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Canines, Consanguinity and One-medicine: All the Qualities of a Dog except Loyalty

Chris Degeling, 2008

The rise of pet culture and the expansion of medical science occurred concurrently in the late–nineteenth century. From this time in Anglo-American societies dogs were simultaneously valorised as 'man's best friend' and the 'ideal model' for experimental medicine. By tracking the hounds into our laboratories and onto the settee, changes in our conception of the properties of blood and canine breeding can be used to excavate covert connections between the contradictory social and scientific utilisations of this species. Describing the movement of genealogical and medical knowledge between the bench-top, the kennel and the clinic illustrates how Rudolph Virchow's earlier promotion of a concept of 'one-medicine' foreshadowed the twentieth-century concomitant development and intermingling of the biomedical sciences and a sophisticated companion animal medical expertise.

One-medicine is a guiding principle of the theory and practice of medicine that assumes diseases of all living beings are inherently similar and inextricably linked. It presupposes an underlying biological unity between species and that curative interventions for human and animals are, therefore, likely to be comparable. Its modern advocates claim Rudolf Virchow—the progenitor of modern cellular pathology—first popularised the idea of a fundamental unity of all medicine in the mid–nineteenth century by stating:

> between animal and human medicine there is no dividing line, nor should there be. The object is different but the experience obtained constitutes the basis of all medicine.[1]

It is likely that Virchow's comments were an observation on developments in contemporary experimental medicine, rather than constituting a historical claim. Nonetheless, most explorations of traditional ethnomedicines—or indeed western allopathic medicine—demonstrate that, throughout history, human and nonhuman animals have often been subject to medical interventions based on analogous theories, pharmacopoeias and surgical procedures.[2]

Since this time the medical profession has evolved to focus on the health and welfare of human beings. Concomitantly, comparative physicians and veterinarians have perceived their

role to include the maintenance of the health and productive capacity of livestock to optimise their transport, military, agricultural, and, more recently, research value. Historically, the exercise of all types of medical expertise prioritised the promotion of humankind's physical and economic wellbeing. Hence the healthcare provided to nonhuman animals has essentially been anthropocentrically-pragmatic. The recent formation of a separate and specialised companion-animal medical expertise, largely devoted to the care of sentimentally important and economically unproductive animals, seems to have altered the character of humankind's self-assumed primacy in these medically-mediated relationships. The major focus of this increasingly technologically sophisticated set of diagnostic, therapeutic, and palliative practices is the health and quality of life of individual companion animal 'patients.' Yet companion animal healthcare promotes human health in ways that are not immediately apparent. In researching and treating the maladies and diseases of canine and feline patients, and by focusing on the benefits humans are thought to derive from the personal bonds with animals, veterinarians are still thought to be fulfilling an important comparative and socially-supportive medical role within the auspices of one-medicine.[3]

At the same time Virchow's explication of the concept of one-medicine has also been important to medical science and the construction of modern biomedical expertise. As well as providing a guiding ethos for veterinary professional activities, Virchow's rhetoric and theoretical deliberations explicitly contained the expectation that the medical science of pathology can be abridged within the natural science of biology.[4] This assumption became a central justification for medical research that supposed the existence of underlying biological unity of commonality between species. Despite the fact that subsequent nineteenth-century research programs never successfully transcended their rhetoric to reduce the contents and entities that constituted pathology to correspond to the contents and entities of the biological sciences, Virchow's idea of producing pathophysiological 'prototypes' of disease has continued to evolve to form an institutional link between biomedical research and human and veterinary medical expertise.

To excavate some of the covert connections between human cultural activities, our interactions with animals, and the creation of biomedical knowledge and clinical capabilities, this article presents a brief history of one small aspect of our medically-mediated relationship with the canine species. Modern pet culture and the institutionalisation—some would say industrialisation—of experimental medicine were historically contemporary phenomena in Anglo-American societies. At the same time as pet dogs were becoming 'part of the family,' the canine became a favoured experimental subject in the modern laboratories of medical science. Rather than trying to understand this paradoxical state of affairs, I will demonstrate how a widening gap between the social status of pet canines and experimental models of the same species has underwritten the accelerated development of a veterinary expertise that provided researchers with paradigms, prototypes and biological materials to approach Virchow's conception of a hybridised medical science of pathophysiology for understanding human diseases.

Inevitably, the creation of this type of meta-narrative of human and animal parts, patients, and comparative health knowledges relies upon the work of many other historians. Diverging from the custom of historical microstudies, the aim of this article is not to pin down the finer detail but to sniff out otherwise broader and at times clandestine relationships and connections. This can only be achieved by occasionally slipping the collar of convention to synthesise different types of histories. In much the same way the anthropologist Sarah Franklin

has traced the pathways of sheep through agricultural production practices to the creation of the clone Dolly, I aim to follow the hounds into our lounge rooms and laboratories to describe some of the material and cultural effects of a socio–medical disjunction that somehow conceives of members of the canine species as both a valued individual patient and a malleable cheap and expendable soft-technology of biomedicine.[5]

One-medicine, humans, and companion animals

In order to frame the co-emergence of twentieth-century biomedical and canine veterinary expertise it is first necessary to explore the depth of the polymorphous association between the domestic dog and humans. *Canis lupus familiaris* is believed to be humankinds' first animal companion. Over thousands of years—through prolonged periods of isolation and human selection—distinct dog breeds have emerged. Often they were 'designed' or morphologically adapted to fulfil certain human social requirements and agricultural needs. Yet despite the domestic dog's importance to hominid societies, it seems that during subsequent millennia the canine rarely received medical care. The vast majority of accounts of antiquarian, preprofessional and early professional veterinary theories and practice almost exclusively refer to the use of *materia medica*, dietetic measures, and surgical procedures upon large, economically-valuable sporting, draught or food-producing species.

Until the twentieth century, the upkeep of most small household animals was often the responsibility of women, the historically oft-ignored first line of medical expertise. Hence the treatment of canine maladies and injuries—under the guidance of what became known as household-medicine—is also likely to have been one of their domestic duties.[6] Occasionally members of the aristocracy published manuals on canine healthcare for an audience of their sports-enthusiast peers. Within the upper reaches of the social order there was a tendency to valorise the aesthetics and character of certain breeds of canine pet and hunting dogs, while other segments of society were more likely to be associated with canines that were valued for their durability, aggression, or other functional attributes.[7]

In his bestselling explication of all things canine the nineteenth-century veterinarian William Youatt followed the classifications of naturalist M.F. Cuvier, which separated canines into three generations on the basis of their cranial morphology and the type of 'company' they kept.[8] Wild dogs and ancient breeds like the Greyhound were in the first group because of their extended nose, moderate intelligence, and the relative lack of human influence in their breeding. In the second group were spaniels, collies, and mastiffs; the most valuable and well-bred dogs with a moderate length of nose and enhanced cranial capacity and intelligence. The final category in Youatt's book was comprised of dogs of violent and brutish nature—such as bull terriers—characterised by short noses, decreased cranial capacity and consequent low intellectual endowment. However, a large number of dogs in Britain and North America at this time were considered to be without breeding. They were commonly described as mongrels, a species of ill-bred liminal and potentially dangerous parasites that existed somewhere between the kitchen, the yard, and what the historians Neil Pemberton and Michael Worboys have recently characterised as 'The rabid streets.'[9]

It is important to emphasise that although one can generalise, attitudes towards animals and divisions for canine ownership along class lines are never fixed but inherently heterogeneous. The master of the hounds for a hunt and the local butcher were likely to value their dogs in different ways. It is arguable, however, that until the latter half on the nineteenth

century pet-keeping amongst the lower orders of Anglo-American society was widely condemned as an unjustifiable indulgence. Towards the end of this period, scientific, medical, technological, and socio–cultural changes affected a pervasive shift in attitude to the keeping of animals as pets.[10] Soon, the overriding distinction by which canines were judged and valued by their owners was not necessarily their purpose but their pedigree. As noted by the social historian Harriet Ritvo, as pet culture evolved 'most observers felt that ownership of a mongrel revealed latent commonness.'[11] Consequently steps were taken amongst the growing numbers of dog fanciers to institutionalise consanguineous-breeding and the careful maintenance of genealogical records to ensure that their favoured variety of pooch sustained a purity and value that distinguished it from the average shepherd's cur or poacher's lurcher. In response to changes in the status of certain types of canines, from the early 1800s both private and charity-based small animal veterinary hospitals began to appear in London, New York, and other major urban centres.

While pedigree canines were more likely to join other domestic species in being subjected to interventions framed from within an organised body of medical lore, little regard was given to the welfare of itinerant crossbreed curs except as a potential source of disease.[12] These otherwise valueless dogs had, however, long been an occasional participant in one other type of cultural activity. Since antiquity their bodies had been a locus for the acquisition of natural philosophical knowledge from which it was possible to draw medically relevant analogies. Mid–nineteenth century veterinarians were well aware of the expansion of these animal-based experimental programs, as many of them were closely associated with the newly established veterinary colleges in Alfort, Berlin, and Bonn. These institutions, apart from educating equine veterinarians, provided a forum for the continuation of systematic animal-based research in the sciences of physiology and pathology.[13]

Image 1: *A physiological demonstration with vivisection of a dog. Oil painting by Emile-Edouard Mouchy, 1832. Image reproduced courtesy of the Wellcome Library, London.*

Consequently many nineteenth-century veterinary practitioners were conversant with the rationale behind an institutional alliance between animal healthcare and experimental medicine. In his Equine surgical manual the American veterinarian George Dadd breaks from his explication of the properties of blood to quote an 'eminent physiologist.' He notes: '[I]n order to arrive at explanation of what is obscure in man, we must look to the lowest and simplest forms of creation … for the assistance we gain in their comparative structures.'[14] These experiments on 'lower' animals were conducted under the empirical conclusion that there was a fundamental underlying unity in the diversity of life, to eventually become the central premise that underpins modern biomedical expertise. The following section explores the deepening interaction of canine bodies and minds within the pursuit of medically relevant knowledge. To evidence the argument I draw upon examples from the history of medicine of the emergence of an understanding of the properties and purposes of blood, and reflect upon the socio–cultural role the canine species played in the development and rationalisation of some of the different medical activities that have surrounded this vital fluid. The rationale for this choice of case study is that the manipulation of blood—including that of its constituent parts and of both the human and animal body—was a mainstay of humoural therapeutics. At the same time it is a substance that could be directly and reliably accessed during treatment and/or physiological investigations. Consequently, it is perhaps not so surprising that the response of the canine body and temperament to different sanguineous manipulations should constitute much of the focus of early experimentation.

Canine models

In 1818 James Blundell—an obstetrician at London's St. Thomas's Hospital—drew upon his experience of intraspecies transfusions in dogs to perform a human-to-human transfusion to treat a woman with postpartum bleeding.[15] His clinical actions—despite his patient's proximate demise—are part of a colourful history. One hundred and fifty years earlier Richard Lower had successfully transfused the blood of one dog to another in front of the Royal Society. To prove the vitality of the transferred blood the recipient dog was allowed to bleed freely, the volume of blood in its circulatory system being supported by the rapidly exsanguinating donor. Within a year the Parisian physician Jean-Baptiste Denis and then Lower had both intravenously transfused ruminant blood into a handful of human patients. Inferences of the humoural therapeutic intent are provided by eyewitness testimony.[16] Further treatments were abandoned when one of Denis's patients expired from a fever soon after his second treatment. Nonetheless the idea of transfusions remained in the public consciousness as a transfigurative experience in popular plays and cartoons.

Image 2: *Xenotransfusion procedures were rarely performed. Yet they were soon represented in a variety of medical treatises. Here a patient is having blood let from his right arm, while the blood of a bound dog is transfused into the left arm. Central panel of an engraving circa 1692.* (Source: Johannes Baptista Lamzweerde, *Appendix ... Ad Armamentarium Chirurgicum* (Boutesteyn Leyden,1692), 28. *Image reproduced c*ourtesy of the Wellcome Library London.

Blundell justified his re-introduction of human transfusion experiments by first demonstrating to himself that transfusion between species was dangerous. He confirmed that dog-to-dog transfusions were unproblematic, yet dogs that he transfused with human, ovine, or bovine blood would often expire. His use of transfusion in humans was restricted to subjects so close to death that the technique could not be blamed for their demise. The frequent failure of the practice to make any material difference to the patient's condition—Blundell is reported to have only performed eleven successful human-to-human transfusions—did not discourage other surgeons from attempting this procedure.[17] Yet as documented by the historian of medicine Susan Lederer, for most of the nineteenth century transfusion remained a controversial, 'little used, if sensational technique.'[18] In line with Blundell's caution it remained a treatment of last resort because most surgeons believed the blood of a healthy donor would provide a 'vital spark' that could reanimate an ailing patient. The primary indication remained postpartum haemorrhage. The utility of transfusion, however, was often complicated by difficulties of transporting the fluid from the donor to the recipient. Despite the construction of elaborate transfusion apparatuses, therapeutic efforts were often curtailed by the propensity of blood exposed to air to clot, making the procedure difficult to perform successfully and prone to the accidental administration of air emboli to the already moribund patient.

Several methods evolved to avoid the complications of clotting. It was not uncommon for surgeons to whip the collected blood to remove the fibrin before administering it to the donor or to attempt to use other liquids like saline or milk as a blood-substitute. By the beginning of the twentieth century the Franco-American medical luminary Alexis Carrel had—to great public and professional acclaim—developed a method of direct transfusion in which a

vessel of the recipient was surgically anastomosed to a vein in the arm of the donor. This technique—and most of the subsequent innovations and procedures introduced to overcome these difficulties—were, to varying extents, tested and refined on canine models. The American surgeon and researcher George Crile—who modified Carrel's method by placing a cannula between donor and recipient—claimed to have conducted over two hundred animal experiments in direct transfusion techniques during his study of the mechanisms and treatment of shock.[19] As the twentieth century progressed, on the basis of further experiments and clinical experiences, transfusion medicine and haematology became an established medical specialty, thereby becoming a routine procedure within the allopathic therapeutic armamentarium.[20]

Haematological knowledge and transfusion practices were founded on experiments conducted under a set of assumptions about biological commonalities between species. At the end of the nineteenth century—inspired by Claude Bernard—countless other experimental programmes were employing lower animals as human analogues for the pursuit of the 'laws' of physiology. Similarly in sympathy with Virchow's vision of a pathophysiologic science, quantitative disruptions to animal function by inoculation, injection, ablation, or dietary manipulation were performed in laboratories throughout Europe and North America to elucidate the aetiology and to understand the mechanisms of pathology.[21] In a short period of time, experimental medicine had moved beyond an interest in the study of comparative structure and function to focus on comparative pathology, which could be defined as a systematic exploration of the injurious effects of interventions on animal bodies.

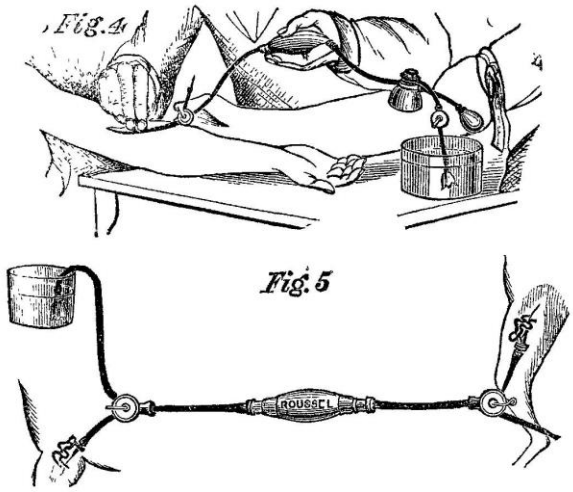

Image 3: *Roussel's transfusion instruments and a demonstration of modification on a canine experimental subject. Once attached, the instrument was primed with water from a jar near the donor's arm. By using two-way taps blood was then moved with a hand pump, first expelling the water through an accessory valve near the recipient's cannulated vein.* (C. Egerton Jennings, "Report of Two Experimental Transfusions on Dogs: Performed in Guy's Hospital Laboratory," *The Lancet* 122, no. 3131 (1883): 366.

Although experimental physiologists employed a variety of different organisms—to ensure the generality of the biological findings—canines were often favoured because they

were easy to obtain, relatively easy to handle, and through their expressions and postures their behaviour was easily 'read.' As many pet owners could confirm, their dogs were able to communicate to humans a sense of their physical and emotional wellbeing. However the psychosocial sympathy between experimenters and canines soon became seen as being problematic. As investigation became more detailed and mechanistic—reducing physiological effects to their minutia within bodily systems—a significant amount of effort was expended attempting to control human and nonhuman emotion in the laboratory such that it did not invalidate the experiment.[22] The need for further standardisation led researchers to reduce the number of species used, which in turn encouraged the selective breeding of test animals like mice and rabbits.[23] As the animal materials of experimental medicine became increasingly homogenised it is claimed that the underlying premise of biological commonalities between species, 'became an a priori assumption rather than an empirical conclusion.'[24] With the codification of systematic and highly organised laboratory practices, the physical size and psychosocial qualities of the canine species preserved its position as 'the ideal experimental animal' for research relevant to the evolving practices of transfusion medicine.[25]

Once Karl Landsteiner identified human blood groups in Vienna in 1901, most haematological researchers became far more interested in differences within—rather than between—species boundaries. The mechanism for separating each blood group was the agglutination and/or lysis of one individual's red blood cells when they were suspended in the serum of another. Within a short period of time researchers in Prague and Baltimore proposed similar classifications systems on the basis of independent but analogous studies.[26] Despite an explosion in interest in this phenomenon—and the genetic properties of each individual's blood—there was a lag before this information influenced clinical practice. For some time surgeons had preferred to use donors from the same family on the assumption that this minimised the chances of reactions from incompatibility. Although the discovery of blood groups did not immediately change human transfusion practices beyond a recommendation that a simple cross-agglutination test be performed—if time allowed before transfusion—it did inspire further experimentation. In New York, the physician Rueben Ottenberg mixed his clinical practice with a career in medical science. On the basis of his experiences of agglutination and haemolytic phenomena in sensitised noncompatible canine recipients and an understanding that blood groups were a heritable characteristic that 'could vary greatly depending on the distribution of blood types in the donor's population of origin,' Ottenberg regularly began to 'type' his human patients and donors before transfusion in clinical practice.[27]

At the same time as canines and other animals were becoming an integral component of industrialised laboratory practices, in Britain and North America the fashion for pet-keeping had become an established norm throughout the aspirational middle classes. Infused with an interest in eugenics, heritability and natural vigour, new canine pedigrees had been created by organised enthusiasts. Existing working-breeds were substantially remodelled to suit aesthetic and performance tastes. From her study of Victorian dog fancier's literature Harriet Ritvo claims that a feature of these genetic manipulations was the establishment of 'unnatural characteristics' as standard breed traits; hereditary effects that often 'provoked the greatest admiration.'[28] Within a short period of time what was already the most morphologically diverse mammal on the planet was further reshaped into a startling new array of shapes and sizes. Similarly the social need for the extensive adoption of 'scientific' veterinary medical practices into small animal healthcare procedures was expanding beyond the boundaries of the upper echelons of society into the middle and working classes who typically aligned themselves with the valorisation of certain breeds.[29] The spread of a utilitarian view of companion animal

ownership meant a Benthemite humanitarian concern for animal welfare became increasingly prevalent across Anglo-American society. Within this transformation, regard for the welfare of animals and an intolerance of unnecessary cruelty came to be seen as the marks of a civilised society.[30]

The increasing popularity of the cultural practice of pet-keeping and the disseminations of a compassionate disposition towards animals soon came into conflict with animal—particularly canine—experimentation. Eventually the edification of sentiment in some western societies affected the scope and content of physiological studies that used companion animals as experimental models. Medical scientists in Britain and North America expended a great amount of effort defending the need for animal-based experimentation and negotiating reliable sources of animal subjects.[31] While the rights, wrongs and scientific value of vivisection came to occupy late-nineteenth-century British and North American political debate, it is noteworthy that despite the widespread utilisation of canines within physiological experimental practices, the knowledge created was explicitly intended to inform human healthcare and not veterinary practitioners. Ultimately, as a consequence of an elevation in socio–cultural status for the domestic dog and a gradual reorientation of veterinary professional interests, a new form of interventionist medical expertise was developed for companion animals.[32] The next section lets the hounds off the leash to explore how some veterinarians adapted clinical techniques from human medicine and adopted knowledge created from animal-based experimentation, thereby attempting to negotiate and straddle a growing disjunction between the canine species' scientific and sentimental value in twentieth-century Anglo-American society.

Canine patients

Despite the increasing prevalence of pets in western society from the mid–nineteenth century and the prominence of the canine test subjects in experimental medicine, companion animal veterinary practice was not a commercially viable proposition for most veterinary practitioners until the beginning of the twentieth century. Except for the published works of some canine enthusiasts like the veterinary surgeon Delabere Blaine, most were disinterested in small animals and considered ministering to their maladies to be beneath the nature of their medical expertise.[33] An injured dog was more likely to be taken to a butcher, gamekeeper, or groomsman than a licensed veterinary practitioner. At this time the vast majority of veterinarians specialised in equine practice. Consequently blood transfusions, although mentioned, were rarely applied in nineteenth-century veterinary therapeutics. For example it was recommended that horses and cattle might receive a litre of blood 'where fatal exhaustion threatens in consequence of severe blood loss or blood poisoning,' but this was last resort therapy.[34] Even at the turn of the twentieth century when veterinarians began to pay more attention to canine ailments, transfusions were considered to be impractical for small animal practice. The authoritative advice was that it was better to intravenously infuse a dog with boiled saline, complemented with highly nutritious and restorative foods like milk, eggs, and brandy than risk death from the 'fibrin ferment' associated with ill-advised transfusions. [35]

From the professional literature it appears that many early-twentieth-century veterinarians were familiar with developments within transfusion practices in human medicine and the indications for its application. As well as anaemia, obstetric emergencies, and traumatic haemorrhage veterinarians were conversant with the signs and characteristics of human haemophilia. For example in 1905 the American veterinarian John Law described haemophilia in humans as a heritable 'constitutional infirmity' in which 'families are very prolific, a condition

counterbalanced by the death of the majority of the victims at an early age.'[36] Law also noted practicalities such that sufferers must be protected from injuries and were treated by transfusion when in crisis. The hereditary nature of haemophilia in humans had been known since an early-nineteenth-century study—amongst others—tracked the bleeding disease in a family from Philadelphia back to the Pilgrim settlement in Plymouth New Hampshire in 1720.[37] Veterinarians occasionally suspected the presence of the condition in their patient population when dogs and horses bled excessively after dentistry or minor surgery, but none claimed to have encountered 'a single clearly defined case in an animal.'[38] The cause of haemophilia—beyond its association with blood coagulation (not vascular abnormality) and its pattern of maternal inheritance in consanguineous males—was unknown at the time.[39] Given the lack of veterinary cases, the received wisdom was that the condition was nonexistent or very rare in animals but if encountered might respond to ergot, adrenalin, serum, or direct transfusion like a human patient.[40]

That veterinarians were knowledgeable about transfusion medicine and current understandings of haemorrhagic diathesis is perhaps not so surprising when one considers the amount of coverage these tragic diseases and seemingly miraculous treatments had begun to garner in the popular press. Susan Lederer has noted how in the first few decades of the twentieth century the drama, danger, and sacrifice associated with transfusion caught the imagination of the American public, with stories that 'served to illustrate the power of kinship' and the 'importance of affiliation.'[41] For those patients who could not prevail on a family member for a sanguinous contribution, many hospitals developed networks of 'professional' donors. Eventually, concerns about syphilis and innovations in the preservation and storage of blood meant that the practice of 'blood banking' was inaugurated to avoid problems of donor 'type' availability and sanitation. The first 'bank' was established in Chicago in 1937 and other North American cities rapidly followed. The politics of colour and identity soon became prominent as the transfer of blood across racial lines remained controversial, despite the fact that efforts to differentiate blood from different races by 'reliable' investigators had been unsuccessful.[42] Crucially, beneath these developments was an escalation of animal-based research in university and hospital laboratories, on blood coagulation, safe storage techniques, and the mechanisms of haemolysis.[43]

By the 1930s those veterinarians who had made the leap to meet a burgeoning market for companion animal healthcare were very interested in transfusion medicine. Following on from Crile's canine research, most veterinarians understood the major indication for canine transfusion to be haemorrhagic or toxic shock. Soon the number of papers on this practice presented at veterinary conferences and published in professional journals began to escalate. Direct and indirect transfusion techniques for canines were relatively easily adapted from human clinical routines.[44] Yet at first it seems that ideas about consanguinity and race—as rendered in the popular press—were highly influential in how veterinarians proposed to perform this practice. An article in *The Veterinary Journal* in 1922 notes: 'It is of the highest physiological importance that the bloods mixed should be identical,' because experience in human medicine had shown 'it is dangerous when transfusions are carried out between white and black, or yellow races.'[45] This type of speculation was gradually abandoned as knowledge about the presence and heritability of canine blood groups was gleaned from reports of canine haematological experiments in physiology journals.[46]

Despite the efforts to put veterinary practices on a more scientific footing, at first confusion remained as to the significance of donor compatibility. Experience and laboratory

data confirmed that any two randomly selected dogs would be compatible in three out of four cases, because of a relatively weak cross-agglutination reaction in the canine.[47] The weakness of the reaction, however, meant that tests for incompatibility were poorly trusted. Consequently the rule of thumb remained that cross-breed dogs were a universal donor and transfusions between pure-breeds should be avoided if possible. To meet the needs of their patients, many veterinary hospitals in Britain and North America established colonies of 'well looked after' large cross breed dogs as in-house donors for direct transfusion and blood banking.[48] Later studies confirmed that this caution was warranted. The narrowed gene pool within specific breeds made these individuals far more likely to have a blood type incompatible with trouble-free canine blood donation.[49]

Image 4: *'Bruno'—a three-month-old American Eskimo cross-breed—receives blood donated by 'Onyx' the Greyhound at Western College of Veterinary Medicine in Canada. Image printed with permission of Dr. Liz Snead.*

From the sanguineous history presented above it is possible to conclude that the one-medicine contract and its comparative methodology had come full circle. Knowledge derived from the treatment of human disease and animal-based experimentation became the template for the development of analogous companion animal therapies. In a contra-flow to traditional research practices, companion-animal veterinarians appropriated hypotheses and interventions from human medicine into their conception of how to recognise, organise, and treat small animal diseases. The medical knowledge and therapeutic procedures applied to the flesh of human patients provided a 'trusted' body of knowledge for the rapid advance of clinical applications of new theories of disease, diagnostic techniques, and interventions in small animal veterinary medicine. At the same time as experimental medicine expanded the role of animal-subjects to develop models for understanding the mechanisms of the human body, this information was appropriated by increasingly scientifically-literate small animal veterinarians to attend to the needs of their canine patients. Medical expertise based on animal experimentation was, now, applied to benefit animals. And yet the entanglement of human and animal medicine has only increased in the second half of the twentieth century. With improvements in understandings of genetics, veterinary clinicians began to describe the relationship between canine blood lines and heritable diseases, providing knowledge and a source of biological materials that soon became the fulcrum for the rapid expansion of biomedical expertise.

Biomedicine and canine disease

It is time to once more call back the hounds and return to issues of canine breeding and consanguinity. As the major parasitic, infectious, and nutritional canine diseases were brought within therapeutic control in Anglo-American societies in the 1950s, at the behest of dog owners and breeders, veterinarians increasingly turned their attention to genetic diseases.[50] Researchers were still seeking to circumscribe the hidden processes and invisible materials of life, but increasingly they did so with a view to compare them to the newly elucidated mechanisms of disease. Companion animal medical expertise, often considered an ancillary or boutique veterinary 'custom,' had conspicuously advanced to a point where it was recognised by medical researchers as a potential source of further knowledge and experience. In the clinic and within their own research, veterinarians were familiar with human medical knowledge and technology. In addition, with the institutionalisation of shared programmes for human and veterinary medical research, their theoretical knowledge was increasingly based upon carefully conducted physiological investigations of canine biology. However, unlike human physicians, a veterinarian's clinical practice revolved around diagnosing and treating the essential missing half of the new equation of biomedical comparison, naturally-occurring canine diseases.

As veterinary medicine sought to combine their clinical knowledge with expertise in genetics, biomedical researchers realised that thirteen millennia of genetic pressure applied by humans to the canine species had created a pathological resource.[51] The extreme variety of canine morphologies—a product of human fancy—had artificially narrowed the gene pool within standard breeds and had thereby also created a wide spectrum of breed-specific genetic diseases. The increasing sophistication of companion animal expertise provided the basis for the intensification of the interaction between canines and biological researchers. More than fifty years of clinical experience diagnosing and treating canine maladies aided the identification of breed-specific heritable diseases. While most subsequent veterinary clinical activities were directed at establishing selective breeding practices to remove 'poor' genes, the careful selective breeding of these afflicted individual in laboratories was undertaken to enhance the gene-expressive canine population. These disease models could then be carefully 'produced' to standardise individual types of animals, assure their reliability and enhance their biomedical productivity. Purebred canines with heritable diseases were now farmed as purpose built models for human pathology, alongside populations of healthy canines who maintained their presence on laboratory bench tops to provide the necessary norms for pathological description and biomaterials for physiological and therapeutic manipulations.

The historian of medicine Stephen Pemberton has detailed the construction of one variety of biomedical technology, the canine model of haemophilia A.[52] In 1946 the veterinary faculty at Cornell University identified a clotting disorder in the male puppies in a litter of Irish setters.[53] Through its clinical expression and inheritance pattern, veterinarians and geneticists assumed this canine malady to be likely to be analogous to so-called 'classic' human haemophilia. Medical researchers were alerted and the remaining dogs were purchased from the breeder. Successive generations were progressively interbred to produce a population of full-blown haemophiliacs. To keep these animals alive, let alone breed, required intensive medical management. Affected individuals were dependent upon plasma transfusions from a parallel colony of healthy donors every three to four days. Through these efforts the carrier and disease expressive populations were 'enhanced' to produce diseased individuals and biological materials like plasma, splenic, and bone marrow tissues that allowed ongoing biomedical investigation. Other heritable coagulation diatheses were soon identified in other canine

purebreds like the Cairn terrier and Alsatian, which were then similarly medically managed and genetically enhanced for the purposes of research.[54] Naturally enough, the insight derived from the biomedical characterisation of these canine conditions was then available to inform the treatment of haemophilia in both human and canine patient populations.

During the last few decades of the twentieth century, through the medium of animal-based experiments and investigations, medical researchers have come some way towards realigning their construction of 'pathology' to approach Virchow's ideal of a hybridised science of pathophysiology. This has been achieved by the description of DNA profiles and the emergence of other biomedical phenomena like oncogenes that provide an articulation between the sciences of pathology and biology because they exist as both normal biological entities and pathologic signs.[55] Within the evolution of these experimental practices, multidisciplinary research teams have been harvesting the larder of 'naturally-occurring' heritable companion animal pathologies as an ethically-appropriate analogue for human clinical research. The standardisation of breeds and the description of their genealogies allowed these types of animal experiments to transcend what Cheryl Logan has called 'empirical generality,' to focus on the pathophysiology of specific human diseases.[56] These knowledge production practices are often conducted in partnership with university veterinary faculties. They have generally been funded and conceived for the benefit of humankind, but have also had a professional pay-off in also improving the veterinary knowledge base and the level of privately marketable clinical expertise.

The animal cost of biomedical knowledge is often rationalised with utilitarian ethical arguments. Since the beginning of the twentieth century the editors of American Physiological Research Journals deliberately tempered and depersonalised the language used in their publications to try and distance the reader from the procedural realities of animal-based experiments thereby minimising their political exposure.[57] As for veterinarians, the historian Susan Jones has demonstrated that by convincing pet owners that animal-based research benefits all animals, veterinarians have been able to dilute the dissonance between the elevated status of the family dog and the experimental utilisation of the same species. In the process they have acquired a role as 'experts' on the humanitarian use of animals.[58] Despite the consolidation of the animal rights movement and the pertinence of epistemological arguments about the fallibility of human-animal analogies, the wider public and the veterinary profession itself generally subscribe to the belief that well-organised animal experimentation advances medical science, which ultimately improves the health and wellbeing of humans.[59] By intervening in the maladies of canines as if they were human, veterinarians have unwittingly improved the diagnosis and treatment of some human diseases. Humans have been used as models for canine interventions while canines have been used as models for human pathologies on the assumption that this type of experimentation is more humane towards all species than *ad hoc* extrapolations from clinical experience. Given the history of research conducted under the premise of Virchow's concept of innate biological communalities between species, it is not unreasonable to imagine that current investigations in 'comparative genomics' will provide a fulcrum for the continued co-production of companion animal and biomedical expertise.[60]

Conclusion

The construction of a scientific basis for modern medicine has relied upon subtle transformations and transubstantiations of nonhuman animals into functional simulacra of living human beings. Much of this research has been conducted within the laboratory implicitly guided

by Virchow's premise of a fundamental unity or biological commonality between species. At the same time personal attachments and relationships with individual animals gained broader acceptance as individuals and groups in western societies have come to value certain canine attributes and selected these within dog breeds. As these 'companion' animals became socially worthy of expert medical care, veterinarians have sought to improve the diagnosis and treatment of illness in small animals by at first duplicating and then contributing to developments in human medical practice. The impetus for the further development of a canine medical expertise has come from two distinct and contradictory sources: first from the owners of animal companions who required a passionate veterinary professional commitment to the investigation and treatment of small animal diseases, and from researchers working within the medical profession who have sought to utilise the canine as models for human pathophysiology.

Veterinarians have been able to straddle the growing divergence between the social and scientific valuation of the canine species to facilitate the procurement of biological materials and pathological models for the development of biomedical knowledge. With the description of 'naturally occurring' heritable breed-specific canine diseases, purpose-bred canines became a primary source for the materials of investigations that sought to combine—or at least correlate and re-align—some aspects of the discontinuous medical sciences of physiology and pathology. In this way the development of modern biomedicine and a sophisticated healthcare for valued animal patients in the second half of the twentieth century have been co-produced as closely allied types of expertise. Treating some dogs as if they were priceless has conversely and covertly also informed the expansion of canine-based experimental studies. Because companion animal ownership is now widely considered to be beneficial to human health and associated professionals increasingly employ programmes that involve animal-assisted therapies, both of these seemingly dissonant activities continue to reside under the umbrella of the one-medicine ethic and methodology, said to guide veterinary professional activities.

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[1] Despite the nebulous origin's of Virchow's thesis, these words have taken on a life of their own and have appeared in a variety of publications: from policy documents produced by the US National Institute for Science to the veterinary professional literature. Calvin W. Schwabe. "The Challenge of 'One Medicine'," in *Veterinary Medicine and Human Health*, edited by G. Stamathis (Baltimore: Williams & Wilkins, 1984), [1–13] 2.

[2] The term 'ethnomedicine' describes a medical system within its cultural context. The relative homogeneity of each ethnomedicine is now widely recognised. It is claimed: 'throughout history and continuing today, the medical arts for *Homo sapiens* and their food, work, and later pet animals have evolved together.' (Constance McCorkle and Edward Green, "Intersectorial Healthcare Delivery," *Agriculture and Human Values* 15 (1998): [105–14],105.)

[3] The term 'companion animals' came to prominence in the socio–medical research conducted in the US in the 1970s, which promoted the view that pet ownership was beneficent to human health. For a summary of the qualitative research see Andrew T. Edney, "Companion-animals and Human Health: An Overview." *Journal of the Royal Society of Medicine* 88, no. 12 (1995): 704–08.

[4] Peter Keating and Alberto Cambrosio, "Does Biomedicine Entail the Successful Reduction of Pathology to Biology?" *Perspectives in Biology and Medicine* 47 (2004): 357–71.

[5] In a recent book Franklin has foraged through the history of agricultural innovation, the biopolitics of Empire and colonisation, and the interaction of animal husbandry practices with

the life sciences to culturally contextualise the creation of reproductive cloning technologies. See Sarah Franklin, *Dolly Mixtures: The Remaking of Genealogy* (Durham: Duke University Press, 2007).

[6] Margaret Pelling. "Knowledge Common and Acquired: The Education of Unlicensed Medical Practitioners in Early Modern London," in *The History of Medical Education in Britain*, edited by Vivian Nutton and Roy Porter (Amsterdam: Rodopi, 1995), 250–78.

[7] Keith Thomas, *Man and the Natural World: Changing Attitudes in England 1500–1800*. (London: Allen Lane, 1983).

[8] William Youatt, *The Dog,* edited by E.J. Lewis (Philadelphia: Lea and Blanchard, 1852), 33.

[9] Neil Pemberton and Michael Worboys. *Mad Dogs and Englishmen*. (New York: Palgrave Macmillan, 2007). 26–33.

[10] Harriet Ritvo, "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, 1988), 13–31.

[11] Harriet Ritvo, *The Animal Estate: The English and Other Creatures in the Victorian Age* (London: Harvard University Press, 1987), 91.

[12] The association between dog bites and hydrophobia (rabies) has been known since antiquity. At other times companion animals were feared because it was thought their diet and lifestyle—as itinerant or vagrant animals—would predispose them to retain harmful miasmas within their fur and spread plagues and other diseases. Mark S.R. Jenner, "The Great Dog Massacre," in *Fear in Early Modern Society*, edited by William Naphy and Penny Roberts (Manchester: Manchester University Press, 1997), 52–6.

[13] Caroline Hannaway, "Vicq D'azyr, Anatomy and a Vision of Medicine," *Clio Medica: Acta Academia Internationalis Medicinae* 153 (1994): 312–28; and Paul Elliot, "Vivisection and the Emergence of Experimental Physiology in Nineteenth-Century France," in *Vivisection in Historical Perspective*, edited by Nicolaas. Rupke, (Beckenham, Kent: Croom, Helm, 1987): 48–77.

[14] George H. Dadd, *The Modern Horse Doctor: Containing Practical Observations on the Causes, Nature and Treatment of Disease and Lameness in Horses*, (Boston: Jewett, Proctor & Worthington, 1856), 26.

[15] James Blundell, "Experiments on the Transfusion of Blood by the Syringe," *Medical & Chirgical Transcripts* 9 (1818): 56.

[16] On 21 November 1667 Pepys noted that after Arthur Coga had been hired to receive the transfusion, he deliberately chose the species of the donor (a lamb) because of its transfigurative properties. Some members of the Royal Society, in front of whom the transfusion was to take place, reasoned that the lamb's blood would, because of its docile nature, 'have a good effect on him as a frantic man by cooling his blood.' See Samuel Pepys, *Diary,* vols 1-8 (London: 1908), entry for 21st Nov, 1667.

[17] James Blundell, "Observations on Transfusion of Blood," *The Lancet* 12, no. 302 (1829): 321–4.

[18] Susan E. Lederer, *Flesh and Blood: Organ Transplantation and Blood Transfusion in Twentieth-Century America* (New York: Oxford University Press, 2008), 38.

[19] George Crile, "The Technique of Direct Transfusion of Blood," *Annals of Surgery* 46, no. 3 (1907): 329–32.

[20] William H. Schneider, "Blood Transfusion in Peace and War, 1900–1918," *Social History of Medicine* 10, no. 1 (1997): 105–26.

[21] William F. Bynum, "'C'est Un Malade': Animal Models and Concepts of Human Diseases," *Journal of the History of Medicine and Allied Science* 45, no. 3 (1990): 397–413.

[22] Otniel E. Dror, "The Affect of Experiment: The Turn to Emotions in Anglo-American Physiology, 1900–1940," *Isis* 90, no. 2 (1999): 205–37.

[23] For an examination of the creation of the now ubiquitous lab rat see: Karen A. Rader, *Making Mice: Standardizing Animals for American Biomedical Research, 1900–1955* (Oxford: Princeton University Press, 2004).

[24] Cheryl A. Logan, "Before There Were Standards: The Role of Test Animals in the Production of Empirical Generality in Physiology," *Journal of the History of Biology* 35, no. 2 (2002): [329–63],329.

[25] Reuben Ottenberg, David .J. Kaliski, and Simon S. Friedman, "Experimental Agglutinative and Hemolytic Transfusions," *Journal of Medical Research* 28, no. 1 (1913): [141–63],141.

[26] Lederer*,* 144–50.

[27] William H. Schneider, "Blood Transfusion Between the Wars," *Journal of the History of Medicine and Allied Science* 58, no. 2 (2003): [187–224],195.

[28] Ritvo, *Modern Pet Keeping,* 24.

[29] The sociologist Adrian Franklin claims that since the beginning of the twentieth century in Britain, canine breeds became 'clear markers of a complex system of social identity.' He points out that some breeds offer the possibility of identification with particular groups in society: Corgis and Wales, pedigree gun dogs among the rural middle classes, toy breeds among urban retirees, and traditional fighting or racing dogs among some sections of the working class. See: Adrian Franklin, *Animals and Modern Cultures: A Sociology of Human-Animal Relations in Modernity* (London: Sage, 1999), 99–101.

[30] James Turner, *Reckoning with the Beast: Animals, Pain, and Humanity in the Victorian Mind*, (Baltimore: Johns Hopkins University, 1980); and Keith Tester, *Animals and Society: The Humanity of Animal Rights* (London: Routledge, 1991).

[31] For a discussion on the politics of antivivisection in Britain and North America see Richard D. French, *Antivivisection and Medical Science in Victorian Society*, (Princeton: Princeton University Press, 1975); and Susan E. Lederer, "The Controversy Over Animal Experimentation in America, 1880–1914," in *Vivisection in Historical Perspective*, edited by Nicolaas Rupke, (Beckenham, Kent: Croom Helm, 1987), 236–58.

[32] The metamorphoses of animal use and veterinary professional identity in western societies during the twentieth century is far too complex an area to explicate satisfactorily within the bounds of this article. For a detailed analysis of this subject in the United States see Susan D. Jones, *Valuing Animals: Veterinarians and Their Patients in Modern America* (Baltimore: The John Hopkins University Press, 2003). For research pertaining to Britain see Anne Hardy,

"Pioneers in the Victorian Provinces: Veterinarians, Public Health and the Urban Animal Economy," *Urban History* 29, no. 3 (2003): 372–87.

[33] Delabere Blaine, *Canine Pathology,* 2nd edition (London: Boosey and Sons, 1824).

[34] George Fleming, *A Textbook of Operative Veterinary Surgery* (London: Baillière, Tindall and Cox, 1890): 110–12.

[35] Jorno Dollar, *The Practice of Veterinary Surgery* (London: Gay & Bird, 1903), 157.

[36] James Law, *Text Book of Veterinary Medicine*, 2nd edition, 5 vols (Ithaca: J. Law, 1905), 506.

[37] John C. Otto, "An Account of an Hemorrhagic Disposition Existing in Certain Families," *Medical Repository* 6 (1803): [1–2],1.

[38] E. Wallis Hoare, *A System of Veterinary Medicine* (London: Baillière, Tindall and Cox, 1913), 1297.

[39] Thomas Addis, "Hereditary Haemophilia: Deficiency in the Coagulability of the Blood the Only Immediate Cause of the Condition," *Quarterly Journal of Medicine* 4, no. 1 (1910): 14–32.

[40] D.S. White, *A Text-Book of the Principles and Practice of Veterinary Medicine,* 2nd edition (Philadelphia: Lea & Febiger, 1920), 193.

[41] Lederer, 52.

[42] John G. Fitzgerald, "An Attempt to Show Specific Racial Differences in Human Blood by Means of the Reaction of Fixation" *Journal of Medical Research* 21, no. 1 (1909): 41–5.

[43] For examples of this literature see: Richard Weil, "Sodium Citrate in the Transfusion of Blood," *Journal of the American Medical Association* 64 (1915): 425–6; and Angus Wright, "Isohemolysins and Isoagglutinins Occurring in Dogs," *Proceedings of the Society for Experimental Biology and Medicine* 34 (1936): 440–3.

[44] A. Lockhart, "Modified Blood Transfusion in the Dog," *Canine and Feline Practice* II, February (1936): [52], 52–3.

[45] G. Mossu, "Blood Transfusions," *The Veterinary Journal* 78 (1922): [221–23], 222.

[46] For example the relevance of Daniel Melnick and George Cowgill's canine physiological studies on iso-immunisation from repeated transfusion was discussed at length at the annual meeting for the American Veterinary Medical Association of 1937. Other topics covered included the moves of Chicago Cook County Hospital towards institutionalising indirect transfusions of "banked" citrated blood in human patients. See Chas W. Bower, "Blood Transfusion in Dogs," *Journal of the American Veterinary Medical Association* XCII (1938): 136–44.

[47] William H. Olson, "Natural Isohemagglutination in Dogs," *American Journal of Physiology* 131, no. 1 (1940): 203–9.

[48] Harry J. Robertson, "Blood Transfusions in Dogs," *Journal of the American Veterinary Medical Association* 98 (1941): 482–94; and Hamilton Kirk, *Index of Treatment in Small-Animal Practice*, 3rd edition (London: Baillière, Tindall and Cox, 1954): 661.

[49] Scott N. Swisher and Lawrence E. Young, "The Blood Grouping Systems of Dogs," *Physiological Reviews* 41, no. 3 (1961): 495–520.

[50] D.F. Patterson and W. Medway, "Hereditary Diseases," *Journal of the American Veterinary Medical Association* 149 (1966): 1741–54.

[51] E. Ostrander, F. Galibert, and D.F. Patterson, "Canine Genetics Comes of Age," *Trends in Genetics* 16, no. 3 (2000): 117–24.

[52] Stephen Pemberton, "Canine Technologies, Model Patients: The Historical Production of Hemophiliac Dogs in American Biomedicine," in *Industrializing Organisms*, edited by Susan Schrepfer and Phillip Scranton (New York: Routledge, 2004), 191–214.

[53] R.A. Field, C.G. Rickard, and F.B. Hutt, "Hemophillia in a Family of Dogs," *Cornell Veterinarian* 36 (1946): 293–9.

[54] In the late 1950s, veterinarians in Ontario Canada identified haemophilia B in a litter of Cairn terriers and established a laboratory practice around a medically-managed colony of these dogs. For an example of these biomedical studies see T. Hovig et al., "Experimental Hemostasis in Normal Dogs and Dogs with Congenital Disorders of Blood Coagulation," *Blood* 30, no. 5 (1967): 636–68.

[55] Peter Keating and Alberto Cambrosio call these phenomena 'biomedical substances,' in their book detailing the pathophysiological realignment of postwar oncology. See Peter Keating and Alberto Cambrosio, *Biomedical Platforms; Realigning the Normal and the Pathological in Late Twentieth-Century Medicine* (Cambridge, Massachusetts: MIT Press, 2003), 2.

[56] Logan, 329.

[57] Susan E. Lederer, "Political Animals: The Shaping of Biomedical Research Literature in Twentieth-Century America," *Isis* 83, no. 1 (1992): 61–79.

[58] Susan D. Jones, "Reconciling Use and Humanitarianism," in her *Valuing Animals: Veterinarians and Their Patients in Modern America* (Baltimore: The John Hopkins University Press, 2003), 141–54.

[59] There is a strong case that animal models of causality—like those used in toxicity testing—have little epistemic value for the development of treatments for human disease. See Hugh LaFollette and Niall Shanks, *Brute Science: Dilemmas of Animal Experimentation*, *Philosophical Issues in Science* (New York: Routledge, 1996).

[60] Lena Peltonen and Victor McKusick, "Genomics and Medicine. Dissecting Human Disease in the Postgenomic Era" *Science* 291 (2001): 1224–9.