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PRINCIPLES AND PRACTICES OF MEDICINE

The Co-existence of Various Anemias.

ABSTRACT. The medical textbooks in our university library present 'principles' as the basis which underlies medical 'practice'. In this article it is argued that this helps different medical logics to co-exist. The example analyzed is that of anemia in the Netherlands. Currently this is defined pathophysiologically, statistically and clinically. These three definitions are intertwined with different strategies for the creation of normal hemoglobin levels and the detection of patients with anemia. The discrepancies between them, however, do not lead to the controversies that might be expected by those who believe in consistency. Instead, the rhetoric of principles-and-practice helps to bring about peaceful co-existence.

Medical textbooks like to have 'principles' as well as 'practice' in their titles.[1] The *principles* are the multiple layers of so-called 'scientific foundation' which 'underpin' the medical enterprise. They stem from basic medical sciences such as anatomy, physiology, biochemistry, pathology, or from the steady accumulation of clinical trials. Their object is the body, its pathology and the natural history of disease. According to the textbooks the principles state the main rationales which underlie medical intervention. The latter form part of medical *practice*. Practice stands for what physicians and those around them do. It takes place in medical surgeries and hospital wards. But the argument goes that while practice rests upon the foundations of principles, extra-scientific factors such as insecurity, pressure, emotions, scarcity, time-constraints, lead it to depart from the ideal.

This rhetoric of 'principles and practice' is common not only in medicine, but is also found in medical sociology and anthropology. In his sociological classic *The Profession of Medicine*, Freidson wrote: "In the course of application, knowledge cannot remain pure but must instead become socially organized as practice" (1970:346). Since he wrote those words sociologists have put a great deal of effort into showing the extent to which social organization influences medical practice.[2] And the same is true for anthropologists. For instance, in the introduction to *Physicians of Western Medicine* medical anthropology is presented as a discipline that can help medicine to move away from the idea that it is 'uniquely scientific'. "An anthropological understanding of biomedicine will situate its practices within a cultural context and elucidate the cultural origins, expectations and values which drive and constrain it."[3]

Concentrating as they did on the social and cultural factors that influence 'practice', sociologists and anthropologists for a long time ignored 'the principles' of medicine. Biomedical 'facts' were supposedly about 'nature', and thus beyond the reach of social science. Even those who did pay attention to the

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theoretical frameworks of biomedicine more often than not defended their work in terms of a dichotomy between a scientific core and a social periphery. For instance, in an otherwise interesting article about the changing criteria of obesity in biomedicine, Ritenbaugh (1982:357) states that these criteria are "not based on biomedical data – [which] suggests cultural forces at work". Biomedical data and cultural forces are thus treated as mutually exclusive.[4]

Recently, however, efforts have been made to abandon this dichotomy and analyze biomedical knowledge itself as another socio-cultural phenomenon.[5] The introduction to *Biomedicine Examined* talks of: "the meanings and values implicit in biomedical knowledge and practice and the social processes through which they are produced" (Lock 1988:3). An early example of an anthropology of biomedical knowledge, which rapidly became a classic in the field of social studies of science and technology, is Latour and Woolgar's (1979) study of the construction of the hormone TRF in the laboratories of the Salk institute. Latour and Woolgar meticulously describe day-to-day life in this Nobel-prize winning laboratory and talk about scientists' dealings with rats, test tubes, measuring machines and the traces they leave on graph paper. By highlighting the actual work that goes into assembling numbers and phrasing articles, these authors demonstrate that facts aren't found, but made. They show, in other words, how the principles of medicine are practically produced.

Like interviewing, operating, assesing X-ray pictures or writing prescriptions, research is a practice, too. What is more: these different types of practice are related. The facts about TRF do not stay enclosed in their original laboratory. They may 'inform' other practices, including those to be found in hospitals. Once TRF is made, moreover, once its chemical composition is determined, it isn't just a word in an article, a fact in theory, and another element to be listed by textbooks under the heading 'hormones'. It is also a material entity that can be industrially produced. As a material entity, TRF leaves the laboratory to be used elsewhere. It is used in other laboratories, but also, perhaps, in hospitals. The principles of medicine, then, are practically produced and in their turn help to produce other practices. The links between 'research networks' and 'clinical networks' – as Latour and Woolgar call them – take all sorts of forms.[6]

Studies such as Latour and Woolgar's *Laboratory Life* undermine the standard conceptions of science. There is no such thing, they argue, as pure science which articulates principles which then get dirtied in the harsh and messy social world when they are 'applied' in practice. The construction, evaluation and reconstruction of scientific facts are as social – and material – as anything else. They are practices in their own right. This means that how these practices are linked with others, for instance in industrial or hospital settings, is an interesting empirical question rather than a stable characteristic of 'science'.

In line with this tradition we refuse of the principles-and-practice rhetoric and use sociological and anthropological techniques to analyse the 'hard core' of biomedicine. The rhetoric is, indeed, like a shield, one among many, which protects the so-called principles from study by social scientists. But it does more than this. We want to argue that calling some things 'principles' and others 'practice' is also a way to make divergent medical logics co-exist peacefully. This implies that analysing instances of the principles-and-practice rhetoric may be helpful if one wants to study the *heterogeneity* of medicine.

While showing convincingly that principles and practice are intertwined, scholars in the social studies of science haven't given diversity in medicine – or, for that matter, in other disciplines – the attention it deserves. To be sure, there have been many controversy studies, but these have focused on closure. The point has been to show that winners and losers are not determined by 'nature' or 'reality', but by a wide range of social and material factors. What has seemingly been forgotten, however, is that in controversies often nobody wins nor loses. Many controversies do not end with victory by one party but rather by loss of interest on all sides. If they are somehow able to divide their common field divergent approaches may stop fighting – or never engage in conflict in the first place. This heterogeneity, the co-existence of divergent logics, is very common in medicine,[7] and the rhetoric of principles-and-practice is one of the ways in which such incompatibilities are pacified.

In this article we develop this argument by analysing texts about 'anemia' circulating in Dutch medicine. The Netherlands has a mixed medical culture. There are strong local traditions. For instance, general practitioners see all patients who come to visit them, and refer only about ten percent to separate hospital-based specialists. Again, intellectually, in the past Dutch medicine looked east. Before 1940 in the Netherlands most textbooks were read – and many written – in German. Nowadays, however, medical textbooks used for teaching purposes and the journals in medical libraries are mostly in English, whether from American, British, or other sources, while a few are in Dutch.[8] These are the mixed textual materials we found in two Dutch university libraries which we used as the material for this article. And if we make statements about medical practice, it is to *the Dutch situation* we allude.

Periods of observation in various medical settings allowed us to observe what has often been underscored by medical anthropologists: "It cannot be assumed that medical texts reflect very closely what clinicians actually do" (Lock 1985:124). Yet the material mobilized throughout this article consists mainly of quotations taken from textbooks and journals written for hematologists, general practitioners and medical students. These texts are not only about bodies and diseases, but also instruct current and future physicians how to act. As they contain a wealth of detail, we wanted first to analyze these before turning to the details and surprises yielded in interviews and observation. We therefore examined the 'principles' and 'practices' from a restricted corpus of medical texts.[9]

The results of this analysis will be presented in several steps. The first fits the traditional scheme: proposed practices often simplify the principles on which they supposedly rest. Such practices have too many other things to reckon with. The second is more surprising. There are shifts between the logic inherent in prescribed practices and the logic inherent in the underpinning principles: they simply do not deal with the same 'anemia'. The third demonstrates that a logic that is said to be 'merely practical' at one point may elsewhere be known as 'a good principle'. The principles-and-practice rhetoric, we conclude, allows the various logics regarding 'anemia' that medicine incorporates, to exist side by side and avoid controversy.

SIMPLIFICATIONS

In the classical picture of the relation between medical principle and clinical practice, the latter falls short of the ideal stipulated by the former. We start by giving an example that fits this picture rather well. It serves as a good contrast to the more surprising relations between principles and practice which follow.

In current medicine, the question of whether a patient has anemia is not answered until the hemoglobin level of her blood has been measured. The laboratory is called in: "The only way to reach an accurate diagnosis, upon which rational treatment of any blood disorder can be based, is to use the laboratory" (Smith 1984:146). When does the hemoglobin level found in the laboratory become a reason to label a patient 'anemic'? The number in itself, or so the medical textbooks explain, does not tell the whole story: there is a lot to be reckoned with while interpreting it. Pages and pages are devoted to listing warnings about variables that may influence the results of hemoglobin measurement. "One [subject in a study] who had 123% hemoglobin after a steam bath recorded 108% hemoglobin one hour later after having drunk 600 g of water" (Natvig 1963:357).[10] Was the patient sitting, standing or lying down when her blood was tapped; was blood taken from a vein or a fingertip, in the morning or late in the afternoon, in warm or cold weather, before or after the patient drank a pot of tea?[11] And which measuring method was used? "The results differ depending on the technique employed. ... One should know what techniques have been used when evaluating a blood count" (Helman and Rubenstein 1974:37).

The textbooks also warn that the doctor should interpret individual laboratory hemoglobin levels in the light of the reference values most appropriate for the individual under consideration. Reference values vary significantly between people living at different altitudes, amongst children of different age groups, between children and adults, between males and females, non-pregnant and pregnant women, etcetera.[12]

While on one page a textbook may extensively explain the principles of blood tapping, measurement techniques and population specificity, and state that these must be taken into account, on another page that very same textbook may resort to a more *do-able* form of advice:[13] "Clinical suspicion of anemia must always be confirmed with a blood count, remembering that normal haemoglobin levels vary with both age and sex by as much as 4 g/dl, so that 'anaemia' may be overdiagnosed in children and in women if they are expected to have the haemoglobin level of men" (Smith 1984:147).[14] Of all the factors relevant to the selection of the appropriate reference group, only age and sex are mentioned here. And the complications of blood tapping methods and measurement techniques have entirely disappeared from this practical instruction.

A more concise general practice textbook even states bluntly: "Anaemia is a deficiency of blood haemoglobin level below 12 g per 100ml" (Fry 1985:189).[15] For all practical purposes, as a routine, so long as a hemoglobin level is above 12 g/100 ml all is well. The general practitioner should only start thinking if the form on which the laboratory technician has written the patient's hemoglobin level shows a number below the magic level of 12 g/100ml. There is actually a technological device in which the magic line of 12 g/100ml has been incorporated. It consists of screw-cap reagent bottles containing a medium in which a precise quantity of perchloric acid has been dissolved and to which exactly 20 microlitres of blood must be added. "The colour change from pink to blue occurs over a range of haemoglobin content from 12.0 to 12.7 grammes per cent and in this range an intermediate colour is observed" (Watt 1972:218). Wherever this *ferrotest 80* kit goes, the colour pink – that is a hemoglobin level below 12 g/dl – indicates anemia.[16]

Many of the complexities of hemoglobin measurement and interpretation are circumvented in everyday clinical practice. Some criticize these simplifications, saying they reduce the rationality of medicine. Others believe them to be an achievement: if clinical practice were to try to take overly complex principles into account, it would become a cumbersome affair and make too many mistakes. Simplification, then, is a means by which clinical practice can be optimized. Still others just live with simplifications because, whether rightly or wrongly, they have been incorporated into existing techniques and procedures and thus appear to be there to stay.

A SHIFT: PATHOPHYSIOLOGY AND STATISTICS

In clinical practice some of the complexities raised by textbooks principles are left out: this is something 'everybody knows'. Social scientists – and general practitioners – have pointed out that at the same time many *new* complexities enter the scene. How to decide which patient has to be checked? How to get the patient to go to the laboratory to have a blood sample taken? How to make sure the laboratory sends its results back quickly? How to communicate these results to the patient in a comprehensible manner? And under what circumstances do doctors indeed go to all this trouble? This is where the importance of 'social and cultural factors' – of whatever happens in doctors' offices – has been highlighted. We are not going to contribute to that argument here. The question we want to address is the difference between principles underwritten and practices performed. Is this simply a question of the number or nature of the complexities involved? To ask the question is to suggest an answer, and the answer is: no. For it is also the case that the logic at work in the so called principles differs from that at work in practices that are said to draw on these.[17]

To illustrate this, let us now turn to the problem of the *normal hemoglobin level*. In the laboratory, hemoglobin levels are measured. Against what standards are these hemoglobin levels assessed? When is a hemoglobin level considered 'too low'? When is it called 'normal'? The textbooks state that the hemoglobin molecules in red blood cells bind oxygen in the lungs and release it in the tissues. In line with this, pathophysiology teaches that a hemoglobin level is normal if the quantity of hemoglobin in the blood is sufficient to carry the required oxygen to the tissues and abnormal if compensatory mechanisms have to try to counterbalance its shortage.[18] Pathophysiology is thus concerned with the *oxygen supply to the tissues*. If this supply fails or is in danger of failing, pathophysiology speaks of 'anemia'. Since the actual hemoglobin level needed for a sufficient oxygen supply varies between people, the pathophysiological criterion for anemia centers on the individual. Indeed, since the need for oxygen varies between organs, it can even be stated that "in essence, each organ within each patient sets its own functional definition of anemia" (Keitt 1988:879).

In medical textbooks this pathophysiological story is presented as one of the principles of anemia. These same textbooks explain that in current medical practice, the standards for anemia are *not* made separately for each and every individual – let alone for everyone's different organs. In the laboratory the hemoglobin levels of large numbers of people belonging to distinct populations – usually men, pregnant and non-pregnant women and children of several different age groups – are measured. A gaussian curve is subsequently drawn through the measured points. The reference value, the 'cutoff' point, or lower limit of a 'normal hemoglobin level', is then defined by drawing a vertical line at some point through this curve. This point is set at the value of two standard deviations below the mean of the population, so that 95% of the values are included in the normal range, or in some other slightly different way.[19]

The link between pathophysiology and this statistical approach is not a relation between a complex principle and a practice that is simple. Nor does it become any clearer by specifying some social factor that makes statistical practice messier and less scientific than the principles of pathophysiology.

Something else is happening here. Pathophysiology and laboratory statistics do not refer to the same object. They each define 'anemia' in their own way. One of the textbooks we examined even states this explicitly: "Pathophysiologically, anemia is defined as a condition in which the circulating hemoglobin is reduced to levels that are inadequate to oxygenate the peripheral tissues, but in the laboratory it is defined by hemoglobin or hematocrit levels more than 2 SDs below normal values" (Sonnenwirth and Jarett 1980:903).

The two definitions are not interchangeable. There are discrepancies between them. Most hematology textbooks cite these discrepancies and then explicitly distance themselves from the statistical definition of anemia. "By convention the normal range is defined to include 95 per cent of a reference population that is assumed to have a normal (gaussian) distribution. In this definition 2.5 per cent of 'normal individuals' will fall below this arbitrary statistical limit and be classified as anemic" (Keitt 1988:878). The authority of the 95 percentage line is undermined by calling it a mere 'convention' and an 'arbitrary limit'. One may fall outside its range and still be a 'normal individual' in a pathophysiological sense. "Some of these individuals in the general population will be truly anemic, while others are statistical outliners" (id.). 'Truly anemic' here means: anemic according to pathophysiology. If pathophysiology is taken to represent the truth, some 'statistical outliners' are falsely treated as being ill.

Inversely, some of the people within the limits of the statistically defined 'normal range' may have hemoglobin levels that, according to pathophysiology, are too low *for them* – which implies they are 'anemic'. The textbook (talking about the hematocrit, the volume of red cells, a value closely related to hemoglobin level) puts it as follows: "Unfortunately this statistical definition of anemia may fail to detect truly anemic patients whose hematocrits have decreased significantly without leaving the defined normal range" (id.). The textbook points out that there is a way to escape the imperfection of statistics. It consists of knowing the personal 'normal value' for the individual one wants to diagnose: "Here the only valid reference figure is a previous hematocrit in that individual" (id.). Sometimes, more or less by accident, a patient's file contains a previous hematocrit or a previous hemoglobin level that can serve as a pathophysiologically solid standard. But a collection of individual 'normal values' is not institutionalized as a routine.

Here we have hit upon something crucial. At present, laboratories work along statistical lines. This could be different. A practice of establishing normal values in line with pathophysiology is conceivable: it would require a health care system in which everyone went to see a general practitioner once or twice a year to have some blood tapped. The most important parameters of this blood would then be measured and written down in the patient's file. So long as the patient had no symptoms, the measured values would be taken to be her own physiologically normal values. As soon as the values suddenly dropped or rose, further investigation would be indicated. And if a patient came to see her doctor with symptoms that might be related to anemia, the doctor could compare her blood values of that particular moment with her normal ones that had been measured several months earlier. Thus, pathophysiology not only defines 'anemia' differently from statistics, but also offers suggestions for a different practice for setting the normal values used in its diagnosis.[20]

As it is, such a practice only has a marginal existence. The previous hemoglobin values of patients are sometimes used as a reference if they happen to be known. Urging its readers not to overlook slight anemia (which may be an important clue to the presence of 'a disease that might be readily amenable for treatment'), a hematology textbook states: "valuable points of reference are previous blood examinations of the patient in question; a reduction of 10% may be the first clue that something is amiss, even if the new values are within 'normal' limits" (Wintrobe et al. 1981:530). The normal limits set by statistics are put between quotation marks. A better way to proceed is suggested: look at previous blood examinations of the patient in question. But this pathophysiological suggestion is not pursued with so much fervor that the readers are advised to always keep track of all their patients' normal values. A patient's personal norms can be used if, by chance, they happen to be noted somewhere in her file.

Pathophysiology does not contain the principles underlying the current practice for assessing normal hemoglobin values. This practice follows a statistical logic. A practice creating standards along pathophysiological lines is conceivable – but despite all their warnings against statistics, hematology textbooks never advocate it seriously. Pointing to the gap between statistical and pathophysiological anemia does not lead to proposals for another course of action. No conflict is staged. It is acknowledged that a statistical definition of anemia has been incorporated into the current medical standard setting. A few lines before revealing the 'flaws' of a statistical definition of anemia, one of the textbooks we analyzed states as a simple fact about current medical practice that: "Anemia is defined as a reduction in the hematocrit or the concentration of hemoglobin in a sample of peripheral venous blood when compared with similar values obtained from a reference population" (Keitt 1988:878). At the end of that very same page the statistical 'normal values' are carefully listed in 'table 132–2' (id.). That is impressive. There they are, for every reader to memorize and use when evaluating the hemoglobin levels of the patients who come to her office. 'Truly anemic' is pathophysiologically anemic. These are the principles this textbook adheres to. But meanwhile the readers are taught how statistics can be put into practice.

A TURN: STATISTICS AND THE CLINIC

Textbooks write about the pathophysiological as well as the statistical way of setting standards without making too much fuss about the discrepancies between them. They do so by presenting the pathophysiological approach to standards as part of medicine's 'principles' and the statistical one as its 'practice'. The principles-and-practice rhetoric, we therefore hold, is instrumental in avoiding conflict. It facilitates the peaceful co-existence of the diverging logics contained in medicine. This interpretation is supported by the fact that a logic designated as 'merely practical' in one content, can suddenly be 'a nice but unpractical principle' in another. To elaborate this, we now move from the practice of producing hemoglobin standards to a place where these standards are used.

It is hard to find pathophysiology in the office of a Dutch general practitioner. The instruments used by physiologists to assess the oxygen saturation of the tissues are nowhere to be seen. The compensatory mechanisms making up for low hemoglobin levels can only be detected in physical examination in extreme and exceptional cases. The data on previous hemoglobin values needed to determine an individual's normal level are lacking. So much for the practical existence of pathophysiology in the general practitioner's office. The general practitioner does dispose, however, of statistically created hemoglobin standards. They are printed on special forms handed out by the local laboratory. Patients or their blood can be sent to this laboratory where their hemoglobin levels are measured. But which patients should be sent? Whose blood warrants hemoglobin measurement? Once that is decided, a general practitioner's biggest problem is over: taking statistical standards as a guideline, the laboratory will answer the question 'does this patient have anemia'. But the work of a general practitioner doesn't start with a rack of test tubes filled with blood. At the outset there are only patients.

General practitioners could, of course, try to find all those with anemia in the entire population for which they are responsible. This would imply screening all their patients, say every year or two, for low hemoglobin levels.[21] As anemia can be one of the first signs of severe underlying pathology which might thus be detected and treated, screening for low hemoglobin levels is sometimes proposed. But though it may be good idea in principle, in practice the textbooks say this is not so. "In theory there appears to be a good case for regular mass population screening for anaemia but in actual practice it is much better to be aware of the possibility of anaemia and to concentrate on selected known cases at follow-up and on special at-risk groups" (Fry et al. 1976:487). So general practitioners do not go out to tap blood from all their patients, but stay in their offices and wait for patients who come to them with the relevant *symptoms*.

The symptoms of anemia differ somewhat from one textbook to another. Lack of iron or loss of blood, a 'comprehensive account of clinical medicine' teaches:

"leads to the gradual onset of the symptoms of anaemia, with lethargy, weakness, dizziness and palpitations particularly on exertion. In addition, the hair and nails may become brittle and the nails spoonshaped (koilonychia). Pruritus vulvae may occur and, in severe cases, cerebral irritability and even cerebral oedema may arise" (Lich 1990:1044).[22] Another book gives the following list: "Heart murmurs are a common cardiac sign in anemia. ... Loss of normal skin elasticity and tone, resulting in a dry, shriveled appearance, has been described. ... Headache, vertigo, tinnitus, faintness, scotoma, lack of mental concentration, drowsiness, restlessness, and muscular weakness are common symptoms of severe anemia" (Wintrobe et al. 1981:534–5).

A third definition of anemia pops up here: one that is clinical. It differs from both the pathophysiological concern with tissue oxygen supply, and the statistical concern with the gaussian distribution of population hemoglobin levels. The clinical definition is concerned with complaints, impairments, dysfunction. Clinically, 'anemia' is an ailment, an affliction.[23] When it comes to whose blood should be measured, it is the clinical definition of anemia that is incorporated into the current organization of general practice. Only patients with the relevant symptoms are 'suspected of anemia'. This clinical organization implies that not every patient with a hemoglobin level below the statistically set norm is detected. Some patients who are statistically anemic have no symptoms. They may never show up in their doctor's office, since they do not feel sick. "Many women who are found to be anaemic, present no symptoms and the finding is often incidental" (Fry et al. 1976:484). Only because their blood is examined for some other reason are their hemoglobin levels incidentally found to be too low. In some cases, the absence of symptoms even coincides with hemoglobin levels that are very far below the statistical norm – whether it is 12 or 10 g/100 ml. "It is surprising what severe degrees of anemia, below 5 g/100ml, may be compatible with the normal duties of a mother and housewife" (id.).[24]

There is a discrepancy between the statistical and the clinical logic regarding anemia. 'Severe degrees of anemia' – in a statistical sense – may go undetected if the question whether or not people's hemoglobin levels are measured depends on a clinical logic. Yet this does not lead to any controversy. Screening, though it may be 'a good principle', is not advocated as a better practice. It would be difficult, for one thing, to make each and every patient comply with a screening procedure. Moreover, screening only makes sense if there are enough deviants in a population. Otherwise, statistics teaches, the false positives due to measurement problems may outnumber the 'real anemics'. Difficulties such as these are presented to explain why a clinical logic is currently incorporated into the organization of general practice. In another context, that of the hospital, screening for low hemoglobin levels is indeed performed. Patients admitted to a hospital cannot but comply and in a hospital population real deviants tend to outnumber false positives. Thus hospitals may follow a statistical logic in their detection of anemia.[25]

Clinical logic is incorporated into the organization of the detection of patients with anemia in general practice. It is said that statistics is a nice principle, good elsewhere, but impractical for us. So, in the principles-and-practice rhetoric, statistics does not always occupy the practical pole. In relation to pathophysiology and the question of normal values, it does. But when it comes to the question of whose hemoglobin should be measured in general practice, statistics finds itself on the side of the principles. The detection of those with anemia follows a clinical course. This practice, again, cannot simply be said to fall short of the ideals of statistical principle, but incorporates a rival definition of anemia. This becomes more articulate in the (rare) articles by authors who are prepared to defend this rival definition explicitly. Their defence of clinical anemia shares with pathophysiology the critique of the 'arbitrariness' of statistical norms for normal hemoglobin levels. "Haemoglobin concentration is best considered as a continuous quantitative variable and, if it is, then any so-called 'lower limit of normal' is seen as an arbitrarily chosen point in its distribution" (Elwood et al. 1969:615). From a clinical perspective, however, a non-arbitrary 'lower limit of the normal' would not be the point where the oxygen level of the tissues risked becoming insufficient, but the point where patients start to be hampered by their lack of hemoglobin and consequently exhibit the clinically recognizable symptoms of anemia.

According to clinical logic, people have no anemia as long as they have no symptoms. This raises the question of whether there is a hemoglobin level below which people start to have symptoms. The authors quoted above set out to answer this question by studying a population of women in Wales. In the region where the study was conducted, the statistical standard for the hemoglobin level of women was 12 g/dl. The authors excluded women with levels lower than 8 g/dl from their research-sample. They conclude: "We failed to obtain any convincing evidence of a significant association between any of the 6 symptoms studied and haemoglobin level" (Elwood et al. 1969:24).[26] Many of the women who had hemoglobin levels below 12 g/dl did not have any symptoms, only some of them did. To answer the question whether the women with symptoms did indeed have anemia, they were given iron treatment. Symptoms caused by anemia are likely to improve from iron treatment since a lack of iron is usually part of the anemic pattern. None of the patients with symptoms, however, improved upon iron treatment, so it was unlikely that they had anemia in the first place. As the authors found no relation between the symptoms and hemoglobin levels below 12 g/dl and above 8 g/dl, they suggest that only patients with hemoglobin levels below 8 g/dl or maybe even 6 g/dl have the kind of symptoms textbooks attribute to anemia.

A clinical definition of anemia can be endorsed and used to attack the current statistical standards. A few researchers have done so in journal articles. But general practice handbooks do not quote these articles to defend office-based detection of those with anemia. They do not state that screening for anemia is wrong because it doesn't make sense to diagnose and treat people on the basis of a norm arbitrarily set by statistics. They do not claim it is their task to do something about ailments, not about deviance.[27] The current habit of office-based general practice is never defended in this way. No conflict over principles is waged in this matter. Statistical principles are never undermined, attacked, discarded – or even discussed. They are merely set aside as impractical.

CONCLUSION

The principles-and-practice rhetoric suggests the existence of a set of consistent principles about 'anemia' explaining what anemia *is*, and a practice for *handling* anemia based upon these principles. The practice, or so the rhetoric goes, may deviate from the guidelines set by the principles because it is influenced by social and cultural factors and has to fit it into a local setting. In recent social and anthropological studies of science this rhetoric is denounced as a shield protecting the principles from being studied by social scientists. We claim, however, that the principles-and-practice rhetoric doesn't *merely* do that. We suggest that it also helps *different* explanations of what anemia is and *different* ways to handle anemia, to co-exist, side by side, in peace.

Pathophysiology doesn't just define anemia as a lack of oxygen in the tissues, it also contains suggestions for the practice of drawing up standards. If one were to take anemia as a matter to do with individual body requirements for oxygen, one would draw up standards on the basis of personal records. Where standards are established with the aid of population surveys, however, pathophysiology isn't applied. Another definition of anemia is inherent in this practice. Standard-setting by statistical means defines anemia as a deviant hemoglobin level. Pathophysiology and statistics differ both at the level of the definition of 'anemia' *and* at that of setting standards. At the level of definition anemia 'is', on the one hand, a lack of oxygen, and on the other a hemoglobin level below the statistical norm. At the level of medical practice good standards are, on the one hand an individual matter, and on the other a question of investigating large numbers.

The clinical logic of anemia also works at these two levels. In contrast with both pathophysiology and statistics, it defines anemia in terms of a specific series of signs and symptoms. These signs and symptoms are the clinical clues for the detection of anemia and they form the clinical reason to try and do something about it. Whereas statistics might suggest that in a specific population anemia should be detected by screening, in the logic of the clinic this is a bad idea. By screening one detects people without complaints who happen to have hemoglobin levels below the statistical cut-off point. From a clinical point of view it is wrong to call these people 'anemic'. The clinical approach to detection is to wait for patients who come to the doctor's office and present their complaints.

Medicine, in short, contains several divergent *logics*, encompassing both an object definition and a strategy for handling that object. The definitions and the strategies both imply each other: neither has priority over the other. A definition of anemia, whether explicit or not, is inherent in any practice handling it. And a way of handling anemia, whether broadly practised or not, is presupposed or proposed in any articulation about it. At some points, the various logics which make up medicine can be inconsistent.[28] The consequence of following one logic rather than another may clash. Several of these collisions have been described above. Using personal hemoglobin standards, and working with standards based on population statistics, gives the same results in many but not all patients. Some patients will be diagnosed as anemic according to one logic and not according to the other. And the clinical detection of anemics implies a different organization of health care than that suggested by the need to find all statistical deviants. Only one of these can be brought into being at any given time.

The differences in medicine do not, however, lead to the controversies that might be expected by those who believe in consistency. They are not fought out to the end – that is until either one of them wins or a third approach takes over. Medicine doesn't aspire to consistency. Instead, it encompasses many divergent logics. Their co-existence assumes several shapes. One is that each logic *literally* has a different place in medical practice. For the Dutch situation, some of these places were outlined here. In *general practice*, the detection of anemia is organized along clinical lines, whereas in *hospitals* it is done statistically. Or: the *detection* of anemia in general practice may be organized along clinical lines, but when it comes to make *diagnoses*, the general practitioner sends a blood sample to the laboratory for hemoglobin measurement.[29]

Another shape taken by the co-existence between diverging logics is that each logic is *figuratively* accorded a place of its own. This is done when one logic is supposed to tell the *truth* about an object, while another is used to *handle* it. In the example discussed these divisions of tasks take the following shape. Pathophysiology is granted the honor of formulating the principles of anemia, even when statistics are used when it comes to creating standards. General practitioners who detect patients with anemia in practice by waiting in their offices for people who come to present their symptoms, may nevertheless state that screening might be a good idea in principle. 'Principles' and 'practice' are turned into virtual places. So long as a logic stays in its habitual place, it doesn't clash with a contradictory logic located somewhere else.

Setting principles and practice apart facilitates the co-existence of inconsistent logics, just like the regional division of medicine into general practice and hospitals; or 'detection' and 'diagnosis'. But there is a difference. Saying that one logic forms a part of medicine's principles while locating another in medical practice is not only a specific way of separating two logics. It is a specific way of linking them as well. The logic called 'principles' is presented as *underlying* what is done in 'practice'. Medicine thus appears to be a solid whole. Not a heterogenous assemblage of bits and pieces with frictions between them, but something with practices founded on principles. At the same time, the status of the two logics is not symmetrical. One logic, by calling it a principle, is granted the truth. The other, by being put into practice, gains the world.

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NOTES

1 Some examples: V. de Vitta, S. Hellman and S. Rosenberg, eds. Cancer. Principles and Practice of Oncology. Philadelphia: J.B. Lippincott Company 1984; T. Speight. Drug Treatment. Principles and Practice of Clinical Pharmacology and Therapeutics. Auckland: ADIS Press Limited 1987; A. McGehee Harvey, et al., eds. The Principles and practice of Medicine. New York: Appleton-Century-Crofts 1980; S.L. Turek, Orthopaedics. Principles and Their Application. Philadelphia: J.B. Lippincott Co. 1984; G. Mandell, R. Douglas and J. Bennett, eds. Principles and Practice of Infectious Diseases. New York: Churchill Livingstone, 1990; J. Macleod et al., eds. Davidson's Principles and Practice of Medicine. Edinburgh: Churchill Livingstone, 1987.

2 See for a good recent example: Clark, Potter and McKinlay (1991).

3 Gaines and Hahn (1985:11).

4 Ritenbaugh claims that only a distinction between 'biological data' and 'biological categories' allows us to analyze the categories of biomedicine as cultural phenomena.

Thus she seems to forget something she herself underlines a little further along in her article: data do not fall from the sky. Ritenbaugh uses the example of anemia. She says that hemoglobin levels are 'data' while the distinction between normal and abnormal hemoglobin levels are cultural categories. In what follows, we try to make clear that 'measuring hemoglobin levels' is not a self-evident activity. It is a technological and human effort, not undertaken everywhere, not even everywhere inside western medicine. Moreover, it can take many forms. The production of these things called 'data', then, is a (sub!)cultural specific practice – amenable to social scientific analysis.

[5] One of the reasons social scientists defended a cleavage between knowledge of the natural and knowledge of the social was to protect social phenomena from usurpation by natural scientists, especially biologists. That strategy is endangered when social scientists start to analyze biomedicine and thus cross the mutual boundary from the other end. Is this a great danger? We don't think so, as the strategy of 'domain protection' isn't a very strong one in the first place (Mol 1991).

[6] For recent studies in a similar vein, exploring the links between research practice and clinical practice see Fujimura (1992) and Vos (1991). For earlier examples of studies of medical knowledge see Wright and Treacher (1982). And for a recent hospital field study focussing upon medical knowledge in daily physician's work see Berg (1992).

[7] See also Mol and Lettinga (1992). This attention to heterogeneity is, of course, also the concern of many other sociological and anthropological studies. Some go into differences between national or regional traditions, others point out how different specialties cherish different approaches of the 'same' disease, still others analyze how single physicians cope with the heterogenous knowledge resources medicine puts at their disposal (Mc Crea & Markle 1984; Vos 1991; Engelhardt 1984; Helman 1985). More often than not, however, these studies focuss on such things as 'concepts of disease' (e.g. Engelhardt 1984) or 'explanatory models' (e.g. Helman 1985). Thus their language incorporates a distinction between the cognitive process of conceptualization and explanation (principles) on the one hand and research activities and clinical activities (practice) on the other.

If one wants to escape this dichotomy, one has to look for other words. In this article we attempt to use the term 'logic' as encompassing both the conceptual and the practical handling of an object. Like the Foucauldian term 'discourse', however, 'logic' has a connotation which is more cognitive than we would like. We didn't opt for 'discourse' because, even if a 'discourse' contains words as well as buildings, it is mostly used to designate something big and all-encompassing. This hinders the study of heterogeneity. We didn't use the other obvious possibility, 'network', either. This is because a 'network' stands for a series of elements with linkages between them, and we want to say something specific about the linkages in the networks we study. This is that they make a story, have their own specific coherence, their own 'logic'. We would prefer a better word but, so far, we haven't found one.

[8] In sociology, anthropology and philosophy the Dutch situation is far more complicated, as many Dutch scholars read Dutch, English, German and French literature, or at least three out of these four. This international orientation is something we seem to have to pay for by adressing the local intellectual problems of others in the illusion that one thus surpasses the local – i.e. the Netherlands. Being fluent in a language spoken by little more than 20 million people – in the Netherlands and Belgium – has its drawbacks. We cannot write in Dutch and be 'international' at the same time. Note that this article is in English.

[9] Besides assembling all the – scarce – Dutch material, we searched two university libraries, one in Maastricht and one in Utrecht, for British and American textbooks on general practice and family practice, hematology, internal medicine and laboratory medicine. Interesting differences between the Dutch, British and the American sources could be derived from this. For instance, in most British books on general practice the chapter on hematology is written by a general practitioner, while in American family practice books these chapters have hematologists as their primary author. As we found a similar pattern of frictions between 'principles' underscored and 'practices' prescribed in

all textbooks, however, we decided not to go into national differences – which would be another possible route to the heterogeneity of biomedicine. Taking that additional level of variations into account here would have made our text unduly complex. Besides textbooks, we used several articles found through the Index Medicus and MedLine on the problem of setting standards for normal hemoglobin levels.

[10] The hemoglobin level measurement units varied over the years and still vary in different countries. In this quotation percentages are used: 100% stands for the alleged normal level of the population to which the measured patient belongs. It is not used any more. In most of the English literature the unit of preference is g/100 ml of g/dl, although since the molecular weight of hemoglobin is known, international agreements propose mmol/l as a unit for hemoglobin levels. In the Netherlands these international agreements are followed. As much of the medical literature read in the Netherlands is in English, translation problems abound.

[11] *Cf.* Dacie and Lewis (1984:5), Ravel (1984:14) and Linné and Ringsrud (1979:185).

[12] See, e.g., Sonnenwirth and Jarett (1980:795), Linné and Ringsrud (1979:191), Williams et al. (1983:9–10). In the United States there is a discussion on the question whether 'whites' and 'blacks' in the United States should be measured against different standards. The question is whether the lower hemoglobin levels of 'blacks' should be attributed to genetic factors and count as a population characteristic or to environmental factors and count as a sign of pathology. In tropical medicine this discussion takes yet another form. See: A. Mol and R. Hendriks, A Moral Geography of Anemia, in preparation.

[13] Making things 'do-able' is not specific for medical practitioners. 'Fundamental' scientists do so as well. For the way scientists make things 'do-able', see J. Fujimura (1987).

[14] Note the asymmetry in this quotation: the warning is not that men will be underdiagnosed if they are expected to have the hemoglobin level of women or children.

[15] This case of proposing one unique standard is rare: most textbooks, in their practical advice, reckon at least with age and sex differences.

[16] Our point here is not that the ferrotest 80 is widely used. It isn't: since its introduction in the early seventies it has become more and more common to transfer the measurement of hemoglobin from the general practitioner's office to a fully equipped laboratory. But this observation doesn't undermine the fact that practices may get inscribed in techniques and thus solidify. See for the inscription of practices in machines: Akrich (1992).

[17] We do not focus on social or cultural *influences upon* medicine, but on the heterogenous *logics within* medicine. In this we follow the strategy set out by Latour in his analysis of 'the pasteurization of France'. Instead of a sociological explanation of Pasteur's successes or a history of the cultural influences upon Pasteur, Latour presents a semiotic reading of the texts written in Pasteur's times. This reveals not only the biology but also the sociology they contain. See Latour (1989 and 1991).

[18] Such compensatory mechanisms include increased respiration, increased and redistributed blood flow and a reduced hemoglobin oxygen affinity at low oxygen tension. See e.g. Wintrobe et al. (1981:531–533) and Williams et al. (1983:58–60).

[19] For an insightful historical analysis of the gaussian curve see Hacking (1990).

[20] Here we have an example that nicely illustrates that 'data' have to be made. It even makes clear that there is no neat division between 'research practice' and 'clinical practice'. In order to assemble a certain type of *knowledge*, in this case that of individual hemoglobin levels, a specific *organization of the clinic*, one in which people without complaints visit their doctors regularly, is required.

[21] In this case measuring everyone's hemoglobin level would not be a way to find their individual normal values. Normal values would already be set by means of statistics before the screening procedure started. Measuring everyone would be a way to find deviants: people with hemoglobin levels below the statistical standards.

[22] Lich, 1990, p. 1044. According to the handbooks iron deficiency is the most frequent type of anemia. One of its causes is excessive blood lost, caused in turn by afflictions

ranging from cancer to parasites, to menstruation problems.
[23] This 'ailment' is partly defined in terms of the stories patients tell about themselves and partly in terms of what doctors observe in a physical examination. Traditionally, medical sociology differentiates between 'illness', the patient's story – understood either in psychological or in cultural terms – and 'disease', the object of biomedicine. Here we see, however, that the clinically defined 'disease' anemia contains the patient's story as one of its necessary ingredients. Moreover, patients often come to see their general practitioner with questions like "can I have my hemoglobin level checked, please?" Thus even laboratory anemia isn't necessarily foreign to patients' self-perception. The interweavings are numerous (Willems 1992).
[24] This quotation nicely illustrates the incorporation of presumptions about people's social lives in disease definitions.
[25] Let us underline here that we are not discussing the 'opinions' or 'frames of mind' of physicians. A general practitioner may well *believe* that a low hemoglobin level is 'really' what anemia is about, while the symptoms are 'only symptoms'. But that doesn't prevent her from working in a practice organized along clinical lines. And a specialist at a hospital where screening for anemia is done routinely may not *believe* in screening, but has to live with it. It would be far too much trouble to make an exception for her patients and not measure their blood values until the need would arise. What we are discussing, then, is not people's beliefs, but logics incorporated in practices.
[26] The symptoms studied were: irritability, palpitations, dizziness, breathlessness, fatigue and headache.
[27] This is a principle defended by many philosophers who explore concepts of health and disease. For a classical attack on a statistical conception of disease and a defence of a clinical one see Canguilhem (1978).
[28] To a certain extent our approach can be compared to Engelhardt's (1984) pragmatism. With the example of tuberculosis, he proposes to end the philosophical quest for one disease model and instead start an inquiry into the different disease models various medical practices entail. Engelhardt's pragmatist idea that some approaches happen to be 'practical' in one context and others in another, however, glosses far too easily over the discrepancies and frictions between different possible practices.
[29] That different logics reign in different 'places' has so far mainly been investigated by taking either social groups or geographical areas as their locations. For a study which combines these, see McGrea and Markle (1984). They nicely show that in the USA researchers and feminist groups tend to oppose estrogen replacement for (post)menopausal symptoms while medical practitioners favor it, whereas in the UK practitioners tend not to prescribe estrogens although researchers and feminists encourage them to do so. For a conception of space that goes beyond that of mutually exclusive places, see: A. Mol and J. Law (forthcoming).

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