Please cite as:

Degeling C. (2009). Negotiating Value: Comparing Human and Animal Fracture Care in Industrial Societies. *Science Technology and Human Values*, 34(1), 77-101. doi: 10.1177/0162243907310298

Negotiating value: comparing human and animal fracture care in industrial societies

Chris Degeling (2009)

Abstract

At the beginning of the twentieth-century, human and veterinary surgeons faced the challenge of a medical marketplace transformed by technology. The socio-economic value ascribed to their patients – people and domestic animals – was changing, reflecting the increasing mechanisation of industry and the decreasing dependence of society upon non-human animals for labour. In human medicine, concern for the economic consequences of fractures "pathologised" any significant level of post-therapeutic disability, a productivist perspective contrary to the traditional corpus of medical values. In contrast, veterinarians adapted to the mechanisation of horse-power by shifting their primary professional interest to companion animals; a type of veterinary patient generally valued for the unique emotional attachment of the owner, and not the productive capacity of the animal. The economic rationalisation of human fracture care and the "sentimental" transformation of veterinary orthopaedic expertise indicates how these specialists utilised increasingly convergent rhetorical arguments to justify the application of innovative fracture care technologies to their humans and animal patients.

Keywords:

Fracture care, Industrialisation, Veterinary History, Human/animal relations

Introduction:

The subject of this paper is provided with an extremely concise précis by the Bristol-based general surgeon William Hey Groves in 1935.[i] In the introduction to his English translation of Lorenz Böhler's orthopaedic treatise *The Treatment of Fractures*, Hey Groves notes:

> The proper treatment of fractures is not only a scientific or a philanthropic duty, but also a business proposition, in other words it pays to treat fractures well.

(Böhler 1935, 2)

The proposition to which Hey Groves is alluding is not an exhortation to the wider medical profession to line the pockets of the fledgling specialty of orthopaedic surgery by increasing their rate of referrals for minor fractures. Hey Groves's concern is an example of a rhetoric of economic rationalism that began to influence the provision of fracture care at the end of the nineteenth century. This rhetoric, derived from the non-medical domains of industry and finance, elaborated the need for optimal efficiency of service delivery and production. The belief was that hindrances to economic growth, including those within the domain of medical practice, could potentially be overcome through the judicious application of the principals of scientific management and deliver prosperity for the broader population (Cooter 1993; Howell 1995). [ii] For industry and transport, this entailed an appreciation of the productivity of workers, after they had recovered from traumatic fractures.

Traditionally, the sanctity of the doctor-patient relationship required that any interests external to those of the patient were excluded from surgical practice. This trust has been described as a "sacred cord" which ensured the pricelessness of any medical intervention (Lederer 1995). Nonetheless, to support their argument for fracture care reform and to attract financial backing, some surgeons began to introduce concepts like efficiency and economic utility into the delivery and assessment of their orthopaedic practices. Rather than strictly focussing on the "good" of the individual patient, these surgeons also tried to consider the various social and everyday economic roles and functions that people performed, particularly in their working lives. They noted that incurring an injury, such as a fractured bone, often significantly diminished or even permanently eliminated a person's ability to function productively in contemporary society. Injury rehabilitation and disability pensions cost money or tie up resources profitably employed elsewhere. The improper treatment of fractures came to be seen as having a price for the individual and for society. Consequently, persevering with substandard treatment technologies was an economically-measurable failure of accepted surgical practices. It was argued that poor fracture care diminished the health of individuals, and the nation's potential wealth, health and happiness.

In this paper I explore the idea that effective fracture care is good for business, industry and most certainly therefore society, and situate it in a wider economy; an economy that until the late 1940s included a significant workforce of domestic animals such as bullocks and horses which provided much of the power in pre- and early industrial societies. I compare and contrast the general methods and motivations for the delivery of fracture care to both humans and other animals throughout the period of industrialisation in the United States and more particularly the United Kingdom. In the footsteps of the sociologist Vivian Zelzier (1985), I attempt to price the seemingly priceless, and provide an analysis of human and veterinary fracture care as an example of how an assessment of the emotive and/or productive value of the patient can sometimes influence the therapeutic practices of medicine.

In applying the idea of an economy to orthopaedic practices, I am not discounting or denying the role of compassion, altruism or humanitarian sentiment as primary medical motivations. Surgeons, both human and veterinary, no doubt wanted to help individual patients to recover from painful and debilitating conditions. Nevertheless, by analysing this history from the perspective of the patient's productive value, it becomes clear a rhetoric which encouraged economic considerations has had a substantive role in the promotion and adoption of innovative fracture care practices in both humans and animals. [iii]

Surgical Technologies

Just as machines and instruments such as the electric toothbrush or the microwave oven are products of the applied sciences, surgical instruments and standard surgical practices are types of technologies. In fracture care, these tools and skills have evolved through the last two hundred years to incorporate aspects of physiology, metallurgy and biomechanical science. Specialised instruments and surgical inserts now embody or encapsulate much of the content of the knowledge of their use. They have become the material artefacts of more sophisticated surgical technologies (Latour 1987). Consequently many orthopaedic procedures are now impossible to undertake without specialised instrumentation. The subdivision of areas of medical expertise and control of access to specific medical instruments can be considered the hallmark of processes of professional specialisation and the means of ensuring some standardisation of practices (Blume 1992; Weisz 2006).

The development of standardised and scientific sets of orthopaedic technologies, in the second half of the twentieth century, has inevitably relied upon experimentation on animal models (Schlich 2002). Knowledge and tools derived from laboratory practice were then available to specialised human and animal practitioners, across species barriers. Within this larger fracture care economy, some domestic animals have come to occupy the position of both model and patient. There has been some critical exploration of the role of animal models in the creation of biomedical knowledge, but as yet not much attention has been paid to the participation of animal patients in the development and acceptance of innovative medical technologies (Rock, Mykhalovskiy, and Schlich 2007).

The technological intensification of Western societies and the increasing sophistication and specialisation of human and veterinary orthopaedic surgery occurred, by what seems to be a reciprocal arrangement. However, the relationship between the creation of surgical technologies and the demand for their application is not so clear-cut. This paper aims to illustrate how these species-specialised practitioners chose to promote, shape or create a market for fracture care technologies in distinct patient populations prior to the escalation of the biomedical project. Before industrialisation, and before the creation of orthopaedic laboratories – as was the case with other types of technologies and applied science – expertise in fracture care was not necessarily so closely bound to a specific set of clinicians, sets of tools and specialised institutional locations. In fact, expertise in treating human and animal fractures was often located in one and the same practitioner.

The Distribution of Expertise

At the beginning of the nineteenth-century, members of the College of Surgeons and the generalist surgeon apothecaries were not the only experts available to provide fracture care for an injured patient. Irregular health practitioners like bone-setters, the newly-minted corps of veterinary practitioners, and members of the Guild of Equine Farriers (an ancient apprenticebased occupation) were all available in the medical marketplace to set and tend the fractures of humans and economically valuable animals. Surgeons would on occasion treat animals, bone-setters would treat both human and animal alike, and "horse-doctors" would treat people. Removed from the centres of medical excellence and learning like London and New York, the practices and concepts that informed remedial therapeutics existed in an uninterrupted continuum across the species barriers for a significant proportion of the human and animal population (Porter 1993; Curth 2002). Therefore despite their social standing and education, the vast majority of fracture care practitioners were guided by the same principles of successful intervention. Consequently, for simple fractures these practitioners employed similar restorative manipulations, splinting techniques and other accessory practices with highly similar rates of success.

The differences in the types of fracture therapy that were applied to an injured human or animal varied more across the spectrum of a patient's perceived utility to the pre- and early industrial economy, rather than according to which type of accredited or irregular practitioner was providing them. Consequently, three modes or archetypes of therapeutic procedure can be identified, which were essentially demarcated by the patient's economic or intrinsic value. The first and most basic method of fracture treatment is currently still occasionally referred to as "masterly inaction" or "the method of absent treatment." It was applied to animals of sufficient sentimental value to require some minor level of intervention. If the most cursory care were to be undertaken on an economically-valueless creature, like a pet or companion animal, it would be confined to a space no bigger than twice its length to encourage "natural" splinting and discourage mal-union or the formation of a false joint at the fracture site. For fractures complicated by a wound or high on the limb, methods of reduction and retention were rarely applied. The animal was cage-rested to minimise the risk of complications and obviate the bad symptoms, while the animal's broken bone reformed and regenerated spontaneously (Perrin 1923). [iv]

The second and by far the most common therapeutic archetype became known in the twentieth-century as "conservative measures." An expression intended – in part – to distinguish these techniques from later, more aggressive, operative fracture care procedures. Despite the fact they were promoted by their proponents as the orthodox, empirically-derived, ancient, tried and trusted techniques, handed down from the Hippocratic corpus, the means by which these techniques achieved the reduction and retention of fractures often relied upon highly innovative procedures and external appliances. Conservative measures were applied to humans, and also many economically valuable large animals like horses and bullocks with uncomplicated fractures. Using the very same methods and principles, the techniques for treating animals were simply adapted from human fracture care to treat a much larger patient. [v] There were, of course, differences. For complicated or potentially infected fractured limbs in human patients, most surgeons – unlike veterinarians or irregulars – would counsel upon the necessity of a life-saving amputation. [vi] An option deemed to be impractical and inappropriate for almost all analogous animal cases.

Finally, there was some experimentation with surgical methods of internal fixation of fractures before the end of nineteenth-century. Some "radical" surgeons, frustrated with inconsistent post-treatment outcomes and the indirect character of conservative fracture care procedures, were beginning to apply the techniques and principles of operative surgery. Rather than trust “nature,” they developed different technological solutions where metal plates, screws, bone pegs, and other types of internally-placed appliances were introduced to the patient’s body to reduce and retain fractures while they healed. Until the middle of the twentieth century, operative fracture care was really only an experimental therapeutic archetype which did not broadly penetrate everyday surgical practice. The deliberate surgical exposure of a fracture – even with a “no touch” technique – was perceived to be a great risk to the patient’s welfare and therefore limited to the practices of a few adventurous, some would say “cavalier,” specialists surgeons (Cooter 1993; Schlich 2002).

Before the onset of industrialisation, the major differences between fracture care in humans and animals were the goals and motivations for treatment. The choice of therapeutic procedures in these two different types of patient was informed by very different sets of criteria and values. These can be separated into two positions: the first position represents a form of functional pragmatism based on the patient’s present and future productive value; the alternative was to deliberately leave the patient’s future productivity out of consideration, and to take those steps – including limb amputation – necessary to ensure the patient’s survival. Hence there are two aphorisms, appropriate for human patients or injured animals. “No foot, no horse” was applied in the treatment of draught animals where the optimisation of its functional value guided surgical decisions. [vii] Accordingly in draught animals the decision to treat was made upon strictly pragmatic economic grounds. A horse without the use of its full complement of feet was functionally no longer a horse. Because these animals were valuable and often hard to replace, treatment was commonly attempted in simple fractures of the lower limb. If however the fracture was compounded or the animal otherwise compromised, then as an economic unit it was obviously more valuable slaughtered and sold as a dressed carcass than as a living disabled non-functional liability to its owner. In large animal therapeutic practices, the return of the animal patient to a viable productive function was the only goal of treatment in the vast majority of cases.

In contrast, in human patients, the goals of treatment were informed by a distinct spectrum of moral and ethical values. In human fracture care, the first imperative was always to save the patient’s life. The patient’s ongoing “economic” viability – the ability to earn a living – was always an issue peripheral to the risks posed to the patient’s “life or limb.” [viii] Before the introduction of Listerian antisepsis in the 1890s and antimicrobials in the 1930s, amputation was the mainstay of surgical responses to severely comprised and potentially gangrenous fractured limbs (Cooter 1987). As a broad generalisation about the distinct goals of human and animal fracture care procedures, veterinary practitioners were required to achieve “functional” results in their treatment of fractures until the end of the nineteenth-century. In contrast, human practitioners were required to provide a life-saving treatment first, and then limb-saving treatment if it was deemed to be a reasonably sound clinical possibility. When restoration was attempted, humans and animals were often treated with the same techniques, but these treatments were utilised within two distinct fracture care economies.

The Industrialisation of Fracture Care

Throughout the period of industrialisation, the causes and social meaning of fractures in humans and animals changed. To illustrate how they changed, it is necessary to bring the "history of accidents" into focus. Accidents on occasion happen at every station of the social order. In 1845 James Prior, the English surgeon and Deputy inspector of Hospitals and Fleets, mused upon the seemingly arbitrary distribution of broken bones in London's human population:

> Occasionally they fall to the lot of every class in society; of the higher, whether thrown from their horses or carriages, or even when exposed to less degrees of violence; of the lower, from those numberless and often dangerous, operations of labour incident to their station in life. (Prior 1845, 579)

Not surprisingly, humans were not alone in suffering from traumatic misfortune. The draught animals on which agriculture, industry and transport relied were in no way immune from accidents that caused them catastrophic physical injury. Unlike some other human illnesses or animal diseases, these accidents were not viewed as extraordinary or supernatural events but are seen as an everyday occurrences or part-and-parcel of the risks of daily life (Schlich 2002).

By the second half of the nineteenth century, sections of the labour movement, philanthropic societies, even some industrialists reasoned that economic, industrial and scientific progress should be balanced against the social and economic costs of personal injuries on the roads and at the workplace. The overarching mechanism – intended to maintain the balance between personal cost and social benefit of industrialisation – was the introduction of workers' compensation awards (Bynum 1994). Hence an accident was no longer only an issue of personal culpability: the inattention or ignorance of the employee in the workplace. Accidents became the responsibility of the employer. In a market where the financial responsibility for risk was a saleable commodity, industrialists naturally enough indemnified themselves with insurance policies; in effect creating an economically-informed frame for the scrutiny of risks to the public in the provision of transport, and to employees of mechanised industry. The upshot of these changes for medicine was that workers no longer had to pursue their employers to pay for their treatment, and insurance companies sought the medical profession's assistance in looking for cost-effective and efficacious solutions for fracture care rehabilitation (Cooter 1993).

With industrialisation and its implicit frame of economic scrutiny, accidents began to have more easily recognisable and quantifiable social and economic consequences. Some surgeons interested in trauma willingly began to organise themselves around the requirements of trade unions, transport and industry; stakeholders which now shared an interest in promoting the rehabilitation of accident victims. Conservative fracture care systems (like the rigid, externally applied frame of the Thomas splint) and the more aggressive operative technologies (typified by the techniques developed by William Arbuthnot Lane) were both promoted by their proponents as efficient and standardised technological solutions to meet this demand (Schlich 2002). Within the promulgation of these surgical management strategies, accidents were "transformed from individualized happenings to a type of medical concern requiring its own organization and professional politics." (Cooter 1993, 103) The change towards fracture "management" was not primarily reliant upon advances in medical technologies. It was encouraged by a new, more elevated valuation of human labour. Consequently, the rhetoric within which surgical practitioners proposed different solutions was not only about saving each patient's life; it also began to mirror a movement towards a progressive, productivist outlook which sought to promote the benefits of a well-regulated and controlled industrialised society (Rosenberg 1987; Pickstone 2003).

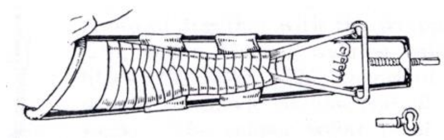

Figure 1. The Thomas splint applied to a femoral fracture. The key and screw provide fracture extension. (Hey Groves 1921, 328)

For human surgeons, the change from only promoting their skills as a life-saving fracture treatment, towards advocating a particular brand of efficient, technologically standardised fracture management was gradual. For example in 1847, James Prior attempted to make light of the relationship between fracture care and disability expenditures:

> According to the rules of the schools, you should have cut off the arm and the leg; but by the exercise of better rules, those of a sound discretion, you have saved the patient their limbs, and the country the payment of two pensions. (Prior 1847, 305)

The tone of discourse was to become slightly more serious. In 1897, the surgeon Mr A. Pearce Gould was promoting the views of Arbuthnot Lane at a meeting of Swansea Medical Society, by attempting to directly quantify, "the loss of function after a broken leg in terms of pounds, shillings, and pence," noting that, "a working man's earning power – his market value – is often seriously diminished by an injury that has been repaired and that surgically seemed of secondary importance." (Pearce Gould 1897, 1601) By 1921, the maintenance of an individual patient's post-treatment productive function had become a high enough priority within surgical circles that Hey Groves was able to claim:

> The factor of occupation is so obvious as hardly to require more than mention… If we can distinguish between two elements in labour, viz., strain and skill, there can be no doubt that deformity is much more serious in relation to the later than the former. (Hey Groves 1921, 19)

It is apparent that through this period, economic arguments began to influence the choices made in human fracture care. Surgeons placed a greater emphasis on patient functionality and discussed different fracture care systems on the basis of their ability to limit post-accident disability. The surgical priority was still – at all cost – to preserve the life of the patient, but it was now also possible to promote surgical technologies on the basis of their benefit for the patient and therefore the workforce's future productivity.

In the domain of veterinary expertise, there was as yet no internal professional or external socio-political pressure for animal practitioners to change their treatment methods or their organisation. The new discourse in human fracture care, which emphasised functionality, was highly familiar to veterinarians because their orthopaedic practices had always been framed in economic terms. Most practitioners were “generalists” who – because of the nature of the market for their expertise – knew more about valuable animals like horses than other less valuable species (Fisher 1993). Thus veterinary surgeons were still content to employ the same traditional technologies in their treatments. The problem was, the number injured draught animal patients who were sufficient value to require treatment was in a gradual, seemingly inexorable decline.

The Organic Mechanics

Until the nineteenth century, veterinarians were the mechanics of agriculture and military transport. [ix] Their employment and training was mainly for the purposes of maintaining industrial horse-power. Yet somehow after twelve-thousand years of co-evolution, horses and bullocks were no longer the primary source of mechanical energy for human enterprise (Jasny 1935). [x] Consequently, the adage “No foot, no horse” began to require a rejoinder. As the basis of their practices dissolved, veterinarians learned that “no horse” also meant a sharp decline in the need for veterinary expertise (Jones 2003). Animals were still being injured, but the financial component of these events was changing. On the occurrence of even minor fractures, veterinarians, or more commonly stable owners and farmers, were increasingly forced to resort to slaughter to try and salvage some of their asset’s value (The Treatment of Fractures 1910). Accordingly, unlike other professional groups, many veterinarians expressed distinct Luddite sentiments in the discourse of this period, probably because the basis of their livelihood was threatened. In journals and veterinary college branch meetings, the motorcar was often portrayed as a virulent social pathogen destroying the nation’s way of life. [xi]

The increasing prevalence of the motorcar on public roads was a product of urbanisation, the accumulation of disposable income and the beginnings of a consumer society. Motorised transportation had undoubtedly increased the number of injured dogs and cats presented to veterinarians for medical treatment – a clientele with money to spend on non-essential or luxury items like pets – but few in the profession imagined this developing branch of their practices could adequately compensate them for their loss of equine income ("Young-Tom" 1908; Taylor 1911). For most veterinarians, small animal practice was seen as “the bastard orphan of a profession,” which was being slowly annihilated by the mechanisation of transport and industry (Schnelle 1968, 6).

Despite the disdain of many of their peers, an increasing number of veterinarians began to specialise in smaller, non-production animals and set about acquiring the skills necessary for this type of practice. Soon, the number of articles in veterinary journals relating to small animal practice began to increase. Companion animal surgical manuals were published which detailed how to apply splints, plaster and internal wires to small animal fractures. In Frederick Hobday’s (1906, 332-343) *Surgical Diseases of the Dog and Cat*, the section on fracture care also included instructions for the safe amputation and the fitting of false legs to companion animal patients. The book provided a repertoire of measures that ensured the practitioner was equipped for most clinical eventualities. Concomitantly, in human medicine, by the second decade of the twentieth century, continuing differences in opinion about the safety and efficacy of new fracture care technologies forced the British Medical Association (BMA) to undertake a broad review of current practices. At its conclusion, the commission found, along the same line of argument promoted by Arbuthnot Lane, that operative measures in "expert hands" were superior (Report of the Committee on Treatment of Simple Fractures 1912). Despite the greater risks of infection and non-union, the anatomical reduction and retention of a fractured bone by methods of internal fixation, when done properly, was far more likely to return the patient to normal physical function than conservative methods. Operative fracture care was therefore theoretically, if not yet in practice, the most cost-effective option.

In the wake of the BMA report, Hey Groves began to test the different internal fixation technologies on animal models to try and ascertain the best methods available for fracture care in human patients. [xii] The Great War interrupted his research after one set of publications (Hey Groves 1914). During the course of the war, most military surgeons abandoned operative technologies after an epidemic of iatrogenic injuries. They came to rely on the Thomas splint as the standard "conservative" response to lower limb fractures. After his wartime experiences, Hey Groves returned to animal experiments and published the previously mentioned treatise. The stated aim was to demonstrate to his surgical contemporaries:

> the various methods of treatment should all be brought into our service as occasion requires, instead of being regarded as independent, rival or mutually destructive systems. (Hey Groves 1921, ix)

Few surgeons were confident enough to employ his suggestions. As documented extensively elsewhere, most surgeon's experiences during the war coloured their understanding of the appropriate organisation of a fracture care service for society, and the risks involved in the utilisation of operative technologies (Cooter 1993). Despite their potential for efficiency, until the end of the twentieth century, the use of operative technologies for the treatment of fractures in human patients was considered by most surgeons to be unreliable, reckless and therefore unnecessary (Schlich 2002).

In comparison, for those veterinarians who had chosen to make the leap and specialise in companion animal veterinary practice, the First World War was disastrous, as pets came to be seen as an irresponsible waste of resources during a national emergency (Canine Practice 1916; Adaptability 1917). Conversely, the war also provided for a five-year reprieve for the skills of the equine veterinarian; traditional horse-power being a more affordable, manoeuvrable, reliable and effective form of locomotive biotechnology for supply-lines than its mechanised replacements near the front (Singleton 1993). At war's end, most in the profession knew equine practice would never again gainfully support the majority of veterinarians. Among other successful diversifications, such as becoming the experts in the intensification and industrialisation of agricultural production, undertaking food safety inspections, and other public health initiatives, many veterinarians also began to seek a means to exploit or meet a growing consumer sentiment or cultural fetish for pet animals (Hardy 2003; Jones 2003).

The fashion for pet animals meant some people removed dogs and cats from their traditional roles outside the house and began to value them inside the house - like a member of the family (Ritvo 1988; Archer 1997). Concomitantly, people began to equate their ability to make choices regarding the health and welfare of their companion animals with their responsibilities as animal owners within a consumer driven economy (Franklin 1999). The escalation in the sentimental or emotive value of pets was also fed by the growing popularity of dog heroes like *Lassie*, and the marketing of the products of large multinational pet food companies, ably supported by the wider entertainment industry which celebrated the dog as man's best friend (Hirschman 1994). As animal owners conferred their pets with human-like qualities and began to find happiness in these relationships, articulate consumers began to demand more than the previous cursory attention given to companion animals from the majority of the providers of veterinary expertise.

The Practice of Sentimentality

In veterinary practice, pragmatism had dictated that the therapeutic goal of any veterinary treatment was to extract the most economic advantage out of an injured or sick animal for its owner. Now many owners seemed to expect a similar level of expert, humane, and all-encompassing health care for their pets as they would for their youngest child (Voith 1985). The major issue for this new sentimentally-motivated and consumer driven clientele was not the economic value of the patient but the affordability of the treatment. The value of individual pet animals was in some sense becoming difficult to economically price, while the economic value of individual draught and agricultural animals often precluded them from anything but "running repairs" and preventative treatments. To practice upon individually-valued companion animals, veterinary surgeons chose to mimic the trends and structures of the increasingly hospital-based and surgically-oriented human medicine. They directly copied procedures from human surgery; diagnostic and interventionist techniques that seemed appropriate for analogous ills in animals and were therefore deemed likely to be practical.

Practitioners like E. A. Ehmer (1925, 47) argued that traditional methods for fractures – like masterly inaction – were "surely not scientific" nor "highly remunerative," for veterinarians trying to make a living in small animal practice. Soon the Thomas splint – first developed to treat injured dockyard-workers in Liverpool – was adopted for veterinary use by E.B. Dibbell (1930) and then adapted for the treatment of canine fractures by Erwin Schroeder (1933). As well as the techniques discussed in Hey Groves's animal experiments – described by one practitioner as "the postulates of successful operation" (Stainton 1932, 188) – veterinarians tested the suitability of Arbuthnot Lane's bone plates, the fracture massage methods of Lucas-Championnierre, Lorenz Böhler's plaster casts, Kirchner wires and various skeletal traction techniques for companion animal practice (Barrett 1936; Schroeder 1939).

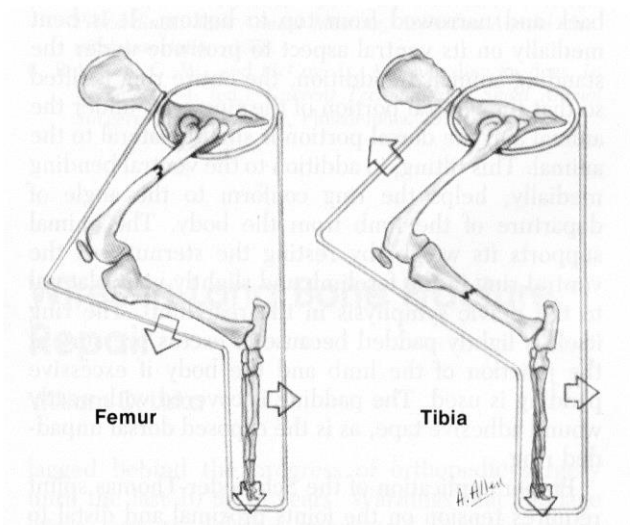

Figure 2: The Schroeder-Thomas splint, adapted to the mechanics of the canine hind limb. The arrows indicate the direction in which traction should be applied. (Slatter 1985, 2001)

By the end of the 1930s, small animal specialists like Major Hamilton Kirk began to argue that all fractures in companion animal patients now required some form of active intervention, "if only to allay the suspicion in the owner's mind that the practitioner did not know what to do." (Wright 1937, 13) To meet and create the demands of this new fracture care economy, veterinarians needed to acquire a repertoire of efficacious techniques and technologies. Not just for simple fractures, as noted by Lieut.-Colonel Greenfield, "even for places it was impossible to apply an ordinary splint", because "clients were dissatisfied if nothing was attempted." (McCunn 1933, 1251) At conferences and college branch meetings veterinarians would discuss their experiences with alternative methods (Kirk 1928; McCunn 1933). These veterinary debates were not as sophisticated or as heated as those of their confréres in human medicine. Their concerns included the retention and immobilisation of fracture fragments, asepsis and the limitation of complications to treatment, but it does not seem concepts like "cost" and "price" – no doubt prominent in their dealings with their clients – were foremost in their intra-professional deliberations, except to ensure that small animal expertise was appropriately valued. When veterinarians like the American F. Perrin began to specialise they were aware they needed to be properly remunerated for small animal work; first to pay the "grocery bills," and second to ensure the procedure did "not look so insignificant to the owner." (Perrin 1923, 490) Consequently it seems that while practicing veterinarians sought practical solutions to their fracture care problems, they were also attempting to negotiate a humane pathway between their clientele's economic and sentimental valuation of their companion animal patients. [xiii]

Even so, some veterinarians struggled to come to terms with the consumer-sentiment and human-animal bond that underpinned the demand for companion animal expertise. At a meeting on small animal fracture care at the British Veterinary Congress in 1933, the passionate temperament of the veterinarian, Mr C. Wentworth Elam, raged against the impact and prevalence of the new "macroscopic" blight to humankind, mechanisation and machines. He opined:

> [Our] work on behalf of humanity has largely been nullified by the activities of macroscopic agents in the form of man-invented machines, … In the case of one machine alone, *i.e.,* the motor car, it is appalling to find to-day that the motor car is destroying each year 100 per cent. more persons in Great Britain than all the tuberculous cows in this island. The garages of Great Britain house far more death-dealing agents than the all the byres of the British farmer. (McCunn 1933, 1248)

Mr Elam foreshadowed his observations with a warning for his veterinary colleagues of an inevitable plague of rats; the roadside carnage in the canine and feline populations allowing the potential development of a public health crisis of semi-biblical proportions leaving the country "unfit to live in," (McCunn 1933, 1248) It seems that on this somewhat satirical basis, and because pets "play a very important part in our national life," Elam claimed that fracture care for small animals could be of great benefit to society. (McCunn 1933, 1249)

The technological intensification of small animal veterinary practice occurred at a rapid pace, as the individual clinical focus of small animal practice co-produced a new consumer-driven form of medical economy. Despite the growing demand for this expertise, post-war specialists in companion animal veterinary practice were often educationally ill-equipped for their chosen professional path. In an interview Dr. Currey, who trained at Ontario Veterinary College and was one of the first specialised small animal veterinarians to set up practice in Maryland, credits the early advances in small animal medical knowledge to a deliberate practice of "observation, reading and borrowing from human medicine". Of his formal education he comments, "It was a good school, but I can't say it trained me for small-animal work. There were only a few lectures on small animals." (Perry and Perry 1964, 114) It seems his experiences were fairly typical. It is likely that human medical procedures were the foundation of much of the intensive and individually-directed medical and surgical interventions that came to characterise small animal practice. Nonetheless, even within their initially-limited clinical means, by treating fractures in companion animals as if they were human beings, these veterinarians were also validating the sentimental value owners attached to their animals (Jones 2003).

The Benefits of Sentiment in Fracture Care Economies

At the end of the 1930s, human medical researchers and clinicians began to note some of the clinical successes and failures of different diagnostic and therapeutic techniques employed by companion animal veterinary practitioners. As a consequence of the development of their own clinical and research practices, small animal veterinarians were slowly becoming recognised as the natural ally of experimental medicine and biomedical research (Schillhorn van Veen 1998; Michell 2000). The onset of World War Two accelerated this process, especially in the US where veterinarians were enrolled into many medical research programmes, the vast majority of which involved the use of animal models (Schwabe 1993). The best example of the coalescence of human and animal orthopaedic research practices in this new "humane" and industrialised society is provided by the career of the veterinarian Otto Stader. His contribution to orthopaedic surgery reflects changes in the emotive and productive value accorded to different types of patients and the convergence of the rhetorical arguments utilised in the promotion of innovative human and animal fracture care practices.

After service in the American veterinary core in World War I, and the financial crash of 1929, Stader abandoned large animal fertility work and established himself as a small animal practitioner in Ardmore, Pennsylvania (Pettit 1990; Shomer 1995). While in practice he noticed the unsuitability of the current technologies – like the Schroeder-Thomas splint – for many of the fractures suffered by restless companion animals. These methods irritated and restricted the animal's motion such that it was almost impossible to stop the patient interfering with or fouling the cast or supporting appliance. Because of their noxiousness, these methods often failed to stabilise the animal's fracture long enough for it to heal. Stader recognised methods that allowed "articular freedom" while minimising the risks of operative fracture reduction could overcome most animal fracture complications (Stader 1937; 1939). Unhappy with the post-treatment results he was achieving, Stader began to experiment and modify existing fracture care technologies, at first harvesting and adapting parts from his son's bicycle (Stader 1934; Pettit 1990).

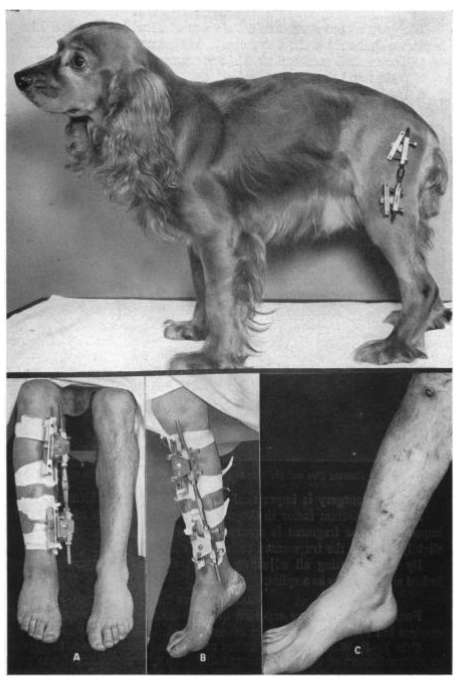

Figure 3: Stader splints applied to canine and human patients (Lewis, Breidenbach, and Stader 1942, 630)

Using another less adjustable form of external fixation device known as an Anderson splint as a prototype, Stader developed his own system of external fixation. It was adjustable, lightweight and yet rigid, allowed patient manoeuvrability, and was easily applied to any class of long bone fracture. Because of the minimal disruption to the patient's tissues needed to correctly reduce and apply the four-point pin system to the fractured limb, the splint was perfect for treating restless and poorly-controlled animal patients. Furthermore, because of the minimal contact between the implant and the patient's bones, the splint could be confidently applied at some distance from the associated wounds across the site of the fracture, eliminating many of the iatrogenic risks still associated with other less adjustable forms of external fixative and all methods of internal fixation. The Stader split seemed to offer a solution to the problems of ambulation and maintaining aseptic control for fractures in pet animals. By May 1942, Stader claimed to have successfully treated over 1200 companion animal patients with his system (Lewis, Breidenbach, and Stader 1942).

The veterinary splint was introduced to military surgeons when Stader applied the apparatus to a fracture in a police dog, in a prearranged demonstration. Because the splint was not bulky like a cast, allowed relatively free movement of the joints either side of the injury and was not dependent upon an external source of traction, the United States Navy first tested and then purchased the fracture care system in 1942 for use on its servicemen, specifically for when they were at sea. The only adjustment apparently needed for an interspecies transfer of the technology was to increase the scale of the apparatus to fit the long-bones of *Homo sapiens* (Shaar 1942; Stader 1943). The Naval surgeon Captain Shaar extolled its virtues in the *American Nursing Journal*:

> The Stader reduction and fixation splint requires no extension apparatus, no special frame or fracture table, and no plaster cast. It is a self-contained reduction and fixation unit for fractures, complete in itself. (Shaar 1944, 218)

Accordingly, the apparatus was perceived to be perfect for use in cramped or surgically challenging environs in circumstances, "where teamwork, organisation and control of asepsis and antisepsis are imperfect." (Shaar 1944, 216) A patient wearing the apparatus could be mobile and easily withstand the pitching of a ship, unlike an injured serviceman in "traction." Furthermore, if the ship sunk or the patient fell overboard, he would not necessarily sink into the depths weighed down by a cast.

In a published contribution, soon after the human trial of the Stader splint was completed, Captain Shaar (1942, 1581) was of the opinion that the apparatus "should be of considerable value to general practitioners, who treat the majority of fractures." A group of non-specialised human medical practitioners – whom it was perhaps assumed – could easily acquire the same level of technical proficiency as veterinarians. The fact that a veterinarian, and not a human surgeon developed the apparatus, also garnered an unusual amount of press, for what was one of many novel external fixation devices being tested at the time. [xiv] *TIME* (1942) and *LIFE* (1943) magazines both ran with this cross-disciplinary angle to provide a feel-good story during the first years of America's war. Concomitantly, the availability of Stader's fracture care technology meant that American sailors could be sent to work in a dangerous environment – such as a battleship on active duty – without a greater risk of otherwise preventable post-fracture death or disability. A return to a policy of shipboard amputations was seen as a likely outcome, if conventional "human" fracture technologies were employed at sea. Consequently, thousands of servicemen were treated for fractures with a Stader splint during the later years of the war.

Figure 4: The General Electric X-Ray Corporation's advertisement in *The Journal of Bone and Joint Surgery*. (Soon Available for Civilian Use 1944, adv. 7)

However, as in the surgical theatres of the First World War, the new fracture care technology was often incorrectly applied. Surgeons using the Stader apparatus would cause unnecessary iatrogenic tissue damage through the incorrect placement of pins through muscle layers, which on occasion would lead to pin seepage, septic sequestra, non-union and other post-operative complications. Soon, other military and civilian surgeons like Robert Mazet and Irwin Siris (1944) published articles reminding their colleagues that external splint systems were not a panacea. In their view, the technologies were not safe in the hands of "one not experienced in the treatment of fractures." (Mazet 1943, 858) Notably neither surgeon had employed the Stader splint; their experience was confined to Anderson and Haynes's versions of the apparatus. Even so in a follow-up report to their initial more optimistic applications, Captain Shaar and his naval colleagues acknowledged the Stader's system had its flaws and "faulty technique may result in failure." (1944, 471) Given their questionable wartime record, "anatomical splint" systems fell out of favour with both human and veterinary orthopaedists, only to be revived in the 1970s – in veterinary circles – as the technique of choice for badly comminuted long-bone fractures (Slatter 1985).

In a frank assessment of the technology some twenty years later, the doyen of post-war British orthopaedics, John Charnley, notes of Stader's splint:

the principle of this method offers the best theoretical conditions for an open

> fracture of the tibia to heal without infections. The bad reputation which this splint has acquired is the result of its abuse. (Charnley 1963, 234)

Despite its chequered history in the hands of Canadian and American military surgeons, the point remains that the Stader apparatus – developed to treat valued companion animals – was perceived to be the most practical cost-effective solution to a site-specific surgical problem in humans. The technology was employed to treat fractures in human patients in environments where it was thought orthopaedic-control, organisation and efficiency could not be so easily guaranteed to permit the use of other, more familiar fracture care technologies.

Conclusion

This is a story about changes in how human and veterinary surgeons choose to portray the benefits of specific surgical technologies and fracture care practices. It is apparent that after a post-industrial revaluation of human and animal labour, and the subsequent comodification of pet animals, new ways of describing the relative value of different fracture care techniques began to emerge. In the human medical-marketplace, alongside the traditional rhetoric of the inviolability of the doctor-patient relationship, productivist concerns like cost-efficiency and functional-disability began to permeate the fracture care discourse. This new way of justifying particular technologies and techniques bears a striking resemblance to the criteria veterinarians had used to justify fracture care practices for production animals. For veterinarians, after the demise of the animal labour economy, practitioners were forced to adapt to a clientele that was no longer driven by economic pragmatism and the maintenance of their asset's productive value. While some veterinarians like Mr Elam clung to a notion that veterinary fracture care expertise was for the "good" of society, companion animal owners and specialised small animal veterinarians were mainly motivated by the mixture of humanitarian and consumerist sentiment that surrounded the personal relationships formed between human and companion animal.

In creating and/or shaping a market for new fracture care technologies, human and animal surgical practitioners have adopted increasingly convergent arguments. The previously economically-pragmatic veterinary profession have had to promote their new animal patients' intrinsic value, while human surgeons began to discuss their practices in relation to their human patients' post-treatment functionality. The Stader splint technology seems to be situated near the nexus of these rhetorical strategies. To promote the splint human surgeons have described the control and efficiency the technology provides human practitioners for effective "fracture management" in poorly controlled medical environments. In contrast veterinary surgeons have focussed upon the value of the technology in the treatment of individual patients, noting the relative freedom the splint permitted otherwise poorly controlled pet animals. From the standpoint of fracture care economies, many of the differences in the rhetoric that surrounded the two markets for this technology can be related to the replacement of domestic animals by human beings as the central object of productive value.

The pattern of exchanges and adaptations of specialised human and animal technologies also hints at the differences in value accorded animals within biomedical research and orthopaedic practice. As human and veterinary orthopaedists developed interchangeable fracture care technologies for humans and animals, some animals were valued individually within irreplaceable human-animal relationships (Brown 1985), whereas others were perceived as ethically appropriate and affordable surgical models to test out technologies, before they are applied to humans (Michell 2000). A much more detailed study of the discourse that surrounds animal experimentation in veterinary fracture care is required but it seems probable that concepts like control, efficiency and function are commonly utilised to bridge the disjunction in the value accorded orthopaedic animal models and the negotiated value of individual animal patients.

Bibliography:

Adaptability. 1917. *Veterinary Record* 29:309.

Archer, J. 1997. Why Do People Love Their Pets? - The New Synthesis. *Ethology and Sociobiology* 18:237-259.

Barrett, E. 1936. The Treatment of Fractures in the Small Animals by Means of the Unpadded Plaster Cast. *Veterinary Record* 48:1086-1087.

Blume, S. 1992. *Insight and Industry: On the Dynamics of Technological Change in Medicine*: MIT Press.

Böhler, L. 1935. *The Treatment of Fractures. Translated from the fourth enlarged and revised German edition*. Translated by W.H. Groves. 4th ed. Bristol: John Wright & Sons.

Brown, D. 1985. Cultural Attitudes Towards Pets. *Veterinary Clinics of North America* 15:311-318.

Bynum, W.F. 1994. *Science and the practice of medicine in the nineteenth century*, *Cambridge history of medicine.* New York: Cambridge University Press.

Canine Practice. 1916. *Veterinary Record* 28:389.

Charnley, J. 1963. *The Closed Treatment of Common Fractures*. 3rd ed. Edinburgh: E. & S. Livingstone LTD.

Cooper, M., G. Barton, and A. Brodell. 1947. *Progress of Farm Mechanization*: US Dept. of Agriculture.

Cooter, R. 1987. Bones of Contention? Orthodox Medicine and the Mystery of the Bone-Setter's Craft. In *Medical Fringe and Medical Orthodoxy, 1750-1850.*, edited by W. Bynum, Porter, R. London: Croom Helm.

———. 1993. *Surgery and Society in Peace and War: Orthopaedics and the Organisation of Modern Medicine*. London: The Macmillan Press.

Curth, L. 2002. The Care of the Brute Beast: Animals and the Seventeenth-century Medical Market-place. *Social History of Medicine* 15:375-392.

De Ville, K. 1992. *Medical Malpractice in Nineteenth Century America: Origins and Legacy* New York: New York University Press.

Dibbell, E. 1930. Splints for Fixation of Fractures and Dislocations in Small Animals. *North American Veterinarian* 11:29-34.

Dog Splint for Human Legs. 1942. *TIME Magazine*, Monday, Oct. 12, 1942, 54.

Dunlop, R., and D. Williams. 1996. *Veterinary Medicine: An Illustrated History.* New York: Mosby.

Ehmer, E. 1925. Our Method of Handling Fractures. *North American Veterinarian* 10:47-49.

Fisher, J. 1993. Not Quite a Profession: The Aspirations of Veterinary Surgeons in the Mid-nineteenth Century. *Historical Research* 66:284-302.

Franklin, A. 1999. *Animals and modern cultures: a sociology of human-animal relations in modernity*. Thousand Oaks, Calif.: Sage.

Hardy, A. 2003. Professional Advantage and Public Health: British Veterinarians and State Veterinary Services, 1865-1939. *Twentieth Century British History* 14:1-23.

Hey Groves, E.W. 1914. Experimental Principles of the Operative treatment of Fracture and their Clinical Application. *The Lancet* 436:435-441, 513-522.

———. 1921. *On Modern Methods of Treating Fractures*. Bristol: Wright.

Hirschman, E.C. 1994. Consumers and Their Animal Companions. *Journal of Consumer Research* 20:616-632.

Hobday, F. 1906. *Surgical Diseases of the Dog and Cat*. 2nd ed. London: Baillière, Tindall and Cox.

Howell, J.D. 1995. *Technology in the hospital: transforming patient care in the early twentieth century*. Baltimore: Johns Hopkins University Press.

Hughes, T.P. 2004. *American genesis: a century of invention and technological enthusiasm, 1870-1970*. Chicago: University of Chicago Press.

Jasny, N. 1935. Tractor Versus Horse as a source of Farm Power. *American Economic Review* 25:708-23.

Jones, S.D. 2003. *Valuing Animals: Veterinarians and Their Patients in Modern America*. Baltimore: The John Hopkins University Press.

Kirk, H. 1928. Some Canine and Feline Problems. *Veterinary Record* 8:935-944.

Lacroix, J.V. 1916. *Lameness of the horse*. Chicago: American journal of veterinary medicine.

Latour, B. 1987. *Science in action: how to follow scientists and engineers through society*. Cambridge, Mass.: Harvard University Press.

Lederer, S.E. 1995. 'The Sacred Cord': Doctors, Patients, and Medical Research. In *Subjected to Science: Human Experimentation in America before the Second World War*. Baltimore, MD: Johns Hopkins University Press.

Lewis, K.M., L. Breidenbach, and O. Stader. 1942. The Stader Reduction Splint: For treating fractures of the shafts of long bones. *Annals of Surgery* 116:623-626.

Mazet, R., JR. 1943. The Use and Abuse of the Anatomic Splint in the Treatment of Fractures of the Lower Extremity. *Journal of Bone and Joint Surgery Am* 25:839-858.

McCunn, J. 1933. Fractures and Dislocations in Small Animals. *Veterinary Record* XIII:1236-1254.

McShane, C. 2001. Gelded age Boston. *The New England Quarterly* 74:274-302.

The Medical Profession and the Early History of the Motor-Car. 1910. *The Lancet* 175:56-59.

Michell, A. 2000. Only one medicine: the future of comparative medicine and clinical research. *Research in Veterinary Science* 69:101-106.

Motor Cars and Health. 1897. *The Lancet* 150:1264.

The Motor Grievance. 1907. *Veterinary Record* 24:443, 460, 472, 538, 551.

Pearce Gould, A. 1897. An Address on the Progress of Surgery and the Treatment of Simple Fractures. *The Lancet* 149:1599-1602.

Perrin, F. 1923. The Treatment of Fractures. *North American Veterinarian* 4:490-493.
Perry, J., and J. Perry. 1964. *Veterinarians and What They Do.* New York: Franklin Watts.
Pettit, G. 1990. A History of Veterinary Orthopedic Surgery. In *Canine Orthopedics*, edited by W.G. Whittick. Philadelphia: Lea & Feibiger.
Phillips, J., A. Fenn, and J. Harman. 1943. Stader Splint: Veterinarian's device is adapted to human beings. *LIFE Magazine*, February 22, 44-46.
Pickstone, J.V. 2003. Production, Community and Consumption: The Political Economy of Twentieth-Century Medicine. In *Companion to medicine in the twentieth century*, edited by R. Cooter and J.V. Pickstone. London: Routledge.
Porter, R. 1993. Man, Animals and Medicine at the Time of the Founding of the Royal Veterinary College. In *The Advancement of Veterinary Science: History of the Healing Professions*, edited by A.R. Mitchell. Wallingford U.K.: C.A.B. International.
Prior, J. 1845. Remarks on some of the injuries of bones arising from accidents. *The Lancet* 45:579-583, 608-612.
———. 1847. Some injuries of bones, arising from accidents. *The Lancet* 49:302-306.
Report of the Committee on Treatment of Simple Fractures. 1912. *British Medical Journal*:1505-1541.
Ritvo, H. 1988. The Emergence of Modern Pet Keeping. In *Animals and People Sharing the World.*, edited by A.N. Rowan. Hanover & London: University Press of New England.
Rock, M., E. Mykhalovskiy, and T. Schlich. 2007. People, other animals and health knowledges: towards a research agenda. *Social Science and Medicine* 64:1970-1976.
Rosenberg, C.E. 1987. *The care of strangers: the rise of America's hospital system*. New York: Basic Books.
Schillhorn van Veen, T. 1998. One medicine: The dynamic relationship between animal and human medicine in history and at present. *Agriculture and Human Values* 15:115-120.
Schlich, T. 2002. *Surgery, Science and Industry: A revolution in fracture care*. New York: Palgrave Macmillan.
———. 2007. The Art and Science of Surgery: Innovation and Concepts of Medical Practice in Operative Fracture Care, 1960s-1970s. *Science, Technology & Human Values* 32:65-87.
Schnelle, G.B. 1968. The History of Veterinary Radiology. *Veterinary Radiology & Ultrasound* IX:5-10.
Schroeder, E.F. 1933. The traction principles in treating fractures and dislocations in the dog and cat. *North American Veterinarian* 14:32.
———. 1939. Recent Progress In Canine Orthopedic Surgery. *North American Veterinarian* 20:54-61.
Schwabe, C.W. 1993. Interactions Between Human and Veterinary Medicine: Past, Present and Future. In *The Advancement of Veterinary Science: History of the Healing Professions*, edited by A.R. Mitchell. Wallingford U.K.: C.A.B. International.
Self, R. 1934. Open reductions and mechanical devices in treating fractures in small animals. *Veterinary Medicine* 29:120-128.
Shaar, C. 1942. The treatment of fractures and bone and joint surgery with the Stader Reduction and Fixation Splint. *Surgical Clinics of North America* 22:1537-83.

———. 1944. The Stader Splint. *American Journal of Nursing* 44:215-220.

Shaar, C., F. Kreuz, and D. Jones. 1944. End Results of Treatment of Fresh Fractures by the Use of the Stader Apparatus. *The Journal of Bone and Joint Surgery* XXVL:471-474.

Shomer, R. 1995. Otto Stader veterinary orthopedist. *Veterinary Heritage* 18:11-12.

Singleton, J. 1993. Britain's Military Use of Horses 1914-1918. *Past and Present*:178-203.

Siris, I.E. 1944. External Pin Transfixion of Fractures. *Annals of Surgery* 120:911-942.

Slatter, DH., 1985. *Textbook of Small Animal Surgery*. Edited by DH. Slatter,. II vols. Vol. II. Philadelphia: W.B. Saunders Company.

Soon Available for Civilian Use: Stader reduction and fixation splint. 1944. *Journal of Bone and Joint Surgery Am* 26:adv.7.

Stader, O. 1934. A method of treating femoral fractures in dogs. *North American Veterinarian* 15:25-29.

———. 1937. A Preliminary Announcement of a New Method Of Treating Fractures. *North American Veterinarian* 18:37-38.

———. 1939. Treating Fractures of the long bones with the reduction splint. *North American Veterinarian* 20:55-59.

———. 1943. Stader splint approved in human surgery. *Journal of the American Veterinary Medical Association* 104:332.

Stainton, H. 1932. The Fractured Canine Femur. *Veterinary Record* XII:187-189.

Taylor, F. 1911. A Few Canine Motor Accidents. *Veterinary Record* XXIV:356-358.

The Treatment of Fractures. 1910. *Veterinary Record* 23:105.

Voith, V.L. 1985. Attachment of People to Companion Animals. *Veterinary Clinics of North America* 15:289-297.

Weisz, G. 2006. *Divide and conquer: a comparative history of medical specialization*. New York: Oxford University Press.

Wright, J. 1937. Some Observations on the Incidence, Causes and Treatment of Bone Fractures in the Dog. *Veterinary Record* 49:2-16.

"Young-Tom" 1908. Canine Specialists. *Veterinary Record* XX:711.

Zelizer, V.A.R. 1985. *Pricing the priceless child: the changing social value of children*. New York: Basic Books.

Endnotes:

[i] I thank Hans Pols and Rachel Ankeny for their support throughout early drafts and subsequent rewrites of this article. I am also indebted to the five anonymous reviewers whose critical insight and encouragement has focussed the argument.

[ii] In America this rhetoric is associated with “Taylorism” and its more consumerist counterpart “Fordism.” These management strategies entail breaking down industrial procedures and specialising labour to perform individual tasks to optimise the efficiency and productivity of manufacturing processes. For an overview of the wider impact of Taylorism see Hughes (2004).

[iii] Roger Cooter (1993) has detailed how economic considerations were at the forefront of the re-organisation of hospitals and systemisation of specialised surgical practice in nineteenth-century Britain. As well as his excellent study of the evolution of the “AO” group of orthopaedic surgeons – and the

worldwide penetration of their standardised instruments and operative procedures – Thomas Schlich (2002; 2007) has also recently published an article in this journal describing the discourses of control and efficiency, which surrounded the introduction of osteosynthesis to routine surgical practice.

[iv] The angular anatomic configuration of the appendages of dogs and cats often allowed treatment by masterly inaction to produce remarkably good functional results because changes in the standing joint angles, compensate for shortened bones which meant “many animals walk almost normally in such cases.” Self (1934, 120)

[v] For an overview of early twentieth-century large animal fracture care practices see Lacroix (1916).

[vi] The amputation procedure was of course hazardous, but perceived by most human surgeons to be the less reckless course of action for comminuted or compound fractures than attempting restoration. By the middle of the nineteenth century the risk was not just for the patient. The legal historian Kenneth De Ville (1992, 100) notes: “Physician who exercised the most up-to-date techniques and preserved badly injured limbs often found themselves in greater legal danger than those practitioners who followed the archaic practice of perfunctory amputation.”

[vii] “No foot, no horse” is an adage that has been in use for centuries. The earliest reference that I could identify is: Jeremiah Bridge, 1751. *No Foot, No Horse: An Essay on the Anatomy of the Foot.* Cited in Dunlop (1996, 284).

[viii] The first references to “life and limb” (rather than ‘life or limb’) I could locate are in the OED. The expression dates from around the thirteenth century and relates to the person, his body and even his worldly possessions. This complements the use of the expression “life or limb” in the Fifth Amendment of the Constitution of the United States of America, which relates to the rules surrounding double jeopardy in criminal prosecutions. Whatever their etymological roots, the phrases are now common in orthopaedic discourse.

[ix] Of the perception of the role of veterinary surgeons and the value of different animals before the First World War, “Young Tom” (1908, 711) claims: “Ask the *average* person for his or her definition of a veterinary surgeon, and three-fourths will reply ‘A man who doctors horses.’ In country districts ‘and cattle’ will probably be added, but very rarely is any mention made of dogs. Veterinary surgeons have only themselves to blame for this, because until comparatively recently the dog was not considered worth a second thought.”

[x] This was not a sudden transition. In the UK and the US there was a long intermediate stage, where horses and tractors would commonly both be used on the same farm or as part of an urban transportation system. See: Cooper (1947) and McShane (2001).

[xi] For example, in 1907 there was a yearlong exchange on the impact of the motor-car in the correspondence to the editor in the *Veterinary Record*. The chief contributor was a Mr. George Upton, who because he was a proponent of accepting the inevitability of mechanization was eventually accused of being more interested in promoting “matters mechanical and not veterinary.” See: The Motor Grievance (1907, 443, 460, 472, 538, 551). For an inter-professional comparison, some representatives of the medical profession were excited by the possibilities for improvements in sanitation and hygiene with the removal of horses from the streets, and celebrated the medical profession’s role in the widespread uptake of motorised transport. See: Motor Cars and Health (1897) and, The Medical Profession and the Early History of the Motor-Car (1910).

[xii] The use of animals as clinical models for fracture care was a relatively rare occurrence until after The Second World War. Certainly animal models had long been utilised in the science of osteology – for example Sir Astley Cooper and the American Surgeon Nicholas Senn both conducted experiments on animals to support their respective positions on the potential for healing of intracapsular proximal femoral fractures – but it was not really until the second half of the twentieth century that animal

experiments were seen as a scientific imprimatur for the introduction of innovative surgical technologies to human patients. See Schlich (2002; 2007)

[xiii] In veterinary practice, treatment choices are often determined by the economic means of the owner. Veterinarians are aware that "price" sensitivities need to be negotiated during the consultation so it is not unusual for a spectrum of different treatments to be offered. Often, the "best" treatment available is the one that the owner can afford, balanced against an assessment of the animal's quality of life.

[xiv] The human surgeons Roger Anderson and H. H. Haynes had both developed their own ambulatory external pin fixation systems, which were used by civilian surgeons in wartime America. Unlike the Stader splint, both systems relied upon a separate device to effect fracture reduction. Therefore they were perceived to be less adaptable and self-contained than the veterinary apparatus.