirit of revolution," with the NIIP's F. W. Lawe going so far as to classify strike action as a form of "industrial mental disorder."[76] In the interwar years, as the language and ideas of psychoanalysis began to permeate British psychological discourse, industrial disputes began to be interpreted as the result of psychological "complexes," "psychopathic dispositions," or the unconscious "projection" or "inversion" of internal conflicts in the mind of the worker.[77] Control of the workforce could be imposed, psychologists informed employers, through the "timely application of psychotherapeutic measures (based on the recent developments of abnormal psychology)."[78]

Despite industrial psychologists' noble claims to be interested in the "whole man" or in "human nature"—claims that have often been taken at face value by historians and sociologists—the discourse of the human factor in the science of work in practice entailed a radically limited view of what the "human" was.[79] At the same time as industrial psychology designated for itself an ever-greater field of surveillance and influence in the lives of workers, it reduced the worker to a mere element in the industrial process. The human factor was precisely that: a *factor of production,* to be considered alongside raw materials or machinery.[80] If it was considered a more complex variable, this did not change the fact that the ultimate horizon for its study was the maximization of output and profit. Ensuring the worker's happiness was justified on the grounds that "If he is not happy he is not likely to be productive"; the promotion of "health" was because "health is essential for industrial efficiency."[81] The goal of the study of the human factor was explicitly to "turn every ounce of man-power into productive channels."[82] The more psychologists talked about the human factor, the more the worker was alienated from his or her own humanity, reduced to a statistical element in the productive body.[83] This was less the humanization of industry than the industrialization of the human.

THE INDUSTRIAL PSYCHOLOGY OF FATIGUE

The research work of the IFRB and NIIP carried over many of the same preoccupations that had dominated the science of work up to

and including the First World War. While the psychological turn expanded the range of subjects that came under the work scientists' gaze, fatigue—broadly defined as a declining capacity for productive work—continued to claim a central place in the industrial psychology of the interwar period. While a means to measure fatigue, or even a satisfactory definition, proved elusive, the concept of fatigue—as the antithesis to efficiency—and the goal of its eradication, continued to structure the science of work.

The IFRB had been set up in 1918, as its name and terms of reference indicated, with the problem of industrial fatigue explicitly in mind. Central to its early work was the search for an objective test of fatigue. "The ideal to be aimed for," wrote the board's Horace Vernon, "is a test which can be easily applied, in the course of a few minutes, to any industrial worker at any time in the course of his working day, and afford a quantitative measure of his state of fatigue." As the interwar period progressed, however, doubts were increasingly expressed about the utility of fatigue as a scientific concept. "The term is glibly used," wrote the NIIP's E. P. Cathcart, "yet the average man would find it hard if not wellnigh impossible to define."[84] Attempts to measure fatigue as a physiological or psychological entity, or to find the biological laws governing its operation, were repeatedly frustrated.[85]

In a 1921 report to the IFRB, Bernard Muscio concluded that it was not in fact possible to define fatigue independently of the tests used to measure it.[86] For a reliable test of fatigue, Muscio argued, it would be necessary to show a correspondence between the phenomenon being measured (for example, output) and some independently verifiable physiological measure of fatigue. All attempts to determine the physiological nature of fatigue, however, had proved inconclusive: neither calorimetric measures of energy lost from muscle nor chemical analysis of the metabolic products of muscular work had provided reliable measures. Tests in which output was assumed to vary inversely with fatigue—without reference to any other variable—followed a circular logic: fatigue was being defined in the same terms in which it was measured.

Perhaps counterintuitively, however, Muscio did not conclude that fatigue study or the measurement of output was of no value. While the physiology of fatigue might remain a mystery, "fatigue investigation" as it had been previously been carried out could still provide important

practical results for industry. The quest to find a scientific test for fatigue or to uncover its biological mechanisms was an unnecessary distraction from the real purpose of the science of the work: the maximization of output. Ignorance of the precise nature of fatigue, Myers similarly argued, did not make it impossible to measure its effects. Just as it was possible to measure the strength of an electrical current by observing the deflection of a needle yet without knowing the precise nature of electricity, it was possible to measure fatigue in terms of "deflections" in output."[87]

In some cases, the difficulties identified by Muscio in finding an *objective* measure of fatigue led to a greater openness toward the subjective elements of exhaustion. While continuing to maintain that subjective estimations of fatigue would be unable to give a direct indication of working capacity, a small number of industrial psychologists nonetheless began to explore ways in which "feeling-tone" (the term proposed by Muscio) could be systematically studied, measured, and used to determine and improve their capacity for work. "So long . . . as we have no direct method for the exact measurement of fatigue," one IFRB report argued, "the personal evidence of workers should not be neglected or its value undermined."[88] New methods—such as the standardized interview and the questionnaire—were increasingly used to solicit workers' feelings, emotions, and desires.

In practice, tests of output as a means to estimate fatigue remained commonplace in the work of both the IFRB and the NIIP. If the theoretical foundations of fatigue measurement had been challenged, its practical utility to the sponsors of industrial psychology remained evident. If output figures could not tell researchers anything about the "intrinsic nature" of fatigue, they could still provide important data that could be used to increase the efficiency of the productive body. Indeed, freed from the need to posit any physiological basis to fatigue symptoms, the category could take on an even more expansive scope. Industrial fatigue, argued the IFRB, should be understood as encompassing "all conditions affecting the body or mind that impede the normal man from working at his maximum efficiency."[89] Thus, while the term "fatigue" increasingly faded into the background, its status as the antithesis of efficiency meant that it remained the crucial structuring concept in the interwar science of work.

BOREDOM AND MONOTONY

In an increasingly mechanized industrial world, industrial psychologists argued, workers were subject to new unfamiliar stresses, which demanded new methods of investigation. While previous research into industrial fatigue had mainly focused on the effects of physical overwork, changes to the production process brought with them new problems of a specifically psychological nature. With the advance of mechanization, rationalization, and standardization, the labor process was increasingly becoming characterized by monotonous and repetitive work, with many workers relegated to "mere machine-minding functions" in which they were forced to work in a mechanical rhythm at a pace that was not in their control.[90] These altered circumstances, psychologists argued, required a new approach in the scientific study of work: "Previous investigations into the effects of industrial employment on the worker have been made under conditions which even then were beginning to change. . . . [O]bservations made under conditions which involved manual—and often heavy—discontinuous work on the part of the employee, while retaining their fundamental value, have lost to some extent their particular application."[91] As early as 1920, Myers was arguing that the "physiological factors involved in purely muscular fatigue are now fast becoming negligible compared with the effects of mental and nervous fatigue." The "psychological factor," he proposed, "must therefore be the main consideration of industry and commerce in the future."[92]

The chief problem of work under modern industrial conditions, psychologists argued, was not so much the working of employees to physical exhaustion but the insidious effects of monotony and boredom.[93] Monotony and modernity went hand in hand: the subdivision and mechanization of labor and the standardization of operations were "increasingly characteristic of industrialism," and boredom seemed unavoidable for "the great mass of workers in large-scale industry."[94] While for some writers "monotony" and "boredom" could be used interchangeably, others attributed the former term only to the job or task and reserved the latter for the worker's subjective response. Boredom was seen as different from fatigue, in that its presence did

not necessarily indicate a decreased *capacity* for work. However, it was seen to "simulate" fatigue in decreasing the *output* of work. Moreover, it was argued, the forced continuation of work in spite of boredom could produce genuine and long-lasting fatigue in the workforce.[95]

In theorizing boredom, monotony, and mental fatigue, Myers was again influential. Monotonous work, Myers observed, such as minding a particular machine, required attention to be focused on a single task, often for extended periods. To achieve this concentration on a single "mental process," the worker had to maintain a psychological "attitude" favorable to the task at hand.[96] In order to do this, it was necessary for the mind to "inhibit" all other processes that were incompatible with the task at hand. Inhibition was an active process, involving the conversion of energy into mental and physical work. While at the start of work, the inhibition of competing mental processes was often unconscious, after a certain amount of time engaged on repetitive work, an increasingly greater effort was required to suppress inner impulses or reactions to external stimuli.[97] The unpleasant subjective sensations of boredom and its outward signs—such as fidgeting or yawning—were expressions of the gradual failure of inhibition, eventually making the continuance of work impossible.[98] Just as the sensations of physical fatigue had been seen by physiologists to have a prophylactic function, for Myers the phenomenon of boredom played an important protective role, preventing work from being continued to the point of exhaustion.[99]

While fatigue and boredom were often distinguished from one another, the importance of both was ultimately their detrimental effect on productivity. It was vital to maintain the interest of machine operators in their work not out of concern for their well-being but to ensure that output was maintained. "Monotony," as one writer on factory administration put it, was "the greatest enemy of efficiency."[100] While psychologists solicited the personal feelings of workers as to their boredom, these were made useful only by comparison with curves of output.[101]

The IFRB and NIIP experimented with different ways to alleviate the effects of monotony and to maintain a level of interest in the performance of repetitive work. Rest pauses, psychologists argued, were essential not just for physical recovery but to relieve boredom.[102] The distribution and duration of rest breaks was a problem that should not

be left to the workers but rather one that required "expert analysis" and psychological expertise.[103] In contrast to fatigue, boredom could also be alleviated by changes in activity or type of work throughout the day.[104] Interest could also be maintained, psychologists suggested, drawing explicitly on Taylorist bonus systems, through the introduction of competitive or financial incentives or the opportunity for promotion.[105]

When repetitive work was continuous, and demanded little concerted mental effort, psychologists noted, boredom could also be relieved by "day-dreaming," talking, or singing with their coworkers.[106] While this was endorsed to a certain extent as a remedy to boredom, some psychologists were concerned that such activities were not conducive to greater output. In particular, there was concern expressed about whether the fantasies engaged in by workers were healthy or pathological. The bored worker, argued one psychologist, was "an excellent seed-bed for the most stupid of doctrines provided only they promise him relief from work he rightly or wrongly hates."[107] In this context, it was far better if mental diversions were organized and provided by management. Psychologists recommended the introduction of music or radio lectures, played through a loudspeaker, as a means of combating monotony and maintaining rhythm, suggestions taken up by the British government during the Second World War in the form of the *Music While You Work* and *Workers' Playtime* radio broadcasts.[108]

Importantly, industrial psychologists observed that different individuals reacted differently to uniformity of work. While for some it meant monotony and reduced output, others were able to maintain efficiency without reporting feelings of boredom. The "more intelligent operatives," for example, tended to be more bored by repetitive work, while others preferred work in which they did not have to think too much.[109] Monotony, psychologists concluded, was in the eye of the beholder: a psychological or emotional attitude of the worker rather than an essential quality of the job itself.[110]

THE PRODUCTIVE BODY AND THE INDIVIDUAL

Industrial psychology's interest in individual differences in their study of boredom and monotony was part of a wider concern with the "psychology of the individual" in the years leading up to the Second World

War. With the development of experimental psychology, an emphasis on psychological universals was replaced by a language of variance, classification, and distribution. Psychology in Britain, Nikolas Rose has argued, developed precisely as an applied science of individual differences. Psychologists developed ways to conceptualize, measure, and interpret differences between people and to identify "pathological" individuals requiring control and regulation by the state and other institutions. "Psychological normality," Rose argues, "was conceived of as merely a lack of socially disturbing symptoms, an absence of social inefficiency: *that which did not need to be regulated*."[111]

While at first glance there would appear to be an inconsistency in, on the one hand, psychologists' apparent concern for the individual and, on the other hand, what I have argued was the actual focus of their work, the productive body, in fact, however, these two apparently opposing tendencies were intrinsically linked. The concern of the psychologist—and of the institutions who employed psychological expertise—was, Rose argues, "not the plight of the individuals themselves, but the consequences of such individuals for the population as a whole."[112] While Rose's account of the development of psychology focuses on the question of "feeble-mindedness"—its classification, quantification, and regulation—similar processes can be identified in the interwar science of work. Psychological research between the wars found that knowledge of individual differences between workers—in fatigability, in susceptibility to boredom, in efficiency and output—could be utilized to maximize the efficiency of the firm, the nation, and the productive body.

The study of individual differences was central to the science of the human factor. What set humans apart from machines in the production process was the difference between "mechanical uniformity" and "human variability."[113] Workers, psychologists argued, varied widely in their "natural fitness" for different kinds of work.[114] If an individual was placed in a job to which they were unsuited, they were far more likely to suffer from fatigue, boredom, and inefficiency.[115] Psychology could assist by providing means by which to select the right job for the individual ("vocational guidance") and the right individual for the job ("vocational selection").[116] Such techniques, practitioners argued, were essential for "the proper utilisation of human effort in

industry."[117] Yet the benefits, as psychologists were keen to point out, were not simply—or even primarily—for the workers whom they placed in jobs. As Myers argued, "Vocational guidance is important not only for the benefit of the person who receives it and of those with whom he is brought daily into social contact. The adoption of an unsuitable occupation and its subsequent abandonment mean inevitably *a huge national loss*—a loss in productive efficiency, a waste of human effort and material, and a waste of time—in needlessly interviewing, training and employing successive unfit applicants until a suitable worker is found."[118] The frequently evoked figure of the "industrial misfit" was portrayed by industrial psychologists as "a charge to the employer, to the trade union, and to the State."[119] "Improvement in the methods of the placing the right man in the right job," wrote the NIIP's F. W. Lawe, "will undoubtedly result in the increased efficiency of the whole economic machine."[120]

The design and application of vocational tests constituted a large part of the day-to-day work of the IFRB and especially the NIIP. In practice, vocational selection was much more commonly implemented than vocational guidance, largely because it was of more immediate practical utility to employers—who paid for the research—to find the right person for a particular job than to guide individuals into the jobs for which they were best suited. Selection had been discussed by Hugo Münsterberg in his 1913 work on industrial psychology, and various forms of psychological testing were used in Britain during the First World War (for example, by the Air Board in selecting pilots).[121] However, the rise of industrial psychology in the interwar period saw methods of vocational selection increase in sophistication and become more widely used. At the 1919 Cambridge conference organized by Myers and Muscio, Cyril Burt, a pioneer in the use of "psychometric" methods to quantify, measure, and test psychological capacities who would go on to chair the IFRB's Vocational Guidance Department and sit on the executive council of the NIIP, set out the forms that vocational selection might take. He distinguished four forms a test might take: the "sample" test, in which candidates attempted a typical example of the work; the "analogous" test, in which an artificial task was contrived to require similar psychological capacities as the work in question; "empirical" tests, in which the test task was not similar to the work

but had been shown to be a good indicator of suitability; and, finally, the "analytic" test, in which, according to Burt, "an endeavour is made to resolve the work into its elementary psychological constituents," which could then each be tested in isolation.[122]

The analytic test was described by Burt as the most comprehensive and systematic method of vocational testing. Citing an example of Münsterberg's, Burt described how the job of a telephone switchboard operator could be decomposed into around a dozen distinct physical or mental processes. Workers in a telephone exchange were subjected to tests of acuity of hearing, vision, intelligence, attention, memory, speed of movement, space perception, and other relevant capacities and ranked according to their ability. Their scores were then averaged and compared with their actual work performance, showing a high correlation between the two.[123] Likewise, an IFRB study into vocational selection in a printing works divided the task of the hand compositor into seven different "capacities," elaborating specific tests for each.[124]

Vocational selection, as it was taken up by psychologists in the interwar period, represented the subdivision of the Fordist assembly line taken to the most extreme level. Each operation in the labor process was separated into its smallest possible discrete parts.[125] In turn, psychological testing split the individual into manifold abstract "aspects" or "capacities." The worker was alienated from their own bodily and mental powers, reduced to a series of figures in a psychologist's notebook. In vocational guidance, the interest of the individual in the kind of work they wanted to do was subordinated to the supposed innate or inherited abilities that fitted them to take on a certain role within the industrial machine.[126] In contrast to the science of work's proclaimed concern for the worker in the whole, here the individual disintegrated under the psychologist's gaze. Vocational guidance and vocational selection operated at the level not of the person but of the capacity, the aptitude, the process. The faculties of the biological body were transformed into capacities of the productive body; the creative possibilities embodied in the worker were viewed solely in terms of their role in the process of production.

The attributes psychologists attempted to measure included not only manual and intellectual skills but also "qualities of temperament and character."[127] Employers, for example, could select employees based

on their relative "submissiveness" and "assertiveness" scores, and subjects exhibiting "rebelliousness" or "strong left-wing leanings" could be weeded out early.[128] Psychologists argued that vocational guidance should be available for children as young as eleven years old, extending the reach both of psychological expertise and of the totalizing logic of productivity into the development of schoolchildren.[129] Going further still, others sought to combine industrial psychology with eugenics, extending the principle of vocational selection to the question of human reproduction, orienting the entire human life cycle to the purpose of productive efficiency.[130]

TIME AND MOTION

In concert with vocational guidance, industrial psychologists brought the techniques of time and motion study within the scope of the British science of work. Originally associated with the scientific management system of Frederick Winslow Taylor, the techniques of time and motion study were developed to analyze work tasks to ensure the greatest possible efficiency and economy of movement. Like vocational selection, time and motion study depended on decomposing the labor process into its constituent parts. Here, though, instead of the physical and psychological capacities required for the task, the work was broken down into each discrete movement required for its execution. In time study, each element of the work cycle was individually timed to determine the average or minimum time necessary to complete it. By this means, management could determine and standardize the duration of industrial tasks as well as rearrange the production process to ensure the most efficient use of time. Motion study, pioneered by Taylor's disciples Frank and Lillian Gilbreth, consisted in the minute study of the worker's movements at each stage of an operation, so that efficiency and economy of motion could be maximized at each stage. In order to visualize the entire work cycle, the Gilbreths developed the "chronocyclegraph" technique (fig. 4).[131] Workers were made to perform a task (for example, swinging a hammer) against a dark background with a small electric light attached to the relevant part of their body (in that case, the hand holding the hammer). By taking a long-exposure photograph of the process, it was possible to obtain a clear visualization of the entire work

cycle, with the movement of the worker represented in the lines made by the light. With further developments of the technique, including placing a regular grid behind or in front of the worker, having the light interrupted at intervals of a known duration, and having each flash of light fade in intensity over time, it was further possible to determine the speed and direction of the movement in three dimensions.[132] By analyzing the work process in terms of time and motion, the Gilbreths argued, it was possible to determine the "one best way" to perform any given task with the greatest efficiency and least fatigue.[133]

In the interwar period, both the IFRB and the NIIP experimented with time and motion study, with the latter widely using both techniques in its factory investigations. In carrying over those methods perhaps most emblematic of scientific management's quest to speed up work at the expense of the worker, industrial psychologists knew

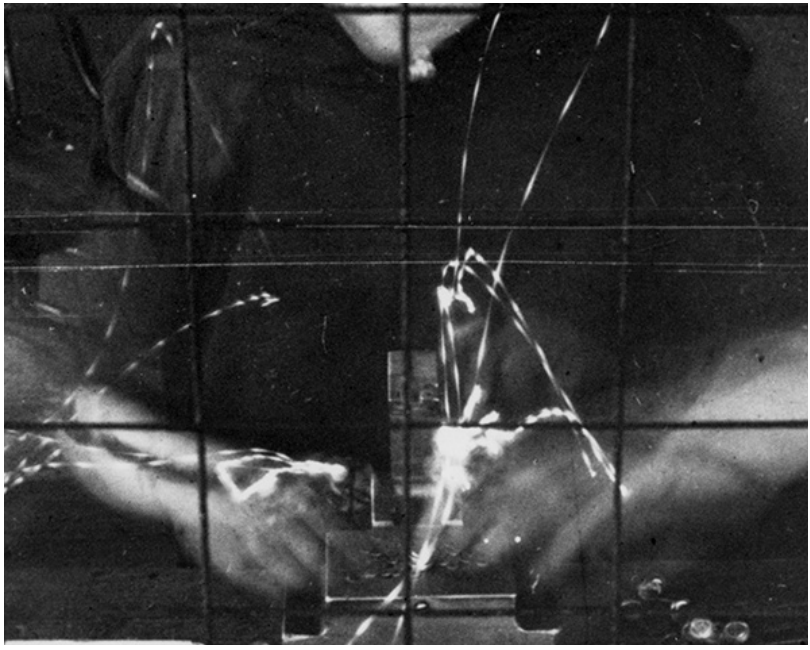


FIGURE 4. Time and motion study. The Gilbreths' chronocyclegraph. Frank and Lillian Gilbreth Collection, Archives Center, National Museum of American History, Smithsonian Institution.

that once again they would need to be extremely careful in distancing themselves from the efficiency engineers. Whereas Taylorist advocates of time and motion study were interested purely in speeding up work and increasing output in the short term, they argued, industrial psychology sought to use the methods to the benefit of both capital and labor, increasing efficiency over the long term by economizing on the effort and energy expended by the worker and protecting their productive capacities.[134]

Time and motion study, British industrial psychologists argued, was "a fitting complement to vocational selection."[135] Where psychological testing would ensure that the right people occupied the right jobs, time and motion study would provide the most efficient methods by which the job could be done. In contrast to the efficiency engineer, the professed aim of industrial psychologists was not simply to increase worker's *speed* but also to increase their *ease* of motion. Echoing the "law of least action" cherished by nineteenth-century physiologists, psychologists aimed to reduce movements that were "unnecessary and therefore wasteful of time and energy."[136] By dividing the work task into a series of discrete movements, it was possible to ensure that every individual motion was constructed from the "most efficient, or least-wasteful, movement elements" and, in turn, that every complete work cycle was made of the most efficient individual movements.[137]

While Taylor and the Gilbreths set themselves the task of "standardising the human element in industry," an IFRB report on time and motion study argued, industrial psychology stressed differences between workers and variation in the performance of individuals. Imposing a standard—of time or output—was counterproductive, industrial psychologists argued, since it led to some workers being pushed to exhaustion and some holding back their energies so as not to exceed the standard.[138] Where possible, it was argued, the pace of work should be set neither by the machine nor by blanket targets of output but determined by the natural efficiency of the individual worker. While there were undoubtedly good and bad working methods, there was not, as the efficiency engineers claimed, any "one best way" of doing a given task.[139] Equally efficient workers often had different methods—unique individual "styles"—with which they carried out their work, and to impose a standard method of working on all workers,

"regardless of their individual physical and mental differences," would be contrary to industrial efficiency.[140]

The attempt to standardize the labor process, psychologists argued, failed to understand the fact that workers had different "natural rhythms," and any practice of management or administration that failed to take this into account would fail to get the maximum productivity from their workers.[141] Just as Myers had envisioned industrial psychology as removing "obstacles" in the way of a worker's natural productive powers, rather than pushing them artificially the IFRB report on time and motion study argued that the proper use of these techniques was

> to devise some method of doing the task in question, which shall be more in accord with physiological and psychological laws, and that will utilise the natural aptitudes of the worker in a more efficient way. Those working on this principle will not seek to discover how quickly a worker can perform a task, but will endeavour to arrange that the task may be done in such a way as to interfere in the least possible degree with the worker's rhythm. The effort of the worker will become the centre of attention and not the task.[142]

The ultimate goal of time and motion study, a later article in the NIIP's *Human Factor* journal argued, was to establish a rhythm in accordance with the physical and mental qualities of the individual worker.[143]

While repeatedly stressing that increased output was not necessarily the *object* of time and motion study, however, psychologists were always quick to add the reassuring qualification that it was, in any case, the ubiquitous result.[144] Individual rhythms were cultivated not because of the benefit to the worker but because by this means workers' bodies were made productive. While industrial psychologists argued that the individual was "more than a sum of parts thrown together haphazard," the productive body was nonetheless produced as an industrial organism, made up of individuals who, if working according to their own rhythms and logics, could nonetheless be incorporated within the all-encompassing logic of productivity. For all that industrial psychology stressed the importance of the individual, in practice techniques like time and motion study functioned to remove initiative

and particularity from the labor process. In the science of work, just as in the eerily faceless portraits of the chronocyclegraph, distinctions between workers were blurred to the point of invisibility, while the clean lines of the work process itself were starkly foregrounded.

MAKING HEALTHY WORKERS

In the final instance, industrial psychology stood or fell on its ability to prove itself useful to its sponsors. The services of the IFRB and NIIP were employed by government and employers not out of a charitable desire to make their workers happier or healthier but to improve productivity and increase profits. As Myers noted, employers—especially the increasingly large conglomerates who were hiring the services of the NIIP—were becoming "as deeply interested as any health authority in promoting both mental and physical health . . . for they recognise that mental and physical health is essential for industrial efficiency."[145] In justifying their science to their sponsors, it was necessary for industrial psychologists to assert that health, happiness, and productivity were "intimately associated," that if the worker "is not happy he is not likely to be productive," and that "healthy workers are efficient workers."[146]

In 1928 the Industrial Fatigue Research Board changed its name to the Industrial *Health* Research Board (IHRB). The annual report for that year explained the change:

> At the time of their formation the Board were confronted mainly with special problems of health and efficiency arising from the long hours that were worked during the war. Under existing conditions those are of relatively small importance, and the Board's investigations are now, for the most part, directed towards problems far removed from that of fatigue as such. The Board have also felt that the possession of a title expressing what they aim at eliminating instead of what they wish to enhance is something of a disadvantage.[147]

While stressing that "no modification in [the board's] present aims and method" was proposed, the shift in the conception of the board's work from reducing fatigue to promoting "health" was an important

one and characteristic of the direction of the science of work in the interwar period. As Vicky Long has observed, in the years after the First World War, industrial science and medicine in general moved from a focus on injury and disease to "a broadly conceived model of health which embraced physical and mental well-being in all spheres of life." The functioning of "health" in industrial psychology, however, is more complicated than the notion of a "holistic vision of occupational health" suggests.[148]

The view of health taken by industrial psychology was once ambitiously expansive and profoundly narrow. On the one hand, as the first report of the newly christened IHRB explained, health was to be conceived of "not merely as the antonym of disease, but in the widest possible sense, as including all that concerns the worker's fitness and comfort within the sphere of his work."[149] Building on the work of the HMWC and the Ministry of Munitions' Welfare Department during the war, industrial psychology advocated a comprehensive view of industrial health and the human factor, extending far beyond the factory. Health, as an article in the *Journal of Industrial Welfare* put it, depended "upon the interplay of the individual personality, the specific conditions of the industrial task, the economic factors, the domestic and general social environment."[150]

On the other hand, however, just as had been the case for the HMWC, health—from the industrial point of view—could only ever be measured in productivity. Indeed, the health of the individual worker was measurable only as a constituent part of the productive body. It was not the health of the worker that concerned psychologists but the "industrial health of a factory" or "the health and efficiency of society."[151] The task of industrial psychology was conceived not at the level of the individual body but as being "to make of the industrial *population* a source of strength."[152] Worker welfare was measured in terms of national efficiency. Industrial health, as conceived of in the 1920s and 1930s, was the property not of workers but of industry itself, in the abstract. As a report of the IHRB explained: "Taking a purely medical analogy, knowledge of 'industrial ill-health' can be analysed as if the ill-health due to the human factor were a disease of the industrial system, just as pneumonia is a disease of the respiratory system, and can be treated under its various aspects according as it is

related to causes, symptoms, diagnoses and treatments." "Industrial ill-health," the report continued, could not be read from the individual body, "owing to there being no bodily symptoms capable of systematic record manifest in the worker himself." It was not the biological body but the productive body that was to be the site of intervention. "In the absence of direct tests," the board argued, "the industrial health pathologist . . . has to start with the symptoms." The chief indicator of industrial ill-health, of course, was a fall in output, "a symptom produced by every variety of adverse factor in industry."[153] For all the broad claims of industrial psychologists, the science of work began and ended with the question of output. The extensive reach of psychological expertise, from the factory into the school or the home, could only ever be justified by reference to productivity.

The progress of industrial psychology in the interwar period followed a dialectical path in which an ever-widening scope of application was accompanied by an ever-narrowing frame of reference. By the 1930s, the science of work in Britain had advanced from the exclusive study of fatigue to become a far more wide-ranging enterprise, encompassing body and mind, conditions of work, feeling and emotions, and, increasingly by the end of the decade—under the influence of Australian-born Harvard psychologist Elton Mayo—social relationships and group dynamics.[154] Industrial psychology both broadened the scientific understanding of fatigue and colonized whole new areas of study. However, the guiding purpose that had motivated the study of fatigue—the most efficient use of energy to produce the maximum possible output—remained the central principle of the science of work.

CONCLUSION

Psychology advanced as a discipline in the first half of the twentieth century through its practical applications. While still a marginal subject in universities, psychology was able to find itself a market by claiming to offer scientific solutions to social problems. Theoretical or "pure" psychological knowledge was formed in this context and to a large extent shaped by the people and institutions who funded psychological research. In the interwar period, the factory was the most important site for these negotiations of psychological knowledge and expertise,

to an extent previously unrecognized by historians of the discipline. At a time when academic departments of psychology in Britain were few, the IFRB/IHRB and particularly the NIIP constituted two of the chief avenues of employment for psychologists, with the latter institution also providing courses and qualifications in the subject. The influence of the institutions on British psychology in the twentieth century should not be underestimated. Of the first twenty presidents of the British Psychological Society—from Myers's appointment in 1920 to well into the 1950s—only four had not at some point either served on the executive councils or been directly employed as an investigator by one or both of the institutions.[155] Indeed, Myers, recognized as the most influential psychologist of the first half of the twentieth century, dedicated the greater part of his career to the science of work, resigning his position at Cambridge in 1922 to take on the full-time direction of the NIIP. In this context, industrial psychology should be seen less as a merely applied form of preexisting pure psychology than as a crucial moment in the development, professionalization, and institutionalization of the discipline as such.

The interwar period saw the science of work that had developed in Britain since the end of the nineteenth century reach its stage of greatest maturity and largest influence. The First World War, and the example of the HMWC, had illustrated to the government the possibilities associated with the scientific organization of labor. At the same time, the spread of monopoly capitalism, bringing with it large-scale conglomerates with problems of coordinating and controlling large workforces, provided an important market for self-proclaimed experts who promised to provide scientific solutions to the problems of rationalization. Psychologists established themselves as technocratic "servants of power" whose expertise could be hired by government and industrialists to serve whichever ends they chose. Changes in working conditions and the increasing mechanization of industrial processes shifted the terms of the science of work away from the physiology of fatigue and into problems of monotony, boredom, and the "human factor" in industry. Industrial physiology gave way to industrial psychology, and new sciences of the mind, the individual, and behavior were mobilized in the name of industrial efficiency. While the terms of debate and the foci of investigation shifted, the fundamental problem of

the science of work remained the same: how to gain the maximum output from the minimum expenditure of human energy. Both industrial physiology and industrial psychology saw the worker—physically and mentally—as a constituent part of an anonymous working population, as "human material" that needed to be managed as an element in the productive process.[156]

Industrial psychology was, in the words of its practitioners, a "science of human engineering," concerned not only with the "production of things" but also with the "production of men."[157] In a very real sense, as the NIIP's Thomas Pear stated explicitly, psychologists set out to "alter human nature"—the bodies and minds of workers—in the service of industrial efficiency.[158] "Normal" psychology, health, and happiness were reconfigured in terms of the demands of industrial capitalism: for docile, efficient, and productive workers.[159] If industrial psychologists became interested in the feelings, the emotions, and the domestic and social lives of workers, it was only to extend the reach of work science into areas that had previously been beyond the control of either direct factory discipline or scientific intervention—to fully incorporate the psychological into the productive body.

CHAPTER 4

THE MARKET IN EFFICIENCY

On February 10, 1921, an exhibition opened at London's Olympia to celebrate and promote an ideal that had, since the end of the previous century, become increasingly influential in British society. Replacing—for one year only—the annual Ideal Home Exhibition, the *Daily Mail* Efficiency Exhibition was billed as "an event of vital importance to the nation and individual."[1] Over two floors of the exhibition center, more than two hundred separate stands showcased the latest innovations in "Scientific," "Industrial," "National," and "Personal Efficiency."[2] Among the main attractions were demonstrations of radiotelegraphy from the Marconi Wireless Telegraph Company, a working exhibit showing the production process of a daily newspaper, and a specially constructed replica of the American efficiency engineer Frank Gilbreth's "motion study" laboratory. In a program of conferences that ran alongside the exhibits, representatives from the Industrial Fatigue Research Board and the nascent National Institute of Industrial Psychology contributed to discussions of "health," "industrial hygiene," and "fatigue reduction."[3]

The proximate reason for holding the exhibition in 1921 was the economic recession that had struck the previous year and the associated, ongoing problems of recovery following the First World War. One "irresistible attraction" allowed visitors to watch disabled former servicemen demonstrating a variety of skilled trades, in which they had been retrained by the Ministry of Labour's Industrial Training Department. Here the reconfigured body of the worker, restored from something "inefficient, because disabled," to an example of "100 per cent. efficiency," served as "the most refreshing and inspiring" metaphor for Britain's own postwar reconstruction.[4]

At the same time, however, the event was an opportunity to express a more expansive vision of efficiency as a logic of modernity. While Richard Overy has characterized the interwar years in Britain as a "morbid age," in which political and economic anxieties manifested in metaphors of pathology, it was also a period in which schemes of technocratic rationalization and progress held enormous cultural purchase.[5]

Just as at the end of the nineteenth century pessimistic analyses of decline, degeneration, and fatigue fueled scientific efforts to revitalize and reenergize the nation, so in the first decades of the twentieth century the promise of efficiency inspired not only the scientific interventions into human labor discussed in the previous chapters but also a wider set of aspirations for individual and national transformation. The popular counterpart to the "quest for efficiency" that Geoffrey Searle has identified as a significant current in British political thought between 1899 and 1914, this *culture* of efficiency that emerged in the early twentieth century would remain influential throughout the 1920s and 1930s.[6] This was a period that witnessed the emergence of what the sociologist Daniel Bell would later characterize as "the logic of efficiency as a mode of life."[7] Alongside "energy," "efficiency" emerged as a byword for progress in a range of spheres, cutting across narrowly defined political or ideological affiliations.

Efficiency's enthusiasts came from all sections of society and from across the political spectrum. "Efficiency," wrote the Banffshire Presbyterian minister William Straton Bruce in 1926, "is a word that we all love. We love the thought and we love the thing." While a rural parish in the northwest of Scotland might not be the first place one would think to look for exponents of this characteristically modern, capitalist, and technocratic rationality, for Bruce, "every good Christian value" could be "distilled into efficiency." In his book *On Efficiency,* Bruce even developed a kind of updated Sermon on the Mount for the industrial age: "Blessed is the efficient worker! He shall win in every race. He deserves to get the victory in every contest. He shall keep the Crown of the Causeway. The world's markets of right belong to him. He is the respect of every Employer; and his too, the regard of the Master of us all." In another context entirely, Field-Marshal Haig's victory dispatch on the end of the First World War praised the "energy and efficiency" of British troops in Europe. For the president of the Board of Trade, Sir Robert Horne, opening the *Daily Mail* exhibition in 1921, "Efficiency is character in action . . . , the pathway to prosperity, and the only sure foundation upon which any modern state can hope to maintain its existence."[8]

Both "energy" and "efficiency" were—etymologically and culturally—inextricably linked to the idea of "work," evoking not only the laws

of thermodynamics but also the mechanized factories of industrial production. While efficiency broadened its applications in the first decades of the twentieth century, its associations with industry remained crucial. Increasingly, the framework of *industrial* efficiency was the standard by which all other areas of social, cultural, and political life were judged. In no sphere was this more the case than in popular ideas about the body—in particular, the body of the worker.

This chapter explores the ways in which the ideas of energy, fatigue, and bodily efficiency permeated British society beyond the limits of the laboratory, the factory, and the research institutions that have been discussed so far. Far from being confined to these limited institutional settings, the conceptual and ideological frameworks that structured the science of work were expressions of a broader cultural logic. The doctrines of work scientists were echoed and reaffirmed, utilized, and adapted in a range of contexts. Advertisers of medical products and foodstuffs marketed their products on the basis of their ability to reduce fatigue, boost energy, and increase efficiency, while fashions for "physical culture" and psychological self-help commodified the body, encouraging consumers to invest in their own productive capacities. In exploring the wider cultural resonances of efficiency and fatigue, my intention is not to impose a top-down model of diffusion from above in which scientific and industrial knowledge is seen as directly shaping other forms of discourse and conduct. Rather, I want to emphasize that the science of work itself developed in a particular culture and in a particular epistemological and ideological context. In some instances, more or less direct lines of influence or adaptation can be shown, while others provide evidence for a shared repertoire of assumptions, metaphors, and ideas.

As Iwan Rhys Morus has argued, scientific notions of the "human motor" and the rapid extension of a consumer market in health and the body, both of which can be traced to the late nineteenth century, are interconnected phenomena. On the one hand, discourses of physiology and psychology, scientific management, and the science of work looked to standardize the body, treating the worker "like other components of mechanical systems." At the same time, the "bodies that late nineteenth-century . . . consumers were encouraged to buy for themselves were the products of systems of standardized mass

production."[9] Into the interwar period, as James Stark has shown in his study of antiaging, commercial entrepreneurs consistently seized on language, concepts, and technologies developed in the natural and human sciences—from endocrinology to electricity to nutritional science—to sell consumers the promise of rejuvenation and youth.[10] These markets, like the science of work, were predicated on the notion that the human body was something that could be improved, perfected, made more efficient. If in the research of the work scientists the purpose of the human body was increasingly being established as productive work—and productive capacity the most important index of health—at the same time, through advertisements, consumer products, and self-help literature, these ideals of bodily efficiency were also being sold back to workers themselves, completing the circle of productive consumption.

ADVERTISING THE PRODUCTIVE BODY

From the late nineteenth century onward, a wide range of commercial products began to be sold on the basis of their ability to reduce fatigue and promote energy. In press advertising, people were encouraged to view their bodies as perfectible machines whose efficiency could be increased through various forms of consumption. In the culture of efficiency that flourished in the early decades of the twentieth century, the term became almost an advertising catchword, a floating signifier applied to a wide range of products. In certain markets, however, appeals to energy and efficiency were near ubiquitous. In this section, I concentrate on a range of commodities that were to different extents marketed as "health" products: chiefly patent medicines and processed food products. In particular, I focus on marketing that targeted working-class consumers. Such advertisements, I argue, reflected and helped to popularize the model of the body being advanced in the science of work during the same period. Sometimes drawing directly on the language, methods, and results of the science of work, advertisers sought to promote their products as means to make the body productive and thus increase the consumer's wage-earning powers. In newspaper and magazine ads, consumers were encouraged to view their body through the eyes of capital. Repeatedly, the ideal of productivity was sold to workers as the ideal of health.

The decades from the 1870s to the Second World War witnessed a vast expansion in the sale and marketing of patent medical products.[11] In this period, drug companies were "some of the most profitable businesses in the entire manufacturing sector" and among the heaviest advertisers in terms of money spent on promoting their products.[12] The historian Takahiro Ueyama has described a growing "marketplace" in health from the late nineteenth century onward. The number of patents for medical commodities registered each year multiplied rapidly between the 1870s and the First World War, with direct-to-consumer advertising of medical products becoming increasingly widespread.[13]

Medical advertising drew on the same anxieties—and often from the same metaphorical repertoire—as the professional medical establishment. From the late 1870s, an increasing range of medical products were marketed as remedies for the various problems of overwork and "life at high pressure." Advertising literature portrayed in vivid terms "the ugliest features of our complex civilisation": "the alarming prevalence and increase of Loss of Brain and Nerve Power, and all Nervous Affections induced by Overwork and Worry, and the Complexity and Strain of Modern Life."[14] In line with the medical literature of the period, patent remedies for overstrain and nervous exhaustion tended at first to target the urban middle- and upper-middle-class professionals and "brain workers" seen as the chief agents of modernity. Those most subject to "the 'wear and tear' incurred by the modern high-pressure mode of life" were the "BRAIN-WORKERS, CLERGYMEN, LITERARY and other PROFESSIONAL MEN who are habitually overworked, or periodically subject to severe mental pressure."[15]

Advertisers were quick to adopt the language of "energy" associated with late-nineteenth-century physiological models of the body as a "human motor." Countless ailments, it was claimed, could be cured by "restor[ing] the nervous force and vital energy throughout the whole body."[16] While the manufacturers of patent medicines were often wide-ranging in the claims they made for their products—with a single remedy typically purporting to cure a diverse catalog of problems—increasingly toward the end of the century, "loss of energy" and "fatigue" began to feature prominently. Medicines, tonics, and "specifics" were sold on the basis that they would restore "Health, Strength and Energy."[17] Stimulant-based concoctions, such as Hall's

Coca Wine and Mariani Wine (both of which contained cocaine), were advertised as cures for "mental and physical fatigue," "indispensable to brain-workers and those who suffer from exhaustion."[18]

The notion of physical energy as a curative force was most explicit in treatments that claimed to use "medical electricity." In the second half of the nineteenth century, a period that was seeing the increasing adoption of electrical technologies in a variety of domestic and commercial contexts, numerous products began to be promoted that claimed to harness electrical energy and transfer it to the ill or exhausted body.[19] "Electropathic belts," "magnetic corsets," "patent galvanic chain bands," and "pocket batteries" were advertised as means to "promptly renew that vital energy the loss of which is the first symptom of decay."[20] One manufacturer, Pulvermacher's, claimed that its "Galvanic Belts" were "so arranged as to convey a powerful electric current direct to the affected parts, gradually stimulating and strengthening all the nerves and muscles, and speedily arresting all symptoms of waste and decay."[21] In drawing an equivalence between human "life force" and electrical energy, the manufacturers of such products drew on contemporary models of the human energy and the body derived from the laws of thermodynamics, promoting and reinforcing the model of a human body working according to the same principles as an industrial machine, converting an external source of energy into physical work. Despite drawing negative attention from the medical profession, and even the courts, about the wild claims made for the curative powers of electricity—and despite the fact that many of the products advertised carried no electric charge or current at all—some forms of the treatment seem to have enjoyed long-lasting popularity.[22] An 1886 advertisement for the Medical Battery Company's Electropathic Belt claimed already to have treated "over a quarter of a million patients," while ads for "curative electrical treatment" persisted throughout the interwar period.[23] As James Stark has shown, into the 1920s and 1930s, various commercial electrotherapies were advertised on the basis of their ability to "rejuvenate" old and tired bodies, in language that echoed work science's concerns with energy and fatigue.[24]

As well as the direct advertising of medical commodities, the late nineteenth century saw the development of a number of new food products marketed specifically on the basis of their health- and energy-giving

properties. As Mark Finlay has shown, food advertising from the second half of the nineteenth century onward increasingly "tapped into consumers' faith in science and nutrition."[25] Foods were recommended to consumers on the basis of "a thorough knowledge of the natural laws which govern the operations of digestion and nutrition."[26]

Nutrition science in the nineteenth century, Harmke Kamminga and Andrew Cunningham have argued, developed in a close relationship with the modern nation-state and its biopolitical functions.[27] As discussed in chapter 1, British scientific interest in nutrition emerged in the context of debates concerning the physical sources of the body's energies.[28] In a thermodynamic universe, food was the "fuel" that powered the human motor, as well as providing the materials from which the muscles were built and maintained. As anxieties began to grow about the physical condition of Britain's working population toward the end of the nineteenth century and into the twentieth, dietary science became increasingly influential in public health debates, with new developments in the science of nutrition, such as the discovery of vitamins in the 1910s, provoking intense scientific, governmental, and public interest.[29] As with the study of work, the study of nutrition can be understood as a science of the productive body, its horizons set not by national well-being but by national efficiency. As James Vernon has shown, government officials and scientific researchers aimed at finding "the amount and type of food that human bodies required in order to remain healthy, and beyond that, to become more productive." There was also significant direct overlap with the science of work. The Health of Munition Workers Committee, for example, devoted three of its twenty-one memoranda to the subject of diet, emphasizing that an examination of the "value and character of the food consumed by munition workers" was "desirable in the interests of efficiency."[30]

In the late nineteenth and early twentieth centuries, manufacturers increasingly employed the services of "industrial food scientists" who "drew upon and adapted nutrition science to form the basis of advertising campaigns, incorporated it into new products, or harnessed it to find profitable uses for waste materials."[31] For a number of food manufacturers, the science of nutrition and the science of work were used to market foods on the basis of their purported ability to develop the productive energies of consumers. Typical of this approach was the

marketing of the meat extract Bovril. Developed in the 1880s, in the context of concerns about the lack of nourishment in working-class diets, Bovril provided a concentrated form of protein that was cheaper than meat. Taking its name from the energy-giving substance "vril," from Edward Bulwer-Lytton's science fiction novel *The Coming Race,* Bovril was explicitly sold as a "preventive of weakness and fatigue," "reviving energy and giving real sustenance to the fagged-out body and brain."[32] Throughout the 1890s and into the twentieth century, Bovril ads emphasized its ability to "give strength," "increase vitality," "maintain vigour," "make muscle," and "sustain health."[33] In 1899 the Bovril Company added "Virol"—a malt extract—to its range of products. While chiefly advertised as a product for children, marketing for Virol also stressed its "sufficiency of flesh-forming, energy-forming, and heat-producing material, combined in the proper proportions."[34]

Bovril and Virol were advertised as "the perfection of scientific nourishment," and the Bovril Company enlisted the services of a number of prominent scientists to boost the credibility of its claims.[35] Its chairman was Lord Lyon Playfair, who (as discussed in chapter 1) was the chief British proponent of Liebig's experimental work on the chemical composition of foodstuffs in the mid-nineteenth century.[36] Also listed as a director was the physician and politician Robert Farquharson, an early contributor to the medical debate about overwork in the 1870s.[37]

While drawing on contemporary anxieties about the exhausting pace of modern life and "working at high pressure," the Bovril Company's marketing addressed itself explicitly to both middle- and working-class customers.[38] A series of newspaper ads in 1905 and 1906 asking "Who Said Bovril?" depicted a series of customers from a range of white- and blue-collar occupations, including a nurse, a physician, an office clerk, a railway guard, a cook, and a professional footballer. "Whether you are working in the office, factory, or field," another ad promised, "you will find that Bovril gives you the extra strength to meet the extra strain."[39]

While Bovril and Virol were specifically designed with nutrition in mind, and advertised from the very beginning as "energy" foods, the late nineteenth and early twentieth centuries also saw already existing products adapt their advertising strategies to emphasize energy, efficiency, and productivity. The confectionary manufacturers Cadbury and Rowntree—both also early adopters of work science and industrial

psychology in their factories—provide two good examples of this. While both companies had their origins much earlier in the nineteenth century, from the 1880s both started advertising their cocoa products as remedies against exhaustion and boosters of productive energy. "An energetic man needs stamina," ran a typical advertising line, "and the regular use of Cadbury's Cocoa is exceedingly beneficial for sustaining against fatigue."[40] By drinking a cup of morning cocoa, a Rowntree's ad in a working-class newspaper proclaimed, "the consumer lays in a store of strength, energy and staying power against the labours of the day."[41] Right through the interwar period, manufacturers of food products continued to sell their products as a means to promote the productive powers of body and mind. Physical and mental efficiency, they implied, were marketable commodities. Health—the worker's "capital"—was something to accumulate and invest, bringing a return in the form of future earning power.[42] "You know how essential health is for you," as an Ovaltine advert of 1924 put it. "Your happiness, your material prosperity depend on your mental and physical efficiency."[43]

As well as the benefits to individual health and efficiency, advertising often stressed the consumer's obligations to the social body. In a number of ads, the individual's responsibility for their own nutrition and a national "quest for efficiency" were explicitly linked.[44] Dr Tibbles' Vi-Cocoa, for example, a processed "health food" first sold in 1897, was directly marketed as a service to the nation. Drawing its power from the "nutriment and vitalising properties" of the kola nut, Vi-Cocoa promised to increase the health and productivity of the workforce in age of competition, overwork, and fatigue: "No matter whether physical or mental labour is mean, or even if, as is too often the case in these days of fierce struggle for existence, an excess of either has to be accomplished, Dr Tibbles' Vi-Cocoa will prove of inestimable service."[45] Promotional material provided testimony from "thousands upon thousands of sturdy British workers, who have benefited by the health, strength and stamina building properties of Vi-Cocoa," with one ad in 1898 going so far as to demand that "it must become a national food, to the general advancement of British health and vigour."[46]

During the First World War, an advertising campaign for Bovril drew on the figure of the munition worker as the symbolic embodiment of the nation's wartime strength. An advertising poster produced in

1915 showed a muscular male munition worker, hammer in hand, pausing from his work to drink a mug of Bovril, the work of armaments production continuing in the background. The slogan on the poster, "Bovril gives Strength to Win," was widely used throughout the war years. In an extraordinary follow-up advertising campaign the following year (fig. 5), the poster image was reproduced next to a photographic reenactment of the pose by a (supposedly) real-life munition worker, whose name was given as Leon Clark. A testimonial from Clark explained that he was employed "on what is considered the most difficult and laborious job in the Arsenal." Inspired by "the Bovril Munition Poster," Clark's testimonial informed the reader, he had begun "taking Bovril regularly," resulting in a marked increase in his capacity for work. Beneath Clark's quote, the advertising copy stressed the product's ability to build working bodies and produce labor power. Bovril itself was nothing less than "concentrated energy." Combining ideas of patriotism and productivity, the ad appealed directly to war workers: "Give your best to the Nation," it urged. "You cannot afford to be ill nowadays; the nation cannot have you ill."[47] As in the scientific work of the HMWC, the biological body of the individual was collapsed into the productive body of the nation. Bovril fortified not just the worker but the country.

Somewhere between patent medicines and "energy" foods such as Bovril and Vi-Cocoa were the new processed "tonic foods" that came on to the market at the turn of the twentieth century. Products such as Sanatogen and Plasmon—both forms of concentrated milk protein—were not marketed as medical products. At the same time, however, as Lesley Steinitz has noted, they "had none of the usual immediate physiological effects or material properties of food." While Plasmon could be bought premixed with oats, chocolate, and cocoa or in biscuits, in addition to its pure state, it was not advertised on the grounds of taste or texture. At the moment of consumption, as Steinitz observes, a product such as Plasmon or Sanatogen could be appreciated only "for its intellectual, rather than physical or emotional qualities." Its appeal lay explicitly "in its medical and scientific credibility."[48] More directly than the other food products who jumped on the efficiency bandwagon in the first decades of the twentieth century, therefore, the marketing of tonic foods appealed to the ideals of health, energy, and productive power.

A Munition Worker and BOVRIL

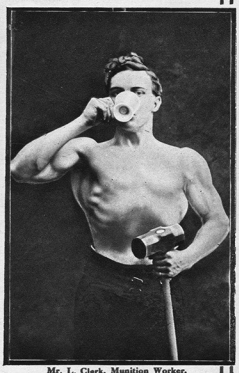
The Bovril Munition Poster.

A striking effect of a famous poster.

Mr. Clark writes:—

"About a year ago I saw the Bovril Munition Poster—'Bovril gives strength to win.' I'll put it to the test, I thought, and I did. For twelve months I have been on what is considered the most laborious and difficult job in the Arsenal. Sometimes the temperature of the shop reaches 120 degrees. All that time I have been taking Bovril regularly, and I can safely say with the Poster, 'Bovril gives strength to win.'"

(Signed) Leon Clark.

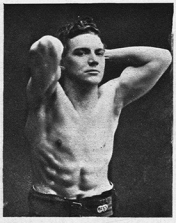


Mr. L. Clark, Munition Worker.

Look at the Splendid Result.

The photograph of this munition worker is the very picture of splendid health and energy, and forms a remarkable testimony to the wonderful body-building powers of Bovril.

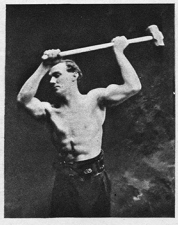
Put Bovril to the test yourself. Bovril is "concentrated energy." It takes a joint of beef to make a bottle of Bovril. If you wish to



Give your best to the Nation—

add to your strength, add to your energy, by taking Bovril. Whether you are working in office, factory, or field, you will find that Bovril gives you the extra strength to meet the extra strain. And above all, if you are feeling "run down," if you are ready to fall a victim to any sickness that may be about, take Bovril at once as a safeguard. You cannot afford to be ill nowadays; the nation cannot afford to have you ill. Therefore fortify yourself with Bovril.

In spite of the increase in the cost of beef (the raw material of Bovril) the price of Bovril has not been increased since the outbreak of the war.



The Body-Building Power of BOVRIL

FOR THE FRONT.—The most convenient pack to send out to officers is Campaigning Bovril. Six 4-oz. tins in a compact parcel.

is proved by independent scientific investigation to be equal to 10 to 20 times the amount taken.

FIGURE 5. "A Munition Worker and Bovril." © Illustrated London News Ltd./Mary Evans.

Sanatogen and Plasmon ads exploited anxieties about the relationship between modernity and fatigue. Often, they evoked an ancient or "natural" state of human health that had been corrupted by urban, industrial modernity. They compared the overfatigued brain worker "amid the rush roar of cities" to the "open-air laborer with his . . . strong unharassed nerves."[49] Often, advertisements were illustrated with racialized classical motifs, depicting energetic Hellenic athletes enjoying a state of uncontaminated "pagan health" and purity.[50] In a modern urban world of "keen competition and strenuous energy," Sanatogen promised to restore the "vigour and elasticity" enjoyed by rustics and ancients.[51]

If their advertising often glorified an ancient past, however, Sanatogen and Plasmon were at the same time eager to show that they were scientifically up to date. The "human being demands special care and attention if he would successfully resist the effects of the extreme pressure under which his work is carried on," a promotional pamphlet for Sanatogen declared. "Of old, the natural recuperative powers served to repair and renew man's store of energy. To-day these powers demand assistance, and such aid has been supplied by *Science*."[52] Promotional copy for tonic foods often adopted a scientific and technical vocabulary remarkably similar to that used by the science of work, drawing on the language of thermodynamics to describe the "potential energy" contained within foodstuffs being "rapidly transmuted into nervous and mental energy."[53] Drawing on a common metaphor, nervous energy was described as "the true petrol of the human motor, the real driving power of body and mind, indispensable to health, happiness and efficiency."[54] Through scientific consumption, advertisers suggested, the imperfect biological material of the human body could be engineered into a maximally efficient productive machine: Sanatogen would "brace . . . up the whole system to the *maximum* capacity of health and vigour" and maintain it "at its highest pitch of efficiency."[55] Sanatogen, advertisements promised consumers, would "enable you to do your full day's work at full speed, *practically without fatigue*."[56]

Marketing campaigns for "food tonic" products did not just share a common imagery with the science of work, however. Increasingly in the interwar period, advertisers could be found making explicit reference to

the experimental methods, techniques, and results of industrial physiology and psychology. One 1925 ad, for example, presented intriguing scientific "proof" that "a Sanatogen user is still fresh and energetic when the other man is tired." The text described a "fatigue test" conducted by an "eminent physician." A group of "indoor workers" was tested for fatigue before and after a two-week course of Sanatogen. Without the benefit of Sanatogen, the ad claimed, the test subjects had after six hours of work "exhausted 86% of their energy." After taking the tonic for two weeks, the same amount of work used up only 20 percent of their energy, "being *practically as fresh and fit as when they started work*."[57] The stark difference in fatigability was displayed by means of a graph, on which a smiling worker was superimposed. Another ad described the use of "an ingenious fatigue-machine" (possibly a version of Mosso's ergograph or McDougall's "dotter") to show "the steady increase of nerve-strength, through Sanatogen, in a young man who suffered from . . . fatigue." After twenty days, it reported, the "patient . . . was able to do, without fatigue, twice the work he did formerly."[58]

Significantly, as well as appearing in the popular press, patent medicines and energy foods were also advertised in specialist publications aimed at employers. Here, rather than the worker being asked to view their body in terms of productivity, the employer was directly encouraged to view the health of his employees as an unexploited source of further efficiency. In the advertising pages of *Industrial Welfare,* for example—a magazine aimed at the "progressive" employers who were the chief audience for the ideas of the science of work—employers were enjoined to "Give your staff Bovril!" or "Tone up your workers" with Virol.[59] Some ads quoted directly from institutions like the Industrial Fatigue Research Board, while others stressed, "Production depends upon efficiency and efficiency on physical fitness."[60] Placed alongside ads for industrial materials and machinery, those that emphasized the physical and mental health of the workforce subtly reinforced the conceptual equivalence—made explicit in the work of industrial physiologists and psychologists—between the "mechanical" and "human" factors of production. From the point of view of the employer, the body of the worker was no more than "human material" to be made productive and engineered for efficiency.

SCIENTIFIC MANAGEMENT OF THE BODY

As well as the marketing of efficiency-enhancing medical and nutritional commodities to workers and employers, the period from the late nineteenth century to the start of the Second World War also saw the emergence of a new culture of health and fitness that glorified the productive body. New regimes of bodily care and exercise promoted the optimization of physical efficiency—at the level both of the individual and of the working population. As Ina Zweiniger-Bargielowska has described in her impressive study of "body management" from the 1880s to the 1930s, "a loosely linked group of life reform and physical culture promoters, doctors, public health campaigners, and policy-makers" united around the Greco-Roman hygienic ideal of *mens sana in corpore sano*—a healthy mind in a healthy body. As Zweiniger-Bargielowska explains, while the bodily disciplines promoted by these reformers were rarely entirely new, "hygienic regimen experienced a resurgence in the late nineteenth century against the background of rapid urbanization, rising living standards, flourishing mass consumerism, intense international economic competition and imperial rivalry."[61] While Zweiniger-Bargielowska does not explicitly emphasize the development of industrial labor power in her book, I want to argue that systems of body management, and in particular the "physical culture" movement, represented another popular counterpart to the science of work that emerged contemporaneously, motivated by similar concerns about the deterioration of the working population.

Incorporating a wide range of practices, physical culture was described by the Danish "apostle of health" Jørgen Peter Müller as any "work performed with the conscious intention of perfecting the body, mind, and soul, and increasing one's individual health, strength, speed, staying power, agility suppleness, courage, self-command, presence of mind, and social disposition."[62] Bodily entrepreneurs such as Müller, the German bodybuilder Eugen Sandow, and "Britain's Strongest Man," Thomas Inch—all of whom achieved considerable fame in early-twentieth-century Britain—sold numerous books and pamphlets and provided correspondence courses promoting their own individual "systems" of physical culture.[63] These included instructions

on exercise, diet, and personal hygiene, promising to "turn ill health into vigour, weakness into strength, lassitude into energy, and mental dulness [*sic*] into life and activity."[64] Physical culture systems were most popular among "the lower-middle and more prosperous sections of the working class" and were widely advertised to, and taken up by, both men and women.[65]

The conception of the body elaborated by physical culturists followed much the same lines as the human motor described by the industrial physiologists. A 1902 article in *Health & Strength* magazine ("the national organ of physical fitness") titled "The Mechanism of the Human Body" confidently asserted, "There is no movement known to engineers which does not exist in our bodies."[66] The human body, physical culturists argued, was a living machine that followed certain physical laws and was capable of "rational" improvement. Efficiency was a paramount concern: "waste of energy" was the physical culturist's cardinal sin.[67] "Vitality," according to one author, represented the total "of the cosmic energy which the human organism transmits from its potential state into manifestation."[68] Physical culture systems promised to develop the "nervous force" and "muscular energy" of their adherents.[69]

Much like the marketing campaigns for health-food products, the language and iconography of physical culture often stressed classical ideals of bodily hygiene and beauty.[70] As Ana Carden-Coyne has argued, classical representations of the body took on increased significance after the First World War, providing an aesthetic framework for the reconstruction of bodies, and bodily ideals, destroyed in the conflict.[71] Even before the war, however, physical culture was drawing on classical tropes to promote an image of the ideal body (and, in particular, of an idealized male body). Magazine articles emphasized the bodily perfection of Greek sculpture, while photographs of Sandow replicating the Dying Gaul or the Farnese Hercules were reproduced in magazines.[72] The strongman William Bankier performed and published under the name of Apollo and was billed as "the Scottish Hercules."[73] Yet alongside and beneath the adoption of an ancient aesthetic lay a wholly modern preoccupation with physical and industrial efficiency. "Success depends today less upon ability than upon energy," as the editor of *Health Culture* magazine put it, going "not to the man who knows the

most, but to him who can stand the most work and the longest hours and the most anxiety."[74] "Health," in the words of Müller, was nothing less than "the general efficiency of the body."[75]

Physical culturists promoted a strongly individualistic model of self-improvement that—like the market in patent medicines and health foods—presented a commodified view of health and fitness as an investment in personal earning power through increased capacity for work. "Your Health is your Fortune" stressed an advertisement for Eustace Miles's pamphlet *Thorough Fitness and How to Secure It*.[76] "Health is the working-man's capital," Bankier echoed, "and he ought to watch over it more than the capitalist over his largest investment."[77] Rather than stressing the social or structural conditions for physical deterioration, culturists such as Müller proclaimed, "Illness is generally One's Own Fault," and, correspondingly, health, strength, and beauty were available to all those willing to commit to developing their own energies.[78]

For physical culturists, however, individual self-development was not simply a personal duty but a national imperative. If the responsibility for improvement fell on the individual, the benefits would be enjoyed by the nation as a whole.[79] The challenges of industrial modernity and international competition required a mass development of working power: the efficiency of the entire productive body was at stake. "The exigencies of modern life throw an increasing strain on the physical and nervous system of the people," proclaimed the debut issue of the physical culture magazine *Vim* (marketed to a working-class readership) in 1902, "and the nation has . . . awakened to the necessity of seriously considering what can be done to arrest the increasing tendency to exhaustion and degeneracy, to improve the physique of the inhabitants of these islands, and to establish, as far as possible, in every unit of the population, a sound mind in a sound body."[80] In 1918, now rebranded as *Health & Efficiency,* the magazine proclaimed, "The first essential of national greatness is the health of the people."[81]

As in the science of work, the biological and the social were rhetorically collapsed: the development of the individual body elided with the expansion of the nation's productive powers. "The 'physical education' of the people is of such paramount importance, alike to the individual and the State," as one article in *Health & Strength* expressed it, "if

we are to maintain our industrial, our commercial, and our National position."[82] The individual body was reduced to a "unit of population," a statistical component of national industrial capacity, significant only insofar as it represented a microcosm or component of the nation's productive body.[83]

POPULAR PSYCHOLOGY AND PERSONAL EFFICIENCY

In physical culture, the problems of industrial physiology found a popular expression. Similarly, from the late nineteenth century onward, the problems that preoccupied industrial psychologists were discussed in a vibrant literature of popular psychology. As Mathew Thomson has emphasized, in a twentieth- (and twenty-first-) century culture saturated with ideas of the psychological, historians of psychology "can no longer rest content with telling the story of the theoretical and professional development of the discipline alone." The first half of the twentieth century, Thomson has shown, was a period "in which the vigor of an associational, alternative psychological culture reached its height."[84] The production and dissemination of psychological knowledge were not limited to the (as we have already seen) still infant academic or professional discipline. Likewise, while industrial psychology thrived in this period, it was by no means the only arena in which psychological knowledge about the worker and the working body was elaborated.

I use the term "popular psychology" to describe a wide range of texts that fell outside of the boundaries of academic, professional, or institutional psychology. This includes a vast array of different works, with widely varying audiences—in terms of both size and social composition. It encompasses—among other things—self-help manuals, correspondence courses, and practical advice books, all genres that flourished in the early twentieth century. Many of the works discussed went through several editions, enjoying large readerships, while others were less successful. While the majority of authors that will be discussed were British in origin, a number of North American and European works were also widely read. Some of the authors discussed explicitly described their work as "psychological" or "scientific," though not all of them did. Where many drew on the language of existing psychological

theories, others advanced their own. In general, authors of popular psychology—or "practical psychology," as they most often termed their work—combined theoretical concepts borrowed or adapted from academic psychology with a "commonsense" pragmatic wisdom. As with industrial psychology (and even more markedly so), popular psychology stressed practical results over abstract speculation.

Above all, popular psychology focused on individual self-improvement. This could mean different things to different authors (and no doubt readers). As Thomson has observed, notions of holistic, spiritual self-development were often held in tension with more materialist goals of increased earning power, competitive advantage in the business or industrial worlds, and increasing one's capacity for work.[85] If in this section I stress the latter element of popular psychological writing, it is because this tension was never more than partially resolved. More often than not, and increasingly over the period, the ideas of personal fulfillment were expressed in the language of industrial efficiency. My intention is to show not only the wide availability of this language and the concepts it entailed but also the increasingly limited possibility of thinking psychologically outside of the terms of work and productivity.

Like the physical culturists discussed above, popular psychology writers addressed their work explicitly to the problems of an urban, industrial modernity, characterized, on the one hand, by speed, dynamism, and progress and, on the other, by overwork, fatigue, and degeneration. The "Age of Energy" was always in danger of becoming the age of exhaustion.[86] "In the stress and strain of modern life," a popular pamphlet warned, "success becomes every day a matter more difficult of attainment."[87] Echoing the concerns of the more orthodox industrial psychologists, a common refrain in popular texts was that "industrial and mechanical progress" had advanced at the expense of "personal progress."[88] In the rush for technological advancement, the psychological health of the population had suffered. Popular psychology and self-help promised a development of the human individual that would keep pace with the development of society.

The comparison with physical culture was often made explicitly. In his best-selling self-help book *Mental Efficiency,* the writer Arnold Bennett commented on the growing craze for physical exercise. "Surprise a man in his bedroom of a morning," he observed, "and you

will find him lying on his back on the floor, or standing on his head, or whirling clubs, in pursuit of physical efficiency." It was a "strange thing," then, that no one "had the idea of devoting a quarter of an hour a day after shaving to the pursuit of mental efficiency."[89] Commonly, psychological self-development programs stressed that "as other physical organs are capable of being developed, so also is the brain," with Bennett suggesting the adoption of a regime of "mental calisthenics," or an "intensive culture of the reason."[90]

The near-ubiquitous, if somewhat nebulous, goal of mental training was "Success"—a destination that popular psychology claimed was in reach of anyone willing to work for it.[91] In contrast to much of orthodox psychology (and particularly its more Darwinist forms), popular psychology stressed the malleability of human psychology, the capacity for change and improvement within every person. While industrial psychologists did explicitly aim at a change in the psychological orientation of the worker, their concern with the measurement and classification of types—consigning the "industrial misfit" to the psychological scrap heap—arguably showed the limits of their optimism. In contrast, popular writers stressed the universal potential of psychological self-knowledge to transform almost any individual. The ordinary man or woman was a reservoir of untapped potential. The truism that "the average man uses . . . only from 10 per cent. to 20 per cent. of his mental powers" was widely repeated (though the exact proportions changed), and the "latent powers locked up in ourselves" were just waiting to be released.[92] "We must believe that every normal person possesses the raw material out of which he can develop Man-Power," one course urged its students, "and that in this development lie his possibilities of advancement."[93]

Once again, *energy* (or sometimes *force*) was a crucial organizing concept. Richard J. Ebbard, an early exponent of the psychological self-help genre, described his 1902 work *How to Acquire and Strengthen Will-Power* as "a rational course of training of volition and development of energy," a notion developed further in his 1903 *How to Restore Life-Giving Energy*. The Hungarian émigré Emil Reich promoted a "science of success" that he christened "Energetics," a doctrine that he applied not only in self-help books but also in his "psychological view of history."[94] Just as "success in life" was the expression of the

"concentrated energy" of the individual, he claimed, so the "success of nations" was due to an inherent racial "energy capable of carrying them irresistibly along to path of the ideal which their life of struggles has helped them to conceive."[95]

No less than the physical culturists, popular psychologists drew on the metaphor of the human motor converting energy into work. In his 1911 book *The Human Machine,* Arnold Bennett described the combination of body and brain as "a machine wonderful beyond all mechanisms in sheds, intricate, delicately adjustable, of astounding and miraculous possibilities, interminably interesting," "complex and capable of quite extraordinary efficiency." For E. R. Thompson, in a later book of the same title, the brain could be understood "as a sort of dynamo for the manufacture of originality, of thought FORCE." Bennett professed not to value work "for its own sake" but rather for "the more full and more intense consciousness of being alive which it gives." Nonetheless, his views of human nature and the body's potentials were consistently constrained by a thoroughly work-centered, mechanical, and thermodynamic imagery. The "art of living," he wrote, was nothing more than "the art of extracting all its power from the human machine."[96]

In the twentieth century, the popular sciences of energy and success were crystallized into the concept of "personal efficiency." First appearing around the time of the First World War, throughout the interwar period the phrase appeared in numerous books of self-help and practical advice. Self-improvement manuals offered the "secret of efficiency" or laid down "laws of efficiency" to be followed.[97] From the mid-1920s, the publishers W. Foulsham & Co. published a series of *Efficiency Handbooks,* costing a shilling each and containing everything from memory training to guides to business success, vocational advice for boys and girls, and even a pocket encyclopedia.[98]

A popular counterpart to the "human factor" of industrial psychologists, the concept of personal efficiency placed the worker within the context of a broader industrial civilization. While the focus on the individual personality and development seemed to elevate the individual above the world of industry and machinery, the simultaneous emphasis on efficiency reinforced a view of the working body and mind as productive forces or as capital to be invested. A 1914 manual

titled *How to Become Efficient* proposed the "scientific management of the brain and its work." Personal efficiency, authors claimed, was "the originating cause of every other kind of efficiency."[99] It was not machinery or finance but human capital that was "the true basis of efficiency."[100] Not only the technical and material factors of production were capable of being made more efficiency but workers as well. Moreover, they could be persuaded to do it themselves.

Some guides explicitly positioned themselves as tools for workers—and sometimes for employers—to maximize their earnings. One *Course of Study in Personal Efficiency* set out its objectives as follows: "Ever increasing development of personal efficiency and earning or service rendering power. The development in the individual of the qualities that make for success and a greater degree of happiness in work. The apprehension and appreciation of those prime factors that lead to a successful career."[101] Definitions of personal efficiency often stressed working life: "The efficient individual is he or she who can render the maximum amount of service in the particular sphere of activity to which he or she is placed."[102] Sometimes, self-help authors echoed work scientists almost exactly: "The aim of every worker should be to do the maximum of work with the minimum display of effort."[103] Others offered looser or more expansive definitions. "Personal efficiency," students of one correspondence course were told, "is not merely a business asset. . . . Our studies have shown it to be the manner of living our lives richly, fully and intelligently."[104] Writers stressed the development of one's own "powers," positive thinking, the importance of energy conversation, and the reduction of "all forms of waste" in all areas of life.[105] The introduction to an American course published in England stated its purpose as being to "help others to increase their health, productiveness and happiness."[106] In the final instance, however, the development of personal efficiency was almost always justified most forcefully in economic terms.

Perhaps the practical psychology scheme that most successfully captured the British imagination in the early twentieth century was Pelmanism. Devised in the 1890s by the journalist William Joseph Ennever (though also associated with the mysterious, possibly fictive, figure of Christopher Louis Pelman), the Pelman System was a program of mental training by correspondence that gained huge

popularity in the first decades of the twentieth century.[107] By 1914 the Pelman Institute claimed to have enrolled two hundred thousand people in its course. The First World War apparently fueled enthusiasm for psychological improvement, and by 1918 the number had doubled.[108] Originally focusing primarily on techniques to improve memory, the Pelman System developed into "a full course of instruction in mental efficiency, designed to meet every requirement of life." Drawing on familiar language, it promised to "develop energy, enterprise and self-confidence" and to train students to "think in a *productive* manner."[109]

Pelmanism had a wide social reach, although, like physical culture, it mainly attracted the lower middle class and more well-off sections of the working class. In the opinion of the contemporary social chroniclers Robert Graves and Alan Hodge, it was designed for the "foremen, clerks, and small tradesmen [who] wished to rise into the middle class of manufacturers and wholesale merchants."[110] In its publications and promotional materials, the Pelman Institute addressed itself to "every class of society" and to both men and women.[111] A 1904 pamphlet contained a wide selection of unsolicited endorsements from satisfied customers, listed by occupation. Whether real or invented (and the homogeneity of style and repetition of phrases across different testimonials suggest the latter), the range and selection are evidence of the different consumers the institute attempted to attract. It included schoolmasters, reverends, university students, and "business men" but also clearly targeted a working-class audience. "If you think a workingman's testimony worth having," began one message, "you have my full permission to place my letter along with your other testimonials." "I have carefully gone through the five courses," read another, "and I hasten to assure you, though only a working man, the very deep gratification and delight I feel through the application of your marvellously simple 'System of Memory Training.' . . . I sincerely and thoroughly recommend your splendid System . . . to every mechanic."[112]

Popular in its presentation, Pelmanism nonetheless claimed to be based on "absolutely irrefutable psychological principles," embodying "the latest researches of English, American and European specialists in the science of mind."[113] The course emphasized the ability of positive thinking and mental training to generate "human energy" and,

increasingly in the interwar years, emphasized the reciprocal influence of physical and mental fitness.[114] While conceding that in some cases mental inefficiency was due to heredity, Pelmanism broadly stressed the capacity of all to improve: "Just as physical power can be developed and a weak body made into a strong one, so can mental power be developed; and a mind that is merely average can be raised to a much higher degree of efficiency."[115] The Pelman course stressed the importance of education and development, especially in young people, and it is worth observing that the "critical years," identified as between the ages of fourteen and twenty-five, were precisely those in which boys and girls, or young men and women, would enter the labor market.[116]

Pelmanism cultivated a strong aspirational appeal. In the struggle for success, its proponents claimed, mental training would provide an invaluable competitive advantage: "In the present state of human society, manual skill is far more common than mental efficiency, and consequently must demand less remuneration. The alert and capable mind . . . can demand and will receive its own price." Graves and Hodge even went so far as to suggest—perhaps not entirely flippantly—that the influence of Pelmanism, with its emphasis on individual competition over collective solidarity, could go some way to explaining the decline of revolutionary agitation in the interwar period. The masses gave up socialism for personal efficiency, and "the revolutionary crowd-spirit had thus been canalized into a million streams of individual ambition."[117] Certainly, as with the majority of popular psychologies, Pelmanism stressed the responsibility of the individual for their own success or otherwise.

Perhaps the only serious challenger to Pelman's dominance in the interwar self-improvement market was the practical psychology of Émile Coué. First published in Britain (in translation from French) in 1920, Coué's psychology was based on the technique of "conscious autosuggestion," a method encapsulated in his famous mantra: "Every day, in every way, I am getting better and better." Coué's visit to London in 1921 was breathlessly reported in the national press, and *The Practice of Autosuggestion by the Method of Émile Coué,* a 1922 book C. Harry Brooks popularizing Coué's methods as a means to "happiness and efficiency," is estimated to have sold more copies than any other psychological work in early 1920s Britain.[118] Developing the theme of

untapped human potential, Coué (and Brooks in turn) stressed the advantages that could be gained by harnessing the power of the unconscious. In contrast to Freudian views of the unconscious that centered on repression and neurosis ("poking about in the dark places of the mind and bringing to light all kinds of hidden horrors," as one practical psychologist put it), Couéism evoked a wealth of abilities lying dormant yet accessible through the systematic application of conscious suggestion.[119] "It must be evident," Brooks explained, "that if we fill our conscious minds with ideas of health, joy, goodness, efficiency, and can ensure their acceptation by the Unconscious, these ideas too will become realities, capable of lifting us on to a new plane of being." For the Couéists, the unconscious did not stand in opposition to consciousness but complemented and sustained its functions. Drawing on the imagery of the factory, Coué's unconscious was "a power-house. . . . It provides the energy for constant thought and action, and for the performance of the vital processes of the body."[120]

The language of personal efficiency remained influential well into the 1930s, attracting an eclectic range of writers and thinkers. Alongside more conventional "systems" of self-help and mental training, practices as varied as hypnotism, Christian ethics, and yoga all adopted the vocabulary of psychological efficiency as a means to promote their own programs of self-improvement.[121] In these varied arenas—and across a range of social groups—ideas of mental energy and efficiency (expressed in more or less "scientific" forms) were disseminated to the British public. From the end of the nineteenth century to the beginning of the Second World War, hundreds of thousands of subscribers to personal efficiency programs—and perhaps many more who read about Coué or the Pelman Institute in local and national newspapers—began to understand themselves, in Mathew Thomson's phrase, as "psychological subjects."[122] The appeal of these schemes lay in their optimistic view concerning individual improvement and their pragmatic orientation toward concrete and material goals. For many, no doubt, their sensitivity to the problems of industrial life and work, and their promises of self-development, provided a sense of meaning, purpose, and reassurance. At the same time, though, the psychology of personal efficiency encouraged its adherents to adopt a view of the mind that was always defined in relation to the concept of work. Health and

self-fulfillment were increasingly measured in terms of productivity and "working capacity."[123]

HERBERT CASSON: EVANGELIST OF EFFICIENCY

Perhaps no one person better encapsulates the interwar enthusiasm for efficiency in Britain than the eccentric figure of Herbert Newton Casson. Born in Canada in 1869, the son of a Methodist missionary from England, Casson had an eventful youth and young adulthood. After initially following his father into the church, he was forced to leave after only a year, having apparently been convicted of heresy. Emigrating to the United States in 1893, Casson converted to socialism, becoming a notorious agitator and orator, reportedly drawing audiences of thousands to his rallies. After a disagreement with his comrades over his opposition to the Spanish-American War, Casson joined a commune in Tennessee, an "adventure," he would later claim, that "cured me of all sympathy with Socialism or Communism."[124] After traveling to Ohio to meet the industrialist John Patterson, Casson was once again converted and thereafter devoted himself to the cause of capital. Moving to New York, Casson made a name for himself as a journalist and author—specializing in interviews and biographies of inventors, scientists, and businessmen—before joining the consultancy firm of the efficiency engineer Harrington Emerson, an associate of Frederick Winslow Taylor. In 1911, in partnership with H. K. McCann, Casson helped to found what would become one of the world's largest advertising companies.[125]

In 1914 Casson sold his shares in the H. K. McCann Company, doubling his initial investment, and moved to England, intending to retire. The outbreak of the First World War, however, convinced him of the need to publicize in Britain the theories of scientific management and organizational efficiency he had brought across the Atlantic. On the outbreak of the conflict, Casson offered his services to the British government but received no reply (the germ of a vociferous and long-standing hostility that Casson would hold for the rest of his life toward all governments and to the British government in particular). Taking matters into his own hands, Casson set about using the huge sums of money he had accumulated in America to promote his own doctrine

of efficiency in Britain. First he established his own British branch of the Sheldon School of Business Science—a business-advice and education institute founded by his friend, the American "philosopher of selling," A. F. Sheldon in 1902—primarily to promote efficiency methods in munitions factories (alongside, though in no way affiliated with, the HMWC).[126] In 1914 he gave public lectures in Manchester and London on industrial administration and in February 1915 founded the Efficiency Exchange, with premises at Empire House in London, an organization that would consume the rest of his life.

The Efficiency Exchange functioned as a business consultancy, providing services and information to employers and managers.[127] But for Casson, its chief purpose was as an organ of propaganda and education. Between 1915 and his death in 1951, Casson published through the exchange an enormous number of books—almost all written by himself—promoting the doctrine of efficiency. His son, Edward E. Casson, estimated that overall his father had published 184 books over his lifetime, the majority of them written after his arrival in England. At the same time, from 1915 until his death, Casson was the sole editor, publisher, and practically the sole writer of the monthly *Efficiency Magazine,* aimed chiefly at employers. With an initial circulation of twenty-four thousand, by the time Casson died, it was claimed to have a readership of more than two hundred thousand, in six languages.[128] If his claims actually to have started the "efficiency movement" in Britain were exaggerated, Casson was certainly one of its greatest evangelists and an undeniably effective popularizer and propagandist. As the introduction to his biography put it, "He was efficient in selling 'Efficiency.'"[129]

For Casson, efficiency represented a philosophy that extended well beyond the limits of business organization. "Efficiency could be applied to every individual, and to the whole field of human endeavour."[130] Commonly using the human body as a metaphor for organizations and industrial practices, Casson created a strong homology between bodily and social efficiency. In both cases, the goal to be aimed for was the greatest output from the smallest exertion of energy. In political terms, Casson argued that social progress relied on "the production of a comparatively small number of improved individuals, who are superior to the mass in knowledge, skill or character, and who, by reason of their superior powers, render a new service to the mass of people

among whom they live." Thoroughly disillusioned with democracy after his socialist "adventure" in America, Casson became convinced that the technocratic government of this "Efficient Few" was the only way to ensure an efficient society.[131]

While Casson's apprenticeship had been in the scientific management movement in the United States, he did not believe that American notions of efficiency could be imported wholesale to the British Isles. Taylorism, he claimed, did not suit "the mind and temperament" of the British people. There was, he wrote, "a higher quality of human nature in Great Britain than in the United States," and as such the concept of efficiency needed to be broadened "so as to take in human qualities as well as methods and machinery."[132] It was Casson's opinion that industry needed to be "humanized" in order to get the full "body power," "brain power," and "heart power" out of employees.[133] As he made clear, however, a commitment to "humanism" was motivated not by concerns for workers' welfare ("regimentation," "mass movement," and "systematization" were, after all, acceptable demands to make of an American workforce) but only by the desire to get a "higher percentage of result" from the resources available.[134]

While the *Efficiency Magazine* was aimed chiefly at employers—"the Efficient Few" of his technocratic fantasy—Casson also saw the value in targeting workers directly.[135] Casson celebrated what he saw as the "reconstruction" of psychology from a metaphysical to a practical science, and *Efficiency* ran frequent ads for courses in Pelmanism. "Personal success," Casson emphatically asserted, was something that could be taught.[136] Alongside the magazine, Casson established his own personal efficiency courses—available both by correspondence and in person—with lectures and classes held not only at the London headquarters of the Efficiency Exchange and the Sheldon School but also in Glasgow, Liverpool, Leeds, Birmingham, and Manchester. Diplomas were granted to all those who completed the course, and Casson encouraged employers to subsidize their employees' training by contributing half of the fees.[137]

In terms of their structure and content, Casson's correspondence courses resembled the popular psychology systems that became popular in the same period, consisting of a series of "textbooks" mixing self-help advice with exercises for the participant to complete. In a

similar fashion, Casson emphasized the opportunities for individual fulfillment—material and spiritual—that self-improvement could bring. "This Course of Study," as the first book of *The Casson Office Course* put it, "is not only to benefit your employer or company. It is to benefit *yourself*. It is to increase your personal efficiency. It is to show you how to do your best." Much more than Pelmanism or Couéism, however, Casson's courses were typified by a quantitative, measurement-centered approach more reminiscent of scientific management or industrial psychology. In one exercise, for example, students were asked to plot a "personal efficiency chart" over a day's work, marking as a "percentage of their efficiency" their performance over eighteen psychological "qualities" (for example, "loyalty," "memory," and "obedience") and calculating an average.[138]

As with industrial physiology and psychology, Casson elaborated a theory of the body based firmly on the concepts of energy and work. "The human body," he wrote, "is a conscious machine, and the brain is its engine."[139] For Casson, the "secret of Health" was "the daily restoration of Energy."[140] Frequently, he compared the body to an energy "tank," "reservoir," or "cistern."[141] All the actions of the human body, he argued, could be reduced to two basic functions: taking energy in and giving out work. In several of his books, courses, and articles, Casson represented this schematically (fig 6).

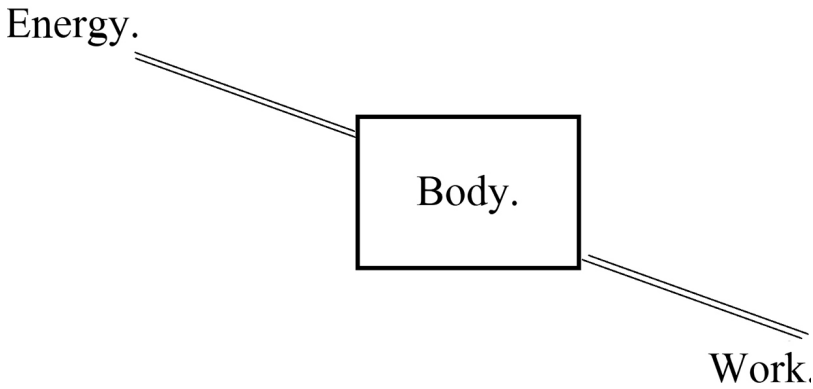


FIGURE 6. "The body is like a tank." Diagram reproduced from *The Casson Office Course* (1918).

Here the working body was reduced to its productive form in the most radical terms. Casson encouraged his readers to be "engineers" of their own body, constantly developing their productive capacities and increasing their own efficiency.

The aim of training the population in efficiency methods was explicitly to create—in physiological and psychological form—employees most suited to work in a modern, increasingly mechanized and bureaucratized industrial society. For Casson, "efficiency meant the development not only of better business but of better men."[142] As he put it in his autobiography: "Efficiency must mean more than mass production, modern equipment and clever selling and advertising. It must mean more than methods and apparatus and chemistry. It must mean the development of a higher type of man."[143] In a 1938 book (a limited run sent to each of *Efficiency*'s four thousand lifetime subscribers), Casson's enthusiasm for human engineering and his evolutionary fantasy of "the Efficient Man" was combined with eugenics, as he dreamed of the day when "the principles of Efficiency will be applied to the production of a better-born human race."[144]

If Casson was a fundamentalist in his pursuit of efficiency, his writings only expressed, in an extreme form, ideas in broad circulation in the interwar period. By the 1930s, as the sources in this chapter have shown, similar views of the human body and its relationship to work could be found in a wide variety of places. During the First World War and the interwar period, Casson was personally hostile toward the HMWC and the Industrial Fatigue Research Board, although this likely had more to do with professional competition—and a general distrust of government institutions—than any substantial theoretical disagreement.[145] In turn, Casson's lack of scientific credentials, and his association with the scientific management movement, meant that he was never likely to be cited by such institutions. In essential terms, however, the philosophies and techniques promoted on the one hand by Casson and on the other by the science of work had far more in common than separated them. For both, the explicit aim was to develop the efficiency of the working population, and, for both, the physical body of the worker was the arena in which this development would be played out.

CONCLUSION

In his influential account of working-class culture, *The Uses of Literacy,* based in large part on his own experiences growing up in interwar Leeds, the literary critic Richard Hoggart quotes from a manual on physical culture published in 1934: "Regard your body as an engine—far more wonderful than any man-made machine—and you will find that you can derive endless pleasure from cleaning, fuelling, lubricating and testing it, as well as from actually racing it." Such an attitude, Hoggart claimed, "would be alien to [the] world" of the working-class reader for whom the book was intended.[146] Rather than a mechanical system, to be maintained, optimized, or enhanced, the working-class body as Hoggart understood it was a site of lived experience, pain, and pleasure.

In analyzing the primary material discussed in this chapter, it is often difficult to ascertain the responses of its intended audiences. Beyond the (often suspect) claims of advertisers and publishers as to sales and circulation figures, and the equally dubious letters and testimonials from satisfied customers, the reaction of the ordinary consumer recedes from view. Even where reliable data is available as to the readership of a particular text, this—as Jonathan Rose cautions—is no reliable measure of its influence. A critical reader, as Rose writes, cannot assume "that whatever the author put into a text—or whatever the critic chooses to read into that text—is the message that the common reader receives."[147]

The primary material itself provides only a few tantalizing clues as to the response of reader-consumers. In a copy of *The Casson Office Course* held by the British Library, for example, exercises have been dutifully filled out and annotated by a William C. Butler, a printers' clerk from Bermondsey in South London and "lifelong subscriber to *Efficiency Magazine*." A keen student, Butler maps his personal and professional progress from June to November 1918, recording his results on a "Personal Efficiency Chart." On blank pages, or stuck between sheets, are newspaper clippings on health, industrial relations, and office efficiency methods, as well as appointment cards for fortnightly meetings of the "London Office Course Circle."[148]

While it is hard to gauge how typical Butler's enthusiasm was, even among others who participated in similar schemes, his notes provide a small personal window into an early-twentieth-century culture of commodified efficiency. From the late nineteenth century, workers like Butler were invited, as consumers, to invest in enhancing their own productivity. The science of work was accompanied in the commercial sphere by energy-enhancing medicines and foods, physical culture, and the various "personal efficiency" schemes associated with Pelman, Coué, Casson, and others. Far from being isolated phenomena, or unrelated curiosities, I have argued, these varied pursuits represented forms of a wider culture of efficiency. In these various forms, workers were sold the ideal of the productive body. As Hoggart suggests, however, the standards that scientists, entrepreneurs, and propagandists projected onto the working body were not necessarily straightforwardly accepted. In order to evaluate the extent to which logics of productivity and efficiency were internalized, contested, and resisted, it is necessary to effect a shift in perspective. In the final chapter of the book, the relationships between work, health, and the body are viewed from the worker's point of view.

CHAPTER 5

THE WORKER'S VOICE

> *The history of the working class . . . is punctuated by a continuous struggle to redefine the nature of work and health.*
>
> —Vicente Navarro, "Work, Ideology, and Science: The Case of Medicine"

The science of work, scientific management systems, and the cultural expressions of efficiency ideology discussed in the previous chapter were all elements in the construction of a productive body. These discourses, I have argued, took as their subject not the individual worker but a standardized and homogenous workforce, geared toward the production of surplus value. The science of work—through all its iterations—was fundamentally predicated on the idea that body and mind could be measured according to objective, quantifiable standards. The individual body was viewed as a productive system in microcosm: an assemblage of aptitudes and capacities, capable of fine-tuning for maximum efficiency. At the heart of the science of work and the related discourses of efficiency that emerged in the early twentieth century was a promise to produce bodies that were docile, efficient, and productive.

In viewing the science of work as an agent in the formation of the productive body, however, it is important to avoid the traps of teleology and determinism. Both Marxist accounts of the subsumption of labor under capital and Foucauldian accounts of the rise of disciplinary power have been criticized for ignoring the role of contingency and individual agency in the shaping of work and the body.[1] It is important to bear in mind that the imposition of discipline—the making of productive bodies—is never a one-sided or linear process.[2] Rather, it is the product of social struggle, often over long periods of time.[3] Disciplinary power is never total, and there are always possibilities of counterhegemonic discourses and resistances.[4]

Looking at the science of work from only from the perspective of scientists and their institutions—backed in turn by government and

employers—reinforces the notion of the working-class body as a passive subject or construct of power. These sources—if perhaps the most straightforward to obtain—present a necessarily one-sided view of work science. The voices of workers—their capacities for dissent, resistance, and counterdiscourse—are absent or distorted. This chapter attempts, to borrow the sociologist Michael Burawoy's phrase, to "bring the workers back in" to the history of work science, to recover voices that disrupted, challenged, or resisted the productivist logics of the industrial physiologist or psychologist.[5]

While the published and archival records of the science of work are substantial, there are relatively few sources in which workers' responses to work and to work science can be found. Nonetheless, within the official record, it is still possible to uncover moments in which the worker speaks. While in theory the worker's voice was rigorously excluded from the science of work, on a number of occasions scientists were forced to confront workers' opinions and to give them expression. For some factory investigators, the necessity of interaction with workers in the course of their work suggested a case for the inclusion of subjective data in their research, and this was occasionally discussed in print. More often, the micropolitical difficulties of scientific investigation in the factory required careful management of the attitudes and opinions of workers, so as to avoid provoking hostility or unrest. While workers were rarely quoted directly, investigators' impressions of their responses illustrate how seriously concerns about workers' opposition were taken and begin to indicate how workers themselves related to work science.

A further partial insight into workers' responses can be traced in the records of the trade-union movement. While here again, the voice of any individual worker disappears—subsumed under a single institutional voice—the records of organized labor can nonetheless help to build a picture of how workers reacted to the science of work. Vicky Long has argued that the Trades Union Congress played an important role in determining the shape of the interwar debate on workers' health.[6] However, by examining the TUC's links to work-science institutions, and its use of scientific evidence in campaigns against Taylorist scientific management systems, I argue that, for various reasons, the TUC largely accepted and promoted the productivist model of industrial

health and the working body espoused by the science of work. While in the short term unions were able to successfully recast traditional demands in terms of health, and to slow the progress of more extreme forms of scientific management, in the long term they effectively ceded all claims on the body at work to scientific expertise.

Beyond the institutional records of science and organized labor, there is the writing of workers themselves. The Burnett Archive of Working Class Autobiographies, collected by John Burnett, David Vincent, and David Mayall, contains a number of unpublished memoirs by working-class men and women dating from the eighteenth century to the twentieth. In addition Burnett, Vincent, and Mayall's annotated bibliography, *The Autobiography of the Working Class,* indexes numerous other published and unpublished works.[7] Drawing chiefly on these sources, the final part of the chapter looks to reconstruct responses to work and to work science from those who experienced them directly. If these sources do not carry the same issues as the institutional records of science and labor, they are—of course—no less mediated, and no less problematic, as a means to divine workers' attitudes. The vast majority of them, for example, were written a significant amount of time after the events they describe took place. They were composed for a wide variety of reasons—some explicitly advancing a particular political position, for instance, with others presented simply as a record of a life—and different authors, naturally, select different aspects of their life and work to focus on. The list of authors in the Burnett archive is skewed heavily toward men and also to the left of the political spectrum.[8] Many of the authors—particularly those whose memoirs were published—achieved a degree of distinction in their lives, most usually as a writer or in the field of politics, and in this respect as well are less than characteristic of the broader working population.

In selecting these autobiographical sources, then, I can make no claim of representativeness; nor do I want to. The men and women quoted here do not—and cannot—represent any putative homogenous "working-class voice." The autobiographer, as John Burnett points out, is never "a strictly representative figure." "Memoirists," cautions Jonathan Rose, can never be "entirely representative of their class, whatever that class may be, if only because they are unusually articulate."[9] That this chapter is not representative, however, is determined

by more than practical considerations. My concern is not with any monolithic "working-class experience" as such but with identifying and recovering points of interruption, alterity, and resistance—points at which the physical and emotional responses of workers display the potential to disrupt hegemonic logics of work, health, and the body. As such, I have *sought out* radical voices, agonistic voices, and voices of dissent that are—by definition—atypical.

Drawing on critical theories of affect, the personal responses of workers to their work, to work science—and to the logics of health and efficiency that it promoted—are interpreted here as political, or proto-political, acts. Affect, as Brian Massumi argues, is not something that is separate from politics, something that becomes political or politicized. It is "a dimension of life . . . which carries a directly political valence." This is not to say, however, that emotional life is always consciously or explicitly political: "The concept of affect is politically oriented from the get go. But moving it onto a 'properly' political register . . . is not automatic. Affect is proto-political. It concerns the first stirrings of the political, flush with the felt intensities of life. Its politics must be brought out." "Politics starts in the animated inhabitation of things," as the anthropologist Kathleen Stewart puts it in her experimental essay on affect and everyday life. The "dreamboats and horror shows" of political ideology and spectacle, Stewart argues, should not draw attention from the "ordinary affects" that form the basis of the political.[10]

Raymond Williams's work on "structures of feeling" addresses this same gap between affect and ideology, between "what is actually being lived" and "what it is thought is being lived." Williams, in his words, focuses on "feeling" as opposed to "ideology" in order to "go beyond formally held and systematic beliefs" and access "meanings and values as they are actively lived and felt." In examining the autobiographical writing of workers, I am interested in what Williams describes as "a kind of feeling and thinking which is indeed social and material, but each in an embryonic phase before it can become fully articulate and defined exchange."[11]

In thinking through the relationship between the affective and the political, I draw on the work of the literary theorist Sianne Ngai. In her 2005 book, *Ugly Feelings,* Ngai focuses on the "critical productivity" of everyday negative emotions such as envy, anxiety, paranoia, and

irritation. Such emotional states, she argues, are relatively unexplored because—unlike anger, love, or terror—they are ambiguous and inconclusive, failing to offer the catharsis associated with those more immediately impressive emotions. These "minor negative affects" at first seem unlikely to provide the basis for political action. In fact, as Ngai makes clear, ugly feelings often present themselves as problems of "obstructed agency," appearing as a barrier to decisive action rather than a stimulus.[12] Nonetheless, as she has recently argued, "for all their weak intentionality (in most cases), these negative feelings still retain an immanent criticality. They prepare a way for agonistic thinking, in spite of lacking the sharply defined objects so important to cognitive appraisals."[13]

The physical strains and anxieties of work, the minor everyday irritations of the workplace, the restrictions imposed by rationalization, could present themselves as a barrier to agency, yet, at the same time, they could also provide the affective basis for political action.[14] In exploring the ugly feelings of work through the voice of the worker, this chapter elaborates some of the ways in which the "politicality of affect," in Massumi's words, can begin to be "brought out."[15] In terms of a fully articulated or coherent project of "resistance," or perhaps even of political consciousness, most of these examples fall very considerably short. Where they are significant, however, is in crossing the boundary between the affective and the ideological, the personal and the political, from the physical and mental effects of work, and of working-class life, to a nascent critique of capitalist social relations as such.

THE WORKER'S VOICE IN THE SCIENCE OF WORK

In theory, the voice of the worker was excluded from the science of work. In their quest to find objective measurements of human capacity, work scientists repeatedly attempted to bypass the subjective feelings of workers or to discount them as irrelevant. Work-science institutions like the HMWC, for example, argued that, where possible, investigations should be undertaken without the worker being aware that they were under scrutiny. In the day-to-day conduct of factory investigations, however, this was not always possible. The voice of the worker entered into the science of work in two main ways: first as a scientific

concern and second as a practical or political one. Investigators working on the factory floor often found that listening to workers' opinions could in fact provide useful data, even if this influence was often disavowed later. Perhaps more significantly, however, investigators knew they had to carefully manage the feelings of workers if they were to be able to conduct their work without arousing hostility or outright resistance. The science of work, in this sense, was itself well aware of the politicality of affect.

For the investigators employed by work-science institutions, contact with workers—an awareness of their conditions, personal interaction, and the formation of some kind of working relationship—was usually unavoidable. For the scientists who worked in close quarters with ordinary laborers, the rigid distinction between objective phenomena and subjective feeling was sometimes difficult to maintain. The fleeting inclusion of the worker's voice in various texts by work scientists suggests that workers were able to exercise some agency over the production of scientific knowledge.

It is notable that, where the voice of the worker was considered by the science of work, it was more likely to be in the writings of the investigating staff—employed by one of the institutions of work-science research or directly by a manufacturer and mainly engaged in factory placements—rather than in any of the theoretical textbooks produced by more senior work scientists. The less prestigious role of investigator was usually held by younger researchers, often recent graduates, and also included a significant number of women. One such investigator, Patricia Hall, was employed by Benjamin Seebohm Rowntree to conduct psychological tests on workers in his York cocoa works. In a report on her investigations, cowritten with H. W. Locke, the head of Rowntree's education program, in 1938, she drew attention to the difficulties of a limited positivist approach. "A scientific approach to the study of human experience, in whatever sphere is not easy," Hall and Locke wrote. "The first difficulty is to discern the facts which appear to be relevant to the problem to be studied, and to confirm their relevance." In a comprehensive investigation of working conditions, the "prejudices, preferences and phantasies of individuals" could not be discounted: "They are forms of human experience, even if at first they seem irrelevant to the enquiry, their frequent recurrence shows

that they are really pertinent, and that rightly assessed they will both broaden and strengthen our basis for deductions and conclusions."[16]

Similar reflections on the value of subjective data could be found within the large institutions of work science. In a 1925 report for the IFRB, board investigator H. C. Weston argued that the testimony of workers was a neglected resource. A focus on scientific precision and "objective proof," he argued, had "perhaps tended to overshadow the importance of the direct personal evidence of workers themselves." While workers' estimations of their own physical and mental capacities were "known to be often unreliable," Weston ventured, when combined with objective data, they could nonetheless be of scientific use. "Exceedingly interesting results might be obtained," he speculated, "if, coincident with hourly output records . . . the workers were asked to make, at similar intervals, brief records of their feelings of fitness, boredom, rate of working, etc., so that these could be summarized, and subsequently considered in the light of the objective indications of the output curve." So long as there was no infallible test of objective fatigue, he reasoned, "we cannot afford to neglect introspective evidence which only a worker can supply." In their studies of repetition work for the IHRB in the 1930s, S. Wyatt and J. N. Langdon likewise argued that "boredom" and "discontent" were "personal experiences which cannot be directly observed or measured" and that "evidence of their existence must depend primarily on introspective data." In 1938 the IHRB's Philip Vernon prepared "a critical survey of methods used by psychologists for obtaining records of the verbal attitudes and affective judgements" of workers. While experimental psychology had developed reliable methods for measuring "educational and industrial *abilities,*" he argued, the realm of "*emotions* and *motives*" remained unexplored.[17]

Even for these investigators, however, the incorporation of the worker's voice into their research was possible only on very limited terms. Often, as for Bernard Muscio in his experiments on "feeling-tone," a preoccupation with workers' subjective responses to work was governed by a quest to make them measurable, intelligible—like declining output—in terms of graphs and figures.[18] Even where investigators did admit the potential utility of subjective evidence on its own terms, this was often undercut by a somewhat patronizing presentation of workers' capacity to understand or articulate their own

feelings. In Patricia Hall's study of workers at the Rowntree factory, for example, workers' views were at once asserted to have a place while simultaneously discredited and diminished. "It is only by asking the individual workers themselves," Hall and Locke's report claimed, on the one hand, "that we can find out their estimate of the importance of different factors concerning their behavior; for instance, they alone can adequately express their own boredom." At the same time, however, "The average worker is unaccustomed to careful self-analysis, and is unaware of the ease with which his judgement can be deceived by factors tending to complicate comparison and to obscure the real issue he has to decide."[19]

Most often, while investigators often found the views of workers useful in the practical task of collecting data, they simply disavowed it in theory. The voice of the worker rarely made it into the official reports of the work-science institutions, even if it had been solicited as part of the research. Questionnaires and interviews, when used, were rarely quoted in the final results, and, in general, the voice of the worker was more likely to be paraphrased than directly relayed. In general, where workers' views or emotions were included in the literature of the science of work, they functioned simply to confirm the results the investigator already claimed to have proven. Ugly feelings were evoked only as evidence of their own disappearance. Charles Myers, for example, after supervising the introduction of motion study and other new working methods at an iron foundry, reported that workers reported less fatigue—and no boredom or monotony—after the changes. Similarly, following the reorganization of a tin-can factory by the NIIP, the institute's journal reported that workers "stated that they felt less fatigued at the close of each day under the improved methods, despite an average 35 percent. increase of output."[20] In both cases, improving the subjective experience of workers was secondary to an objective increase in productivity rather than an end in itself.

For the science of work, concern with workers' thoughts and feelings was usually less about their scientific value than their potential to disrupt their investigations, undermine their authority, and cause problems with employers. The primary practical concern for investigators was consent. In order to conduct investigations in the factory, it was necessary to obtain at least a minimum of cooperation from

workers themselves. Work scientists were mindful of the suspicion with which workers were apt to view the introduction of outside experts and aware of the difficulties of maintaining the appearance of impartiality, particularly when they owed their presence at the factory to the grace of management.

Here again, the science of work was eager to distance itself from the forms of workshop reorganization associated with Taylorist scientific management, even while putting into practice many of the same technologies of measurement and control. Workers' opposition to the introduction of scientific management, particularly in the United States, was seen as a warning of the dangers of imposing any system rationalization that did not have the consent of workers. Industrial physiologists and psychologists regularly pointed to the 1911 strikes at Watertown Arsenal in Massachusetts—in which industrial action over the introduction of time study had led to the banning of scientific management in US government-contracted work—as an example of the risks involved.[21]

In his discipline-founding *Lectures on Industrial Psychology* in 1917, Bernard Muscio stressed the need for psychologists to take seriously the objections of workers to the introduction of scientific techniques of workplace reorganization and rationalization, including a long passage enumerating "labour's charges against scientific management." It was often the view of the workers, Muscio argued, that scientific management was no more than a strategy to speed up production, that increased productivity would not be reflected in increased wages, and that improved efficiency would lead to unemployment. Scientific management was seen as a way to "make men into mechanisms," to "destroy individuality," devalue craft skill, reduce the power of organized labor, and interfere with collective bargaining.[22] While workers were most often mistaken in their assumptions, Muscio sought to argue, it was nonetheless crucial that industrial psychologists should do their utmost to persuade workers that the science of work would not harm their interests.

This was as much a question of propaganda as it was one of scientific methodology. Workers, it was repeatedly stressed, were apt to associate the introduction of any kind of "scientific" expertise with Taylorist scientific management and to view it with hostility. The very

term "scientific management," Charles Myers had determined when founding the NIIP, "would incur the workers' uncompromising opposition": the phrase was deliberately excluded from the institute's title and rarely used in its dealings with labor.[23] Investigators, the industrial psychologist Susie Brierley (later Isaacs) wrote in 1920, were commonly perceived as "belonging to the camp of the enemy."[24] The scientific expert was viewed, at best, as a "highly paid ornament," though most commonly as "a speeder-up" or a "weeder-out" of inefficient workers.[25] As late as 1933, in an article titled "The Psychological Difficulties of the Institute's Work," the NIIP investigator Nigel Balchin could still be found protesting "the type of ignorance which confounds us . . . with efficiency engineers."[26]

An NIIP symposium called "The Attitude of Employees towards the Institute's Investigations" brought together several of the institute's rank-and-file investigators to discuss problems of consent in conducting investigations. Workers' views of work science, it was agreed, varied considerably. "The attitude of the workers is never alike in any two factories," Gladys Roberts observed. "It may be very different in two departments of the same firm, and among individual workers one finds, and always will find, differences as wide as the range of human character." Workers' attitudes toward work science, Arthur Stephenson noted, from his investigations in coal mines in Britain and Ireland, varied widely and depended "to a high degree on their attitude to the investigator." Political convictions were undoubtedly important: on one occasion, Stephenson recalled, "on paying a courtesy call at the coal face to the President of the local miners' union, I was informed that, unless I had come for the express purpose of destroying capitalism, the President had no time to bother with me." At the same time, however, more prosaic factors were also influential: workers' attitudes were shaped "by local tradition, and by differences in temperament," and he claimed to "have found outstanding differences between workers in, say, Lancashire, Scotland, and Ireland."[27]

Beyond associations with scientific management, the NIIP's investigators noted, there was a tendency for workers to view any kind of innovation in the factory with distrust or hostility. "We all have a tendency to be sceptical of what is new," observed N. Crombie, "and Industrial Psychology is not exempt from this scepticism." In certain

industries, noted Stephenson, "there is sometimes a great deal of suspicion of any stranger." "The "working-man in particular," A. B. B. Eyre added, held an "innate objection" to "anything new under the sun." H. C. Weston, of the IFRB, reported a range of reactions, "from amused tolerance to excessive awe, from cynical scepticism to open hostility."[28]

The consent of labor was particularly difficult to obtain, scientists noted, when workers were unable to comprehend the purpose of the investigations being carried out. Not only did workers consider scientists "masters" men," Crombie explained, but "we come as exponents of a science of which they know little and therefore fear the more." The more complex or esoteric the science, Rowntree's investigators Hall and Locke recalled, the more difficult it was to convince workers of its utility. A "certain amount of prejudice and apprehension" toward psychological tests was "almost inevitable," they claimed, "as to the uninitiated, such tests appear to belong to the realm of the occult."[29] Older and more highly trained workers in particular, investigators noted, were likely to resent the suggestion that scientific experts could teach them new or improved methods. "I can't understand how you can tell me to do my job better when you haven't served your time," Crombie reported, was "a question frequently asked by skilled workers."[30] Investigators constantly found themselves battling the assumption "that anything scientific is necessarily far removed from practice" and therefore of no use to the experienced laborer.[31]

Factory investigators developed various strategies by which to obtain the consent of workers, which were occasionally outlined in methodological articles. Several researchers stressed the importance of building a personal rapport with workers. "My advice . . . to a psychologist who takes up a position in industry," wrote B. V. Moorrees, head of Rowntree's Psychological Department, in the journal of the NIIP, "is to make immediate personal contact with the workers, no matter what other steps in the way of propaganda have been taken." Often, these articles stressed the "personal qualities" or the "certain special technique" required by investigators. Obtaining the best results required not only a scientific training but also "inexhaustible tact and patience" and "a sympathetic understanding of the worker's position." The "first consideration of the investigator," Weston's report for the IFRB argued, "should be to set his prospective "witness" at ease."[32]

When it came to collecting data from workers, or involving them in experimentation, investigators stressed the importance of relating to workers on a personal level. Only "when a friendly relationship has sprung up" between the experimentalist and their subject, one article argued, was it possible to obtain reliable data. Here again, the proximity of investigators to their subjects often complicated the theoretically strict separation between the subjective and the objective or between the researcher and the focus of research. The NIIP's Winifred Spielman (later Raphael) advocated the involvement of factory employees in designing tests and recommended that psychologists not only observe operatives at work but where possible try to learn the job themselves. Others emphasized the need to convince workers that the science of work would benefit them directly. Where workers were able to understand the nature and the purpose of experimentation, and to appreciate its impact on working conditions, they argued, they would naturally offer their support. For the NIIP's Gladys Roberts, "The surest way to dispel doubt is to produce results." "Many instances could be cited," agreed Arthur Stephenson, "in which workers, who were suspicious at first, co-operated most heartily when the beneficial nature of work was explained to them."[33]

Sometimes investigators would go to considerable lengths to develop an understanding with workers. May Smith, before conducting an investigation into laundry work for the IFRB in the 1920s, herself took a job as a laundry worker for several weeks, "in order to understand something of the work," later describing how she put this experience to use in the course of her research: "When a factory where I was investigating found itself rushed, or had to work on Sunday, I could help with the actual work, and in return all kinds of unusual facilities for research were willingly granted, even to the length of being allowed to give psychological tests which took workers away from their work for considerable periods." By putting herself in the place of the women she was studying, Smith was forced to admit (though only in an article written some decades later) that "the observer's point of view is often wrong," and her later recollections of factory life provide a brief but tantalizing glimpse of workers' attitudes both to their own work and to that of the investigator:

> I was timing the hourly output of an old hand-ironer at one period and asked her if she found the work monotonous. "Not at all," she said, "every shirt is different," and then she looked at my notebook and said, "What are you going to do with all them figgers when you've got 'em?" This was a little difficult to explain, but I did my best, "And you talk to me about monotony! They've fair got you this time."

Whether such friendly exchanges were typical of relations between worker and investigator (Smith breezily concluded that "co-operation was not hard to get") or not, such anecdotes nonetheless suggest that investigators often found it necessary to have access to a much broader view of the worker than could be given by the narrowly focused research tasks (in this case measuring hourly output) that they were ostensibly there to perform, even if ultimately these insights did not make it into their published reports.[34]

Despite the various issues faced by factory investigators, in official reports, in published texts, and in material sent to clients, work-science institutions were keen to present workers as receptive to the aims of their investigations. If they conceded that they were often met with suspicion, work scientists were keen to stress that workers could be gotten onside and that—by the end of an investigation—they were usually fully supportive. Winifred Spielman, for example, claimed to "have never known any group of workers who disapproved of the principles of vocational selection. Occasionally they are lukewarm in support, but generally they are enthusiastic." "When all has been said and done," she concluded, "the commonest attitude is one of thanks and appreciation."[35] Without having direct access to the other side of such conservations, it is difficult to know faithful these accounts are, though the concerns expressed by investigators themselves suggest things were not always so easy. There were obvious propagandist reasons for work-science institutions to stress the harmonious relationships between investigators and workers, however, in terms of both differentiating themselves from controversial scientific management systems and—for an institution like the NIIP, which relied on fees—reassuring potential customers that its investigations would not lead to unrest.

If the voice of the worker was only fleetingly glimpsed in the research work conducted by work scientists, the NIIP did provide one space for a more direct expression of workers' opinions, although here again the purpose was largely instrumental. From 1932 to 1938, the institute's journal, the *Human Factor,* included a regular feature called "The Worker's Point of View," a selection of which were published, in a book of the same name, in 1933.[36] "Under this heading," the journal's editors explained, "it is hoped to publish a series of articles from working men, giving an inside view of industrial conditions and problems."[37] As might be expected, the articles were almost unanimously in favor of the institute's work. As a rule, they "mirrored the NIIP's ideology and could at times be as technocratic and scientistic as anything the psychologists wrote."[38] While it is unclear how the authors were selected or commissioned, at least one of them—J. H. Mitchell, a former miner who had won a university scholarship—was already in training as an NIIP investigator.[39] Often, the articles were on very technical subjects, with several calling for psychological research in specific areas of industry. While many were scathing in their descriptions of contemporary working conditions, few were at all critical of work science's practices or assumptions. Workers described the negative physical and mental effects of work (and in particular of scientific management programs) only as a contrast to the enlightened philosophy of the industrial psychologists. Like the investigators who reported on workers' willingness to cooperate, articles in the series painted a picture of a workforce that, though having an "innate tendency" toward conservatism, was nonetheless open to the benefits of scientific expertise.[40] A 1932 article by John Gibson, titled "Let the Scientist Try," was typical of this outlook: "I am sure," he wrote, "that, at the present moment, the inquiries of the specialist and the application of the knowledge of the industrial psychologist can go forward with the minimum of opposition and the maximum support of the workers."[41]

THE SCIENCE OF WORK AND THE UNIONS

In addition to carefully managing their interactions with workers on the shop floor, work-science institutions were also eager to gain the support of organized labor. The HMWC, IFRB/IHRB, and NIIP all appointed trade-union representatives to their executive committees,

and each institution maintained correspondence with the TUC. Given that the TUC and its affiliated unions generally opposed (often vigorously) the introduction of "scientific management" schemes—and in particular the infamous Bedaux system—throughout the first decades of the twentieth century, it is perhaps surprising that they gave their near-unanimous backing to the science of work represented by industrial physiology and psychology. In doing so, they largely accepted—and even promoted—the models of health and efficiency that the science of work advanced.

In part, the acceptance of work science by organized labor was due to a concerted effort by work-science institutions to court union support. The NIIP in particular was determined in its attempts to attract the backing of organized labor. Before the institute was officially formed, in 1919, its founders arranged a conference with labor leaders, and names of prominent union officials were added to the institute's list of supporters.[42] In a paper cowritten with Mona Wilson around the time of the institute's founding, Charles Myers called for unions to "take an active share in the administration and propaganda" of the institute and hoped that they would send some of their members to be trained in industrial psychology.[43] Trade unions were regularly canvassed for support, and many provided financial backing.

A pamphlet distributed by the NIIP in the mid-1920s, titled *The Human Factor in Industry*, listed the reasons for organized labor to embrace industrial psychology. The NIIP was "scientific" and "not-for-profit," meaning that it would act impartially. Investigations were conducted in the factory or the office, and there was thus "no danger of advice being given by scientific experts who are ignorant of practical conditions." Employers were well disposed to psychological expertise, the pamphlet argued, and psychological methods tended to improve industrial relations. Most important, workers themselves had "expressed repeatedly the opinion that owing to the Institute's investigations their working conditions have improved, and strain, fatigue, and irritation have been reduced." Workers and investigators, the pamphlet claimed, enjoyed the "happiest relations."[44]

The charm offensive staged by institutions like the NIIP, however, is not enough to explain the positive attitude toward the science of work adopted by organized labor, particularly in the interwar period.

After a period of increased union membership and militancy in the first part of the century, particularly during and immediately after the First World War, the 1920s and 1930s saw the position of organized labor in British society weaken significantly. Between 1920 and 1933, union membership fell from 8.3 million to a low of 4.4 million.[45] The postwar recession and widespread unemployment put unions on the back foot, and employers began to reverse many of the gains that labor had made in the previous few years. Following the failure of the General Strike in 1926—and the punitive reaction of the government—union leadership across British industry retreated to the center.[46] In this context, many saw cooperation with management as the most promising means by which to protect the rights of members and a corporatist approach as the best way to sustain the relevance of unions.[47] Priorities shifted from opposing employers' attempts to introduce new efficiency schemes to protecting workers from the more extreme effects of rationalization.[48]

One effect of this weakened position was an increased focus from unions and the TUC on issues of industrial health. As Vicky Long has argued, in the interwar period, trade unions increasingly "presented traditional industrial relations issues in new garb as health issues."[49] A "burgeoning interest in health issues" in the 1920s and a willingness "to import expertise from outside the trade union movement" (as exemplified, for example, by the appointment of Thomas Legge as the TUC's first medical officer in 1930) in many ways reflected a practical response to a situation of restricted autonomy rather than the positive adoption of a pro-health program.[50] Many of the recommendations advanced by the science of work—at least superficially—echoed traditional trade-union demands, most obviously in making the case for reduced hours. Likewise, the work scientists' emphasis (at least rhetorically) on treating the worker as a human individual rather than a standardized unit could seem to place them on the side of labor. By adopting the terms of the new science of work, and by collaborating with its institutions, trade unions and the TUC were able to reformulate old demands in new language and to gain some of the legitimacy associated with medical and scientific expertise. In addition, by working with institutions such as the HMWC and the IFRB/IHRB (which were run as government departments), unions could hope to open up lines of communication with Whitehall and perhaps affect national policy.

Prior to 1926, there is evidence that the TUC was receptive to more thoroughgoing criticisms of the science of work.[51] A 1924 report into "industrial fatigue and hygiene" prepared jointly by the TUC General Council and the Labour Party Executive Committee, for example, while supportive in principle of scientific research into conditions of work, criticized the HMWC for having "no hint of any motive other than increased output!" Similar objectives, the authors noted, were "still widely prevalent even in the minds of those who recognize the human aspect as well" and were "intensely repugnant to the mind of Labour." While expressing cautious approval of the IFRB—as "not dependent upon business interests for financial or other support"—the report nonetheless insisted that the application of scientific research in the workplace must proceed only after "prior consultation and agreement with the Unions."[52] From the mid-1920s onward, however, the diminished labor movement came increasingly to rely on the authority of the science of work as a means to justify limited improvements to working conditions and to resist more extreme forms of rationalization. Into the 1930s, the TUC consistently collaborated with the institutions of the science of work in campaigns against the introduction of scientific management systems and techniques. In doing so, it largely adopted the terms of work science and its assumptions about health, work, and the body.

At the annual congress in 1932 in Newcastle, for example, a resolution was passed committing the TUC to "an inquiry into the Bedaux system of management," formalizing investigations that had been under way since 1928.[53] The most prominent scientific management scheme in interwar Britain, the Bedaux system used time study to set standard rates of work and a bonus system to incentivize increased efficiency. From the time of its introduction into Britain at Kodak in 1923, Bedaux had aroused hostility from workers and unions, with a series of strikes and industrial disputes through the late 1920s and 1930s.[54] The TUC's conclusions on the system were published in 1933 as *Bedaux: The T.U.C. Examines the Bedaux System of Payment by Results*. The book was prepared after canvassing affiliated unions (and those affiliated with the Scottish TUC) but also, crucially, after consulting with the NIIP. In February 1933, Charles Myers and G. H. Miles hosted TUC secretaries Vincent Tewson and Walter Milne-Bailey at the institute's

headquarters in London to discuss a draft report prepared by the TUC research department. A TUC memorandum described a "very useful discussion . . . on the whole question of the Bedaux system." Both Miles and Myers, it was reported, thought the system "thoroughly unscientific, and likely to be detrimental to the interests of the workers," and "emphasised the desire of the National Institute to work in close touch and sympathetic contact with organised labour."[55]

The conclusions of the 1933 report echoed both the language and the arguments of industrial physiology and psychology. While expressing concerns about insufficient pay for increased work, and about the opacity of the bonus system, the chief problem raised by the report was "the feeling that the human element is being mechanised": "The object of such systems is to produce the maximum output per worker, and carried to extremes this has very undesirable results both physiologically and psychologically. Overstrain and fatigue may follow, and may, over a long period, cause serious injury to the health of the worker. Moreover, the worker under such systems is made to feel that he is a cog in an inhuman machine for increasing output. The tendency is to obliterate individuality and craftsmanship, and to make the worker merely a machine." Crucially, while the TUC leveled these accusations at Bedaux and "other such methods," they were explicitly not aimed at the science of work represented by the NIIP or the IHRB. "It may be pointed out," the report continued, "that so far as is known the Bedaux Company does not employ skilled industrial psychologists or medical experts when the system is installed. All the arrangements are made by engineers who apparently have not been trained in industrial health and welfare. There is no reason to suppose that such persons are able to . . . rate the workers in a way which pays due regard to their well-being and individuality."[56]

For the report's authors, the science of work was seen not as a form of scientific management but as an authority with which to discredit it. "As regards the assessment of the 'Bs'" (the standard work unit employed in the Bedaux system), the report argued, "it must be said that in the opinion of experts in industrial psychology, the task undertaken by the Bedaux engineers is an impossible one. There is no known unit of calculating the unit of work (in this sense) scientifically." Like the work scientists they had consulted with, the TUC had been backed into

arguing that the problem with "scientific management" was that it was not scientific enough. The assumption that the correct organization of work could be determined by scientific principles was fully accepted. Indeed, "in actual fact the only method that can be termed in any way sound," the report claimed, "is that adopted by the investigators of such bodies as the National Institute of Industrial Psychology, who approach the whole problem with due regard to the welfare of the workers."[57] A separate report of the same year prepared by the General Federation of Trade Unions called for strong opposition to "not only the Bedaux, but all similar schemes for harnessing and subordinating men to mechanical processes." Here again, though, the science of work was explicitly excused from these charges and the NIIP in particular singled out for its "serious effort to investigate scientifically and to express in considered language, opinions or inferences which might fairly be drawn from careful observation."[58]

Throughout the 1920s and 1930s, there were repeated calls from within the trade-union movement to collaborate with the science of work. At the 1934 Trades Union Congress in Weymouth, a resolution moved by the Association of Engineering and Shipbuilding Draughtsmen was passed calling for "a comprehensive survey of the whole field of psychological research into conditions of labor (particularly in relation to scientific systems of measurement, such as Micro-Motion studies."[59] A similar motion was passed the following year at Margate.[60] Rather than conducting its own research, the TUC opted to prepare a report summarizing the results of research carried out by work-science institutions: "It must be borne in mind," a TUC economic committee memorandum argued, "that the Industrial Health Research Board, a Government organisation, and the National Institute of Industrial Psychology are both actively pursuing researches into these questions. It may therefore be thought that if any comprehensive investigation is to be carried out, we should co-operate with one or both of these bodies."[61] Ernest Bevin, the general secretary of the Transport and General Workers' Union but also a member of the IHRB executive committee, commented that he "felt it would be good if the Board undertook the investigation both from the psychological and physiological point of view."[62] The NIIP was also contacted and provided an up-to-date bibliography on motion study.[63] A letter from

the IHRB's David Munro to Milne-Bailey in June 1939 confirmed that a preliminary report had been drafted.[64] Due to the outbreak of war, however, the final report was never completed or published.[65]

Perhaps the best evidence of the mainstream trade unions' willingness to accommodate the science of work is the fact that the TUC itself engaged the services of the NIIP on at least two occasions: to devise selection tests for applicants to new office staff in 1928 and the following year to advise on the lighting of its offices.[66] Throughout the 1920s and 1930s, close relationships were built between union officials and representatives of work science, and when, in 1930, the TUC appointed its first permanent medical officer, the man chosen was Thomas Legge, a former medical inspector of factories, who had also been one of the original members of the IFRB. Despite there even being talk at this time (in correspondence with the TUC) of rebranding the NIIP as the Workers' Research Institute, in reality the unions' reliance on the science of work to support its health agenda in the interwar period meant accepting a productivist view of health and the body far more likely to be shared by employers than workers.[67] Increasingly, the health of the worker could be considered only within a framework of economic productivity and national efficiency, a position made clear by Legge's successor as the TUC's medical spokesman, Hyacinth Morgan, in a 1935 letter to the *Times*. "The trained employee is a valuable national asset," Morgan wrote. "To keep such a worker in continuous good health is an advantage as well as a duty."[68]

Trade unions, and the TUC, gave their support to the science of work partly out of tactical considerations. In many cases, long-standing trade union demands could be reframed as the recommendations of industrial science (for example, in making the case for reduced hours and paid holidays).[69] Indeed, in the short term at least, work-science investigations probably did improve conditions for many workers. The price paid by organized labor for these gains, however, was the ceding of claims on the working body to work scientists. By calling on the expertise of industrial physiologists, psychologists, and medics, the trade-union movement added scientific authority and legitimacy to some of its campaigns. In the long term, however, it was arguably the science of work that gained credibility through its association with labor rather than the reverse. Work science sought to position itself as a

mediating influence between the interests of capital and labor, and the assent of the trade-union movement to its expertise helped to secure its status as objective science. By joining forces with the TUC to fight Bedaux and similar systems, work science was able more successfully to distance itself from the Taylor-inspired efficiency schemes that in many ways it continued to resemble. While "Taylorism" became a byword for commercial charlatanism or management autocracy, the uncontroversial *acceptability* of the science of work—its claim to nonideological, objective scientific status—meant that its ideas about work, health, and the body were able to be far more influential.

UGLY FEELINGS

In the records of work scientists and the archives of organized labor, the voice of the individual worker disappears into the voice of the institution. The TUC and the institutions of work science both had an interest in presenting workers' responses to the science of work in positive terms. As such, it is difficult to uncover the voices of men and women who thought differently, expressed their dissent, or attempted to resist the logics of discipline and control that work science put forth.

The models of work, health, and the body advanced by the science of work were not descriptions of objective phenomena. They had to be imposed on the working-class body. Workers themselves often viewed or experienced the relationships between work and the body in markedly different ways from the scientists who investigated them. While the science of work attempted to reduce the working body to a series of objective measurable capacities, viewing health in terms of productive efficiency, in workers' own writing the subjective elements of work and health are emphasized. The body was often central to workers' accounts of their own labor, as were the emotional and affective sides of work.

For large numbers of workers in the late nineteenth and early twentieth centuries, fatigue was not an index of working capacity but an everyday embodied experience. In the words of Sianne Ngai, I want to suggest that sensations of fatigue—along with boredom, monotony, and other negative physical and mental responses to conditions of work—can be understood as "ugly feelings."[70] While often such feelings

promoted passivity, or obstructed agency, they could also—for some of the workers discussed here—act as points of embryonic resistance, forming the basis of a political critique of working conditions, the scientific rationalization of work, and capitalist society. If these critiques rarely developed into large-scale collective action—or even into a well-articulated political consciousness—their existence nonetheless draws attention to the interruptions, gaps, and failures in the totalizing ambition of the science of work's productivist logic.[71]

In many working-class autobiographies of the late nineteenth and early twentieth centuries, the body is placed at the center of descriptions of work. Charles Hansford, for example, a bricklayer from Hampshire born in 1902, considered in retirement the strains that his job had placed on him. "Looking back on fifty years of construction work," he reflected, "the conditions of employment and the physical nature of work itself, only two results were possible; either it killed you, or, tempered in mind and body, you would survive." For the Rochdale plasterer and writer Jack Hilton, writing in 1935, the working class was physically marked out by the toll of work on their bodies: "What tailor could meet their slender purses and yet hide the fact that they are toilers? Where is their poise, straightness, carriage, where is their elasticity of heel; what collar could rest unwrinkled when their bony collar bones stick out so generously? How can one's head sit graciously, when the nape of the vertebrae aches with jaded exhaustion?"[72] Another worker turned writer, Laurie Lee, recalled the "city-bred dwarves" that he had known on London building sites, "millstones of labour, ground small by its wasting demands." For others, like the steelworker Patrick McGeown, a life of employment was inscribed in the body in "work-scarred hands and broken nails."[73]

For those who experienced the imposition of new schemes of rationalization or scientific management, the relationships between work and the body were often even more acute. Richard Fox, for example, in the first decade of the twentieth century, witnessed firsthand the introduction of scientific management techniques when employed in a London factory making motorcycle engines: "Here I met the beginnings of that tightening up of workshop discipline which was characteristic of later 'efficiency' schemes. Little red tickets crept into use for every process, and a 'bonus system' was devised. At first this was so modelled that it

seemed to be a jumble of unintelligible figures. But it was a laying of silk strand on silk strand, until at last every limb and movement was controlled by these invisible threads."[74] As the metaphor in the final sentence of his description makes clear, for Fox, the technologies of scientific management were understood—and felt—explicitly as *bodily* disciplines. As rationalization progressed, it was the body of the worker, their physical capacities—"every limb and every movement"—that came more and more under the control of management.

A similar sentiment can be identified in a metaphor that recurs frequently in working-class autobiographical writing of this period: the image of the working body becoming incorporated within the machinery of factory production. Alfred Williams, for example, a Swindon factory worker, wrote after the introduction of time study in his workshop: "So exacting is the labour it admits of no interest whatever in anything else. It is a body- and soul-racking business, just that which keeps a man in a crushed and subdued state, and makes him a very part of the machinery he operates." Wilfred Middlebrook characterized work in a Lancashire cotton mill in the 1910s as a "battle for mastery" between human and machine, in which workers were forever at a disadvantage.[75] For the working-class socialist writer Jack Common, who had himself been employed in a machine factory, mechanization—and "the ever-growing tide of organization" that accompanied it—destroyed individuality and skill and reduced the working body to mere "labour-power fed to machines."[76]

Certainly, in keeping with Ngai's description of ugly feelings, the physical and mental effects of working life were usually experienced first of all as a block on agency rather than as a stimulus to action. This was especially the case with fatigue, a condition that, almost by definition, restricts both physical and mental agency. Kathleen Woodward, for example, recalling long hours in a London garment factory in the early 1900s, wrote of "a tiredness which paralysed all thought and feeling." Her memories of the time, she wrote, were "cast over and obscured in the dull aching memory of the sheer physical tiredness I grew to know." By the end of her working day, sweeping the factory floor, she recalled, "I was so tired by this time that I could only weep impotently as I swept."[77]

Several workers wrote of the limiting effect that exhaustion placed on their lives outside of work. A number of memoirists described having

to battle fatigue just to muster the motivation to write. "Weariness," as one worker put it, "was not conducive to good and sustained writing."[78] A female munition worker in Birmingham during the First World War recalled that "by the end of the day we were too tired for anything but supper and bed."[79] Rather than acting as a stimulus to action, the more likely result of such exhaustion was depression and inertia. Alfred Williams wrote of a fellow laborer so thoroughly "broken in to the new conditions" of rationalization that he had simply "settled down in despair, and decided to bury himself at the toil":

> Night after night, he would return home to his wife and children tired as a dog, too tired even to read the newspaper, or write a letter. He simply sat in the chair or lay in the couch till bed-time, completely worn out with the terrible exertions.
>
> Very soon the abject misery of his conditions found expression in words to his workmates. He was continually wishing himself dead. He said he should like to die out of it. Life was nothing but a heavy burden, and there was nothing better in sight in the future; only the same killing toil day after day.[80]

The restricted agency of exhausted workers often acted to preclude political engagement of even the most basic kind. George Meek, who worked as a casual laborer in late-nineteenth-century London, for example, described the apathy that occupational precariousness and long hours induced: he took "little interest" in politics, because he was "too tired to take much interest in anything."[81]

Many workers wrote of the extent to which they felt they and their fellow laborers had internalized the rhythms of working life. Jack Hilton, for example, a plasterer, described how workers had been conditioned by "heredity and instinct and habit" to "gee-up when the whistle whistles." Stanley Rice, an engine cleaner at the Hornsey locomotive depot in north London in the 1920s, described workers whose "bodies and systems had become so regulated to the routine" of shift work that they often died soon after retirement. Those who urged political consciousness in their coworkers were often frustrated by the apparent inertia that a life of labor had induced. The workers were, as Kathleen Woodward put it, "too tired for the revolt urged upon them, too deeply inured to acceptance." In Alfred Williams's

railway factory, he complained, "A regrettable dullness is discovered by very many of the men, which may be bred of labor itself and the extremely monotonous conditions of the factory." It "would need an earthquake," Williams despaired, "to rouse many of the men out of their apathy and indifference."[82]

The transformation of ugly feelings into any articulate politics was further complicated by factors of gender and class, which directly affected workers' relationships with their bodies.[83] Ideals of working-class masculinity in the early twentieth century (and beyond), particularly in heavy industries, often valorized strenuous labor and the ability to "take it like a man."[84] In this context, even the admission of fatigue was seen as compromising a masculine ideal.[85] "By the end of the week," one worker recalled of his time in a cotton mill, "I was tired lad, doubting my manliness."[86] By contrast, a young male shipyard worker on Clydeside expressed admiration for an older coworker: "He was very strong, and I never knew him tired."[87] Steelworker James Stirling wrote that the punishing "overshifts" in his industry (working from Tuesday morning to Wednesday night with no breaks except for meals) were "very unusual and trying; but there was a bravado air about it. Nobody would admit to being tired by it, though we were hollow-eyed before the middle of the week and stupid with lack of sleep at the end of it."[88]

In these contexts, as Paul Willis has argued, patriarchal values often militate against political consciousness: "Discontent with work is turned away from a political discontent and confused in its logic by a huge detour into the symbolic and sexual realm." As such, "the will to finish a job, the will to really work—is posited as a masculine logic, and not as the logic of exploitation." For George Milligan, a Liverpool dockworker, "a man and his work" could not be separated one from the other. "Give me a true and genuine working-man," Milligan declared, "who has recognised that his mission is to work, and who puts his mind and heart into it, while he is at it . . . who lays down in the clay after his life's work is done . . . but with the record of a man behind him, written in a life of useful toil."[89]

Men were expected to "do men's work untiring."[90] Competition among workers for masculine status often functioned to prevent them from turning their attention to their employers, while also foreclosing the possibility of solidarity or collective feeling. "I have gloried that the race has been to the swift," wrote Jack Hilton, "feeling safe in the

knowledge that I could run a bit. It didn't hurt so bad when I was tired, if I knew that the other fellows were more tired." Manual laborers like Hilton defined their masculinity against those in clerical and commercial occupations deemed effeminate. "We are natural men," he wrote, "and are often disgusted at the depraved femininity that other working-men have adopted."[91] Unemployment and physical injury were often seen as failings of masculinity, as personal rather than structural problems. To be out of work was to have "lost all your manhood."[92]

For the majority of women workers—already at a structural disadvantage compared to men—an added burden of unpaid domestic labor was placed on top of the exertions of paid employment. "After a hard day's work in a hot cotton factory you have very little left," wrote the working-class suffragette Annie Kenney, reflecting on her youth. "It always seemed to be unfair that those people who spent almost twelve hours away from home should on their return find more labour awaiting them, and yet this was the case in most Lancashire homes."[93] Restrictions on the agency of employed wives and mothers were often exacerbated by feeling "too exhausted by having to live two lives in one."[94]

The ugly feelings of working life then—and fatigue in particular—were often experienced as obstructed agency. At the same time, however, they also displayed the potential to disrupt—to interrupt hegemonic logics and challenge disciplinary regimes. One example of such an interruption can be found in Arthur Eaglestone's *Pitman's Notebook,* an account of work in a South Yorkshire colliery, published in 1925 under the pseudonym Roger Dataller. In a passage titled "Revolt," worth quoting at length, Eaglestone first describes the extent to which the body and agency can be restricted by the internalized demands and routines of working life:

> For a day or two—aye, for a hundred days—closer than breathing, nearer than hands and feet, the working place has drawn you in . . . become an all-pervading environment, a hundred times more familiar than the china dogs (a disappearing breed) upon your mantelpiece at home, or the standard of your own brass bedstead.
>
> Acceptance, then. There is surely no other word for it. . . . [R]outine and necessity have cramped your personality into an all familiar rut.[95]

The second-person narration and the evocations of typical working-class home life suggest that Eaglestone is attempting to give voice not just to his own experiences but to a generalized working-class experience of alienation and obstructed agency. Even in such a situation, however, there resides the potential for the ugly feelings of work to suddenly burst into consciousness:

> Comes a morning when that heaving of muscle, bone and sinew: that curious framework of toiling, sweating flesh, becomes unbearably apparent.
>
> Squelch! Squelch! Ominous suction! Your feet are dragging on a slaty, greyish quagmire now, where deeply driven clog-holes still remain, each imprint filled to the brim with muddy water.
>
> Drip! Drip! The moisture sweating from the roof makes impact and ripple upon the tiny pool of each shoe-hole.
>
> Drip! Drip! Drip! upon your burning shoulders as you ladle out the water with a bucket, filling up a square-shaped tank on wheels, that the trammer has trundled up.
>
> Drip! Drip! If work is prayer, then to Hell with it! as you send the bucket skittling away into the mud.
>
> To Hell with everything! your mate included. The odour of his steaming body rises with a sudden offensiveness; the scabrous formation of the caking coal dust on his features; the inanity of his well-intentioned remarks; the grit invading everywhere, stinging and peppery on the soles of your feet and chafing devilishly wherever it may find a lodgement in your clothing; all contribute to an attitude of uncompromising revolt in which anything can happen.[96]

The sudden revelatory moment that Eaglestone describes is in an entirely internal revolt, rooted in the "toiling, sweating flesh" of the worker. There is no dramatic or out-of-the-ordinary event. Instead, it is precisely the everyday stresses and strains of ordinary working life—usually experienced only unconsciously—that suddenly become "unbearably apparent." The overwhelming monotony of work, the slow buildup of dysphoric sensation, the mounting of cumulative minor negative affects that Eaglestone describes are echoed in the repetitive,

onomatopoeic "squelches" and "drips" that begin each paragraph, while the sudden exclamation—"To hell with everything!"—marks the eruption of ugly feelings into consciousness. Unthinking acceptance is suddenly transformed into "uncompromising revolt."

For Syd Metcalfe, growing up in interwar London, the possibility of a commitment to emancipatory politics originated in an emotional interpretation of one's predicament. "We must have wrong first in order that we might strive after change," he reflected, "so that emotions can be sufficiently disturbed to demand that something be done about it." Living in an "atmosphere of constraint," wrote the Birmingham factory worker Vero Garratt, workers were forced to "choose between submission to the 'life of the factory' and a conscious resistance to the unwholesome aspects of it with tact and determination."[97]

Harold Heslop, a Durham coal miner, wrote of the constant internal battle between the expression of ugly feelings and the cramping, disciplining logics of working life. In his memoir, *From Tyne to Tone,* Heslop described the daily feeling of entering the mine: "Once again I felt that utter forlornness that follows after the shearing of individual freedom, as I became a piece, a part of a pawn, in the majestic purpose of the capitalist mode of production." "Was I near to be rebelling?" Heslop pondered. "It did not occur to me to make the assessment. And yet there was a grim feeling of doom upon me." Even where feelings of revolt did express themselves, it was not necessarily in the form of an articulate political consciousness. A disposition to revolt still required an object. "I wish the workers were more discontented," Alfred Williams complained, "though I should like to see their discontent rationally expressed and all their efforts intelligently directed. They waste a fearful amount of time and energy through irresolution and uncertainty of object."[98]

It is no doubt true that acts of rebellion were often small and of a spontaneous or impulsive nature. Edith Hall, a former domestic servant from the south of England who worked in a series of factory jobs in the 1920s and 1930s, recalled one such intervention while operating the "enrobing machine" on the mechanized production line of a London sweet factory:

> These machines covered creams and toffees with chocolate and it was a very boring job to keep the travelling belt always

> filled with the centres. We were allowed eight minutes break for refreshments and we used to take Oxo cubes to make a hot drink. But my young fellow-worker Molly and myself broke the monotony by putting our meat cubes on the enrobing machine and getting them covered in chocolate. We thought it funny, imagining the "tart" and her "feller" in the "pictures" biting into the meat cube covered in chocolate. Molly and I used to be on that machine ten hours a day sometimes.

Here and elsewhere, acts of miniature sabotage were indulged in as respite from the monotony of repetitive work.[99] At the same time, in Hall's case, the imagined consequences for a (presumably better-off, more leisured) consumer provided a measure of satisfaction—or relief of resentment—in staging a scene of minor comeuppance or retribution.

But how could an inchoate assemblage of ugly feelings—Heslop's "grim feeling of doom" or Eaglestone's attitude of "uncompromising revolt"—be crystallized into a definite position of class antagonism? For some workers, the catalyst was a direct exposure to radical politics. Richard Fox, for example (whose description of the effects of scientific management on the body are quoted above), described hearing a socialist speaker in Tottenham in the early 1900s: "Till then I had accepted the world as it was and, though discontented and wretched . . . I had not dreamed of the possibility of question, let alone of swift and violent change. Discontent came to me now not as a limping dragging misery, but with a flaming torch, flower-crowned and shining with the beauty of an ideal." For Fox, socialist ideology provided a cognitive mapping within which to understand an already powerful—if as yet inarticulate—set of negative affects based in the physical and mental experience of work. In the quoted passage, the grindingly physical ("limping dragging") becomes suddenly elevated to "the beauty of an ideal." While the speaker's arguments may have been convincing on an intellectual level, they were able to resonate so powerfully precisely because they gave a definite verbal form to a preexisting disposition rooted in the body. Laurie Lee, likewise, described a brief conversion to communism (when working as a builder's laborer in 1930s London), first of all, as "a physical sensation rather than an intellectual one."[100]

A similar pattern can be seen in the memoir of the working-class communist and trade union organizer Margaret McCarthy (later to become a Labour member of Parliament). McCarthy described the "filthy and unhealthy" factories and mills, "the hours dreadfully long and the work arduous." She wrote of her mother, "too weary at times to walk" after work in a wartime munitions factory, suffering "horrible rending bilious attacks, intensified by over-exhaustion." For McCarthy, rebellion was not a choice: "Considering the social conditions of the times and the circumstances of my life, I do not, in all honesty, see what else I could have done other than rebel. I was a normal, life-loving young teenager, interested in fun, dancing, boys and art. I just wanted to live with all my being and to the full extent of my capacities. But this was denied me." McCarthy's political commitments came from a feeling of embodied frustration, lacking a definite object. She was "possessed by a frenzy for change" but without knowing what change was needed. The Communist Party, she wrote, "embodied and symbolised that great change, appeared as the instrument of it, pointed the way." Here again, political ideology gave structure to an existing emotional response, and political engagement was sustained by a continued affective commitment. Communism, McCarthy wrote, taught "us how, by revolutionising the economic pattern of society, we could solve the remainder of our problems and cure all the ills to which humanity, and particularly the workers, were subjected."[101]

By becoming conscious of their ugly feelings, and understanding them within a new ideological framework, workers were able to see themselves and their fellow laborers not simply as personally unfortunate but as "the utter victim[s] of a cruel and callous system."[102] Fatigue, ill-health, and mental distress could be seen not as individual problems but as the logical products of a system in which workers were systematically disadvantaged.

For the Communist Party organizer Ernie Benson, born in Hunslet in Leeds in 1906, the identification of physical and mental ill-health with the prevailing socioeconomic system was both a foundation of his political commitment and a source of personal strength. In his memoir, *To Struggle Is to Live,* Benson describes a "fit of black depression," experienced after long spells of unemployment, with intermittent

factory work, in the late 1920s. One day, he recalls, consumed by suicidal thoughts, he broke down crying in the middle of the street: "But in that moment of crying, sanity returned. I berated myself for my weakness and vowed I would spend the rest of my life fighting to end this rotten system of society. . . . So whenever I feel the need to refresh my hatred of capitalism, the system which creates poverty in the midst of plenty, which blasts and pulps to death millions more by deliberate methods of starvation and disease, I return to these springs of bitter memory."[103] Here, by locating them within a critique of capitalism, Benson is able to transform ugly feelings from an obstruction on agency to a source of revolutionary motivation.

Within a politicized or structural understanding of physical and mental distress, the ugly feelings of working-class life could be experienced as *collective*. Rather than isolating workers in a state of blocked agency, they could bind them together in mutual antagonism. Kathleen Woodward was quoted above discussing the paralyzing fatigue that she associated with her early working life. As she grew to be involved in politics, however—first, through association with the trade unionist Mary Macarthur and later through membership in socialist, suffrage, and free-thought groups—Woodward was able to mobilize the exhaustion of her and her fellow workers as the basis of a critique of capitalist society.[104] "I accustomed myself to hunger and to the tiredness which takes away all sense of feeling," she wrote, "only, I could not accept; I could not accustom myself to acceptance." Woodward found herself "for ever dwelling on the sufferings of the women about me. . . . My days were consumed in rage and anger against the order of things as I saw it reflected in Jipping Street. . . . Fiercely did I range myself with the forces of the oppressed."[105]

If fatigue and ill-health could be understood in social terms as symptoms of oppression, then it was possible to conceive of individual and collective well-being as something more than the capacity for productive work. In this context, a newly broadened concept of health could be turned against unequal social relations. "It is not to the interest of any community that any of its useful workers should live unhealthy lives," as George Meek put it, "and men who live in continuous worry and want cannot live healthy ones." Someday, Meek concluded, "the workers will tire of mere politicians of every shade and will organise

themselves for the definitive struggle against Capitalism. Then, thoroughly grounded in the economics and ethics of Socialism, they will know what to do."[106]

THE SCIENCE OF WORK IN THE WORKER'S VOICE

In the ways they wrote about their own working lives, many men and women of the early twentieth century implicitly challenged the assumptions of work scientists. Conceptions of health and identity rooted in working-class culture conflicted with the productivist notions of health espoused by the science of work. In reading the voices of workers from their own writing, it is possible to uncover a more complex relationship between work and the body than the sciences of industrial physiology and psychology allowed for.

While a large number of working-class autobiographies reflect on the physical and mental experience of work, and a smaller but still significant number give their impressions of Taylorist scientific management and the Bedaux system, there is relatively little direct evidence of workers reacting directly to the science of work embodied in institutions like the HMWC, IFRB/IHRB, and NIIP. As has been shown, where work scientists described the reactions of workers, they generally gave the impression of a cautiously receptive audience. Likewise, the TUC largely acceded to the models of health and efficiency advanced by the science of work, in part as a strategy to limit the worst effects of Taylorist rationalization. The few instances where workers can be found responding directly to industrial physiology or psychology, however, again suggest a more complicated response. While there were no recorded industrial disputes against industrial physiologists or psychologists, this was probably at least in part, as Steven Kreis has argued, due to the extreme caution with which the institutions of work science approached their investigations.[107] While some workers did welcome work science as the acceptable face of rationalization, others offered critiques that went far beyond those of the TUC, beginning to articulate alternative models of health and efficiency.

Some workers who witnessed firsthand the changes made by work-science investigations wrote positively about the experience, at least in comparison to their previous conditions. Peggy Hamilton, for

example—raised in a middle-class family in St. Albans but employed in a munitions factory during the First World War—praised the work of the HMWC in her memoir. Despite personally clashing with the welfare staff employed in her factory, whom she viewed as patronizing and insensitive, Hamilton nonetheless recalled positively the introduction of scientific expertise into the factory. "Before the First World War factory conditions were really appalling," she wrote. "It took the war to bring the realization that the health and energy of the work-force must be conserved if the output of munitions was to be maintained. With this in mind, a 'Health of Munition Workers Committee' had been set up in 1915 under the chairmanship of Sir George Newman."[108]

Likewise, as has been discussed, the workers and former workers who contributed to the NIIP's "Worker's Point of View" series were broadly supportive of the institute's work and tended to echo a productivist model of health, within a corporatist political model that emphasized the mutual interests of capital and labor.[109] J. H. Mitchell, for example, saw industrial psychology as a means "towards harmony and co-operation" between capitalist and employee, "and so to prosperity for the industry."[110]

This was the view held by William Foster Watson, the author of more than a third of the "Worker's Point of View" articles published in the *Human Factor,* who explicitly compared the science of work with scientific management. Born in 1881 in London, Watson worked as a mechanic in a number of engineering workshops, as well as experiencing long spells of unemployment. In his 1935 autobiography, *Machines and Men,* Watson described his experiences of working under "Scientific Management, Premium Bonus, and other American devices for increasing output," first at Bedford Park Motor Works and then at the Thornycroft motor factory in Basingstoke:

> The plant was started up before time, and one had to get down to the job immediately the hooter ceased; feed and speed bosses were employed to see that this was done. Fixed to each machine was a chart indicating the speeds to be employed, and the feed and speed men, armed with feedmeters perambulated the shop to ensure both men and machine were working to their utmost capacity. . . . Notices were posted forbidding any man to leave

> his machine or vice. . . . We were not supposed to leave the job under any pretext whatever, except when nature demanded.[111]

In some workshops, Watson noted, even "the lavatories . . . were without doors and facing each other, and it was the duty of a perambulating inspector to see that no man exceeded the seven minutes set forth in a conspicuous minatory notice, which further stated that no man must use the place more than twice a day."[112]

As a member of the Amalgamated Engineering Union, Watson became a strong critic of Taylorist scientific management, authoring a pamphlet against the Bedaux system in 1932.[113] Experiencing the autocratic imposition of scientific management in his own workplace as a "humiliation," Watson—after reading the work of Myers and other industrial psychologists—came to view work science as an alternative route to rationalization that would protect the interests of the worker. Taylorism, he claimed, "failed because it was psychologically unsound."[114] The "fundamental mistake" of the "promoters of scientific management," he wrote in the *Human Factor* in 1932, was to regard "every man as a machine without a personality."[115] Taylorism "sought to ascertain the one best way and, having found it, to impose it on all workmen regardless of differences of physical and mental make-up." Taylor "made no allowances for the human factor," looking "upon the operator as an adjunct to the machine, an additional lever—no less an automaton than the machine itself."[116]

Industrial progress through mechanization, Watson argued, did not have to proceed at the expense of the worker's physical and mental health. Machines, he argued, had the potential to bring about a "new and wonderful civilisation," "to provide every man, woman and child with a happier life, teeming with richer possibilities." Rationalization did not have to "dehumanize" the worker or destroy craftsmanship; rather, "mass-production would produce a new, and equally skilled, type of craftsman." He explicitly praised the NIIP's commitment "to making work safer and easier." The organization, he wrote, had "done much to counteract the effect of monotony in the workshop, and its success lies in the fact that the institute bases its work on the fullest recognition of the human factor."[117] If workers could be treated as human beings and "not as mere cyphers," Watson argued, then there

would be "greater harmony in the workshop," "the relationship between employers and workmen would be vastly improved," and this would mean "greater efficiency and increased production."[118]

For other workers, however, scientific management and industrial psychology could not be so easily separated. Richard Fox, for example—quoted above describing his own experiences of scientific management and his introduction to socialism—included both scientific management and the science of work within a broader and more thoroughgoing critique of rationalization. Born in Leeds in 1891 and of Irish descent, Fox grew up in north London. As a young man, while working in engineering jobs, he became a member of both the British Socialist Party and the Industrial Workers of the World union and began writing articles for the radical press. During the First World War, he was twice imprisoned for refusing to serve on political grounds. On his release, in 1919, he took up a scholarship at Ruskin College in Oxford, publishing a memoir of his working life, *Factory Echoes*. From the late 1920s, he published a number of books on the history of the Irish Left and on labor issues, as well as an autobiography.[119]

Like Watson, Fox's writing was grounded in his own experiences of scientific management as "the efficiency expert's raw material."[120] As he put it in his 1928 book *The Triumphant Machine (a Study of Machine Civilisation),* "I write from an intimate knowledge of modern machine industry with its mass production, its speeding up and general soullessness."[121] Like a number of other working-class writers, Fox drew on images of the workers incorporated into factory machinery and of the industrial battle between man and machine.[122] Of his experiences of mass production, he wrote, "No one had any individuality at all. The machine took hold of me with its iron fingers and worked me to the shape required. . . . The whole works was one great machine, of which we were parts that could be easily scrapped and replaced. . . . All suffered, even those who accepted it most placidly. For to be geared to a machine is not a human life." Up to a certain point, Fox's criticisms of scientific management echoed those of Watson and the work scientists in condemning the focus on mechanical over human factors. "Attention was lavished on the stresses and strains of machinery and metal," he recalled, "but the more delicate mechanism of human nerves and sinews—not to speak of human souls—was ignored."[123] In an article of 1926, reprinted in

the *Journal of the National Institute of Industrial Psychology,* Fox even offered qualified praise to Charles Myers for his criticism of Taylorist "efficiency experts."[124]

Elsewhere, however, Fox developed a critique of managerial expertise in the organization of capitalist production that targeted equally the Taylorist efficiency engineer *and* the scientific physiologist or psychologist. "Much that is written concerning industry," Fox complained, "especially in relation to the workers' lives, completely fails in its purpose because of the ignorance of the 'experts' who have had no practical experience of the difficulties and problems of which they write." Despite their claims to have an intimate knowledge of factory life, Fox argued, this was as true of the physiologist or psychologist as it was of the efficiency engineer: "To one who has spent his early years in the workshop, many of the schemes propounded for the curing of industrial ills seem fantastic and absurd. The best of these treat the worker as a piece of machinery whose well-being may be regulated on mechanical lines. Given 'rest pauses,' 'vocational study,' adequate wages, and decent working conditions, the experts assume that the industrial worker will shine with contentment as an engine glistens when the cleaner has finished oiling it." The "omniscient official" left the factory "cheerfully convinced after an hour or two's poking around that he understands all about normal working conditions," Fox observed. "The idea that manual workers cannot be treated as sticks or stones, or automatic machines, never penetrates his scientific cranium."[125]

The solutions proposed by work scientists, Fox argued, were necessarily insufficient precisely because they left the *structure* of work untouched. Regardless of the scientist's intentions, so long as production was governed by the profit motive, scientific expertise would be introduced only on the terms of capital and to the advantage of the capitalist: "The industrial psychologist is called in as a doctor by the employer to treat industry from the standpoint of production. His activities are limited by the task which has been allotted to him, the task of finding out how more wealth can be produced." Since industrial psychology was "itself a product of industry," its remit was necessarily "narrowed down to purely commercial considerations." As a result, the "industrial expert" was unable "to approach the problem from the broad standpoint of human need."[126]

While he recognized some of the results of work science as positive,

Fox argued that it was fundamentally limited by the demands of productivity. If a problem of great importance for human welfare "has no commercial significance, industrial psychologists leave it alone." Likewise, he noticed, specifically citing the HMWC, where output could be increased, the science of work was happy to make recommendations that increased or intensified boredom and monotony.[127]

Scientists, Fox observed, liked to separate their own use of techniques like time and motion study from their potential application as a means of intensifying labor at the expense of the worker. "But so long as industry is organised on its present lines," he argued, "experience proves that they will be used this way. If some professor could only show how to make use of the workman's skin and bones after his vitality has been squeezed out, no doubt there would be a market for the idea." In this context, psychologists' criticisms of scientific management—their championing of the human factor, and their claims to impartiality—struck a false note: "Scientific management has been severely criticised by the advocates of industrial psychology who say that the earlier school of efficiency engineers worked on purely mechanical principles which cannot be satisfactorily applied to humanity. But the industrial psychologists have not yet shown that they work on any fundamentally different idea from the efficiency school which they condemn. Their aim is still to fit men to industry rather than to fit industry to men."[128] For Fox, the industrial psychology of the 1920s and 1930s could be seen simply as the evolution and sophistication of scientific management's methods. Moreover, he argued, the developed science of work had extended its ambitions far beyond those of the original efficiency experts, seeking to control the worker both inside and outside the factory.

In "the days of scientific management," Fox reasoned, experts attempted to solve the human problems of industry on "purely mechanical lines." However, "it was soon found that even from the restricted standpoint of taking the worker as a productive unit, something more had to be done. Certain facts of psychology were stumbled on in the course of the expert's activities." With increasing mechanization and subdivision, as "interest diminished and fatigue increased," it was increasingly necessary to study the worker as well as the work: "When the workers were studied, the second stage in the scientific regulation

of industry began. Rest pauses, more harmonious conditions, workshop canteens, etc., were provided to maintain physical fitness and vigour. Inevitably the experts were led to take an interest in affairs outside the workshop." As Fox repeatedly stressed, however, the interest of science in the lives of workers outside the factory was always motivated by the desire to make them more productive when at work. Psychology was "entering into the lives and leisure of the workers apart from the factory, *but always with the dominant idea of regulating their lives in the interest of production*."[129] "Industrial psychologists began by studying workers as instruments of production. To do so efficiently they had to go farther and penetrate more into their non-working lives. Motion study was not enough; rest pauses and fatigue research, even investigations of housing and living conditions, have reinforced this. How long will it be before they make 'man' and not 'work' the centre of their efforts? My experience indicates that it is time that they did."[130] With the expansion of industrial psychology outside of the factory, Fox noted, came "the direct application of workshop standards to the outside world." A "feed and speed" outlook on life was "carried over from industry into leisure," and narrow metrics of efficiency were increasingly applied to culture, health, and "human well-being."[131]

For the Clydeside communist agitator and educator John Maclean, the opposition between scientific management and the science of work was equally illusory. Scientific management, Maclean argued, was nothing more than "the resort to any and every scientific expedient to increase output," and the institutions of work science precisely fitted this description. In an article of 1918, Maclean cited the wartime experiments of the HMWC as an example: "The whole object of the 'welfare work' organisation is to help in keeping the workers up to the highest pitch of 'efficiency'; and 'efficiency' is now coming to be understood as meaning 'the output per hour.'"[132]

The adoption of physiological and psychological expertise in the interwar period—as embodied in the IFRB/IHRB and NIIP—had as its object, Maclean argued, only "to so care for the body and mind of the worker under scientific conditions that the highest equivalent possible may be attained."[133] If improvements were made to working conditions, it was not out of philanthropy but because it was in the interests of the employer: "Some capitalists have found out, e.g. Cadbury, Rowntree,

and Lord Leverhulme, that a certain standard of living above the animal increases efficiency, and is therefore advantageous to them. These are urging their class to adopt the policy of 'enlightened capitalism' to save capitalism from the establishment of a socialist republic."[134] For Maclean, "applied industrial psychology and physiology"—far from representing an accommodation between the interests of labor and capital—were signs of a reinvigorated and dynamic British capitalism in the aftermath of the First World War, fighting to assert itself against the economic competition of the United States and the ideological opposition of communism.[135]

For working-class radicals like Fox and Maclean, the science of work could not be separated from the economic structure of society. Not only production but the minds and bodies of workers were controlled by capital. As Fox argued, if industry was to be really "placed on a sound psychological basis"—and not on the limited, instrumental psychology of work science—it would require "a complete change of outlook, not merely an improvement of method." It would be necessary to "explore the possibilities of industrial harmony and human well-being in a drastically re-organized industrial order." What was needed was "not the alteration of small details but a new attitude to industry and life, placing the emphasis on the last instead of the first." Anything then, Fox argued, "that will make industry efficient for the purposes of life and so make people healthier and happier comes, if we accept this view, within the scope of industrial psychology even if it has no bearing on more rapid production."[136]

These critiques cut to the heart of the ideology of efficiency that supported the model of the productive body advanced by work science. The apparently value-free ideal of efficiency that dominated social and political discourse in the first decades of the twentieth century was exposed as an ideological construction designed to serve the needs of capital. As Fox himself observed, "one only has to speak of 'Efficiency' and 'Progress' to win assent." But, he argued, "it is all a question of the direction in which progress is made and the purpose of efficiency." In the future, Fox declared, "we shall have to choose whether we will sacrifice some of that efficiency which turns out cheap shoddy goods by using up men and women in factories or whether we shall make for all-round human efficiency."[137]

CONCLUSION

The science of work, this book has argued, was a science of the productive body. Industrial physiology and industrial psychology concerned themselves primarily not with the individual worker—their subjective feelings, ideas, or desires—but with the productivity of the working population. Individual workers were reduced to a series of capacities, which could be optimized for maximum productive efficiency. In such a framework, the worker's voice could be of little consequence. On the occasions where the voice of the worker was considered directly, it was usually as a methodological problem or a disruptive influence. Scientists were forced to develop strategies to ensure the workers' consent.

The science of work was largely successful in gaining the support of organized labor. Trade unions and the TUC lent their support to the science of work for a variety of reasons, some principled and some strategic. One consequence of this, however, was to bolster the legitimacy of work scientists in an area where it was perhaps most tenuous. With the backing of unions and prominent unionists, the institutions of work science could claim to act as objective and impartial mediators between capital and labor. While the results of work science helped the TUC to fight against Taylorist management systems, the support of the TUC also allowed the scientists' own doctrine of efficiency to cement its position as the truly scientific alternative. As the workers discussed in the final section of this chapter show, however, this narrative of acceptance and consolidation does not tell the whole story.

The productive body, in Guéry and Deleule's terms, is the form taken by the social body under capitalism: a body organized through the division of labor for the production of surplus value. The assumptions and conclusions of the science of work follow from, and make sense within, this model. Health is reduced to capacity for work, in a context where productive efficiency becomes the standard against which everything is judged. By drawing attention to some ways in which these disciplinary logics were implicitly or explicitly challenged or resisted, I do not mean to suggest that they were not effective. Nor do I want to imply that any response of workers—individually or collectively—was significant in affecting the dominance of capital, or the progress

of rationalization. By reading the ugly feelings of labor from workers' own writings, however, it is possible to see fleeting moments of potential, in which the possibility of alternative relationships between body and society might be articulated: a social body predicated not on the extortion of surplus value but on collective human flourishing. For Jack Common, hope lay in "the potential, unrealised human force which has until now been kept as sub-human labour power." The "proclamation of that force" would represent nothing less than "the establishment of a Socialist Commonwealth, an aristocracy of total humanity ruling over a serfdom of machines." Jack Hilton, at the end of his 1935 autobiography, addressed himself directly to the "economists" and "experts" who placed production over humanity: "You are full of efficiency, yet methinks we are much worse after taking your medicine. May you be compelled to drink it all yourselves and we be liberated to the extravagancies of the vineyards of the flowing cups. May we ultimately defy all your canons, may we torture you by working less, and talking more, may the added purpose of production be overcome, that is, the purpose of profit."[138]

CONCLUSION

> *But, on the one hand, we have seen that the many individual wills active in history for the most part produce results quite other than those intended—often quite the opposite; that their motives, therefore, in relation to the total result are likewise of only secondary importance. On the other hand, the further question arises: What driving forces in turn stand behind these motives? What are the historical forces which transform themselves into these motives in the brains of the actors?*
>
> —Friedrich Engels, "Ludwig Feuerbach and the End of Classical German Philosophy"

> *The very essence of the materialist method is that, in its examination of any human event whatever, it attaches much less importance to the ends pursued than to the consequences necessarily implied by the working out of the means employed.*
>
> —Simone Weil, *Formative Writings, 1929–1941*

This book has explored the rise of a dedicated science of work in Britain: its emergence, consolidation, and contestation in the years between 1870 and 1939 and its consequences for scientific and cultural understandings of health. In the last decades of the nineteenth century, the articulation of the laws of thermodynamics inaugurated a new model of human physiology conceived in terms of *energy* and *work*. The concept of efficiency—previously associated with industrial machinery—was increasingly made the measure of human bodies. In this context, fatigue—the body's resistance to continued productive work—emerged as the emblematic pathology of modern industrial society, symbolizing economic, social, political, and cultural decline and degeneration. Rarely found in medical discourse before the late 1860s, the final third of the nineteenth century saw a proliferation of attempts to define, describe, and control both physical and mental fatigue. With the elimination of bodily exhaustion, doctors,

physiologists, and psychologists claimed, the productive energies of the nation could be renewed.

In the first decades of the twentieth century, the study of the limits to the body's energies became the basis of a new science of work. New disciplines of industrial physiology and industrial psychology emerged at the intersection of medical, scientific, political, and economic discourses. As well as physicians, physiologists, and psychologists, its proponents included politicians, trade unionists, economists, industrialists, and entrepreneurs. In the metonymic association of the individual body with the nation, and its desire to order social life according to rational principles, work science aligned itself with the national efficiency movement coming to prominence in the early twentieth century. Through the elimination of physical and mental fatigue in the worker, its supporters claimed, the country's energies could be optimized to the point of maximum efficiency. Its technocratic vision of increased productivity, and of an end to class conflict through the application of scientific expertise, attracted adherents from across traditional lines of political division and was supported by successive governments.

Taking shape in debates about hours and conditions of work and the health of the working population in the first decades of the twentieth century, the science of work was brought to national prominence by a crisis not of health but of efficiency. The Health of Munition Workers Committee was appointed by the British government with the explicit aim of increasing armaments production. In the interwar period, its work was continued and expanded through first the Industrial Fatigue Research Board and then the Industrial Health Research Board and complemented by the investigations of the newly formed National Institute of Industrial Psychology, offering a scientific consultancy service to paying customers. Through the 1920s and 1930s, the crude, mechanistic model of the "human motor" as an economy of physical energies was increasingly displaced by a new focus on the psychological aspects of standardized work and a concern for the "human factor" and the individual. As has been shown, however, the science of work was, through all of its iterations, primarily concerned with the question of efficiency at an aggregate level. If industrial physiology and industrial psychology faded out of view as distinct specialisms in the period after the Second World War, this is less because they were superseded, or

made obsolete, and more that the assumptions and rationale behind them were diffused and incorporated into new fields and new institutions, from human relations and management consultancy to the Health and Safety Executive and the National Health Service. While fatigue partially receded from discussions of occupational health in the mid-twentieth century, replaced by newly dominant categories such as stress, the link between pathology and productivity continued to structure the response of scientists, medics, and employers.[1]

Both industrial physiology and industrial psychology, I have argued, are best understood as technologies of *the productive body*. The worker became an object of medical and scientific intervention only insofar as he or she represented a constituent part of the machinery of industrial labor, while the biological body was, in turn, reduced to its economic potentials. Work measurement, time and motion study, and vocational testing fragmented the body of the worker into a series of discrete physical and mental capacities, objectively quantifiable and capable of optimization for maximum efficiency. At the center of the science of work was the promise to produce a body that was suited to the demands of an increasingly mechanized capitalist mode of production: docile, efficient, and above all productive.

To characterize the science of work in this way, it should be emphasized, does not imply a judgment about the intentions of its protagonists but about the structures within which they operated. Under capitalism, the sociologist Jacques Donzelot has argued, schemes to improve the health and welfare of workers under capitalism can only ever be legitimately pursued "within a logic which knows only one motive: to increase profit and productivity."[2] Many—perhaps most—of those associated with industrial physiology and psychology saw themselves as progressives, sincerely committed both to maximizing the prosperity of the nation *and* to improving the lives of workers. Whatever their *personal* intentions, however, industrial reformers' scope of action was strictly constrained by "the iron boundaries of a well-established set of power relations where the capitalist class or bourgeoisie is the dominant class."[3] The very existence of work science was predicated on its usefulness to capital and the state. As such, those elements that increased productivity were prioritized, while those that did not were marginalized. It was not possible for science to make the case for any reform that would improve

working conditions at a cost to capital. Any reform had to be justified, first and foremost, by reference to profitability.

The models of health and the body advanced by the science of work were reinforced and supported by a commodified culture of efficiency, which flourished between the end of the nineteenth century and the start of the Second World War. Advertising materials and self-help literature constructed an individualized model of bodily health and offered to provide a competitive advantage to the worker-consumer by increasing their personal efficiency. Promoters of patent medical products and health foods drew on new scientific ideas of energy, fatigue, and nutrition, offering to revitalize a population exhausted through overwork, while physical culture magazines and popular psychology systems presented aspirational images of physical fitness and mental efficiency.

As the workers discussed in the last chapter show, however, ideals of health and efficiency did not go uncontested. While organized labor largely accepted the terms of work science, ordinary men and women found ways to resist the logics of rationalization. The working body became a central site of contestation and political conflict. For workers on the factory floor, fatigue was not an index of working capacity but an embodied and affective state. Drawing on the work of Sianne Ngai, I have argued that workers' physical and emotional responses to work can be understood as *ugly feelings*. While often working to diminish capacities of resistance, they could also act as points of embryonic political consciousness, occasionally providing the foundation for wide-ranging critiques of capitalist work and society. Even if these critiques rarely developed into a coherent set of politics, much less a movement, in uncovering their emergence I have nonetheless attempted to indicate the potential they carried to disrupt the productivist logics of the science of work and to draw attention to the alternative models of health and efficiency that they suggested.

HEALTH AND EFFICIENCY IN THE TWENTY-FIRST CENTURY

In his conclusion to *The Human Motor,* written in 1990, Anson Rabinbach sketched the "eclipse" of the productivist model of the body over the second half of the twentieth century as a reflection of the "disappearance

of the work-centered society."[4] Today, however, three decades of neoliberal reforms later, it is possible to make the argument that our society—at least in the West—is more work centered than ever. On the one hand, in the United Kingdom, more people are spending more time at work.[5] Between 2010 and 2015, a recent report by the TUC found, the proportion of UK employees working more than forty-eight hours a week rose by 15 percent.[6] In addition, according to a 2016 survey conducted by the Smith Institute, more than two-thirds of workers believed that they were working *harder* than two years previously.[7] On the other hand, reforms to unemployment benefits, the rise of zero-hours and temporary contracts, as well as forced self-employment have meant that increasing numbers of people are becoming trapped in a series of short-term, low-paid, or precarious jobs in which the demands of finding and maintaining work become an all-consuming responsibility.[8]

Rather than declining in importance through deindustrialization and automation, a number of critics have argued, the late twentieth and twenty-first centuries have in fact seen the growth and metastasis of a work-centered worldview.[9] The "apparent decline of the factory as a site of production," Michael Hardt and Antonio Negri have argued, "does not mean a decline of the regime and discipline of factory production, but means rather that it is no longer limited to a particular site in society."[10] As contributors to a recent collection have demonstrated, regimes of control, measurement, and surveillance previously associated with the scientifically managed factory are increasingly becoming the norm in a wide variety of workplaces, from the call center to the university.[11] New communications technologies are making it possible to measure, surveil, and control workers with unprecedented efficiency, leading to accusations in some workplaces of a newly resurgent "digital Taylorism."[12] In an intensification of these trends, at the end of 2018 it was revealed that biotechnology firms were marketing human microchipping products to employers, with trade unions expressing concerns that the technology could be used to store employees' personal data or initiate disciplinary proceedings.[13] In descriptions alarmingly reminiscent of factory conditions a century earlier, the TUC reported on employers already routinely accessing the personal emails of staff, as well as monitoring toilet breaks, with women in some cases being made to wear a red bracelet while on their

period to justify more frequent visits.[14] "It is a strange commentary on our industrial life," as W. F. Watson put it in his 1935 book *Machines & Men,* "that men [*sic*] should prefer the lavatory to the workshop!"[15]

The most compelling evidence of the continued centrality of work, however, is the extent to which the logics of the capitalist workplace have extended beyond the office and the factory to colonize more and more of our lives *outside of employment*. In contrast to a Fordist settlement under which "weekends and leisure time were still relatively untouched," Carl Cederström and Peter Fleming have argued, under neoliberalism "capital seeks to exploit our very sociality in *all* spheres of life."[16] Increasingly, we are expected both to identify with our job as the central aspect of our personality (even as our work becomes increasingly meaningless) and at the same time to submit our leisure activities and personal relationships to calculations of efficiency, productivity, and cost-benefit analysis.[17] What is unique about today's "24-hour capitalism," Cederström and Fleming argue, is not only "that at any moment of the day (and night) someone, somewhere is working but also that at any moment of the day *everyone is always working*."[18]

As Cederström has developed in a separate book, cowritten with André Spicer, in today's work-centered society, we are also increasingly expected to work on ourselves—on our bodies and our health. Like the consumers discussed in chapter 4, we are invited to participate in a commodified culture of self-improvement and self-management—through life coaching, gym membership, dietary supplements, or cognitive enhancement pills—in order to better prepare ourselves "to meet the contradictory demands of present-day capitalism."[19] Through phenomena like the "quantified self" and "lifehacking" movements, facilitated by smartphone apps and "wearable technology" able to track anything from our heart rate and sleep patterns to fluctuations in mood, the worker-consumer is encouraged to view their body as a productive system: an assemblage of physical, mental, and emotional capacities that can be maximized for optimum performance.[20] If the qualities demanded of us have shifted (with flexibility, imagination, and the ability to manage emotions, for example, being prized over the capacity for continuous physical exertion), the underlying principle remains the same: "Healthy bodies are productive bodies. They are good for business."[21]

In recent years, under the pervasive influence of what Mark Fisher has termed "capitalist realism," it has seemed increasingly impossible to imagine an economic, social, or cultural order—life itself—outside the narrowly defined boundaries of the neoliberal status quo. Neoliberalism, as David Harvey has argued, has "become incorporated into the common-sense way many of us interpret, live in, and understand the world."[22] In such a context, a renewed ability to articulate logics that disrupt or challenge the inevitability of present arrangements is of crucial importance.

Nowhere is the inexorability of the present system more forcefully impressed than in discourses about our physical and mental makeup. By naturalizing and individualizing social inequalities, and obscuring their structural origins, the philosopher André Gorz has argued, medical and scientific discourses become "technique[s] for making us accept the unacceptable." Precisely because of their centrality to what Matthew Wolf-Meyer has termed "the construction of the inevitable," however, health and the body can also become key sites of its contestation. Tellingly, in articulating a "strategy against capitalist realism," Fisher argues for a politicization of health—and mental health in particular. Rather than accepting a medicalized model in which psychological suffering is seen as a private pathology, Fisher argues, "it is necessary to reframe the growing problem of stress (and distress) in capitalist societies": "The 'mental health plague' in capitalist societies would suggest that, instead of being the only social system that works, capitalism is inherently dysfunctional, and that the cost of it appearing to work is very high." Likewise, David Frayne has hoped that an insistence on the social causes of physical and mental distress can potentially "contribute to a denaturalization of work and its centrality in modern society." The "limits of our bodies," Frayne argues, "are alerting us to the need for social change."[23]

Underpinning this book's argument has been an understanding that the ways in which we understand our bodies are ideological and that the ways in which we inhabit them are political. Ideas of health, I have argued, far from being neutral or value free, have been shaped by political and economic forces. In the British science of work that emerged in the early twentieth century, norms of capitalist economic rationality and work discipline were codified into medical and scientific

knowledge about the body. An awareness of the fundamentally historical nature of a category like health should draw attention to the fact that the things we take to be inevitable have not always been so and need not be in the future. Likewise, by recovering the voices of those who disrupted, challenged, and resisted the logics imposed by the science of work, I have meant to emphasize not only that the disciplinary forces that shape our lives are never total in their scope but that in our embodied and emotional responses to our social predicament, there is the potential for new kinds of political consciousness, new solidarities, and better futures.

NOTES

INTRODUCTION

1. Edgar L. Collis and Major Greenwood, *The Health of the Industrial Worker* (London: J. & A. Churchill, 1921), 80.
2. See G. R. Searle, *The Quest for National Efficiency: A Study in British Politics and Political Thought, 1899–1914* (Oxford: Basil Blackwell, 1971).
3. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic Books, 1990).
4. See Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain* (London: Athlone, 1998).
5. Rabinbach, *Human Motor,* 2.
6. Anson Rabinbach, "The Body without Fatigue: A Nineteenth-Century Utopia," in *Political Symbolism in Modern Europe: Essays in Honor of George L. Mosse,* ed. Seymour Drescher, David Warren Sabean, and Allan Sharlin (New Brunswick, NJ: Transaction Books, 1982), 42–62.
7. Rabinbach, "Body without Fatigue," 43, 50–51.
8. Rabinbach, *Human Motor,* 275–76.
9. Mark Jackson, *The Age of Stress: Science and the Search for Stability* (Oxford: Oxford University Press, 2013); David Cantor and Edmund Ramsden, *Stress, Shock, and Adaptation in the Twentieth Century* (Rochester, NY: University of Rochester Press, 2014); Mark Jackson, ed., *Stress in Post-war Britain, 1945–85* (Abingdon: Routledge, 2015); Jill Kirby, *Feeling the Strain: A Cultural History of Stress in Twentieth-Century Britain* (Manchester: Manchester University Press, 2019).
10. Joseph Melling, "Labouring Stress: Scientific Research, Trade Unions and Perceptions of Workplace Stress in Mid-Twentieth-Century Britain," in *Stress in Post-war Britain,* ed. Jackson.
11. Vicky Long, *The Rise and Fall of the Healthy Factory: The Politics of Industrial Health in Britain, 1914–60* (New York: Palgrave Macmillan, 2011), 185, 2.
12. François Guéry and Didier Deleule, *The Productive Body* (Winchester, UK: Zero Books, 2014). More recently, the interlinked histories of productivity and the body have been explored by contributors to Peter-Paul Bänziger and Mischa Suter, eds., *Histories of Productivity: Genealogical Perspectives on the Body and Modern Economy* (Abingdon: Routledge, 2017).
13. Guéry and Deleule, *The Productive Body,* 51; Karl Marx, *Capital: A Critique of Political Economy* (London: Penguin, 1990), 1:463–64; Philip Barnard and Stephen Shapiro, "Editors' Introduction to the English

Edition," in *The Productive Body,* by Guéry and Deleule, 11; Justin D. Edwards, "Introduction: Technogothics," in *Technologies of the Gothic in Literature and Culture: Technogothics,* ed. Justin D. Edwards (New York & London: Routledge, 2015), 7.

14. Marx, *Capital,* 644–46; Guéry and Deleule, *The Productive Body,* 52, 106.
15. Barnard and Shapiro, "Editors' Introduction," 13.
16. Guéry and Deleule, *The Productive Body,* 112.
17. Michael Weatherburn, "Scientific Management at Work: The Bedaux System, Management Consulting, and Worker Efficiency in British Industry, 1914–48" (PhD diss., Imperial College London, 2014), 73.
18. Steven Kreis, "The Diffusion of an Idea: A History of Scientific Management in Britain, 1890–1945" (PhD diss., University of Missouri, 1990), 273.
19. Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1998), 175–87. See also Frederick Winslow Taylor, *The Principles of Scientific Management* (New York: Harper, 1913).
20. The clearest exposition of the principles of scientific management in practice can be found in Hugh G. J. Aitken, *Scientific Management in Action: Taylorism at Watertown Arsenal, 1908–1915* (Princeton, NJ: Princeton University Press, 1985), chap. 1. See also Daniel Nelson, *Frederick W. Taylor and the Rise of Scientific Management* (Madison: University of Wisconsin Press, 1980); and Daniel Nelson, ed., *A Mental Revolution: Scientific Management since Taylor* (Columbus: Ohio State University Press, 1992).
21. Kevin Whitston describes industrial psychology as a "complementary rather than a competing management philosophy," while for Steven Kreis, by the interwar period, "scientific management and industrial physiology [had] come to signify nearly the same thing." For Kreis, industrial physiology should be considered as a "formal school of scientific management." Kevin Whitston, "Scientific Management Practice in Britain: A History" (PhD diss., University of Warwick, 1995), 119; Kreis, "Diffusion of an Idea," 215, 33–34.
22. Braverman, *Labor and Monopoly Capital,* 60.
23. Jonathan M. Metzl, "Introduction: Why against Health?," in *Against Health: How Health Became the New Morality,* ed. Jonathan M. Metzl and Anna Kirkland (New York: New York University Press, 2010), 1–2, 6–7.
24. See, for example, Anthony S. Wohl, *Endangered Lives: Public Health in Victorian Britain* (London: Dent, 1983); and Helen Jones, *Health and Society in Twentieth Century Britain* (Abingdon: Routledge, 2014).
25. For historical perspectives on the shifting meanings of health, see Thomas McKeown, *The Role of Medicine: Dream, Mirage, or Nemesis?* (Princeton,

NJ: Princeton University Press, 1979); Alfons Labisch, "Doctors, Workers and the Scientific Cosmology of the Industrial World: The Social Construction of 'Health' and the 'Homo Hygienicus,'" *Journal of Contemporary History* 20, no. 4 (1985): 599–615; Bruce Haley, *The Healthy Body and Victorian Culture* (Cambridge, MA: Harvard University Press, 2013); and Klaus Bergdolt, *Wellbeing: A Cultural History of Healthy Living* (Cambridge: Polity, 2008).

26. See, for example, Vicente Navarro, *Medicine under Capitalism* (London: Croom Helm, 1976); and Peter Sedgwick, *PsychoPolitics: Laing, Foucault, Goffman, Szasz and the Future of Mass Psychiatry* (London: Unkant, 2015), 26–43.
27. Anna Kirkland, "Conclusion: What Next?," in *Against Health,* ed. Metzl and Kirkland, 195.
28. See Luther H. Martin, Hack Gutman, and Patrick H. Hutton, eds., *Technologies of the Self: A Seminar with Michel Foucault* (Amherst: University of Massachusetts Press, 1988).
29. Carl Cederström and Peter Fleming, *Dead Man Working* (Winchester, UK: Zero Books, 2012), 7. See also Amelia Horgan, *Lost in Work: Escaping Capitalism* (London: Pluto, 2021).

CHAPTER 1: THE DISCOVERY OF FATIGUE

1. Mona Caird, "The Evolution of Compassion," *Westminster Review* 145 (1896): 643; "A Physician," "Fatigue," *Quiver* 429 (1908): 1012.
2. See Anna Katharina Schaffner, *Exhaustion: A History* (New York: Columbia University Press, 2016).
3. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic Books, 1990), 2.
4. E. J. Hobsbawm, *Industry and Empire* (Harmondsworth: Penguin, 1990), 126–27, 178–88; Sidney Pollard, *Britain's Prime and Britain's Decline: The British Economy, 1870–1914* (London: Edward Arnold, 1989); H. Berghoff and R. Moller, "Tired Pioneers and Dynamic Newcomers? A Comparative Essay on English and German Entrepreneurial History, 1870–1914," *Economic History Review,* n.s., 47, no. 2 (1994): 262–87.
5. James Anthony Froude, "England's War," *Fraser's Magazine* 3, no. 14 (1871): 135, 144.
6. Joseph Chamberlain (1902) quoted in Julian Amery, *The Life of Joseph Chamberlain* (London: Macmillan, 1951), 4:421; Aaron L. Friedberg, *The Weary Titan: Britain and the Experience of Relative Decline, 1895–1905* (Princeton, NJ: Princeton University Press, 2010).
7. John Addington Symonds, "A Comparison of Elizabethan with Victorian Poetry," *Fortnightly Review* 45, no. 265 (1889): 60; H. D. Traill, *Number Twenty: Fables and Fantasies* (London: Henry, 1892), 12. See also Steffan Blayney, "'Drooping with the Century': Fatigue and the *Fin de Siècle,*" in *Progress and Pathology: Medicine and Culture in the Nineteenth*

Century, ed. Melissa Dickson, Emilie Taylor-Brown, and Sally Shuttleworth (Manchester: Manchester University Press, 2020), 153–72.

8. T. Clifford Allbutt, "Nervous Diseases and Modern Life," *Contemporary Review* 67 (February 1895): 210.
9. Samuel Wilks, "On Overwork," *Lancet* 105 (June 26, 1875): 886.
10. See Schaffner, *Exhaustion: A History;* and Elizabeth Green Musselman, *Nervous Conditions: Science and the Body Politic in Early Industrial Britain* (Albany: State University of New York Press, 2006).
11. Gillian Beer, *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth-Century Fiction* (Cambridge: Cambridge University Press, 2009), 5.
12. J. Clerk Maxwell, "Hermann Ludwig Ferdinand Helmholtz," *Nature* 15 (March 8, 1877): 390.
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CHAPTER 2: INDUSTRIAL PHYSIOLOGY AND THE PRODUCTIVE BODY

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18. *Annual Report of the Chief Inspector of Factories and Workshops for the Year 1912* (London: HMSO, 1913), viii, xii; A. F. Stanley Kent, *Interim Report on an Investigation of Industrial Fatigue by Physiological Methods* (London: HMSO, 1915), 3, 4.
19. A. F. Stanley Kent, *Second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods* (London: HMSO, 1916), Cd. 8335, 50–60.
20. "Mental and Muscular Fatigue: Interim Report of the Committee," in *Report of the Eightieth Meeting of the British Association for the Advancement of Science: Sheffield, 1910, August 31–September 7* (London: John Murray, 1911), 292–97; "Mental and Muscular Fatigue: Report of the Committee," in *Report of the Eightieth [Eighty-First] Meeting of the British Association for the Advancement of Science: Portsmouth, 1911, August 31–September 7* (London: John Murray, 1912), 174–76.
21. Bodleian Libraries, BAAS 338, Section F minute-book, "Appointments to Committees, 1888–1916."

22. "The Question of Fatigue from the Economic Standpoint: Interim Report of the Committee," in *Report of the Eighty-Fourth Meeting of the British Association for the Advancement of Science: Australia, 1914, July 28–August 31* (London: John Murray, 1915), 175–76.
23. Drummond, "Fatigue," 221; Oliver, "Occupational Fatigue," 347; Andrew Scott Myrtle, "Neurasthenia—True and False," *Provincial Medical Journal* 8, no. 86 (1889): 84–88.
24. McDougall, "Fatigue," 479; Kent, *Interim Report,* 4 (emphasis added).
25. Philip Sargant Florence, *Use of Factory Statistics in the Investigation of Industrial Fatigue* (New York: Columbia University, 1918), 20 (first emphasis added).
26. A. F. Stanley Kent, "An Address on Fatigue and Alcohol," *Lancet* 190, no. 4900 (1917): 107.
27. Gillespie, "Industrial Fatigue and the Discipline of Physiology," 431; J. W. Ramsbottom, "Suggestions for an Inquiry into Industrial Fatigue," *Economic Journal* 24, no. 95 (1914): 393; "The Question of Fatigue from the Economic Standpoint: Second Interim Report of the Committee," in *Report of the Eighty-Sixth Meeting of the British Association for the Advancement of Science: Newcastle-on-Tyne, 1916, September 5–9* (London: John Murray, 1917), 263, 251.
28. Kent, *Second Interim Report,* 6; "The Question of Fatigue from the Economic Standpoint: Report of the Committee," in *Report of the Eighty-Fifth Meeting of the British Association for the Advancement of Science: Manchester, 1915, September 7–11* (London: John Murray, 1916), 299.
29. McIvor, "Employers, the Government, and Industrial Fatigue," 728–30.
30. David French, "The Military Background to the 'Shell Crisis' of May 1915," *Journal of Strategic Studies* 2, no. 2 (1979): 192–205; Peter Fraser, "The British 'Shells Scandal' of 1915," *Canadian Journal of History* 18, no. 1 (1983): 77–86.
31. R. J. Q. Adams, *Arms and the Wizard: Lloyd George and the Ministry of Munitions, 1915–1916* (London: Cassell, 1978).
32. See *The History of the Ministry of Munitions,* vol. 1, pt. 2 (London: HMSO, 1922), 17–21.
33. HMWC, *Final Report: Industrial Health and Efficiency* (London: HMSO, 1918), Cd. 9056, 3.
34. David Lloyd George, *War Memoirs of David Lloyd George* (London: Odhams Press, 1938), 1:206–7; National Archives, FD 5/37, British Association Committee on Fatigue from the Economic Standpoint to the National Health Insurance Commission, July 29, 1914; W. M. Fletcher and F. Gowland Hopkins, "Lactic Acid in Amphibian Muscle," *Journal of Physiology* 35, no. 4 (1907): 247–309. See also, for example, W. M. Fletcher, "The Survival Respiration of Muscle," *Journal of Physiology* 23, nos. 1–2 (1898): 10–99; W. M. Fletcher, "The Osmotic Properties of Muscle, and

Their Modifications in Fatigue and Rigor," *Journal of Physiology* 30, nos. 5–6 (1904): 414–38; W. M. Fletcher, "On the Alleged Formation of Lactic Acid in Muscle during Autolysis and in Post-survival Periods," *Journal of Physiology* 43, nos. 3–4 (1911): 286–312; and W. M. Fletcher, "Lactic Acid Formation, Survival Respiration and Rigor Mortis in Mammalian Muscle," *Journal of Physiology* 47, nos. 4–5 (1913): 361–80.

35. National Archives, FD 5/37, W. M. Fletcher to E. L. Collis, December 7, 1914; Fletcher to B. L. Hutchins, October 31, 1914; "The Question of Fatigue from the Economic Standpoint: Second Interim Report," 251–52.
36. National Archives, FD 3/120, Fletcher to George Newman, May 23, 1918; Royal Society Library, CMB 36/16, Minutes of the War Committee of the Royal Society, June 24, 1915.
37. Royal Society Library, CMB 36/19, Minutes of the War Committee, July 15, 1915.
38. National Archives, FD 5/37, Fletcher to Christopher Addison, July 5, 1915.
39. National Archives, FD 5/37, Fletcher to Ministry of Munitions, July 14, 1915.
40. "War Workers' Health," *Daily Telegraph* (17 Se1915).
41. Thomas Bedford, "H. M. Vernon, M.A., M.D.," *British Journal of Industrial Medicine* 8, no. 2 (1951): 96–97. Vernon was not the only industrial physiologist with firsthand experience of factory work. Charles Sherrington, another Oxford physiologist, chair of the British Association Committee on Mental and Muscular Fatigue, and the first chairman of the Industrial Fatigue Research Board in 1918, also volunteered in the Vickers-Maxim factory in Birmingham during the summer of 1915. See H. M. Sinclair, "Sherrington and Industrial Fatigue," *Notes and Records of the Royal Society* 39, no. 1 (1984): 91–104; and John Eccles and William C. Gibson, *Sherrington: His Life and Thought* (Berlin: Springer, 1979), 26.
42. McIvor, "Employers, the Government, and Industrial Fatigue," 730; Gillespie, "Industrial Fatigue and the Discipline of Physiology," 439–40.
43. Henry John Spooner, *Industrial Fatigue in Its Relation to Maximum Output* (London: Co-partnership, 1917), 13.
44. "Gyms and Physical Culture Clubs for Munition Workers," *Health & Strength* 18, no. 8 (1916): 116–17; Spooner, *Industrial Fatigue in Its Relation to Maximum Output,* 16.
45. National Archives, MUN 5/92/346/7, memorandum: "Health and Welfare of Munition Workers," June 5, 1917. The comparison of munition workers and soldiers was common. See, for example, HMWC, *[Memorandum No. 1:] Sunday Labour* (London: HMSO, 1915), Cd. 8132, 3; and HMWC, *Interim Report: Industrial Efficiency and Fatigue* (HMSO, 1917), Cd. 8511, 77.
46. HMWC, *Health of the Munition Worker* (London: HMSO, 1917), 13.

47. National Archives, FD 3/120, Newman to Fletcher, May 24, 1918.
48. See HMWC, *Memorandum No. 2: Welfare Supervision* (London: HMSO, 1915), Cd. 8151.
49. National Archives, FD 5/37, Addison to Fletcher, September 2, 1915. See also Gail Braybon, *Women Workers in the First World War: The British Experience* (London: Croom Helm, 1981), 138–42; and Angela Woollacott, *On Her Their Lives Depend: Munitions Workers in the Great War* (Berkeley: University of California Press, 1994), 71–72.
50. HMWC, *Memorandum No. 7: Industrial Fatigue and Its Causes* (London: HMSO, 1916), Cd. 8213, 3.
51. H. M. Vernon, *Industrial Fatigue and Efficiency* (London: Routledge, 1921), 2; H. M. Vernon, "The Influence of Fatigue on Health and Longevity," *Journal of Industrial Hygiene* 3, no. 3 (1921): 93–98; Derickson, "Physiological Science and Scientific Management in the Progressive Era," 487; HMWC, *Memorandum No. 13: Juvenile Employment* (London: HMSO, 1916), Cd. 8362, 3.
52. HMWC, *Memorandum No. 7,* 6.
53. HMWC, *Memorandum No. 7,* 6–10.
54. *Interim Report,* 4; Florence, *Use of Factory Statistics.*
55. Guéry and Deleule, *The Productive Body,* 102; *Memorandum No. 7,* 6; *Memorandum No. 13,* 11.
56. See Frederick Winslow Taylor, *The Principles of Scientific Management* (New York: Harper, 1913); Daniel Nelson, *Frederick W. Taylor and the Rise of Scientific Management* (Madison: University of Wisconsin Press, 1980); and Robert Kanigel, *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency* (London: Little, Brown, 1997).
57. See chapter 5, 153–56.
58. "The Question of Fatigue from the Economic Standpoint: Interim Report," in *Report of the Eighty-Fifth Meeting,* 322 (emphasis added); HMWC, *Final Report,* 42 (emphasis added).
59. Kent, "Address on Fatigue and Alcohol," 107.
60. Michael Rose, *Industrial Behaviour: Research and Control* (London: Penguin, 1988), 61–66.
61. National Archives, MUN 5/92/346/7, "Health and Welfare of Munition Workers."
62. National Archives, FD 5/37, memorandum: "Industrial Fatigue in Relation to Output," July 14, 1915 (emphasis added). In a letter of 1916, HMWC member Edgar Collis wrote to Fletcher, "Your term 'Physiological Management' hits me as fine; it covers our field as opposed to 'Scientific Management' beautifully." National Archives, FD 5/37, Collis to Fletcher, May 30, 1916.
63. HMWC, *Memorandum No. 7,* 7; A. F. Stanley Kent, "Industrial Fatigue," in *Industrial Administration: A Series of Lectures,* by A. E. Berriman et

al. (Manchester: Manchester University Press, 1920), 194; J. R. Clynes, foreword to *Industrial Fatigue in Its Relation to Maximum Output,* by Spooner, 5–6.

64. See Steve Sturdy, "The Industrial Body," in *Companion to Medicine in the Twentieth Century,* ed. Roger Cooter and John Pickstone (London: Routledge, 2003), 224–25.
65. Florence, *Use of Factory Statistics,* 19; HMWC, *Health of the Munition Worker,* 13.
66. Excluding its appearance in the committee's terms of reference—reprinted in each report—the word "fatigue" appears over 150 times across the twenty short memoranda nominally devoted to other subjects and more than 400 times across the two larger reports.
67. HMWC, *Memorandum No. 8: Special Industrial Diseases* (London: HMSO, 1916), 3; HMWC, *Memorandum No. 10: Sickness and Injury* (London: HMSO, 1916), 3. See also Antonia Ineson and Deborah Thom, "T.N.T. Poisoning and the Employment of Women Workers in the First World War," in *The Social History of Occupational Health,* ed. Paul Weindling (London: Croom Helm, 1985), 89–107.
68. Arthur McIvor, "Manual Work, Technology, and Industrial Health, 1918–39," *Medical History* 31 (1987): 162; Vicky Long, *The Rise and Fall of the Healthy Factory: The Politics of Industrial Health in Britain, 1914–60* (New York: Palgrave Macmillan, 2011).
69. *Interim Report,* 69, 70.
70. HMWC, *Memorandum No. 7,* 3, 4–5; Florence, *Use of Factory Statistics,* 23.
71. Harry E. Mock, "Industrial Medicine and Surgery: A Résumé of Its Development and Scope," *Journal of Industrial Hygiene* 1, no. 1 (1919): 1.
72. HMWC, *Memorandum No. 5: Hours of Work* (London: HMSO, 1916), Cd. 8186, 4; Kent, "Address on Fatigue and Alcohol," 110; HMWC, *Final Report,* 7.
73. Kent, *Second Interim Report,* 4.
74. "Industrial Fatigue and Industrial Unrest," *Lancet* 190, no. 4900 (1917): 126; Commission of Enquiry into Industrial Unrest, *No. 5 Division: Report of the Commissioners for the London and South-Eastern Area* (London: HMSO, 1917), Cd. 8666, 3; Commission of Enquiry into Industrial Unrest, *No. 1 Division: Report of the Commissioners for the North-Eastern Area* (London: HMSO, 1917), Cd. 8662, 9; Commission of Enquiry into Industrial Unrest, *Summary of the Reports of the Commission* (London: HMSO, 1917), Cd. 8696, 6.
75. HMWC, *Memorandum No. 13,* 3.
76. HMWC, *Memorandum No. 19: A Second Appendix to Memorandum No. 3 (Industrial Canteens); Investigation of Workers' Food and Suggestions as to Dietary* (London: HMSO, 1917), Cd. 8798, 11.

77. Florence, *Use of Factory Statistics,* 142–44.
78. See Carolyn Malone, *Women's Bodies and Dangerous Trades in England, 1880–1914* (Woodbridge: Boydell Press, 2003).
79. HMWC, *Memorandum No. 4: Employment of Women* (London: HMSO, 1916), Cd. 8185, 3.
80. "Women in Munition Factories," *Times,* June 28, 1916.
81. HMWC, *Memorandum No. 4,* 3.
82. HMWC, *Final Report,* 14.
83. Quoted in Braybon, *Women Workers in the First World War,* 117–18.
84. HMWC, *Memorandum No. 5,* 6.
85. HMWC, *Memorandum No. 4,* 5.
86. Florence, *Use of Factory Statistics,* 142.
87. See Braybon, *Women Workers in the First World War,* 131–49; and Woollacott, *On Her Their Lives Depend,* 68–79.
88. See, for example, *Interim Report,* 40.
89. See Vicky Long and Hilary Marland, "From Danger and Motherhood to Health and Beauty: Health Advice for the Factory Girl in Early Twentieth-Century Britain," *20th Century British History* 20, no. 4 (2009): 454–81.
90. HMWC, *Final Report,* 7.
91. HMWC, *Memorandum No. 17: Health and Welfare of Munition Workers Outside the Factory* (London: HMSO, 1917), Cd. 8344.
92. Kent, "Address on Fatigue and Alcohol," 110.
93. Braybon, *Women Workers in the First World War,* 117–31.
94. Quoted in Braybon, *Women Workers in the First World War,* 119. The comparison of the "external" work of the factory to the "internal" work of pregnancy (with the former disparaged for women) was common. "Women have done some wonderful work," one commentator observed in 1917, "but a baby is more wonderful than a machine gun" (149).
95. Braybon, *Women Workers in the First World War,* 122.
96. HMWC, *Final Report,* 7; *Annual Report of the Chief Inspector of Factories and Workshops for the Year 1918* (London: HMSO, 1919), Cmd. 340, iv; National Archives, LAB/2419/HQ/844/1918, memorandum: Industrial Fatigue Research Board; "Industrial Fatigue," *Times,* December 20, 1918.
97. Braybon, *Women Workers in the First World War,* 116; McIvor, "Employers, the Government, and Industrial Fatigue."

CHAPTER 3: INDUSTRIAL PSYCHOLOGY AND THE HUMAN FACTOR

1. For the HMWC, as the committee's memo on industrial fatigue conceded, the adjective "psychological" was often no more than a convenient catchall for any problem "inexplicable in terms of physiology." HMWC, *Memorandum No. 7: Industrial Fatigue and Its Causes* (London: HMSO, 1916), Cd. 8213, 6.

2. Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1998), 175–87.
3. E. J. Hobsbawm, *Industry and Empire* (Harmondsworth: Penguin, 1990), 214–18; D. C. Doyle, "Aspects of the Institutionalisation of British Psychology: The National Institute of Industrial Psychology, 1921–1939" (PhD, University of Manchester, 1979), 39–40.
4. Gary S. Cross, *A Quest for Time: The Reduction of Work in Britain and France, 1840–1940* (Berkeley: University of California Press, 1989), chap. 6. Some "enlightened" employers went even further than this. In 1919, for example, the Liberal politician and industrialist Lord Leverhulme could be found advocating for a six-hour day on both grounds. First, it was the only way for capitalism, "progressive democracy," and the British Empire to beat back the advance of "Socialism and Anarchy." Second, as the HMWC had shown, "We have proved conclusively that prolonged hours of toil, with resulting excessive fatigue, produce, after a certain point, actually smaller results in quantity, quality, and value than can be produced in fewer hours where there is an entire absence of overstrain or fatigue." Lord Leverhulme, *The Six-Hour Day & Other Industrial Questions* (New York: Henry Holt, 1919), 3, 16.
5. Timothy J. Hatton, "Population, Migration and Labour Supply: Great Britain, 1871–2011," in *The Cambridge Economic History of Modern Britain,* vol. 2, *1870 to the Present,* ed. Roderick Floud, Jane Humphries, and Paul Johnson (Cambridge: Cambridge University Press, 2014), 110.
6. See John Stevenson, *British Society, 1914–45* (Harmondsworth: Penguin, 1990), 196–99.
7. Loren Baritz, *The Servants of Power: A History of the Use of Social Science in American Industry* (Middletown, CT: Wesleyan University Press, 1960).
8. See Vicente Navarro, "Work, Ideology, and Science: The Case of Medicine," in *Health and Work under Capitalism: An International Perspective,* ed. Vicente Navarro and Daniel M. Berman (Farmingdale, NY: Baywood, 1982), 23–26.
9. L. S. Hearnshaw, *A Short History of British Psychology, 1840–1940* (London: Methuen, 1964), 208. See also John Hall, David Pilgrim, and Graham Turpin, introduction to *Clinical Psychology in Britain: Historical Perspectives,* ed. John Hall, David Pilgrim, and Graham Turpin (Leicester: British Psychological Society, 2015), 8.
10. Hearnshaw, *Short History of British Psychology,* 211. See also Peter Warr, "Some Historical Developments in I-O Psychology Outside the United States," in *Historical Perspectives in Industrial and Organizational Psychology,* ed. Laura L. Koppes (Mahwah, NJ: Erlbaum, 2007), 95–96; and Alan Collins, "England," in *The Oxford Handbook of the History of*

Psychology, ed. David B. Baker (Oxford: Oxford University Press, 2012), 192.

11. Nikolas Rose, *The Psychological Complex: Psychology, Politics and Society in England, 1869–1939* (London: Routledge & Kegan Paul, 1989), 1–3.
12. While acknowledging the significance of industrial research as a "substantial field for the employment of psychologists" between the wars, Rose argues that "the new means of conceptualization which constituted the psychology of the individual were forged in relation to the problems of social life rather than industrial labor." Rose, *Psychological Complex,* 9–10.
13. See chapter 1, 39–43.
14. William McDougall, *An Introduction to Social Psychology* (London: Methuen, 1908), 1, 3, 15–16.
15. See Rhodri Hayward, "The Invention of the Psychosocial: An Introduction," *History of the Human Sciences* 25, no. 5 (2012): 3–12.
16. Cyril Burt, "The Contribution of Psychology to Social Hygiene," in *Foundations of Social Hygiene* (London: British Social Hygiene Council, 1926), 27, 26.
17. See Martin Stone, "The Military and Industrial Roots of Clinical Psychology in Britain, 1900–1945: A Political and Socio-economic Archaeology" (PhD, London School of Economics, 1985), chap. 4.
18. Hugo Münsterberg, *Psychology and Industrial Efficiency* (London: Constable, 1913), 17, 3, 17–18, 303, 26. See also Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic Books, 1990), 192–93, 254–56.
19. "The Question of Fatigue from the Economic Standpoint: Second Interim Report of the Committee," in *Report of the Eighty-Sixth Meeting of the British Association for the Advancement of Science: Newcastle-on-Tyne, 1916, September 5–9* (London: John Murray, 1917), 265.
20. Bernard Muscio, *Lectures on Industrial Psychology* (Sydney: Angus & Robertson, 1917), 5–6, 46, 25–26 (emphasis added).
21. Muscio, *Lectures on Industrial Psychology,* 26.
22. G. Bunn, "'A Flair for Organization': Charles Myers and the Establishment of Psychology in Britain," *History & Philosophy of Psychology* 3, no. 1 (2001): 2. See also Alec Rodger, "C. S. Myers in Retrospect," *Occupational Psychology* 44 (January 1970): 23–29.
23. On the relationship between Myers and Rivers, and their influence, see C. P. Crampton, "The Cambridge School: The Life, Work and Influence of James Ward, W. H. R. Rivers, C. S. Myers and Sir Frederic Bartlett" (Ph.D., University of Edinburgh, 1978).
24. See Bunn, "'Flair for Organization,'" 2–3; and Erik Linstrum, *Ruling Minds: Psychology in the British Empire* (Cambridge, MA: Harvard University Press, 2016), 13–31.

25. Hearnshaw, *Short History of British Psychology,* 172–74; Doyle, "Aspects of the Institutionalisation of British Psychology," 11.
26. "The Question of Fatigue from the Economic Standpoint: Interim Report of the Committee," in *Report of the Eighty-Third Meeting of the British Association for the Advancement of Science: Birmingham, 1913, September 10–17* (London: John Murray, 1914), lx.
27. Charles S. Myers, "A Contribution to the Study of Shell Shock," *Lancet* 185, no. 4772 (1915): 316–30.
28. Charles S. Myers quoted in Bunn, "'Flair for Organization,'" 4.
29. "It was through his pioneer lectures," Myers wrote of Muscio in 1926, "that I first got to know anything about Industrial Psychology. . . . Hence Bernard Muscio was responsible for the development of the subject throughout the British Empire." Hearnshaw, *Short History of British Psychology,* 276.
30. Bernard Muscio, ed., *Lectures on Industrial Administration* (London: Pitman, 1920), v.
31. Charles S. Myers, *Mind and Work: The Psychological Factors in Industry and Commerce* (London: University of London Press, 1920), v–vi.
32. Charles S. Myers, *Industrial Psychology in Great Britain* (London: Jonathan Cape, 1926), 12.
33. C. H. Northcott, "Towards a Science of Human Nature," *Industrial Welfare & Personnel Management* 14, no. 157 (1932): 20.
34. H. J. Welch and Charles S. Myers, *Ten Years of Industrial Psychology: An Account of the First Decade of the National Institute of Industrial Psychology* (London: Pitman, 1932), 1–2.
35. Charles S. Myers, *Present-Day Applications of Psychology, with Special Reference to Industry, Education and Nervous Breakdown* (London: Methuen, 1918), 47, 25–26. See also Charles S. Myers, "Industrial Overstrain and Unrest," in *Lectures on Industrial Administration,* ed. Muscio, 182–84; and Myers, *Mind and Work,* 101–6, 199.
36. Hearnshaw, *Short History of British Psychology,* 276. The discussions between Myers and Welch regarding the establishment of the institute can be found at the British Library of Political and Economic Science, NIIP/1/1, Provisional Committee minutes.
37. Hearnshaw, *Short History of British Psychology,* 280.
38. NIIP/1/1, Provisional Committee minutes, November 14, 1919, January 21, 1920.
39. Bunn, "'Flair for Organization,'" 4.
40. Myers, *Industrial Psychology in Great Britain,* 17.
41. *Second Annual Report of the Industrial Fatigue Research Board, to 30th September 1921* (London: HMSO, 1922), 5–6.
42. For an overview of the organization and work of the IFRB, see Arthur McIvor, "Manual Work, Technology, and Industrial Health, 1918–39," *Medical History* 31 (1987): 160–89.

43. *Second Annual Report of the Industrial Fatigue Research Board,* 11–13.
44. NIIP/11/1, director's list of projects.
45. Doyle, "Aspects of the Institutionalisation of British Psychology," 39–40.
46. *Twelfth Annual Report of the Industrial Health Research Board (Formerly the Industrial Fatigue Research Board) to 30th June 1932* (London: HMSO, 1932), 45; Doyle, "Aspects of the Institutionalisation of British Psychology," 105–6.
47. See Doyle, "Aspects of the Institutionalisation of British Psychology."
48. Hearnshaw, *Short History of British Psychology,* 277; Collins, "England," 197–98.
49. Doyle, "Aspects of the Institutionalisation of British Psychology," 39–44.
50. Baritz, *Servants of Power,* 31; National Archives, DSIR 3/181, Malcolm Delevingne to H. Frank Heath, April 24, 1918.
51. See Ron Roberts, *Psychology and Capitalism: The Manipulation of Mind* (Winchester, UK: Zero Books, 2014), 23.
52. "Dangers of Standardisation," *Industrial Welfare* 4, no. 2 (1922): 57; Susie S. Brierley, "The Present Attitude of Employees to Industrial Psychology," *British Journal of Psychology* 10, no. 2 (1920): 210–11.
53. NIIP/1/1, Provisional Committee minutes, July 28, 919.
54. Welch and Myers, *Ten Years of Industrial Psychology,* 3.
55. National Archives, DSIR 1/381, correspondence between Frank H. Health and Walter Fletcher, April 15–16, 1918.
56. Quoted in McIvor, "Manual Work, Technology, and Industrial Health," 163.
57. C. S. Myers, *A Study of Improved Methods in an Iron Foundry,* IFRB Report 3 (London: HMSO, 1919), 4.
58. Muscio, *Lectures on Industrial Psychology,* 36; N. Balchin, "The Psychological Difficulties of the Institute's Work," *Human Factor* 7, no. 7–8 (1933): 263–64.
59. Muscio, *Lectures on Industrial Psychology,* 154.
60. J. A. Bowie, "The Need for a Science of Industrial Administration," in *Lectures on Industrial Administration,* ed. Muscio, 20–21.
61. James Drever, *The Psychology of Industry* (London: Methuen, 1921), vii.
62. G. H. Miles, "Psychology and Industrial Welfare," *Journal of Industrial Welfare* 2, no. 9 (1920): 282–83.
63. Myers, *Industrial Psychology in Great Britain,* 28.
64. C. S. Myers, "The Human Side of Industry," *Journal of the National Institute of Industrial Psychology* 1, no. 8 (1923): 310.
65. S. Wyatt and J. N. Langdon, *The Machine and the Worker: A Study of Machine Feeding Processes,* IHRB Report 82 (London: HMSO, 1938), iii. See also S. Wyatt, "Workers and Machines," *Occupational Psychology* 12, no. 4 (1939): 249.
66. S. Wyatt, *Individual Differences in Output in the Cotton Industry,* IFRB Report 7 (London: HMSO, 1920), 1; Sheila Bevington, "Industrial Psychology and Welfare Work: Does Overlapping Occur?," in *Industrial*

Psychology, ed. Charles S. Myers (London: Thornton Butterworth, 1929), 211–12.

67. *Second Annual Report of the Industrial Fatigue Research Board,* 20.
68. "The Burlington House Meeting: Speakers' Addresses," *Journal of the National Institute of Industrial Psychology* 1, no. 7 (1923): 271.
69. "Scientific Management and the Human Factor," *Industrial Welfare* 4, no. 5 (1922): 216–17; J. Drever, "The Human Factor in Industrial Relations," in *Industrial Psychology,* ed. Myers, 19.
70. G. H. Miles and A. B. B. Eyre, "Ease and Speed of Work," in *Industrial Psychology,* ed. Myers, 86–87.
71. Brierley, "Present Attitude of Employees to Industrial Psychology," 214.
72. *Sixth Annual Report of the Industrial Fatigue Research Board to 31st December 1925* (London: HMSO, 1926), 17.
73. W. R. Sorley, "Some Ethical Aspects of Industry," in *Lectures on Industrial Administration,* ed. Muscio, 3.
74. B. Seebohm Rowntree, *The Human Factor in Business* (London: Longmans, Green, 1921), v–ix.
75. See, for example, T. H. Pear, "Social Psychology and the Industrial System," in *Lectures on Industrial Administration,* ed. Muscio, 144–45.
76. A. F. Watts, *An Introduction to the Psychological Problems of Industry* (London: George Allen & Unwin, 1921), 21; F. W. Lawe, "The Economic Aspects of Industrial Psychology," in *Industrial Psychology,* ed. Myers, 227. See also G. H. Miles, "Fatigue from the Industrial Point of View," *Human Factor* 11, no. 1 (1937): 8–9; and Myers, "Industrial Overstrain and Unrest," 180.
77. Pear, "Social Psychology and the Industrial System," 169; Myers, *Mind and Work,* 168; Myers, "Industrial Overstrain and Unrest," 179–80. On the reception of psychoanalysis by British psychologists, see Sally Alexander, "Psychoanalysis in Britain in the Early Twentieth Century: An Introductory Note," *History Workshop Journal,* no. 45 (1998): 135–43; and Graham Richards, "Britain on the Couch: The Popularization of Psychoanalysis in Britain, 1918–1940," *Science in Context* 13, no. 2 (2000): 187–89.
78. Myers, *Mind and Work,* 169–70.
79. See, for example, Michael Rose, *Industrial Behaviour: Research and Control* (London: Penguin, 1988), 98–99.
80. Doyle, "Aspects of the Institutionalisation of British Psychology," 76–80.
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CHAPTER 4: THE MARKET IN EFFICIENCY

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CHAPTER 5: THE WORKER'S VOICE

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CONCLUSION

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A new model of health emerged in Britain between 1870 and 1939. This model centered on the working body and was organized around the concept of efficiency. Grounded in scientific understandings of human labor, scientists, politicians, and capitalists of the era believed that national economic productivity could be maximized by transforming the body of the worker into a machine. At the core of this approach was the conviction that worker productivity was intimately connected to worker health.

Under this new "science of work," fatigue was seen as the ultimate pathology of the working-class body, reducing workers' capacity to perform continued physical or mental labor. As Steffan Blayney shows, the equation between health and efficiency did not go unchallenged. While biomedical and psychological experts sought to render the body measurable, governable, and intelligible, ordinary men and women found ways to resist the logics of productivity and efficiency imposed on them, and to articulate alternative perspectives on work, health, and the body.

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