Normal breathing for whom?

During one of the Life of Breath project research meetings in 2018, consultant Dr Sara Booth recounted the story of a school teacher who felt such pressure to consistently hold her stomach in when standing in front of the class that her subsequent propensity to breathe costally (from her chest) impacted on her ability to breathe in fully – with the result that her respiratory problems were exacerbated. As I sat listening to Dr Booth talk, I wondered: how much does such lived experience of being a woman in the world impact on the ability to fill our lungs? Are we not taking our fair share of air? I argue here that we must also consider how life experiences might impact on respiration.

The way that we experience breathlessness is moderated by both the mind and the body. Furthermore, levels of breathlessness cannot be consistently linked to discrete phases of illness. Yet attempts to capture this experience with objective measures such as those offered by spirometry have obscured this multi-dimensional quality. As a result, the measurement of breathlessness in a strictly medical paradigm has privileged the physiological symptoms of breathlessness in a way that fails to account for the lived experience of the patient. Increasingly, researchers have demonstrated disconnect between the subjective individuality of breathlessness and its numerical correlation. In this chapter I argue that considering the history of the measurement of breathlessness sheds light on this recurring disjunct between objective and subjective measures. This chapter explores 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. Considering these historical interactions highlights the related processes by which we have variously decided which groups counted as medically
distinguishable populations. In other words, whose bodies mattered for these measurements. Who were the normal subjects? And was normal breathing universal or varied between groups?

As I show in the first section, spirometry was developed in the nineteenth century as 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 later 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 measuring individuals’ exhalatory ability to displace a volume of water measured in litres. This became known as a person’s ‘vital capacity’. As medical historian Lundy Braun explains, this meant that for the first time: ‘with the help of this new, refined instrument, “lung capacity” became a discrete entity that could be measured, quantified, and ranked.’ The spirometer thus presented vital capacity as lung capacity. Yet using vital capacity to determine health, or even levels of breathlessness, was immediately problematic for clinicians – especially when measuring women, for reasons explained in the section on ‘Breathing like a girl’.

In the following sections, I track the changing normal values used in spirometry. These values will be refracted through the prism of two groups considered to be significant categories at different points in the twentieth century – women and miners. Taking this thematic approach highlights the interactions between race, class and gender in spirometry. In each case I move from the end of the nineteenth century to the present day, allowing for a fruitful comparison between the groups. By considering the first group, women, I demonstrate how difference in lung function between men and women was established, and the varying extent to which such differences were attributed to biological or societal causes. Similarly, analysing the efforts to define normal lung function for miners, my second group, highlights the extent to which abnormal lung function was attributed to the essential nature of the miner’s body, and underlines the impact of politics on the classification of respiratory disability.

As the definitive essay ‘Throwing Like a Girl’ by I. M. Young, which has inspired one of the section headings for this chapter, argued, there are ‘certain observable and rather ordinary ways in which women in our society typically comport themselves and move differently from the ways that men do.’ That such ways of being in the world might impact on health is the implication in Janet Shim’s work on how the categories of race, gender and class are used in epidemiological studies of heart disease. For example, she concludes that for most of the researchers she interviewed, differences between men and women were regarded as simple and clearly binary biological differences. However,
one epidemiologist did postulate that ‘processes related to gender discrimination and perhaps the stress of both attempting to conform to as well as resist normative gender roles could be reasonably hypothesized to affect cardiovascular health.’ It is this position that the people living with heart disease overwhelmingly expressed in Shim’s interviews. That is, they ‘understood gender relations as relations of power and experienced their manifestations as embodied sources of distress, grief, regret, and anger that they explicitly constructed as significant risks to their cardiovascular health.’ Such power relations intersected with race and class to produce chronic, structural oppressions and stresses that extracted a corporeal cost to health.

Braun’s work on the racialisation of spirometry has similar implications, as she outlines the growing evidence pointing to the importance of considering social and environmental explanations as causal explanations for difference in lung function over genetic difference. Indeed, Braun’s book memorably concludes with the exhortation that we must consider lung health as reflective of individual lived experience and intersectional oppressions. As the pioneering work of researchers such as Anna Louise Kirkengen has established, the cumulative impact of successive strains can be considered using an ‘allostatic load’ model, which suggests that overload to the body’s stress responses overtaxes the immune system, the hormonal system and the central nervous system, leading to subsequent body pathologies.

If this is the case, we might see that certain disease causations linked to the biological traits of a group may in fact be the result of specific ways of living as a member of that group, as I argue was the case with the measurement of miners. How, then, should we classify this group – if indeed they should be so classified? And if we decide on a suitable reference class, how would we then define and assess normalcy in that group? In this chapter I use historical case studies to argue that the selection of healthy subjects to create a standard of normalcy worked as a powerful way to manipulate the categorisation of disability as well as obscuring its true causes.

The development of spirometry

John Hutchinson (1811–61) coined the term spirometer and defined vital capacity as ‘the volume of air that a man can force out of his chest.’ For most of the twentieth century spirometry was used as part of large clinical or anthropometric studies rather than becoming incorporated into routine patient diagnostics in the way that the stethoscope was. Only a very few spirometers from the early twentieth century remain, which indicates that these were not ubiquitous diagnostic tools. The spirometers from this period that we do have
are large, to the extent that it is impossible to fit them in most museum display cases used at the Royal College of Surgeons and the Thackray Museum. They are also heavy and cumbersome, difficult for an individual to carry. The Lowne spirometer from 1906 shown in Figure 5.1 retailed at four pounds and fifteen shillings (around £371) and was kept in a heavy, mahogany, felt-lined box that further indicated its expense and rarity.

The word ‘spirometer’ translates literally as breath measurer. However, this translation greatly simplifies the working of this instrument, which only estimates lung capacity as ‘vital capacity’. Yet actuaries were able to wield spirometers to accurately predict premature mortality, and indeed Hutchinson had originally suggested that they should be used in military assessment and in actuarial prediction for life insurance policies. 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.

However, Hutchinson is regarded as the inventor of vital capacity because he found that with every inch of height vital capacity increased by 8 cubic inches. He arrived at this conclusion after using the spirometer to collect data from over 4,000 test subjects, categorised 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. Hutchinson then created corresponding tables showing what the ideal vital capacity ought to be for height. Hutchinson argued that the measure of
vital capacity was impacted by attributes including height, attitude, weight, age and disease.19

Nineteenth-century attempts to accurately measure and scale lung capacity 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 of the normal. Classification and categorisation of relevant group varieties perpetuated scientific acceptance of difference between these groups, and the notion that these groups constituted distinct natural kinds.20 This phenomenon was first identified by Braun, who demonstrated that correcting for race in spirometry cemented acceptance of difference between racial groups.21 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 it is a shaping of reality.22 Yet the objectivity and trust that we associate with numerical scales means that their related classification schema become invisible as categories are replicated as though they are inevitable and natural.23 The attempt to standardise the parameters of normal breathing has thus long been complicated by the drive to categorise 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 after the First World War, when Georges Dreyer (1873–1934) asserted in 1919 that lung capacity standards for pilots needed to be more strictly measured.24 Vital capacity offered a quick and easy way to assess physical fitness and so was used as a routine test 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.25 Incidentally, these open cockpits had noise levels of up to 125 decibels, which meant many First World War pilots ended their careers with substantial hearing loss.26 As a result, ‘the Americans considered letting deaf men fly, reasoning that pilots could not hear anything anyway’.27 While hearing was not considered relevant for successful piloting, lung capacity was. Dreyer argued that Hutchinson’s results did not give enough credence to the impact of weight on lung capacity and so he created new data tables.28 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, as it chiefly comprised hundreds of tables indicating the
normal ranges for weight and height, and their correlation with vital capacity. Dreyer’s epigraph for the book demonstrated that it was clearly created as part of an effort to improve the nation’s physical fitness, with the military particularly in mind.

Dreyer started the book with the assertion that the First World War had made physical fitness an issue of national importance. 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’. Dreyer categorised 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 categorised as class B. However, the impact of social class, Dreyer believed, could be transcended or depreciated by occupational training, and so Army and Navy personnel and blacksmiths were placed in class A while upper-class clerks remained in class B. Indeed, in an article published the year before in *The Lancet* Dreyer had warned against biological essentialism by emphasising that it was clear that ‘difference in vital capacity exhibited by different classes has nothing to do with fundamental bodily deficiencies, but is simply a result of conditions depending upon occupation and mode of life’.

Using his system, the person being measured would first be placed into their appropriate division, and then their vital capacity percentage ascertained for that group. This allowed for the comparison of the reference class groupings relevant to Dreyer: age, sex, class and occupation. Dreyer argued that if someone was found to have ‘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’. As Horrocks and Smith have argued, Dreyer’s standardised method for classifying individuals’ health was particularly appealing to the MRC because of its emphasis on standardised laboratory medicine, and its lack of reliance on a clinician’s subjective opinion.

Despite indicating 15 per cent as the limit of normality, Dreyer was concerned more with identifying fitness levels than with defining illness. His measurements were interpreted thus by C. B. Heald, the medical adviser to the Department of Civil Aviation, who viewed spirometry as a valuable method of measuring physical fitness, providing, as he put it, ‘a scale upon which individuals can be placed in order of physical fitness’.
understanding echoed earlier military observations about the utility of spirometry for assessing the general fitness of recruits. As early as 1860 an MD reported to the *British Medical Journal* that ‘a vital capacity below the average may be considered rather as indicating a generally feeble organisation, less capable of resisting the deteriorating influences to which a soldier is exposed’.36 While some accordingly saw the spirometer as providing a numerical estimation of a person’s overall fitness, it was recognised by others that the spirometer could be used to identify and monitor illness progression, and that there was a subsequent need to collect comparable data on hospital patients. In 1922, Dr Charles Cameron, the medical officer working at the Ochil Hills Sanatorium in Glasgow, made such an attempt by using the Dreyer method to determine the normal vital capacity for 223 male patients. Cameron questioned Dreyer’s vital capacity as being fixed arbitrarily to represent what he termed, ‘the probable normal’. His observations were designed to fill this disability data gap by giving standards for patients with pulmonary tuberculosis.37

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.38 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 against 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.39 For example, miners who complained of breathlessness were often dismissed as malingerers, or their respiratory trouble was diagnosed as being of psychological origin, as we will see in the section below on ‘Normal breathing for miners’.40

By the 1930s, Dreyer’s standards had been largely discredited by statisticians.41 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’, his view was 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.’42 Like Cameron, Moncrieff argued that ‘the standards set out by Flack
for the Air Force appear to be far too high for the ordinary population attending hospitals.\textsuperscript{43} Furthermore, he demonstrated that 94 per cent of the women he tested failed to reach the average standard for a ‘normal’ person.\textsuperscript{44} As a result of such discrepancies, those wielding the spirometer began to seriously question the extent to which deviation occurred between the sexes, as discussed in the next section.

**Breathing like a girl**

Hutchinson had not addressed vital capacity in women in his 1846 publication, and in his second work of 1852 he admitted that he was frequently asked whether his table could also be applied to women. He responded that it was unnecessary to differentiate vital capacity measures from men to women and explained that ‘we see no reason why their vital capacity should not correspond with that of men, for their chest mobility seems to exceed that of men’.\textsuperscript{45} As we saw in Chapter 2, measuring women was simply perceived as more difficult than measuring men, and Hutchinson elaborated that ‘we do not know the vital capacity of women, nor is it easy to determine it,’ and mused upon the extent to which the use of corsetry impacted on women’s breathing: ‘when clothed, as women in this country are wont to attire, they all seem to breathe the same volume as if they lived under one uniform tightness in dress’.\textsuperscript{46} He elaborated on the potential impact of tight stays further when he noted: ‘Observations upon females are more difficult. We never heard a woman acknowledge that she wore her clothes tight, and we have put this question to thousands, and yet we believe a certain number do wear tight dresses.’\textsuperscript{47}

As the dressing habits of Victorian women remained mysterious to him, Hutchinson chose to use the vital capacity of men as standard for women rather than making separate studies. However, this was an unusual move to make in a medical milieu fascinated by the science of difference. Others soon called for representative studies to clarify the normal range of vital capacity in women. The influential statistician and eugenicist Francis Galton (discussed in Chapter 1), for instance, separated his anthropometric studies by sex, as in the 1883 Final Report of the Anthropometric Committee of the British Association for the Advancement of Science, which included breathing capacity standards for boys and girls.\textsuperscript{48} But difficulties in measuring women abounded. Galton decided against measuring women’s heads when they visited his anthropometric laboratory at the international health exhibition because ‘it would be troublesome to perform on most women on account of their bonnets, and the bulk of their hair, and that it would lead to objections and difficulties’.\textsuperscript{49} Again, women proved too ‘troublesome’ to measure easily.
Yet unconventional sexologist Havelock Ellis made use of the spirometer in his 1904 study of ‘man and woman’. He started his chapter on respiration with the claim that ‘it is well recognised that the “vital capacity”, as the breathing power indicated by the spirometer is commonly called, is decidedly less in women than in men’. He elaborated that vital capacity was 3 litres in women compared to 3½ litres in a man of equal height, and that height increased vital capacity in men to a greater extent than in women. Ruminating on the causes for this discrepancy, Ellis attributed it to the fact that women had ‘a less keen need of air’ and noted that they fared better both at high altitudes and in occupations working in front of hot stoves. Various theories were espoused to explain the lower lung capacity of women. One of the most enduring theories was that men’s respirations naturally stemmed from the diaphragm while women breathed from the chest (costal breathing). This point was raised by Hutchinson in 1846 in his reported remarks to the Royal Medical and Chirurgical Society: ‘The breathing in women differed from men only in one respect, their ordinary breathing being chiefly costal and not abdominal. Whether this was due to gestation or not he could not say; he thought there was some doubt of its being caused by the peculiarities of their costume.’ Ellis also believed that women breathed costally (from the chest) rather than from the diaphragm, noting that ‘The characteristic costal breathing of women begins, according to Sibson, about the tenth year of life.’ However, such breathing was, for Ellis, largely attributable to the constraint of corseted dresses.

The association between corsets and costal breathing meant that this type of breath was linked, at least for Ellis and his correspondents, with civility and racial purity. Costal breathing was connected only with women of the more civilised races. For example, Ellis published his correspondence with Dr J. H. Kellogg (of cornflakes fame), who wrote:

I observed the breathing of 20 Chinese women and the same number of Indian women, and I found the abdominal type very marked in every case ... I examined several of the Cherokee and Chickesaw women in the Indian Territory. These women had all worn civilised dress, and some of them had worn corsets. Those who had worn corsets and tight dresses gave tracings like civilised women; those who has only worn loose dress gave normal tracings.

While costal breathing was thus largely regarded as an artificially created difference caused by ‘the evils of tight-lacing’, one of Ellis’s correspondents explicitly elucidated the links between thoracic breathing and sexuality. In what was acknowledged by Ellis as intended as a private letter to him, Dr Louis Robinson expressed his feelings that
one of the reasons (and there must be strong ones) for the persistent habit of tightening up the belly-girth among Christian damsels is that such constriction renders the breathing thoracic and so advertising the alluring bosom by keeping it in constant and manifest movement. The heaving of a sub-clavicular sigh is likely to cause more sensation than the heaving of an epigastric or umbilical sigh.\textsuperscript{57}

Ellis also included remarks from Dr Sargent of Harvard University, who had used the spirometer to demonstrate the negative impact of corset wearing to his students by showing that “The average lung capacity when corsets were worn was 134 cubic inches; when the corsets were removed the test showed an average lung capacity of 167 inches – a gain of 33 cubic inches.”\textsuperscript{58} The spirometer thus became a tool used to demonstrate the negative impact of corsetry and tight stays. In a similar vein, a British textbook giving practical guidance for singers and speakers cautioned in 1891 against wearing corsets, based on evidence showing increased vital capacity measures of women free from corsets.\textsuperscript{59} Its authors – vocal surgeon and voice trainer Lennox Browne and physiologist Emil Behnke – explained that they extrapolated a normal female measure by subtracting a percentage from the male standard.

Until quite recently no experiments have been made in any large numbers of females, and a deduction of 33 per cent has been made for the ‘weaker sex.’ We have for many years been in the habit of making an allowance of only 25 per cent. for females; and more recent experience leads us to believe that even this difference is greater than would be justified by fact in normal subjects undeformed by fashion.\textsuperscript{60}

As the inclusion of ‘undeformed’ indicates, the writers were extremely critical of corsets and their tendency to produce costal breathing or what they sometimes termed ‘collar-bone breathing.’\textsuperscript{61} Spirometry was invoked by the authors in order to demonstrate the injurious effects of corsets. Using a breathing capacity table from the Anthropometric Committee of the British Association for the Advancement of Science, Browne and Behnke took spirometry readings from women with and then without corsets in order to show the numerical gain from breathing without restriction. The authors explicitly appealed to the sensibilities of their female readers by explaining that corsets could cause the ‘horror’ of ‘fat’ accumulating due to suppression of natural breathing:

If, as Mr. Lennox Browne has shown, a lady with normal lung capacity of 125 cubic inches, reduces this to 78 inches by means of her stays, and attains 118 inches all at once on leaving them off, it is certain that her prospects of becoming fat and flabby ... are greatly increased.\textsuperscript{62}
Uncertainty about whether corsets were restricting breathing to the extent that they were altering vital capacity remained. Indeed, the Lamarckian theory of inheritance (which argued that the changes made to an organism in its lifetime could be passed on) was invoked to show that corsetry had led to costal breathing becoming “fixed by heredity into a secondary sexual character.” This observation encapsulates the element of blurriness between biological and environmental causes of difference between men and women crucial to the creation of spirometric standards.

The MRC intervenes

The trouble with girls was recognised by the MRC Pneumoconiosis Research Unit (PRU) in south Wales in 1975 when they proposed conducting studies that for the first time would stipulate the respiratory values of normal women in Britain and thus allow for the monitoring of respiratory health of women working in industry. The initial commission draft was prepared for the newly formed Health and Safety Executive’s Employment Medical Advisory Service (henceforth HSE) and explained that “it is important that in any industry where there is a respiratory hazard it should be possible to compare lung function to women with a normal value.” Yet, as this draft emphasised, “There are at present no reference values in the UK for healthy women with which abnormalities can be compared.” Of course, this may be partially due to the fact that women (since 1842) were prohibited from working in mining, which was the industry that (as we explore in the next section) was subject to most of the UK’s clinical investigations of lung function in attempts to establish the cause of miner’s lung. However, even considering their exclusion from mining, and disregarding the work of women in potentially toxic industries like munitions factories during the First World War, it is still remarkable that there were no accepted normal values for women’s lung function in Britain until 1979. Consider that by 1844 not only did we have normal lung function values for men but we had normal lung function values for subdivisions of men: male policemen, firemen, wrestlers, grenadier guards, miners, aristocrats, small men, tall men and every man in between.

The 1975 attempt to redress the (by then) 131-year imbalance was initially part of a broader remit of research on lung function conducted at the MRC Pneumoconiosis Research Unit, where researchers hoped to obtain further funding for their work from the HSE. Unfortunately, the HSE was not prepared to accept work on the initially proposed general topic of lung function and asked the PRU to split the original proposal into two separately defined commissions. Pioneering lung function expert Dr John E. Cotes (1924–2018)
was the main researcher working on lung function and he found it very difficult to deal with the bureaucracy that the HSE demanded, as Dr Joan Faulkner’s note on their visit with Dr Alan MacAuslan to the PRU made explicit:

It became clear from the start of our discussion that Dr Cotes was going to be very difficult. I had already explained to him in a previous interview that the exercise in which we were engaged was largely a paper one but if we collaborated, it was likely to make things much easier in the long run. I knew that he was incensed about the fate of the proposed work on small airways obstruction in the slateworkers’ survey but I had shown him Dr Norton’s letter to Dr Owen and also emphasised that Dr MacAuslan had been in no way involved in the decision. Nevertheless, he mentioned it on several occasions during the day and although Dr MacAuslan behaved in a civilised, sympathetic and placatory manner, I found the discussion exceedingly difficult to manage. The main trouble was that Dr Cotes repeated over and over again that what he did formed a continuum and that it was virtually impossible for him to split off any part of his work to form one or more specific commissions. His irritation was very evident to the extent that Dr MacAuslan apologised to me on the way to lunch for upsetting Dr Cotes.69

The first of the two PRU commissions was accepted, but the one on lung function in women was subjected to criticism. Indeed, the ill-fated study was beset with difficulties from its inception. At that first difficult meeting with the HSE (represented by MacAuslan), Faulkner (a senior figure in the MRC and the wife of Sir Richard Doll) remarked, ‘I could see that Dr MacAuslan wasn’t over enthusiastic about this project but he accepted it as some of the others that had been suggested seemed to have even less relevance … from the HSE point of view.’70 Even (female!) researchers working at the PRU derided its utility, and Dr Joan E. Box wrote to Faulkner at the MRC urging against stimulating HSE’s interest in the study and arguing that it would divert attention away from more important activities.71 Similarly, Box wrote that ‘Dr Leece’s immediate reaction is that there is unlikely to be strong concern about this – although the subject of improving standards is of some interest to them.’72 Most surprisingly, the principal investigator, Cotes, himself was described as uninterested in the project: when pressed for costings over the phone ‘he was rather vague and said that he had never been keen on this commission and was much more interested in the exercise project’.73 Faulkner reflected on these messages and on the general lack of enthusiasm for the project, and noted that ‘several people make the point that it is probably necessary but dull’.74 MacAuslan at the HSE even wrote to the MRC specifically to reiterate that the HSE did ‘not set a very high priority on this piece of work’.75

Yet other researchers working on lung function at the PRU defended its utility against such attacks. For example, Faulkner was puzzled about Cotes’s
reputed lack of interest in the project and recorded that this seemed ‘to be in conflict with what he told me when I visited him last year with Dr MacAuslan – namely that there was a great need for reference values in healthy British women’. Dr J. C. Gilson similarly stressed that ‘John Cotes emphasises that there is a great need for prospective studies in women. Nearly all the published data of prospective investigations relate to males’.

Adding to this internal division, the project was then subjected to further criticisms from the HSE statistician, who highlighted several problems with the research application. Namely, he felt that the study proposed was not extensive enough to answer the main research question and argued that the groups (totalling 150 subjects) were too small to show significant differences and were neither representative of regional variation in the UK nor reflective of the targeted working population. For instance, he pointed out that ‘there are no women in the 16–25 year interval in any of the groups, which is a surprising omission as this group will be evident very much in industrial working populations’. He also argued that it was unclear what constituted a ‘healthy woman’ and contended that ‘the chosen groups are by no means necessarily representative of healthy women, especially the group whose members all had iron deficiency anaemia’.

The statistician used to review this project was apparently new and his comments were not received well by the MRC or the PRU, who variously argued his analysis was ‘somewhat inappropriate’, based on a ‘misunderstanding of the purpose of the work’ and that he had ‘rather “gone to town” on this commission’. The letter conveying his criticisms was dated 1 April 1976, and the MRC may well have wished that it had been written as a seasonal joke. It was referred to as ‘rather embarrassing’ and the London MRC headquarters branch considered whether they should simply conceal these criticisms from the directors of the PRU in south Wales by ‘sweeping them under the carpet’. However, on further reflection they decided against such a course of action, as Faulkner (working from headquarters in London) explained:

> I don’t think we can evade the questions the statistician has raised and on reflection I think it would be best if you would send these down to the unit. It may well be that the best thing to do is to drop this commission, but it perhaps may be no bad thing for Unit directors to learn gradually a little more about the facts of life. We have protected them to a very great extent so far.

As a result of the statistician’s criticisms the commission was eventually dropped entirely, and Faulkner wrote to convey the news to the HSE, while reiterating the intrinsic value of the project:
Dr Gilson and Dr Cotes accept your statisticians’ comments as justified: they would like to stress, however, that the basic concept behind their work on establishing indices of lung function in women is a valid one. They both emphasise in particular the great need for prospective studies in women, in view of the fact that nearly all the published data of prospective investigations relate to men.  

In 1979, just three years after this letter was written, Thorax published an article with the title ‘Lung Function in Healthy British women’, which provided reference values for healthy British women for the first time. This study was identical to the proposal pitched to the HSE (even down to the title), indicating that the statistician’s comments had perhaps not been so readily accepted after all.

The standards given in this study were replaced just four years later by the first European standardisation document pertaining to spirometry, which was issued by the European Coal and Steel Community in 1983, then updated in 1993. However, by 1997, there was some concern that the impact of cohort effects (changes to people due to things like improved nutrition and decreased passive smoking) and period effects (changes to techniques, instruments and apparatus) meant that the data used for these reference values, as another Thorax article explained, ‘derived from 20 unrelated studies performed between 1960 and 1980 with varying apparatus, measurement conditions, and techniques’ would no longer be valid. In 2010, an article in the European Respiratory Journal bemoaned the constant changes to the so-called ‘standard’ reference equations, and pointed out that ‘the overwhelming number of published reference equations, with at least 15 published for spirometry alone in the past 3 years, complicated the selection of an appropriate reference’.  

Historians of technology have long emphasised the fact that technical standards underwrite their own opacity and through doing so becoming increasingly invisible. Standards create conformations of both instruments and people. Such conformations have often been used to objectify and enforce group differences while at the same time perpetuating their invisibility. These constructions are then reified as though they represent objective measurement. As J. C. Gilson and P. Hugh-Jones reflected in their MRC 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’.

Indeed, the ‘will to standardise’ in order to attain objectivity has been strong within the MRC and has been remarked upon by historians researching
its standardisation of audiometry, depression and Alzheimer’s assessment guidelines.89 Far from being unproblematic and objective, the standardization of disease diagnoses is an inherently political project. For example, the diverse national medical positions on the aetiology of silicosis has been shown to have been directly linked to the social insurance systems present in each different country.90 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. For instance, amidst the Covid19 global pandemic, divergent standards between countries in the manner of calculating death rates have been linked to political expediency. Thus, ‘standards are inherently political because their construction and application transform the practices in which they become embedded’.91

The fight for recognition of and compensation for ‘miner’s lung’ is a clear example of the way in which politics and objective standards can conflict with testimony.

Normal breathing for miners

The Life of Breath Project principal investigators Carel and Macnaughton have explained that the psychological experience of breathlessness has an important effect on the personal perception of respiratory illness.92 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.93 Such testimony concerning the personal perception of illness 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 workman’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 strength that the miner believes he has means that he feels he can battle his illness from a better position 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.94

The miner’s assertion that X-rays ‘don’t tell lies’ demonstrates not only 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.95 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.’96 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.97 Historian Joseph Melling has identified that his inquest was pivotal in motivating the subsequent legislative and scientific debates about pulmonary illness in the 1930s.98

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.99 Oxley and Macnaughton have demonstrated that the language we use to demonstrate breathlessness is highly variable, and subject to difference between cultures and contexts.100 While instrumentation is ideally designed to transcend such socio-cultural contexts, the following section will demonstrate that the clinical investigation of respiratory disease in mining communities was impacted by the normalisation of disability within these communities.

That pulmonary disease disproportionately affected mine-workers had been recognised 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.101 Historian Michael Bloor has attributed the resultant shift in attention from dust in the air to germs in the air to developments in bacteriology.102 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.103 Moreover, following the work of John Scott Haldane (1860–1936), there was some adherence to the notion that coal dust functioned as a prophylactic. That is, coal dust was beneficial: ‘a little dust was good for you.’104 Indeed, miner 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.\textsuperscript{105} 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 historians Perchard and Gildart as key ‘merchant[s] of doubt’.\textsuperscript{106}

In what follows, I set out a brief outline of the legislative changes relating to coalmining which preceded the MRC investigation. These changes were variously resisted or advocated by a number of important bodies, including: the mine 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 MRC 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 miners’ lung.\textsuperscript{107}

Compensation for industrial disease was first offered to UK industrial workers in 1906 through the Workmen’s Compensation Act, although its extension had been strongly resisted by coal owners.\textsuperscript{108} 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.\textsuperscript{109} 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.\textsuperscript{110} 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.\textsuperscript{111} 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 cases of total disability that precluded future work were compensated.\textsuperscript{112} This was 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 tuberculosis.\textsuperscript{113} 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 MRC Committee on Industrial Pulmonary Disease was appointed and in 1931, the Various Industries Scheme was extended to cover more workers and include partial disability.\textsuperscript{114} 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. The disabled worker had to obtain medical certificates from his own doctor before applying to the Medical Board, where his case was usually presented by his trade union, as the financial cost for individuals applying directly to the board was prohibitively high. The introduction of partial disability posed new challenges to the medical community in their ability to accurately and convincingly assess its boundaries, which Braun argues was due to ‘the lack of correlation between the degree of tissue damage and the severity of breathlessness’. 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.

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 prioritisation of geological expertise over clinical criteria. This stipulation also reinforces one of the central claims of this chapter, 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 realisation that ‘the relationship between geological conditions and the onset of disease could not be precisely measured’.

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

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.

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. 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 miners’ unions and the mine owners.\(^\text{123}\) Wragg v. Fox proved to be critical in delaying any practical implementation of the 1931 Scheme and influenced miners’ leaders in their lobbying for clear diagnostic criteria.\(^\text{124}\) 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’.\(^\text{125}\)

Although both local doctors and miners were convinced of the existence of a disease due to coal dust, this belief did not correlate with the diagnostic criteria for compensation.\(^\text{126}\) Furthermore, there was increasing concern that coal miners were suffering from respiratory disability that could not be traced to silica exposure.\(^\text{127}\) 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.\(^\text{128}\)

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. It was charged with investigating chronic pulmonary disease among coal miners, with a particular focus on the south Wales coalfields. As I explained in Chapter 1, the MRC had been funded by government to instigate medical and biological research since 1911, and during the interwar years it was divided into numerous sub-sections which were endowed with significant freedom in their organisation and research.\(^\text{129}\) 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.\(^\text{130}\) Retrospectively, D’Arcy Hart attributed 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’.\(^\text{131}\)

The MRC selected an anthracite colliery for detailed investigation, and examined 560 of the men there, both radiologically and clinically.\(^\text{132}\) The clinical tests involved included examination of sputum, tuberculin tests and spirometric measurements of lung volume.\(^\text{133}\) ‘These lung volume determinations were supplemented by an exercise tolerance test, which categorised levels of ‘respiratory embarrassment’ under four possible subheadings.\(^\text{134}\) These groupings were then further categorised as either normal (class A) or abnormal (further divided by severity into class B or C).\(^\text{135}\) 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 standardised and standardising 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.136 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.137 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.’138 The MRC reports (published 1942–45) were critical in that they proved that there was a link between length of exposure to coal dust and respiratory disability.139 This meant that there was now widespread medical acceptance of a disease due to coal dust that was entirely distinct from silicosis. Finally, in 1943, a disease due to coal dust was both legally recognised and duly compensated.140 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.141

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 MRC assessed the changes that X-ray investigation revealed on 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.’142 The authors of the MRC Medical Survey pondered the seriousness of this disability amongst the working population in the report and questioned whether hidden pulmonary abnormalities ‘among men still at work’ were of any consequence.143 However, Dr Gwent Jones argued that: ‘If the sufferer was only partially incapacitated and obtains a certificate for partial compensation, he is to the labour marker only a part of a man, and being unskilled in any other trade he cannot compete with fit men in new occupations.’144 Such disputes regarding the potential for the disabled man to work permeated the MRC’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.145 Jones’s criticism of the compensation system highlighted how 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'. 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 standardised classifications for what changes constituted disability in relation to respiratory disease. Melling has confirmed that it was very difficult to arrive firmly at any kind of diagnosis using X-ray examination at this time: professional scepticism abounded and techniques and interpretations were not standardised until nearer 1950. 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 utilised in the complex compensation network. As Braun has demonstrated, the spirometer offered 'an objective marker of disability to industrial medicine'.

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 on 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. The MRC’s original clinical investigation used normal lung function values separately determined by Aslett, 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’. 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 5.2).

Only one mine was subjected to a full clinical investigation and the spirometry test there was clearly flawed, as it took its measure of normalcy 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
Figure 5.2  Map of the south Wales coalfield marking the positions of the sixteen collieries of the MRC chronic pulmonary disease inquiry, 1942
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 coalworkers’ pneumoconiosis, these too were considered normal – for coal miners. Rebuttal to attribute diminished lung capacity to the effect of mining work was to continue. For example, in their 1955 report for the MRC, Gilson and Hugh-Jones compared 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.

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 that “They concluded that the difference was psychogenic but it is possible that it was partly due to the effect of mining.”

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. 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, commenting ‘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.’ 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, 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 this difference was attributed to the smaller height and weight of the miners, ‘probably due to the Welsh racial characteristics.’ Indeed, the idea of a Welsh racial factor had long been used to argue against environmental causes of difference, For example in 1883 Galton compared the stature and weight of Scottish miners favourably against Welsh miners to demonstrate ‘an example of the predominance of race over occupation.’ Attributing variability in lung function to racial difference was
eventually enshrined in spirometric measurements by the MRC PRU in south Wales in its standards for ‘Average Normal Values for the Forced Expiratory Volume in White Caucasian Males’.159 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 in both the compensation system and in the promotion of the thesis that inequality between the races was biological rather than environmental.160

Conclusion: ways of breathing

In 1963, *The British Medical Journal* published a letter on ‘the sensation of dyspnoea’ which argued that ‘a respiratory physiologist offering a unitary explanation of breathlessness should arouse the same suspicions as a tattooed Archbishop offering a free ticket to heaven’.161 To demonstrate the impossibility of replicating the feeling of shortness of breath, the author described an approach to imitate ‘the mechanical disadvantages under which patients with asthma and emphysema suffer’.162 Individuals who were identified as ‘normal’ were secured with a broad band placed tightly around their chest ‘arranged to hinder expiration’.163 Spirometric readings and assessments of dyspnoea during heavy work were then taken of the individuals with the band on, and then compared to their previous ‘normal state’. This experiment indicated to the researchers that the feeling of breathlessness was not connected to gas exchange within the lungs or any other quantifiable measurement.

As this experiment signals, medical clinicians throughout the twentieth century were aware of and keenly frustrated by the fact that lung function measurements did not map onto the experience of breathlessness. And today the experience of breathlessness still eludes clinical attempts to capture and quantify it, as ‘one of the difficulties in an experimental approach to breathlessness is how to reproduce the sensation in the laboratory and study it quantitatively’.164 Attempts to reproduce the sensation in the laboratory are problematic because such experimental work needs to be carried out on ‘normal subjects whose bodies and minds have not been subjected to years of chronic breathlessness’ and the effects that may have on physiology and neural mechanisms.165 As a result, we are unable to replicate the long-term physiological and neural effects of living with breathlessness. This disability data gap is unavoidable because those living with long-term respiratory conditions are unable to ‘spend time lying flat in the enclosed tunnel of an MRI scanner’.166 Moreover, it is impossible to replicate or standardise the emotions attached to
feeling breathless, as ‘laboratory dyspnoea does not cause the existential fears dyspnoea sufferers encounter in daily life’.167

To address the ongoing complications around reference classes in spirometry, in 2012, the Global Lung Function Initiative was sponsored by the European Respiratory Society to tabulate new ‘standard’ reference values for spirometry.168 Of concern to the European Respiratory Society was the way in which the different reference equations available for measuring lung function impacted on the classification of patients as ‘normal’ or ‘abnormal’. One 1999 study found that ‘up to 40% of spirometric tests may change their clinical category (from normal to abnormal) simply by changing the equation used’.169 Such misclassification, the authors noted, had important implications for the assessment of disability, and this phenomenon was exacerbated in the elderly and in women.170 This analysis adds to the claims made in this book about the classification of disability as dependent on, and variable according to, certain measurements. Interlinked with the problem of appropriate reference equations is the difficulty of defining and assessing normalcy to represent a healthy population in the first place. Not only, as we saw in Chapter 2, is health difficult to define, the reference classes used in lung function complicate matters further, ‘height, age, sex and, ideally, ethnic/racial group must be taken into consideration when defining the normal range for lung function. The selection of “healthy” subjects who comprise the reference population is of paramount importance’.171 The creation of standards, then, is a powerful way of categorising disability and of defining relevant reference classes in an apparently objective manner.

Certainly, current research does demonstrate incontestable sex differences (on average) between men and women, including lower lung function and lower respiratory muscle strength in women compared to men.172 And there are gender differences, too, for instance in the pattern of COPD diagnosis between men and women: ‘never smokers’ with COPD are predominantly women (perhaps due to higher exposure to indoor air pollutants); women wait longer to be diagnosed with COPD than men and are more likely to have airflow obstruction left unidentified than men.173 Beyond these differences, there is a great deal of anecdotal evidence suggesting that current standards of desirability dictate that women ought to be slim with a demonstrably flat stomach, meaning that women in public often attempt to hold their stomachs ‘in’, consequently impairing their ability to breathe diaphragmatically. How can we be sure to separate out the differences arising from such social pressures as distinct from the biological?

The American folk singer Townes Van Zandt once sang: ‘Well, won’t you lend your lungs to me, mine are collapsing’. The hopelessness of his plea to breathe in someone else’s air is suggestive of the impossibility of ever truly
understanding and experiencing another individual’s way of breathing. As well as frustrating laboratory studies, the unique individuality attached to breathing impacts on user responses to breath prosthetics, the technologies which are the foci of the following chapter.

Notes

1 See Booth et al., ‘The Brain and Breathlessness’ and Spathis et al., ‘The Breathing, Thinking, Functioning Clinical Model.’
2 Carel et al., ‘Invisible Suffering’, p. 278.
3 Williams and Carel, ‘Breathlessness’.
4 See www.lifeofbreath.org and Macnaughton and Carel, ‘Breathing and Breathlessness’.
5 Today vital capacity is measured through total lung capacity minus residual volume.
6 Braun, Breathing Race into the Machine, p. 8.
7 Young, I. M., On Female Body Experience: ‘Throwing Like a Girl’ and Other Essays (Oxford: Oxford University Press, 2005), p. 29.
8 Shim, Heart-Sick, p. 146 and p. 194.
9 Ibid., p. 146.
10 Ibid., p. 156.
11 Ibid., pp. 156–157.
12 Braun, Breathing Race into the Machine, p. 205.
13 Nerbovik, L. T., Kirkengen, A. L., and Hetlevik, I., ‘Might a Systematic Reading of the Thickest GP Patient Medical Records Improve our Understandings of Functional Disorders’, La Prensa Medica Argentina, 101:5 (2015), 1–5, p. 3. For more on Kirkengen’s work linking childhood trauma with adult ill health see Kirkengen, A. L., Inscribed Bodies: Health Impact of Childhood Sexual Abuse (Dordrecht: Springer, 2010).
14 Hutchinson, J., 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.
15 Hutchinson had previously worked for life insurance companies.
16 Pepys, J., and Bernstein, L., ‘Historical Aspects of Occupational Asthma’, in M. Chang-Yeung and J. L. Malo (eds), Asthma in the Workplace (New York: Marcel Dekker Inc., 1999), pp. 1–28, p. 7.
17 Hutchinson, Contributions to Vital Statistics, p. 2.
18 Ibid.
19 His inclusion of ‘attitude’ is notable and likely was meant to indicate the extent to which cooperation of the patient was necessary for the measurement.
20 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. See Chapter 2 for more on this.
21 Braun, Breathing Race into the Machine.
22 Bowker and Star, Sorting Things Out.
23 Porter, ‘Measurement, Objectivity, and Trust’ and Hacking, ‘Biopower and the Avalanche of Printed Numbers’.
24 Dreyer, G., ‘Investigations on the Normal Vital Capacity in Man and Its Relation to the Size of the Body’, *The Lancet*, 194:5006 (1919), 227–234.
25 Smith, D., and Horrocks, S., ‘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 J. Sobal and D. Maurer (eds), *Weighy Issues: Fatness and Thinness as Social Problems* (London: Routledge, 1999), pp. 74–94.
26 Courtwright, D. T., *Sky as Frontier: Adventure, Aviation, and Empire* (College Station: Texas A&M University Press, 2004), p. 41.
27 Ibid. Statistically, Deaf people are very safe drivers, and there is some evidence suggesting this in linked to superior peripheral vision. See Codina, C., Pascalis, O., Mody, C., Toomey, P., et al., ‘Visual Advantage in Deaf Adults Linked to Retinal Changes’, *PLoS ONE*, 6:6 (2011), 1–8.
28 Dreyer, ‘Investigations on the Normal Vital Capacity’, p. 227.
29 Dreyer, G., *The Assessment of Physical Fitness: By Correlation of Vital Capacity and Certain Measurements of the Body* (London: Cassell and Company, 1920), p. 3.
30 Dreyer, ‘Investigations on the Normal Vital Capacity’.
31 Dreyer, *The Assessment of Physical Fitness*, pp. 17–18.
32 Smith and Horrocks, ‘Defining Perfect and Not-So-Perfect Bodies’, p. 78.
33 Dreyer, *The Assessment of Physical Fitness*, p. 18.
34 Smith and Horrocks, ‘Defining Perfect and Not-So-Perfect Bodies’, p. 78.
35 Heald, C. B., ‘The Value and Interpretation of Some Physical Measurements’, *The Lancet*, 196:5067 (1920), 736–741.
36 Balfour, T. G., ‘Contribution to the Study of Spirometry’, *Medico-Chirurgical Transactions*, 43 (1860), 263–269.
37 Cameron, C., ‘The Vital Capacity in Pulmonary Tuberculosis’, *Tubercle*, 3 (1922), 385–399.
38 Flack, M., ‘The Milroy Lectures on Respiratory Efficiency in Relation to Health and Disease’, *The Lancet*, 198 (1924), 693–696.
39 For example, see Aslett, E., D’Arcy Hart, P., and McMichael, J., ‘The Lung Volume and Its Subdivisions in Normal Males’, *Proceedings of the Royal Society of London Series B: Biological Sciences*, 126:845 (1939), 502–528, p. 506.
40 Smith, B. E., ‘Black Lung: The Social Production of Disease’, *International Journal of Health Services*, 11:3 (1981), 343–359, p. 346.
41 Smith and Horrocks, ‘Defining Perfect and Not-So-Perfect Bodies’, p. 75.
42 Moncrieff, A., ‘Tests for Respiratory Efficiency’, *The Lancet*, 220:5696 (1932), 665–669, p. 665.
43 Ibid., p. 668.
44 Ibid., p. 667.
45 Hutchinson, J., *The Spirometer, the Stethoscope, and Scale-Balance: Their Use in Discriminating Diseases of the Chest, and Their Value in Life Offices; With Remarks on the Selection of Lives for Life Assurance Companies* (London: Churchill, 1852), p. 6.
He measured their breathing capacities, as well as eyesight, colour-sense, highest audible note, strength, swiftness, arm-span, height and weight. See Galton, F., ‘On the Anthropometric Laboratory at the Late International Health Exhibition’, *Journal of the Anthropological Institute of Great Britain and Ireland*, 14 (1885), 205–221, p. 210.

Ellis, H., *Man and Woman: A Study of Human Secondary Sexual Characters* (London: Walter Scott, 1904), p. 202.

Hutchinson, J., ‘On the Capacity of the Lungs, and on the Respiratory Movements, with the View of Establishing a Precise and Easy Method of Detecting Disease by the Spirometer’, *Medico-Chirurgical Transactions*, 29 (1846), 137–252.

Ellis, *Man and Woman*, p. 204.

Ibid., pp. 207–208.

Ibid.

Ibid., p. 210.

Ibid., p. 211.

Behnke and Browne, *Voice, Song, and Speech*, p. 97.

Ibid. Emil Behnke also used the spirometer in his work with deaf children as a tool for promoting oralism, see ibid., p. 96.

Ibid., p. 85.

Ibid., p. 94.

Ellis, *Man and Woman*, p. 203.

Ibid., p. 204.

The HSE was formed in 1975 and the first HSE advisory committees were set up in that year to promote research expertise on industry and specialist organisations and improve occupational health and safety. It was this call that the PRU was responding to: see www.hse.gov.uk/aboutus/timeline/index.htm and Joan Faulkner, ‘Note on Visit with Dr MacAuslan to the Pneumoconiosis Unit’, 14 May 1975. Potential Commissions from the Department of Employment: Lung Function in Healthy Women. TNA, FD 9/4168.

Commission draft MRC/HSE/182, ‘Lung Function in Healthy Women 1. Preamble’, 12 February 1976. Potential Commissions from the Department of Employment: Lung Function in Healthy Women. TNA, FD 9/4168.

A. Heeson, ‘The Coal Mines Act of 1842, Social Reform, and Social Control’, *Historical Journal*, 24:1 (1981), 69–88.

Campaign groups working for more recognition of these women argue that the incidence of throat and lung infections and later life health problems for these workers has been overlooked. See www.bbc.co.uk/news/uk-england-hereford-worcester-27685286. Accessed July 2019.
The HSE had not supported a potential commission on small airways obstruction. Faulkner, ‘Note on Visit with Dr MacAuslan.’

Letter from Dr Box to Dr Faulkner, 26 July 1976. TNA, FD 9/4168. Dr Joan Faulkner (1914–2001) worked at MRC headquarters from 1945 and in 1979 became a Senior Principal Medical Officer. She married Richard Doll in 1949 (she was initially his supervisor) and became Lady Doll when he was knighted in 1971 for his epidemiological work demonstrating a link between smoking and cancer. See Keating, Smoking Kills for more on Faulkner.

Note to Dr Chapman scribbled in the margin following handwritten notes on the end of a letter from Dr Joan Faulkner to Dr Chapman and Dr Box, 13 April 1976. TNA, FD 9/4168.

Note for file ‘Costing of Commission 182: Lung Function in Healthy Women’, 24 September 1975, Anne Dalton. TNA, FD 9/4168.

Letter from Dr Joan Faulkner to Dr Box, 29 July 1976. TNA, FD 9/4168.

Letter from Dr Alan MacAuslan to Dr Joan Faulkner, 9 September 1976. TNA, FD 9/4168.

It should be noted that Dr Cotes was dealing with a tragic family situation during these years, which may explain some of his inconsistent behaviour. Letter from Dr Joan Faulkner to Dr Box, 29 July 1976, TNA, FD 9/4168.

Letter from Dr J. C. Gilson to Dr Joan Faulkner, ‘Lung Function in Healthy Women’ (No. 182), 30 April 1976. TNA, FD 9/4168.

Letter from A. MacAuslan of EMAS (Branch H1 of HSE) detailing comments from the statistician to Dr J. Faulkner, MRC, London, 1 April 1976. TNA, FD 9/4168.

Ibid.

Letter from Dr J. E. Box, MRC, London, to Dr J. C. Gilson at MRC Pneumoconiosis Unit, 30 April 1976, and letter from Dr Joan Faulkner to Dr Chapman and Dr Box, 13 April 1976. TNA, FD 9/4168.

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Letter from Dr Joan Faulkner to Dr Alan MacAuslan, 9 June 1976. TNA, FD 9/4168.

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Global Lung Function Initiative 2012 Reference Values in a Swedish Population Sample, *BMC Pulmonary Medicine*, 15:26 (2015), 1602–1611.

85 Stanojevic, S., Wade, A., and Stocks, J., ‘Reference Values for Lung Function: Past, Present and Future’, *European Respiratory Journal*, 36:1 (2010), 12–19.

86 Sumner, J., and Gooday, G., ‘Introduction: Does Standardization Make Things Standard?’, *History of Technology*, 28 (2008), 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 USA.

87 Clarke, A. E., Shim, J. K., Mamo, L., Fosket, J. R., et al., ‘Biomedicalization: Technoscientific Transformations of Health, Illness, and U.S. Biomedicine’, *American Sociological Association*, 68:2 (2003), 161–194, p. 174.

88 Gilson, J. C., and Hugh-Jones, P., Lung Function in Coalworkers’ Pneumoconiosis. (Medical Research Council Special Report Series No. 290) (London: Her Majesty’s Stationery Office, 1955), p. 132.

89 The phrase ‘will to standardise’ is Timmermans and Berg’s, and they use it in reference to the ‘Gold Standard’ in healthcare. See Timmermans, C., and Berg, M., *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 standardised assessment of Alzheimer’s disease diagnosis see Wilson, D., ‘Calculable People? Standardising Assessment Guidelines for Alzheimer’s Disease in 1980s Britain’, *Medical History*, 61:4 (2017), 500–525. For a discussion of the standardisation of audiometric testing within the MRC see Virdi and McGuire, ‘Phyllis M. Tookey Kerridge’. Michael Worboys points out that the MRC invented a new ‘MRC scale’ instead of using the HRSD or Hamilton scale in its study of depression between 1964 and 1965, which supports the claim that the organisation places a high value on standardised scales. See Worboys, M., ‘The Hamilton Rating Scale for Depression: The Making of a “Gold Standard” and the Unmaking of a Chronic Illness, 1960–1980’, *Chronic Illness*, 9:3 (2012), 202–219, p. 210.

90 Cayet, T., Rosental, P. A., and Thebaud-Sorgier, M., ‘How International Organisations Compete: Occupational Safety and Health at the ILO, a Diplomacy of Expertise’, *Journal of Modern European History*, 7:2 (2009), 174–196, p. 177.

91 Timmermans and Berg, *The Gold Standard*, p. 22.

92 Macnaughton and Carel, ‘Breathing and Breathlessness’.

93 Faull et al., ‘Breathlessness and the Body’.

94 Edgar King to Fred Swift, 20 November 1923. Somerset Miners’ Association, Bristol University Library Special Collections, DM 443, Box 6.

95 For my original analysis of this case see McGuire, C., ‘“X-Rays Don’t Tell Lies”: The Medical Research Council and the Measurement of Respiratory Disability, 1936–1945’, *British Journal for the History of Science* 52:3 (2019), 447–465.
96 Ibid.

97 Melling, J., '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, 84:3 (2010), 424–466.

98 Ibid., p. 427.

99 Oxley, R., and Macnaughton, J., 'Inspiring Change: Humanities and Social Science Insights into the Experience and Management of Breathlessness', Current Opinion in Supportive & Palliative Care, 10:3 (2017), 256–261, p. 257.

100 Ibid. This is also true of the subjective and invisible experience of pain, which Joanna Bourke has examined by analysing the metaphors that are used for describing pain, which differ according to time period and participant identity (i.e. their gender, ethnicity and religion). See Bourke, The Story of Pain.

101 Bloor, M., 'The South Wales Miners Federation, Miners’ Lung and the Instrumental Use of Expertise, 1900–1950', Social Studies of Science 30:1 (2000), 125–140, p. 129.

102 Ibid.

103 Melling, 'Beyond a Shadow of a Doubt?', p. 428.

104 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 Cotes, J. E., ‘The Medical Research Council Pneumoconiosis Research Unit, 1945–1985: A Short History and Tribute’, History of Occupational Medicine, 50:6 (2000), 440–449, p. 440. For a more thorough discussion of this remark in the context of the 1930 controversy about miners’ silicosis see Meiklejohn, A., ‘History of Lung Diseases of Coal Miners in Great Britain: Part 3, 1930–1952’, British Journal of Industrial Medicine, 9 (1952), 208–220, p. 211.

105 Interview, D. C. Davies, 1930–1976. South Wales Miners’ Library, Swansea, transcript reference AUD 387, p. 2. The theory was that the irritation in the lungs would cause the men to spit up the silicosis dust.

106 Perchard, A., and Gildart, K., ‘“Buying Brains and Experts”: British Coal Owners, Regulatory Capture and Miners’ Health’, Labor History, 56:4 (2015), 459–480, p. 464.

107 ‘Stuttering’ is aptly used in Melling, ‘Beyond a Shadow of a Doubt?’, p. 430.

108 Perchard and Gildart, ‘“Buying Brains and Experts”’, p. 462.

109 McIvor, A., ‘Miners, Silica and Disability: The Bi-National Interplay between South Africa and the United Kingdom, c. 1900–1930s’, American Journal of Industrial Medicine, 5:S1 (2015), S23–S30, p. S25.

110 Bufton, M., and Melling, J., “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, 49:2 (2005), 155–178, p. 157.

111 Bloor, ‘The South Wales Miners Federation’, p. 129.

112 See Bufton and Melling, “A Mere Matter of Rock” and McIvor, ‘Miners, Silica and Disability’, p. 526.
113 McIvor, ‘Miners, Silica and Disability’, p. 525.
114 Braun, *Breathing Race into the Machine*, p. 143.
115 McIvor, ‘Miners, Silica and Disability’, p. 528.
116 The Silicosis Medical Board in Wales was based in Cardiff. See Dr Gwent Jones, draft report, ‘A Survey on Silicosis in Wales’ (1943). Richard Burton Archives, Swansea University, SWCC, MNC/PP/15/1, p. 19. Henceforth Jones, ‘A Survey on Silicosis in Wales’, SWCC, MNC/PP/15/1.
117 Braun, *Breathing Race into the Machine*, p. 143 and p. 144.
118 *Chronic Pulmonary Disease in South Wales Coalminers: Report by the Committee* (Medical Research Council Special Report Series No. 243) (London: His Majesty’s Stationery Office, 1942), Introduction, p. ix. TNA, FD 41243. Henceforth MRC Special Report 243, TNA, FD 41243.
119 Button, M., and Melling, J., ‘Coming Up for Air: Experts, Employers, and Workers in Campaigns to Compensate Silicosis Sufferers in Britain, 1918–1939’, *Social History of Medicine*, 18:1 (2005), 63–86, p. 75.
120 Button and Melling, ‘“A Mere Matter of Rock”’, p. 161.
121 ‘Report of Court of Appeal Decision Upholding Employers Appeal against Compensation Award’. Various Industries Scheme – Extension to Coal Mines, 1934. TNA, PIN 12/72.
122 Newspaper clipping, ‘Appeals against Compensation Won. Employers’ Protection under Silicosis Scheme. Various Industries Scheme – Extension to Coal Mines, 1934. TNA, PIN 12/72.
123 Button and Melling, ‘“A Mere Matter of Rock”’, p. 164.
124 Ibid., p. 167.
125 Braun, *Breathing Race into the Machine*, p. 143.
126 MRC Special Report 243, TNA, FD 41243, Introduction, p. vi.
127 D’Arcy Hart, P., ‘Chronic Pulmonary Disease in South Wales Coal Mines: An Eye-Witness Account of the MRC Surveys (1937–1942)’, *Social History of Medicine*, 11:3 (1998), 459–468, p. 462.
128 MRC Special Report 243, TNA, FD 41243, Introduction, p. v.
129 Valier, H., and Timmermans, C., ‘Clinical Trials and the Reorganization of Medical Research in Post-Second World War Britain’, *Medical History*, 52 (2008), 493–510.
130 D’Arcy Hart, ‘Chronic Pulmonary Disease’, p. 462; MRC Special Report 243, TNA, FD 41243, Introduction, p. v, which states that the medical survey was undertaken by Hart and Aslett with contributions from Hicks and Yates and the pathological report was made by T. H. Belt with assistance from A. A. Ferris.
131 D’Arcy Hart, ‘Chronic Pulmonary Disease’, p. 462.
132 MRC Special Report 243, TNA, FD 41243, Preface.
133 See ibid., Medical Survey, p. 35 and Preface, p. vii.
134 The four categories were scaled from ‘no, or only slight, respiratory embarrassment’ to ‘breathless at rest’ and included intermediate points. Ibid., Medical Survey, p. 47.
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’, ibid., Introduction, p. v.

Braun, *Breathing Race into the Machine*, p. 145.

Jones, ‘A Survey on Silicosis in Wales’, SWCC, MNC/PP/15/1, p. 12.

Braun, *Breathing Race into the Machine*, p. 145.

Bloor, ‘The South Wales Miners Federation’.

Braun, *Breathing Race into the Machine*, p. 146.

MRC Special Report 243, TNA, FD 41243, Medical Survey, p. 143.

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