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## 'X-rays don't tell lies': the Medical Research Council and the measurement of respiratory disability, 1936–1945

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### Abstract

During the first half of the twentieth century, the mining industry in Britain was subject to recurrent disputes about the risk to miners' lungs from coal dust, moderated by governmental, industrial, medical and mining bodies. In this environment, precise measurements offered a way to present uncontested objective knowledge. By accessing primary source material from the National Archives, the South Wales Miners Library and the University of Bristol's Special Collections, I demonstrate the importance that the British Medical Research Council (MRC) attached to standardized instrumental measures as proof of objectivity, and explore the conflict between objective and subjective measures of health. Examination of the MRC's use of spirometry in their investigation of pneumoconiosis (miner's lung) from 1936 to 1945 will shed light on this conflict and illuminate the politics inherent in attempts to quantify disability and categorize standards of health.

### Introduction

I have not breath enough to blow a candle out.<sup>1</sup>

Letter to Somerset Miner's Association, 1923

The British Medical Research Council (MRC) used spirometry in their investigation to numerically code breathlessness, which enabled them to scale, standardize and adjudicate levels of respiratory disability. Spirometry was a physiological test designed, first, to measure the volume of air that an individual could exhale, and second, to express this as a number indicating individual 'vital capacity'. Although these tests soon developed to account for residual air in the lungs and now include a timed component, in its initial iteration the spirometer simply measured lung volume through exhalatory ability to displace a volume of water measured in litres. This became known as a person's 'vital capacity'. John Hutchinson (1811–1861) coined the term 'spirometer' and defined vital capacity as 'the *volume* of air that a man can force out of his chest'.<sup>2</sup> The word 'spirometer' literally translates as 'breath measurer'. However, this translation greatly simplifies the working of this instrument, which only estimates lung capacity as 'vital capacity'.

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<sup>1</sup>Edgar King to Fred Swift, 20 November 1923, Somerset Miners' Association, Bristol University Library Special Collections (henceforth SMA), DM 443, Box 6.

<sup>2</sup>John Hutchinson, *Contributions to Vital Statistics, Obtained by Means of a Pneumatic Apparatus for Valuing the Respiratory Power with Relation to Health*, London: Statistical Society of London, 1844, p. 2, emphasis in original.

Breathlessness offers distinct challenges for those attempting to measure it. The experience of it is impacted by both the mind and the body and it cannot be consistently linked to discrete phases of illness.<sup>3</sup> This has been a key focus of the Life of Breath Project, which has identified that objective measurements have been assumed to correlate with the lived experience of breathlessness, with the result that ‘breathlessness has for the most part been subsumed by objective measurements’.<sup>4</sup> This research reflects the increasing awareness of the disconnect between the subjective individuality of multidimensional breathlessness and attempts to mark out numerical correlation.<sup>5</sup> In this article I argue that the history of the measurement of breathlessness sheds light on the recurring disjunct between objective and subjective measures. Philosophers Williams and Carel have shown that the privileging of the physiological symptoms of breathlessness relates to attempts to define breathlessness in a strictly medical paradigm which fails to account for the lived experience of the patient.<sup>6</sup> This article builds on their insight by exploring how the drive to translate breathlessness into quantifiable, scalable measures has been influenced by complex historical interactions between medical expertise, industrial interests and compensation schemes. The administrative processes involved in arbitrating compensation for lung disease necessitated defining strict levels of illness, which could ideally be expressed numerically.

As historian Graeme Gooday has elucidated in the context of nineteenth-century electrical technologies, precision measurement instruments often used easily measurable surrogate parameters for what they sought to understand.<sup>7</sup> Such an artificial process may be problematic when extended into the arena of healthcare because of surrogate parameters’ potential for manipulation. In the case of spirometry, the surrogate measurement of ‘vital capacity’ was developed. This was a convenient proxy measurement of lung function and the MRC’s interwar efforts to develop it were permeated by tension and disconnect between subjective reports of breathlessness such as the one in the epigraph above, and the objective measurements provided by spirometers. That miners themselves had situated, ‘lay’ knowledge about the danger the air posed to their bodies has been convincingly demonstrated.<sup>8</sup> This paper complements such research by exploring the Medical Research Council’s efforts in South Wales between 1936 and 1945 to create corresponding objective measurements.

<sup>3</sup>See Sara Booth, Chloe Chin and Anne Spathis, ‘The brain and breathlessness: understanding and disseminating a palliative care approach’, *Palliative Medicine* (2015) 29(5), pp. 396–398; and Anna Spathis, Sara Booth, Catherine Moffat, Rhys Hurst, Richella Ryan, Chloe Chin and Julie Burkin, ‘The breathing, thinking, functioning clinical model: a proposal to facilitate evidence-based breathlessness management in chronic respiratory illness’, *NPJ Primary Care Respiratory Medicine* (2017) 27, pp. 1–6.

<sup>4</sup>Havi Carel, Jane Macnaughton and James Dodd, ‘Invisible suffering: breathlessness in and beyond the clinic’, *The Lancet* (2015) 3, pp. 278–279, 278.

<sup>5</sup>See [www.lifeofbreath.org](http://www.lifeofbreath.org); and Jane Macnaughton and Havi Carel, ‘Breathing and breathlessness in clinic and culture: using critical medical humanities to bridge an epistemic gap’, in Sarah Atkinson, Angela Woods, Anne Whitehead and Jennifer Richards (eds.), *The Edinburgh Companion to the Critical Medical Humanities*, Edinburgh: Edinburgh University Press, 2016, pp. 294–309.

<sup>6</sup>Tina Williams and Havi Carel, ‘Breathlessness: from bodily symptom to existential experience’, in Kevin Aho (ed.), *Existential Medicine: Essays on Health and Illness*, London: Rowman & Littlefield, 2018, pp. 145–254.

<sup>7</sup>Direct measurements of physiology can only pertain to height or weight. For other measurements surrogate parameters must be used; that is, measuring something by measuring something else. See Graeme Gooday, *The Morals of Measurement: Accuracy, Irony, and Trust in Late Victorian Electrical Practice*, Cambridge, Cambridge University Press, 2004.

<sup>8</sup>Michael Bloor, ‘The South Wales Miners Federation, miners’ lung and the instrumental use of expertise, 1900–1950’, *Social Studies of Science* (2000) 30(1), pp. 125–140; Joseph Melling, ‘Beyond a shadow of a doubt? Experts, lay knowledge, and the role of radiography in the diagnosis of silicosis in Britain, c.1919–1945’, *Bulletin of the History of Medicine* (2010) 84, pp. 424–426.

In what follows, I will discuss respiratory disease specifically in relation to its effect on disability with full awareness that, as historian Beth Linker has put it, ‘disability cannot (and should not) be reduced to disease’.<sup>9</sup> Yet historians of medicine focusing on disease have rarely highlighted the disabling effects of disease on people’s lives, even within more recent scholarship prioritizing recovery of the patient voice. Similarly, philosophers of medicine have tended to consider disability alongside disease, using ‘disease’ as an umbrella term under which disability falls.<sup>10</sup> Although taking this position allows for useful conceptual work on the metaphysics of disease, such a position has been critiqued by scholars of disability, who argue that disability is different from disease, not least through demonstrating that disability is not necessarily ‘a bad thing’.<sup>11</sup> Considering the historical evolution of disability classification can illuminate these sometimes arbitrary instrumental categorizations of health and illness. I argue that measurement technologies were a crucial component of the drive to quantify bodily norms and grade sensorial symptoms and are thus an important area for the historical investigation of disability.

In the cases analysed below, I focus on respiratory disability in relation to function, as I discuss how spirometer tests were used to mark the presence of respiratory disease which could not be made visible through X-rays. Thus my focus is on the historical attempts to correlate subjective reports of breathlessness to an objective quantifiable measurement as a way to adjudicate, scale and compensate respiratory disability. By examining the history of measuring lung function in British miners from 1936 to 1945, we can see that the threshold for normal lung function was taken from a baseline measurement of miners in the same colliery, rather than a normal comparison group. That is, healthy lung capacity, for the purpose of assessing respiratory disability, was what was normal for miners. In what follows, I will undertake a brief history of spirometric standards and group categories, explore the difficulty of diagnosing and compensating for respiratory disability in miners, then finally analyse the Medical Research Council’s attempt to create such a diagnostic framework.

## A natural history of spirometry

The invention of a measurement proxy for lung capacity – that is, vital capacity – can be contextualized as part of a wider scientific programme to statistically analyse the norms of human bodies through instrument-based measurements. Scholars have traced the start of both large-scale statistical studies and anthropometric measurements to the late nineteenth century, in which statistics about the human body gained authority in an increasingly eugenic framework.<sup>12</sup> Within this framework, the concept of disability emerged to categorize aberration from the norm.<sup>13</sup> Categorization was a crucial force in promoting the

<sup>9</sup>Beth Linker, ‘On the borderland of medical and disability history: a survey of the fields’, *Bulletin of the History of Medicine* (2013) 87(4), pp. 499–535, 499.

<sup>10</sup>Havi Carel and Rachel Cooper, *Health, Illness and Disease: Philosophical Essays*, Durham: Acumen Publishing, 2013, p. 10.

<sup>11</sup>See Elizabeth Barnes, *The Minority Body*, Oxford: Oxford University Press, 2016; Elselijn Kingma, ‘Health and disease: social constructivism as a combination of naturalism and normativism’, in Carel and Cooper, op. cit. (10), pp. 37–56.

<sup>12</sup>Michel Foucault, *The History of Sexuality*, vol. 1, London: Penguin Books, 1976, p. 139; Ian Hacking, ‘Biopower and the avalanche of printed numbers’, *Humanities in Society* (1982) 5, pp. 279–295; Lennard J. Davis, *The End of Normal: Identity in a Biocultural Era*, Ann Arbor: University of Michigan Press, 2013.

<sup>13</sup>Lennard J. Davis, *Enforcing Normalcy: Disability, Deafness, and the Body*, New York: Verso, 1995.

definition and standardization of disability. As sociologist Matthew Kohrman explains, the rise of statistics prompted both a greater awareness and a standardization of disability.<sup>14</sup>

Vital capacity gained medical credence in this statistical milieu primarily through the effort of John Hutchinson and his 1842 spirometer. Spirometers' accurate ability to predict premature mortality led Hutchinson to suggest that they should be used in actuarial prediction for life insurance policies.<sup>15</sup> Similar devices, known as pulmometers, had been used previously in clinical investigations, for example by Charles Turner Thackrah (1795–1833) in his 1832 study of the industrial workers of Leeds.<sup>16</sup> However, Hutchinson is regarded as the inventor of vital capacity because he found that with every inch of height vital capacity increased by eight cubic inches.<sup>17</sup> He arrived at this conclusion after using the spirometer to collect data from over four thousand test subjects, categorized by variables including occupation and class. He divided his subjects into types, including paupers, sailors, firemen, grenadier guards, mixed classes, diseased cases, gentlemen and pugilists.<sup>18</sup> Hutchinson then created correspondent tables showing what the ideal vital capacity ought to be for height. The spirometer thus presented vital capacity as lung capacity. As medical historian Lundy Braun argues, 'with the help of this new, refined instrument, "lung capacity" became a discrete entity that could be measured, quantified, and ranked'.<sup>19</sup>

However, attempts to accurately measure and scale breathing through the spirometer were complicated by the need to first define the measure for normal breathing – there can be no abnormal without an initial definition for the normal. Recurring questions over whether the parameters of normal breathing were universal or varied between groups marked all such attempts: normal breathing for whom? The classification and categorization of relevant group varieties perpetuated scientific acceptance of difference between these groups, and the notion that these groups constituted distinct natural kinds.<sup>20</sup> This has been illuminated by Braun, who has identified that the practice of correcting for race in spirometry promoted scientific acceptance of difference between racial groups, without due concern for the racial categories employed to organize these data in the first place, or for the ways in which social conditions and living conditions affect lung function.<sup>21</sup> The classification of entities such as race, sex, disease and disability is highly controversial, and important, as in the process of being constructed they are often fashioned as natural divisions. As scholars such as Bowker and Star have attested, this is not so much a reflection of reality as a shaping of reality.<sup>22</sup> Yet the objectivity and trust that we associate with numbers mean that their related classification

<sup>14</sup>Matthew Kohrman, 'Why am I not disabled? Making state subjects, making statistics in post-Mao China', *Medical Anthropology Quarterly* (2003) 17(1), pp. 5–24.

<sup>15</sup>Hutchinson had previously worked for life insurance companies.

<sup>16</sup>Jack Pepys and Leonard Bernstein, 'Historical aspects of occupational asthma', in Leonard Bernstein, Moira Chan-Yeung and Jean-Luc Malo (eds.), *Asthma in the Workplace*, New York: Marcel Dekker, Inc. 1999, pp. 9–35.

<sup>17</sup>Hutchinson, op. cit. (2).

<sup>18</sup>Hutchinson, op. cit. (2), p. 2.

<sup>19</sup>Lundy Braun, *Breathing Race into the Machine: The Surprising Career of the Spirometer from Plantation to Genetics*, Minneapolis: University of Minnesota Press, 2014, p. 8.

<sup>20</sup>To say that a kind is natural is to say that it corresponds to a grouping that reflects the natural world rather than the interests of humans. This is a complex debate within philosophy that this article does not have scope to explore, but it is worth noting that we think classifications in science should (if successful) correspond to nature, and there is much debate about whether things like races, sexes and diseases are natural or social kinds.

<sup>21</sup>Braun, op. cit. (19).

<sup>22</sup>Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences*, Cambridge, MA: MIT Press, 1999.

schema become invisible as their categories are replicated as though they are inevitable and natural – a process that philosopher Ian Hacking has described as ‘kind making’.<sup>23</sup> The attempt to standardize the parameters of normal breathing has been complicated by the drive to categorize the social groups that should represent the standard of normal breathing for that particular group.

Hutchinson’s ideal vital capacity tables represented the standard data sets for assessing normal lung function until the First World War, when Georges Dreyer asserted in 1919 that lung capacity standards for pilots needed to be more strictly measured.<sup>24</sup> Vital capacity offered a quick and easy way to assess physical fitness and so was used routinely in the examination of candidates for the Royal Flying Corps, with the results leading to either rejection or acceptance based on an arbitrary minimum standard. Men with superior respiratory capabilities were sought out for their capacity to withstand the atmosphere of the open cockpits.<sup>25</sup> Dreyer argued that Hutchinson’s results did not give enough credence to the impact of weight on lung capacity and he created new data tables.<sup>26</sup> In collaboration with the MRC he published *The Assessment of Physical Fitness by Correlation of Vital Capacity and Certain Measurements of the Body* in 1920 and dedicated the book to John Hutchinson. This was a large volume, comprising primarily hundreds of tables indicating the normal ranges for weight and height, and their correlation with vital capacity. It was clearly created as part of an effort to improve national fitness, with the military particularly in mind.

Dreyer was thus concerned more with improving fitness than with defining illness and he started the book with the assertion that the First World War had made physical fitness an issue of national importance. Moreover, he prophesied that ‘it is only when the meaning of “the normal” with respect to these measurements is understood, and when the limits of the normal have been properly defined, that it will be possible to study with any prospect of accuracy or success the deviations from the normal’.<sup>27</sup> Dreyer categorized his results by grouping people into three classes – A, B and C – which represented the conditions of perfect, medium and poor physical fitness. These groupings corresponded closely with social class, with boys in public school placed in class A against children in upper-class schools who were categorized as class B. However, social class could be offset by certain occupational training, and so army and navy personnel and blacksmiths were placed in class A while upper-class clerks remained in class B. Using this system, the person being measured would first be placed into their appropriate division, and then their vital capacity percentage ascertained for their group.<sup>28</sup> This allowed for the comparison of the relevant reference groups: age, sex, class and occupation.<sup>29</sup> If the person was found to have

<sup>23</sup>For comparative arguments about the objectivity and power of numbers in biopolitics see Theodore Porter, ‘Focus article: measurement, objectivity, and trust’, *Measurement: Interdisciplinary Research and Perspectives* (2003) 1(4), pp. 241–255; Hacking, op. cit. (12).

<sup>24</sup>Georges Dreyer, ‘The normal vital capacity in man and its relation to the size of the body’, *The Lancet* (1919) 194, pp. 227–234.

<sup>25</sup>David Smith and Sally Horrocks, ‘Defining perfect and not-so-perfect bodies: the rise and fall of the “Dreyer method” for the assessment of physique and fitness, 1918–26’, in Jeffrey Sobal and Donna Maurer (eds.) *Weighty Issues: Fatness and Thinness as Social Problems*, London: Routledge, 1999, pp. 74–94.

<sup>26</sup>Dreyer, op. cit. (24), p. 227.

<sup>27</sup>Georges Dreyer, *The Assessment of Physical Fitness: By Correlation of Vital Capacity and Certain Measurements of the Body*, London: Cassell and Company, 1920, p. 3.

<sup>28</sup>Dreyer, op. cit. (27), pp. 17–18.

<sup>29</sup>Smith and Horrocks, op. cit. (25), p. 78.

as much as 10 per cent less vital capacity than is normal for his class, it is probable that he is suffering from some health-depressing condition, and if he is as much as 15 per cent below the normal limit it is practically certain that he is abnormal in this respect.<sup>30</sup>

As Smith and Horrocks have argued, Dreyer's standardized method for classifying individuals' health was particularly appealing to the Medical Research Council because of its emphasis on standardized laboratory medicine, and its lack of reliance on a clinician's subjective opinion.<sup>31</sup>

In 1920, Wing Commander Martin Flack argued that the vital-capacity value could not adequately describe what was normal for any one individual and proposed the addition of a breath-holding test, which he believed could assess psychological fortitude as well as giving evidence of the healthy lungs needed for flying.<sup>32</sup> It is likely that this psychological addition was designed to identify applicants at risk of developing shell shock, which was of increasing public concern at that time, as well as working to mitigate the fear of malingering. The potential for malingerers to abuse the spirometry test by failing to cooperate was noted as a key concern in many studies using spirometry during this period.<sup>33</sup> Moreover, miners who complained of breathlessness were often dismissed as malingerers, or their respiratory trouble was diagnosed as being of psychological origin.<sup>34</sup>

By the 1920s, Dreyer's standards had been largely discredited.<sup>35</sup> In 1932, Dr Alan Moncrieff asserted that a more straightforward means of assessment was needed and pointed out (quite correctly) that the literature was strewn with disregarded methods and standards. Although he described breathlessness as 'essentially a subjective phenomenon', he felt that quantitative measures were necessary for evaluating the success of cardiovascular surgery and silicosis disability: 'The advantage of such methods is that they provide a numerical statement of the degree of respiratory efficiency or failure, but the grave disadvantage is present for all of them that normal figures may provide a too rigid standard, and wide deviation may be possible in health'.<sup>36</sup> New tests were needed.

This was especially urgent because of the increasing concern that mining workers were suffering from respiratory disability due to their exposure to coal dust. However, medical classifications, healthcare assessments and disability categorizations were connected and complicated by concerns regarding compensation. Attempts to reduce this complexity by the bureaucracies concerned with compensation were marked by attempts to use standardized objective measurements of disability. For example, the first comprehensive classification of disability in Britain was designed by the Ministry of Pensions in 1917 to provide pensions

<sup>30</sup>Dreyer, op. cit. (27), p. 18.

<sup>31</sup>Smith and Horrocks, op. cit. (25), p. 78.

<sup>32</sup>Martin Flack, 'The Milroy Lectures on Respiratory Efficiency in Relation to Health and Disease', *The Lancet* (1924), 198, pp. 693–696.

<sup>33</sup>For example, see Edward Aslett, Phillip D'Arcy Hart and John McMichael, 'The lung volume and its subdivisions in normal males', *Proceedings of the Royal Society of London, Series B, Biological Sciences* (1939) 126(845), pp. 502–528, 506.

<sup>34</sup>Barbara Ellen Smith, 'Black lung: the social production of disease', *International Journal of Health Services* (1981) 11(3), pp. 343–342, 346.

<sup>35</sup>Smith and Horrocks, op. cit. (25), p. 75.

<sup>36</sup>Alan Moncrieff, 'Tests for respiratory efficiency', *The Lancet* (1932) 220, pp. 665–669, 665–666.

for the soldiers returning from the First World War with injuries.<sup>37</sup> Compensation was provided in percentage degrees and this scaling was largely based on the visibility of the injury, a quality which historian Julie Anderson describes as critical to ‘the hierarchy of disablement’.<sup>38</sup> She relates this concept to how disability pensions were scaled and calculated in accordance with the perceived usefulness of the disabled body for work.<sup>39</sup> For example, despite some contemporary protest, deafened ex-servicemen were awarded not quite half of the full pension amount accorded to servicemen who had been blinded, based on the greater ability of the deafened man to work.<sup>40</sup> Similarly, historian Heather Perry has demonstrated that in Germany during the First World War, prosthetics were designed to replace the functionality rather than the form of the missing limb.<sup>41</sup> Prosthetic arms were designed not to mimic the look and use of the lost limb, but to make the arm as useful and efficient as possible in the relevant work sphere.<sup>42</sup> Assessment for the compensation of disability has long been associated with the ability to work rather than the testimony of the patient, partly because this allowed for clear standards for compensation.

The ‘will to standardize’ in order to attain objectivity has been strong within the MRC and has been remarked upon by historians researching its standardization of audiometry, depression and Alzheimer’s assessment guidelines.<sup>43</sup> Far from being unproblematic and objective, the categorization of disease and disability in relation to statistics, standards and measurement thresholds is firmly embedded in a politico-social context. Indeed, the diverse national medical positions on the aetiology of silicosis have been shown to have been directly linked to the social insurance systems present in each different country.<sup>44</sup> Measurement instruments are crucial in promoting standards that allow for easy replication, and easy comparison across different disciplines and locations. Standards are especially powerful because they self-perpetuate and, as Timmermans and Berg have demonstrated, standards can function as political tools. They explain that ‘standards are inherently political because their construction and application transform the practices in which they become embedded’.<sup>45</sup> Historians of technology have long emphasized the fact that technical standards underwrite their own opacity and through doing so become increasingly invisible.<sup>46</sup> Standards create conformations of both instruments and people. Such

<sup>37</sup>Ministry of Pensions. HC Deb, 19 March 1917, vol. 91, cc1588–1694 (1602), at [http://hansard.millbanksystems.com/commons/1917/mar/19/ministry-of-pensions#S5CV0091P0\\_19170319\\_HOC\\_287](http://hansard.millbanksystems.com/commons/1917/mar/19/ministry-of-pensions#S5CV0091P0_19170319_HOC_287).

<sup>38</sup>Julie Anderson, *War, Disability and Rehabilitation in Britain*, Manchester: Manchester University Press, 2011, pp. 42–43.

<sup>39</sup>Anderson, op. cit. (38), p. 42.

<sup>40</sup>Coreen McGuire, ‘The “deaf subscriber” and the shaping of the British Post Office’s amplified telephones 1911–1939’, PhD thesis, University of Leeds, 2016, p. 48.

<sup>41</sup>Heather Perry, *Recycling the Disabled: Army, Medicine and Modernity in WWI Germany*, Manchester: University of Manchester Press, 2014, p. 11.

<sup>42</sup>Perry, op. cit. (41), p. 63.

<sup>43</sup>The phrase ‘will to standardize’ is Timmermans and Berg’s, and they use it in reference to the ‘gold standard’ in healthcare. See Stefan Timmermans and Marc Berg, *The Gold Standard: The Challenge of Evidence-Based Medicine and Standardization in Health Care*, Philadelphia: Temple University Press, 2003. For a discussion of the MRC’s standardized assessment of Alzheimer’s disease diagnosis see Daniel Wilson, ‘Calculable people? Standardising assessment guidelines for Alzheimer’s disease in 1980s Britain’, *Medical History* (2017) 61(4), pp. 500–525. For a discussion of the standardization of audiometric testing within the MRC see Jaipreet Virdi and Coreen McGuire, ‘Phyllis M. Tookey Kerridge and the science of audiometric standardization in Britain’, *BJHS* (2018) 51(1), pp. 123–146. Michael Worboys points out that the MRC invented a new ‘MRC scale’ instead of using the HRSD or Hamilton scale in their study of depression between 1964 and 1965, which supports the claim that the organization values standardized scales. See Michael Worboys, ‘The Hamilton rating scale for depression: the making of a “gold standard” and the unmaking of a chronic illness, 1960–1980’, *Chronic Illness* (2012) 9(3), pp. 202–219, 210.

<sup>44</sup>Thomas Cayet, Paul-Andre Rosental and Marie Thebaud-Sorger, ‘How international organisations compete: occupational safety and health at the ILO – a diplomacy of expertise’, *Journal of Modern European History* (2009) 7(2), pp. 174–196, 177.

<sup>45</sup>Timmermans and Berg, op. cit. (43), p. 22.

conformations have often been used to objectify and enforce group differences while at the same time perpetuating their invisibility.<sup>47</sup> These constructions are then reified as though they represent objective measurement. As J.C. Gilson and P. Hugh-Jones reflected in their Medical Research Council special report, ‘we must be able to measure breathlessness, either by attempting a quantitative estimate of the symptom ... or by arbitrarily selecting a particular physiological test as the best index and relating other test results to this standard’.<sup>48</sup> We need to question the extent to which measurements can tell us something ‘real or true’ about the human body in cases when easily quantifiable measurements are artificially privileged in this way.<sup>49</sup> The fight for recognition and compensation of ‘miner’s lung’ is a clear example of the way in which politics and objective standards can conflict with testimony.

## The Medical Research Council intervenes

Such testimony was provided in 1923 by a miner who wrote to the Somerset Miners’ Association’s agent to question the compensation available for his illness. He wrote,

Dear Sir, I am writing a few lines hoping you don’t mind as I guess you are pretty busy now with election, but I seen [*sic*] an announcement to the effect that all amendments regarding work-man’s compensation bill was passed. I should like for you to let me know if I am likely to get anything as every time I’ve wrote to the home secretary or the clergyman at my home wrote him, he’s always given me so little hope. I cannot see that I shall be doing any work for some months yet although I’m trying my best to get over it but I can’t get breath to walk very far and I don’t think this place is any good for this complaint. There’s an old man here got the same, but I don’t expect him to last very long as he’s no strength to battle against it.

The miner’s reference to the strength needed to fight the condition reflects the insights garnered by the Life of Breath Project principal investigators Carel and Macnaughton, who have explained that the psychological experience of breathlessness has an important effect on the personal perception of respiratory illness.<sup>50</sup> This assessment has been reinforced by recent neuroimaging studies which have identified how variable psychological workings affect the way people experience the bodily sensation of breathlessness.<sup>51</sup> The strength that the miner believes he has means that he feels he can battle his illness from a better position

<sup>46</sup>James Sumner and Graeme J.N. Gooday, ‘Introduction: does standardization make things standard?’, *History of Technology* (2008) 28, pp. 1–13. For example, a British person driving would not notice that the designs of cars, roads, roundabouts, signage and so forth are all embedded and constructed to conform with the arbitrary standard of agreed driving on the left, but these standards become very visible when attempting to drive in the US.

<sup>47</sup>Adele E. Clarke, Janet K. Shim, Laura Mamo, Jennifer Ruth Fosket and Jennifer R. Fishman, ‘Biomedicalization: technoscientific transformations of health, illness, and U.S. biomedicine’, *American Sociological Association* (2003) 68(2), pp. 161–194, 174.

<sup>48</sup>John C. Gilson and Phillip Hugh-Jones, *Lung Function in Coalworkers’ Pneumoconiosis*, Medical Research Council special report series no 290, London: Her Majesty’s Stationery Office, 1955, p. 132.

<sup>49</sup>For a comparative study which makes the point that easily quantified measurements have historically been prioritized in electricity see Graeme Gooday, *The Morals of Measurement: Accuracy, Irony, and Trust in Late Victorian Electrical Practice* Cambridge: Cambridge University Press, 2004.

<sup>50</sup>Macnaughton and Carel, op. cit. (5).

<sup>51</sup>Olivia K. Faull, Anja Hayen and Kyle T.S. Pattinson, ‘Breathlessness and the body: neuroimaging clues for the inferential leap’, *Cortex* (2017) 95, pp. 211–221.

than the older man. In the same letter he gives more details about the progressive nature of his disability:

I didn't know I was so bad before I started work so I had to finish. I've seen my Dr today and he said he was in Bath last night and Dr Thomson told I ought to have compensation for it as he said I was as good as done for ... it's a clear case. Seeing as I've seen the x rays and they don't tell lies any way.<sup>52</sup>

The miner's assertion that X-rays 'don't tell lies' not only demonstrates faith in the apparently objective physical image, but also pre-emptively responds to potential accusations of malingering that constantly dogged the miner's claims of ill health. As his illness progressed without compensation he kept writing, describing his symptoms on one occasion by saying, 'I have not breath enough to blow a candle out'.<sup>53</sup> The writer was not diagnosed as suffering from silicosis until 1929, and he collapsed and died in July 1930, at the age of forty-five.<sup>54</sup> Historian Joseph Melling has identified that his inquest was pivotal in motivating the subsequent legislative and scientific debates about pulmonary illness in the 1930s.<sup>55</sup>

Moreover, from the miner's letter we can see that the use of historically situated and highly specific metaphors supports the claim that a contextual understanding of breathlessness is vital.<sup>56</sup> Oxley and Macnaughton have demonstrated that the language we use to demonstrate breathlessness is highly variable, and subject to difference between cultures and contexts.<sup>57</sup> This is also true of the subjective and invisible experience of pain, which Joanna Bourke has recently examined through the metaphors that differ between times, genders, ethnicities and religion.<sup>58</sup> She explains that '[s]ocial environments and physiology map themselves strongly in the figurative language people employ to communicate their pain'.<sup>59</sup> While instrumentation is ideally designed to transcend such sociocultural contexts, the following section will demonstrate that the clinical investigation of respiratory disease in mining communities was impacted by the normalization of disability within these communities.

That pulmonary disease disproportionately affects mineworkers has been recognized from the early nineteenth century. However, by the end of that century, the orthodox medical position held that tuberculosis due to overcrowding was more likely to be the cause of miners' respiratory distress than the levels of dust.<sup>60</sup> Historian Michael Bloor has attributed the resultant shift in attention from dust in the air to germs in the air to developments in bacteriology.<sup>61</sup> Melling has added that subsequent commitment to this stance was partially fuelled by medics' reluctance to be associated with old-fashioned Victorian fears about coal dust.<sup>62</sup> Moreover, following the work of J.S. Haldane, there was some adherence to the

<sup>52</sup>Edgar King to Fred Swift, 20 November 1923, SMA, DM 443, Box 6.

<sup>53</sup>King to Swift, op. cit. (52).

<sup>54</sup>Melling, op. cit. (8).

<sup>55</sup>Melling, op. cit. (8), 427.

<sup>56</sup>Rebecca Oxley and Jane Macnaughton, 'Inspiring change: humanities and social science insights into the experience and management of breathlessness', *Current Opinion in Supportive & Palliative Care* (2017) 10(3), pp. 256–261, 257.

<sup>57</sup>Oxley and Macnaughton, op. cit. (56), p. 257.

<sup>58</sup>Joanna Bourke, *The Story of Pain: From Prayer to Painkillers*, Oxford: Oxford University Press, 2014, p. 84.

<sup>59</sup>Bourke, op. cit. (58), p. 87.

<sup>60</sup>Bloor, op. cit. (8), p. 129.

<sup>61</sup>Bloor, op. cit. (8), p. 129.

notion that coal dust functioned as a prophylactic. That is, coal dust was beneficial: ‘a little dust was good for you’.<sup>63</sup> Indeed, D.C. Davies, who worked in Ffaldau colliery in 1930, described inhalation of coal dust being used in Llandough Hospital in the late 1930s as a treatment for silicosis.<sup>64</sup> Notable amongst adherents to this view were the Home Office’s medical factory inspector Dr Edgar Collis and the 1927 medical inspector of mines Dr Sydney Fisher, both of whom have been identified by Perchard and Gildart as key ‘merchant[s] of doubt’.<sup>65</sup>

In what follows, I set out a brief outline of the legislative changes relating to coal mining which preceded the MRC investigation. These changes were variously resisted or advocated by a number of important bodies, including the coal owners (represented by the Mining Association of Great Britain), the South Wales Mining Federation and other trade unions, medical specialists, the Home Office, the Mines Department, the Medical Research Council and the labouring communities. Historians disagree about which of these bodies were responsible for the ‘stuttering’ advances in occupational legislation, although there is consensus that complex social, cultural, economic and political forces interrelated with the contested aetiology of miner’s lung.<sup>66</sup>

Compensation for industrial disease was first offered to industrial workers in 1906 through the UK Workmen’s Compensation Act, although its extension had been strongly resisted by coal owners.<sup>67</sup> This in turn followed a domestic government investigation into occupational disease, which resulted in diseases being added alongside injuries as eligible for compensation for the first time.<sup>68</sup> This was despite the fact, as Bufton and Melling have noted, that the Home Office remained adamant throughout the interwar years that the state would not provide any funding for industrial compensation.<sup>69</sup> Silicosis-specific compensation (for those exposed to silica dust) was introduced in 1918 but was only for quarrymen and workmen in other silica-based industries – it specifically excluded coal miners.<sup>70</sup> The situation for coal miners improved marginally in 1929 thanks to the Various Industries (Silicosis) Scheme of 1928, but this scheme had strict eligibility criteria and only cases of death or of total disability that precluded future work were compensated.<sup>71</sup> The reasons for this were largely due to the difficulty of assessing partial disability, and also of diagnosing silicosis or pneumoconiosis in its early stage as a disease distinct from

<sup>62</sup>Melling, op. cit. (8), 428.

<sup>63</sup>This expression is attributed to an address on ‘The effects of dust inhalation in mines’ that J.S. Haldane delivered to the South Wales Institute of Engineers in 1923 and is quoted in John E. Cotes, ‘The Medical Research Council Pneumoconiosis Research Unit, 1945–1985: a short history and tribute’, *History of Occupational Medicine* (2000) 50(6), pp. 440–449, 440. For a more thorough discussion of this remark in the context of the 1930 controversy about miners’ silicosis see Andrew Meiklejohn, ‘History of lung diseases of coal miners in Great Britain: Part 3, 1930–1952’, *British Journal of Industrial Medicine* (1952) 9, pp. 208–220, 211.

<sup>64</sup>Interview of D.C. Davies, 1930–1976 transcript reference no AUD 387, accessed at South Wales Miners Library (SWML), p. 2. The theory was that the irritation in the lungs would cause the men to spit up the silicosis dust.

<sup>65</sup>Andrew Perchard and Keith Gildart, “‘Buying brains and experts’”: British coal owners. Regulatory capture and miners’ health’, *Labor History* (2015) 56(4), pp. 459–480, 464.

<sup>66</sup>‘Stuttering’ is aptly used in Melling, op. cit. (8), p. 430.

<sup>67</sup>Perchard and Gildart, op. cit. (65), p. 462.

<sup>68</sup>Arthur McIvor, ‘Miners, silica and disability: the bi-national interplay between South Africa and the United Kingdom, c.1900–1930s’, *American Journal of Industrial Medicine* (2015) 5, pp. 523–530, 525.

<sup>69</sup>Mark Bufton and Joseph Melling, “‘A mere matter of rock’”: organised labour, scientific evidence and British government schemes for compensation of silicosis and pneumoconiosis among coalminers, 1926–1940’, *Medical History* (2005) 49, pp. 155–178, 157.

<sup>70</sup>Bloor, op. cit. (8), p. 129.

<sup>71</sup>See Bufton and Melling, op. cit. (69), p. 162; McIvor, op. cit. (68), p. 526.

tuberculosis.<sup>72</sup> For the medico-legal bureaucracies involved with miners' compensation, this meant that while the presence of illness was not disputed, the causation was highly contested.

In 1930 the Medical Research Council Committee on Industrial Pulmonary Disease was appointed, and in 1931 the Various Industries Scheme was extended to cover more workers and include partial disability.<sup>73</sup> This may have been precipitated by Britain's substantial involvement in the 1930 International Labour Office Conference on silicosis in Johannesburg. Although the global transfer of silicosis knowledge was important in the development of consensus on mining-disease aetiology, historian Arthur McIvor has argued that the conference policies were unsuccessful in practically improving the situation for disabled workers with respiratory disease in Britain.<sup>74</sup> These disabled workers had to obtain medical certificates from their own doctors before applying to the Medical Board, where their cases were usually presented by their trade union as the financial cost for individuals applying directly to the board was prohibitively high.<sup>75</sup> The introduction of partial disability posed new challenges to the medical community in their ability to accurately and convincingly assess its boundaries and Braun argues that this was due to 'the lack of correlation between the degree of tissue damage and the severity of breathlessness'.<sup>76</sup> Assessing breathlessness as a symptom of disability was especially difficult and presented further challenges because of the need to correlate reported breathlessness to X-ray images. For instance, the MRC noted that symptoms of respiratory disability manifesting as coughs and breathlessness generally ran in parallel with X-ray changes but often could not be connected to any clinical evidence.<sup>77</sup>

Notwithstanding the condition of their lungs, if miners could not prove that they had been exposed to silica dust from working on rock containing at least 50 per cent silica, then their case could be overturned. Bufton and Melling have argued that this resulted in the prioritization of geological expertise over clinical criteria.<sup>78</sup> This stipulation also reinforces the central claim of this paper, that socially useful numbers were crucial in negotiating the boundaries of contested disability and compensation. The subsequent lack of concordance between geological and pathological measures was reflected in the realization that 'the relationship between geological conditions and the onset of disease could not be precisely measured'.<sup>79</sup>

For example, in the seminal 1935 appeal case of *Wragg v. Samuel Fox & Co. Ltd (Sheffield)*, the county judge ruled,

<sup>72</sup>McIvor, op. cit. (68), p. 525.

<sup>73</sup>Braun, op. cit. (19), p. 143.

<sup>74</sup>McIvor, op. cit. (68), p. 528.

<sup>75</sup>The Silicosis Medical Board in Wales was based in Cardiff. See Dr Gwent Jones, draft report, 'A survey on silicosis in Wales' (1943), accessed at the Richard Burton Archives, Swansea University, reference no SWCC: MNC/PP/15/1, p. 19.

<sup>76</sup>Braun, op. cit. (19), p. 144.

<sup>77</sup>Report by the committee, Medical Research Council, special report series no 243, *Chronic Pulmonary Disease in South Wales Coalminers*, London: His Majesty's Stationery Office, 1942, introduction, p. ix, accessed at the National Archives, FD 41243 (not public record, status open), National Archives, FD 41243.

<sup>78</sup>Mark Bufton and Joseph Melling, 'Coming up for air: experts, employers, and workers in campaigns to compensate silicosis sufferers in Britain, 1918–1939', *Social History of Medicine* (2005) 18(1), pp. 63–86, 75.

<sup>79</sup>Bufton and Melling, op. cit. (69), p. 161.

I am satisfied that the applicant was constantly exposed to dust. For the last few years of his life the applicant experienced what he called 'tightness' and finally ceased work on April 19, 1935. He was examined by the medical board appointed for the purpose, and on June 21, 1935, was duly certified as suffering from silicosis and totally incapacitated. The commencement of the disablement was certified as April 19, 1935. After hearing Dr. Platt I was satisfied that the applicant was still totally incapacitated, further that the silicosis was due to the nature of his employment with the respondents, and that the disease could not have been contracted in any other way.<sup>80</sup>

Despite this seemingly damning testimony, when employers Samuel Fox & Co. appealed the decision, Lord Justice Greer took their side, because of the proviso in the Act which stated that the employer should not be liable if they could prove that the employee was not exposed to the silica rock.<sup>81</sup> The ability to do this rested on the applicant having the means to secure (expensive) expert testimony from geologists to back their claim and such support was sought by both the miners' unions and the coal owners.<sup>82</sup> The *Wragg v. Fox* case proved to be pivotal in delaying any practical implementation of the 1931 scheme and influenced miners' leaders in their lobbying for clear diagnostic criteria.<sup>83</sup> The Various Industries (Silicosis) Scheme was thus amended in 1934 to extend to miners working underground, but partial disability would only be granted if 'the nodular features of silica dust were detected on microscopy and X-ray'.<sup>84</sup>

Although both local doctors and miners were convinced of the existence of a disease due to coal dust, this belief did not correlate with diagnostic criteria for compensation.<sup>85</sup> Furthermore, there was increasingly concern that coal miners were suffering from respiratory disability that could not be traced to silica exposure.<sup>86</sup> In 1936 the chief medical officer of the Silicosis Medical Board asserted that the claims for compensation made by coal miners in South Wales were rising. Refusal rates were also increasing, with up to 52 per cent of certificates refused in 1935.<sup>87</sup>

## Normal breathing for miners

It was at this point in 1936 that the MRC was asked by the Home Office and the Mines Department to try and solve the problem of the disparity between visible tissue damage and subjective reports of illness. They were charged with investigating chronic pulmonary disease among coalminers, with a particular focus on the South Wales coalfields. The Medical Research Council had been funded by the government to instigate medical and biological research since 1911, and during the interwar years it was divided into numerous

<sup>80</sup>Report of court of appeal decision upholding employers appeal against compensation award', the National Archives, in Various Industries Scheme – Extension to Coal Mines 1934, pin. 12/72.

<sup>81</sup>Newspaper clipping, 'Appeals against compensation won. Employers' protection under silicosis scheme', the National Archives, in Various Industries Scheme – Extension to Coal Mines 1934, pin. 12/72.

<sup>82</sup>Buften and Melling, op. cit. (69), p. 164.

<sup>83</sup>Buften and Melling, op. cit. (69), p. 167.

<sup>84</sup>Braun, op. cit. (19), p. 143.

<sup>85</sup>MRC, op. cit. (77), p. vi.

<sup>86</sup>Phillip D'Arcy Hart, 'Chronic pulmonary disease in South Wales coal mines: an eye-witness account of the MRC surveys (1937–1942)', *Society for the Social History of Medicine* (1998) 11, pp. 459–468, 462.

<sup>87</sup>MRC, op. cit. (77), p. v.

subsections which were endowed with significant freedom in their organization and research.<sup>88</sup> The medical surveys undertaken from 1936 to 1942 were led by Dr Phillip D'Arcy Hart and Dr Edward Aslett, assisted by a large team of engineers, inspectors and pathologists.<sup>89</sup> Retrospectively, D'Arcy Hart attributed the government intervention to the rise of compensation costs, concern for the health of the miners and the fact that 'there was a war round the corner and they certainly did not want a dissatisfied coal-producing force'.<sup>90</sup>

The MRC selected an anthracite colliery for detailed investigation, and examined 560 of the men there, both radiologically and clinically.<sup>91</sup> The clinical tests involved included examination of the sputum, tuberculin tests and spirometric measurements of lung volume.<sup>92</sup> These lung volume determinations were supplemented by an exercise tolerance test, which categorized levels of 'respiratory embarrassment' into four possible subheadings.<sup>93</sup> These groupings were then further categorized as either normal (class A) or abnormal (further divided by severity into class B or C).<sup>94</sup> The degree of respiratory embarrassment was then measured against the medical history of the miner, which was provided by the mining inspector. The surveyors were satisfied that there was concordance between these two separately obtained measures of breathlessness.

The MRC created further standardized and standardizing measures in their classification of X-rays, dividing them into strictly defined categories: (a) normal, (b) reticulation, (c) nodulation, (d) coalescent nodulation, (e) massive shadows, (f) multiple fluffy shadows and (g-h) indefinite.<sup>95</sup> The identification of the category of reticulation was particularly important because it identified the early stage of disease which resulted in disability in older miners.<sup>96</sup> As Dr Gwent Jones (a GP working in Gower) explained in his 1943 report on silicosis, 'Reticulation describes the X-Ray appearance of the fibrosis as it is first seen – it looks like the first snow on a window'.<sup>97</sup> The MRC reports (published 1942–1945) were critical in that they proved that there was a link between length of exposure to coal dust and respiratory disability.<sup>98</sup> This meant that there was now widespread medical acceptance of a disease due to coal dust that was entirely distinct from silicosis. Thus finally, in 1943, a disease due to coal dust was both legally recognized and duly compensated.<sup>99</sup> The recognition of coalworkers' pneumoconiosis resulted in an exponential rise in certifications under the Act, which overwhelmed the bodies responsible for their administration – the miners' union and the Ministry of Fuel and Power.<sup>100</sup>

<sup>88</sup>Helen Valier and Carsten Timmermann, 'Clinical trials and the reorganization of medical research in post-Second World War Britain', *Medical History* (2008) 52, pp. 493–510.

<sup>89</sup>D'Arcy Hart, op. cit. (86), p. 462; see also MRC, op. cit. (77), which states that the medical survey was undertaken by D'Arcy Hart and Aslett with contributions from Hicks and Yates and that the pathological report was made by T.H. Belt with assistance from A.A. Ferris.

<sup>90</sup>D'Arcy Hart, op. cit. (86), p. 462.

<sup>91</sup>Preface to MRC, op. cit. (77).

<sup>92</sup>See MRC, op. cit. (77), Medical Survey, p. 35, and preface p. vii.

<sup>93</sup>The four categories were scaled from 'no, or only slight, respiratory embarrassment' to 'breathless at rest' and included intermediate points. MRC, op. cit. (77), p. 47.

<sup>94</sup>MRC, op. cit. (77), p. 47.

<sup>95</sup>It is worth noting that these categories are described as 'convenient' and there were some initial restrictions of this compensation. See 'Summary of Chapter 5' in MRC, op. cit. (77), introduction, p. v.

<sup>96</sup>Braun, op. cit. (19), p. 145.

<sup>97</sup>Jones, op. cit. (75), p. 12.

<sup>98</sup>Braun, op. cit. (19), p. 145.

<sup>99</sup>Bloor, op. cit. (8).

Calculations of partial disability levels were based primarily on assessing the functionality of the body in relation to continuing work: could the miner be disabled if he was still working? The Medical Research Council assessed the changes that X-ray investigation revealed in the miners' bodies and concluded in its report that 'the X-ray changes might be compatible at first with ability to work, but they were considered to represent a definite impairment of lung structure and to involve an increasing respiratory disability, manifested, for example, by shortness of breath'.<sup>101</sup> The MRC pondered the seriousness of this disability amongst the working population in its report and questioned whether hidden pulmonary abnormalities 'among *men still at work*' were of any consequence.<sup>102</sup> However, Dr Gwent Jones argued, 'If the sufferer was only partially incapacitated and obtains a certificate for partial compensation, he is to the labour market only a part of a man, and being unskilled in any other trade he cannot compete with fit men in new occupations'.<sup>103</sup>

Such disputes regarding the potential for the disabled man to work permeated the Medical Research Council's investigations. As disability historians Turner and Blackie have recently explored, this kind of attitude reflected the reality for coal miners in the Victorian period, who would often continue to work while disabled.<sup>104</sup> Jones's criticism of the compensation system highlighted that many men continued to work after certification, 'whether he is a caretaker, or a part-time gardener, or just nothing, the "partial" is fortunate compared to the "full" who may be too short of breath to even lace his own boots'.<sup>105</sup> Evaluating the relationship between work and disability was crucial to the new process of assessing disability and loss of function in the medico-legal field. Adjudicating disability was complex and involved new sets of standardized classifications for what changes constituted disability in relation to respiratory disease.<sup>106</sup> Melling has confirmed that it was very difficult firmly to arrive at any kind of diagnosis using X-ray examination at this time: professional scepticism abounded, and techniques and interpretations were not standardized until nearer 1950.<sup>107</sup> In this politically loaded context, in which new X-ray technology could not be fully trusted, the spirometer represented secure evidence of respiratory disease in numerical terms which could be utilized in the complex compensation network. As Braun has demonstrated, the spirometer offered 'an objective marker of disability to industrial medicine'.<sup>108</sup>

However, using spirometry to diagnose pneumoconiosis necessitated a definition of normal with which to make the comparison. Gilson and Hugh-Jones explained in their MRC report of lung function in coalworkers' pneumoconiosis, 'The assessment of the effect of silicosis or pneumoconiosis on lung function implies a definition of normal with which to make the comparison. This is far more difficult than the scant reference [*sic*] in the literature would suggest'.<sup>109</sup>

<sup>100</sup>Braun, op. cit. (19), p. 146.

<sup>101</sup>MRC, op. cit. (77), p. 143.

<sup>102</sup>MRC, op. cit. (77), Medical Survey (ii), incidence of X-ray changes in different mining occupations, p. 168, original emphasis.

<sup>103</sup>Jones, op. cit. (75), p. 17.

<sup>104</sup>David Turner and Daniel Blackie, *Disability in the Industrial Revolution: Physical Impairment in British Coalmining, 1780–1880*, Manchester: Manchester University Press, 2018.

<sup>105</sup>Jones, op. cit. (75), p. 17.

<sup>106</sup>Braun, op. cit. (19), p. 144.

<sup>107</sup>Melling, op. cit. (8), pp. 446–448.

<sup>108</sup>Braun, op. cit. (19), p. 143.

The MRC's original clinical investigation used normal lung function values separately determined by Aslett, D'Arcy Hart and McMichael. However, the normal adult male subjects used as controls for these determinations were in fact taken from sixty-four members of 'the normal members of the working population of an anthracite colliery in Carmarthenshire, the great majority being of Welsh parentage'.<sup>110</sup> The data sets used a normal standard set by apparently healthy miners rather than a non-mining control group. This would not have necessarily mattered if the investigation involved a longitudinal study – investigating the changing health of the same miners over a number of years. However, part of the point of this investigation was to work out if the environment was causing pulmonary disease and so used a cross-sectional method which compared the health of miners in different geographical areas (see Figure 1).

Only one mine was subjected to a full clinical investigation and the spirometry test here was clearly flawed, as it took its measure of normality from the very population in which abnormality was already apparent. This analysis is supported by Smith's study of 'black lung' in West Virginia, which has demonstrated that pathology in coal miners was considered normal for coal miners and that patient testimony as to their own condition was considered secondary to diagnosis. 'What was "normal" for miners, including even a chronic respiratory condition, was by no means normal for the company doctor ... to the extent that [if] their X-rays revealed the pathological changes now associated with coal workers' pneumoconiosis, these too were considered normal – for coal miners'.<sup>111</sup> Indeed, the reluctance to attribute diminished lung capacity to the effect of mining work was to continue. For example, in their 1955 report for the Medical Research Council, Gilson and Hugh-Jones compared D'Arcy Hart and Aslett's use of working miners as controls to a later (1950) study that used men who had never worked in dusty conditions as controls. The 1950 study 'found a big difference in the maximum breathing capacity compared with men applying for compensation who had no evidence of silicosis on the radiography'.<sup>112</sup> That is, men who had never worked in dusty conditions had greater lung capacity than those who had worked in dusty conditions, even though these men would not have been diagnosed with any respiratory disease. This difference was largely attributed to the constitutions of the men involved rather than their working conditions. Gilson and Hugh-Jones explained, 'They concluded that the difference was psychogenic but it is possible that it was partly due to the effect of mining'.<sup>113</sup>

Thus, if causation from dust or disease could not be established, then it followed that the problem must be related to the essential constitution of the miner. Similarly, attempts to clarify normal reference values were marked by attempts to explain variability in lung function through racial and ethnic difference.<sup>114</sup> The MRC's original investigation reported considerations of whether or not the Welsh were actually a separate racial group, and if so, whether that could account for their abnormalities in stature and high levels of lung disease,

<sup>109</sup>Gilson and Hugh-Jones, *op. cit.* (48), p. 27.

<sup>110</sup>Aslett, D'Arcy Hart and McMichael, *op. cit.* (33), p. 504.

<sup>111</sup>Smith, *op. cit.* (34), pp. 347–348.

<sup>112</sup>Gilson and Hugh-Jones, *op. cit.* (48), p. 27.

<sup>113</sup>Gilson and Hugh-Jones, *op. cit.* (48), p. 27.

<sup>114</sup>Braun, *op. cit.* (19), p. 160.

writing, ‘It is relevant here to mention the suggestion that the high incidence of pneumoconiosis in western Wales is associated in part with the racial composition of its inhabitants.’<sup>115</sup> This idea was rejected not because of environmental considerations but because a number of men at the colliery they examined had English parentage. Thus we see that innate biological causes and potential ethnic differences were sought in order to supersede social or environmental factors. Similarly, in the lung volume determinations compiled by Aslett, D’Arcy Hart and McMichael, there was consideration of the fact that the vital-capacity mean was lower in the normal subjects taken from the mines than it was in ‘previous series of normal males’ but that this difference was attributed to the smaller height and weight of the miners, ‘probably due to the Welsh racial characteristics’.<sup>116</sup>

Attributing variability in lung function to racial difference was eventually enshrined in spirometric measurements by the MRC Pneumoconiosis Research Unit in South Wales – through the PRU’s standards for ‘Average Normal Values for the Forced Expiratory Volume in White Caucasian Males’.<sup>117</sup> By 1974, the MRC had refined their measurements to allow them to ‘correct’ for racial difference using a scaling or correction factor of 13 per cent. This reinforced the idea that white lung function was normal lung function and, as Braun has established, this had far-reaching effects both in the compensation system and in the promotion of the thesis that inequality between the races was biological rather than environmental.<sup>118</sup>

## Conclusion

Objective knowledge, as has been discussed in this article, is often sought through the use of instrumentation, such as spirometers. In instrument-based science, objectivity is concerned with the elimination of subjectivity and bias. For Porter, scientific objectivity is associated with impersonalism – specifically, with the obliteration of subjective judgement.<sup>119</sup> This ‘mechanical objectivity’, as Daston and Gallison have termed it, is associated with a strong trust in mechanisms, numbers and measurement instruments.<sup>120</sup> However, ‘in objectification, the failure to recognize the structures that give rise to the regularities leads us to attribute the regularities to something intrinsic to the agents’.<sup>121</sup> That is, rather than seeking causes in the environment, the pathology seen in the coal miners was understood as part of their essential constitution.

Moreover, the burden of proof falls particularly hard on those whose disability is invisible or stigmatized and for whom objective authority is especially necessary. To make the invisible visible and eligible for compensation, instrumentation is used. Yet these tools can be flawed, as we have seen in the case of miners trying to obtain compensation for respiratory disability in the pre-NHS era. Their claims of breathlessness could be dismissed by the superior

<sup>115</sup>MRC, op. cit. (77), p. 111.

<sup>116</sup>Aslett, D’Arcy Hart and McMichael, op. cit. (33), p. 505.

<sup>117</sup>Braun, op. cit. (19), p. 162.

<sup>118</sup>Braun, op. cit. (19), pp. 160, 164.

<sup>119</sup>Porter, op. cit. (23).

<sup>120</sup>Lorraine J. Daston and Peter Gallison, *Objectivity*, New York: Zone Books, 2007, p. 34.

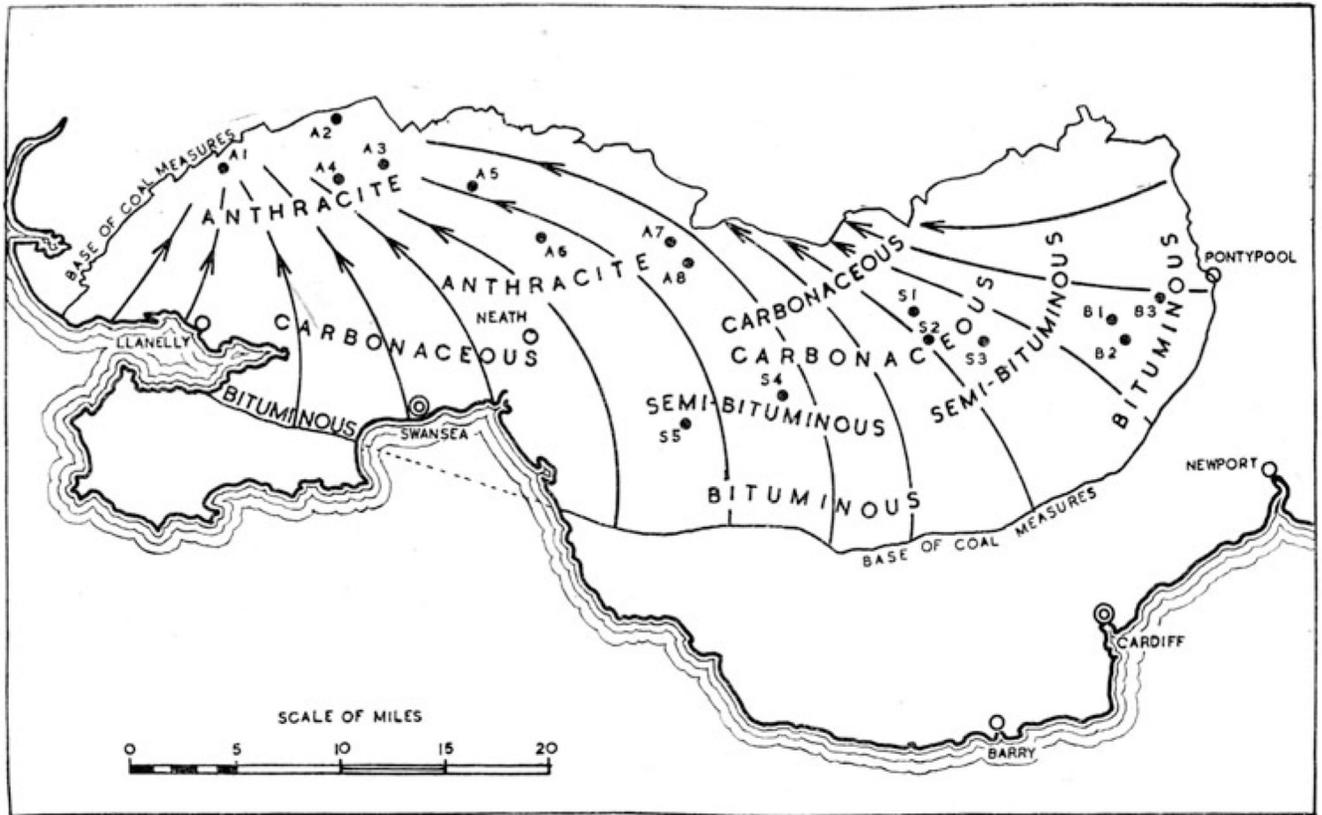
<sup>121</sup>Sally Haslanger, ‘Epistemic objectification and oppression’, in Ian James Kidd, Jose Medina and Gaile Pohlhaus Jr (eds.), *The Routledge Handbook of Epistemic Injustice*, Oxford: Routledge, 2017, pp. 279–290, 284.

objective evidence of X-rays and spirometric measurements – although the normal baseline for spirometric data had been configured not against healthy controls, but against the miners themselves.

As well as making an epistemological argument about how health experience is affected by measurement technologies, this article has also highlighted how such technology interacts with welfare provision. The MRC's medical surveys of the South Wales collieries represent a key conflict between standardization and individuals' personal experience of health. The compensation schemes that developed to manage respiratory illness in miners were reliant on scientific evidence that could be trusted by the various bureaucracies involved in their regulation. There was huge pressure on medical experts to develop objective tests of respiratory disability from the Home Office, the Miners' Federation and, of course, the campaigning trade unions. In this context, the spirometer was used by the MRC to negotiate the disputed symptoms of disease and present standardized classifications. The quantification of the body has thus resulted in the privileging of mechanical authority over subjective experience for explicitly political ends. The process of encoding biostatistics (such as breathing capabilities) into machines has been used to create standards of normality for particular groups of people. Through this process, as machines like the spirometer are held up as objective devices, the classifications used in creating these standards become invisible and remanifest as natural divisions. The normative standards embodied in standardized instrumentation are often invisible to both the measurers and the measured.

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**Figure 1.**

Map of the South Wales coalfield marking the positions of the sixteen collieries of the inquiry. Medical Research Council, special report series no 243, *Chronic Pulmonary Disease in South Wales Coalminers*, London: His Majesty's Stationery Office, 1942, accessed at the National Archives, FD 41243, p. 11.