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# The Neuroscience of Prions

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The field of neuroscience is one that is rapidly evolving and expanding to encompass more areas of research than ever before. With the innovation of new technology and a broader wealth of knowledge, there is nearly no limit to the topics neuroscience can evaluate. One such field is the growing research in prions. A relatively new subject matter, prions are well known in popular culture in the form of Mad Cow Disease. However, there is far more information to be known than bovine-based illness. The purpose of this paper is to expand upon the topic of prions, starting with a brief history and ending with how neuroscience has allowed for a deeper understanding of these physiological terrors.

## The discovery of prions

In the early part of the 18th century, Europe found herself in the midst of a rapidly growing sheep-based economy. Being pressured for both quality meat and wool, farmers began to selectively breed for these particular traits. However, in doing so, their selective breeding yielded unintended consequences [1]. The introduction of scrapies led to an outbreak of animals that would uncontrollably scrape themselves against hard objects, amongst other degenerative neural-based behaviors [1]. With the inability of these sheep to be used for meat or wool, the British government quickly began to financially support research into scrapies before her economy crumbled. As scrapies was only seen in sheep and appeared to not be transmissible to humans, the level of concern the disease presented was minimal and soon the topic nearly disappeared [1]. It wasn't until the 1950's that interest was again peaked, this time with human victims.

With the expansion of Australia, much exploring was occurring in her surrounding islands, such as that of Papua New Guinea. It wasn't until scientists and other explorers traveled deep into the forest that they discovered a manifestation of a scrapies- like illness in the Fore people, called kuru. With symptoms such as ataxia, tremor, uncontrollable laughter, inability to chew or swallow, dementia, and eventual death, those infected with kuru suffered a fate resembling sheep infected with scrapies [1]. Not knowing how it was transferred, the devastation kuru caused amongst the natives of Papua New Guinea was of extreme interest to many. It was not until the 1960's that researchers discovered the transmissibility of kuru, and that it shared features of histology with scrapies and previously recorded Crueztfeldt-Jakobs Disease. These transmissible spongiform encephalopathies, or TSE's, were extremely dangerous and yet it was still not understood what caused them [2].

With the advancements of technology and increased understanding of these TSE's, it only took a few short years to suggest the cause of these diseases to be proteins. And by 1982 they had a name: proteinaceous infectious particles or prions [2].

## What is a prion?

Understanding the brief historical story of how prions were discovered does not provide detail into what they actually are. Defined by the Center for Disease Control and Prevention, a prion is an abnormal, pathogenic agent that is able to induce abnormal folding of specific prion proteins that are found most abundantly in the brain [3]. By changing the conformation of these proteins, brain damage occurs and then there is an eventual showing of physiological symptoms associated with a particular prion. Though this sounds simple enough, the processes behind prion functioning are highly complicated and are still not fully understood. It is here that the field of neuroscience is of great use. By looking at how the understanding of prions has changed over the years, you see the impact that neuroscience has had.

As previously described, the existence of prions was originally observed in abnormal behavior in sheep in the form of scrapies in the early 18$^{th}$ century. However, it was not until the 20$^{th}$ century that adequate research was able to take place. With the advent of the electron microscope and use of ionizing radiation, it was in 1967 when Tikvah Alper and John Stanley Griffith proposed a hypothesis suggesting an agent consisting solely of proteins caused spongiform encephalopathy. Specifically, these were proteins that did not contain nucleic acid that are essential for replication [4]. Alper and Griffith believed that because ionizing radiation did not affect the cell as it did other viruses, these proteins must not have been viruses but something else entirely [4].

This theory held for years while research was still being conducted. Unsure of replication methods or transmissibility, it took several disastrous laboratory accidents to realize that prions were not only contagious, but they were zoonotic [2]. With this knowledge in mind, it was in 1982 when Stanley Pruisner was able to isolate and purify prion proteins and confirmed that the infectious prion consisted primarily of a single protein type, called PrP.

As time has continued, the understanding of prions has become both more complete and more complicated. The purpose of this paper was not to analyze the technical aspect of prions and their biological functioning, but to understand that it is because of advancements in neuroscience that this understanding has come to be. With use of new equipment and advancements in knowledge, topics such as prion replication, specific structure, and means of transmission have been answered allowing for a better understanding of how to control the issues associated with them [6].

## Conclusion

The understanding of prions we have today is a massive expansion to what we knew even thirty years ago, and it all thanks to an expansion in the field of neuroscience. By isolating the specifics of prions, we as a species have been able to formulate treatment for those suffering from TSE's, as well as help avoid them all together.

The research I conducted hugely opened my eyes to this ever growing and changing field of neuroscience. It is truly marvelous to engine search a word and see the amount of research that has been done in order to understand one small aspect of an exceptionally small particle. The topic of prions is one that is still not fully understood

and I believe it is one that will become more heard in years to come. Before it had a name, prions were impacting the world around us and it will continue to do so until we determine a way to eradicate these abnormal proteins that manifest themselves inside our brains.

## References

1. McKintosh, E., Tabrizi, S., & Collinge, J. (2003). Prion diseases. *Journal of Neurovirology* 9: 183-193.

2. Genetic Science Learning Center. (2012). Prions: On the trail of killer proteins. *Learn.Genetics*. Available http://learn.genetics.utah.edu/content/begin/dna/prions/. Accessed 18 February 2013

3. Center for Disease Control and Prevention. (2012). *Prion diseases*. Available: http://www.cdc.gov/ncidod/dvrd/prions/. Accessed 18 February 2013

4. Alper, T., Cramp, W., Haig, D., & Clarke, M. (1967). Does the agent of scrapie replicate without nucleic acid?. *Nature* 214: 764-766.

5. Horwich, A., & Weissman, J. (1997). Deadly conformations-protein misfolding in prion disease. *Cell 89*: 499-510.

6. Prusiner, Stanley. (1996). Moleculary biology and pathogenesis of prion diseases. *Trends in Biochemical Sciences* 21: 482-487.