

## No 14 Sir Charles Sherrington (1857 – 1952) (I)

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1. The last time we looked at reflexes. We saw that the term reflex is rather dangerous because it is used in a variety of different ways. This means that we need to be careful that we ourselves know what we mean by it when we use it.
2. For the purpose of these talks, I said that I would be using Sir Charles Sherrington's definition of a reflex as an innate, automatic response to a stimulus. In this sense of the word reflex, there is no conscious thought involved.
3. The reflexes which mostly concern us as AT teachers are responses by the voluntary muscles to a stimulus. These reflexes, such as the patellar reflex, are programmed into us.
4. But there is an important point to remember about these reflexes. They use the voluntary muscles. Because these muscles are also more or less under the control of the motor cortex, it is possible to interfere with or even suppress the reflexes.
5. This raises a variety of questions relevant to our work as Alexander Teachers which we will be coming to later.
6. Today I am going to talk about Sherrington himself. The AT has had endorsements from various prominent people – such as John Dewey and Aldous Huxley. But by far the biggest name to have endorsed us is Sherrington.
7. He was a scientist of the highest international stature who was awarded the Nobel Prize in 1932. But as well as providing us with a top-level name we can quote, I am convinced that the Sherrington's work provides us with a variety of important insights into what is going on when we give and receive Alexander lessons.
8. As usual, I will tell you my sources, so any of you who want to take things further can do so. There is plenty on the web if you just put Sherrington's name into Google. There is also quite a nice summary biography if you look him up on the Nobel Foundation website.
9. A couple of his colleagues and students have produced books about him. One of the nicest is *Sherrington: his life and thought* by Eccles and Gibson. Both were students of Sherrington and went on to have distinguished careers of their own with Eccles winning the Nobel Prize in 1963.

10. Sherrington himself was extremely prolific. He wrote 320 scientific papers of which a 500 page summary was published in 1940. He wrote a number of books to which I will be referring, of which *The Integrative Action of the Nervous System* is the most famous and the most important.
11. I will begin with a biographical sketch so we know something about the man we are dealing with. He was born in London in 1857 but his father died when he was a small child and his mother remarried a well-known classical scholar called Dr Cabel Rose who lived in Ipswich. Rose was also a notable geologist, archaeologist and art collector.
12. The family home in which Sherrington grew up was a meeting place for writers, poets, artists and scientists. His secondary education was at the very old and famous Ipswich School where he had the typical upper-middle-class education of the time. His subjects included Latin, Greek, history and literature – but no science.
13. His home background and education meant that though Sherrington was later to excel in science he was also very good at languages, wrote poetry, was interested in art, collected rare books and was generally a deeply cultured individual.
14. He was also very good at sports. Even though he was quite small and generally rather diffident he was apparently a very aggressive rugby player and one of the pioneers of winter sports in Switzerland. He also played football for Ipswich Town.
15. He intended going to Cambridge University but, striking a contemporary note, one of his biographers said

*A bank failure so crippled the family's finances that Charles enrolled at St Thomas's Hospital Medical School in order to permit his brothers William and George to go up to Cambridge ahead of him.*<sup>1</sup>
16. While waiting to go to Cambridge – I suppose you could call it his gap year – he managed to keep himself remarkably busy. He began to study at the Royal College of Surgeons and also enrolled as a medical student in St Thomas's Hospital in London in 1876. A couple of years later, in 1879, he made it to Cambridge where he studied Natural Science and medicine.
17. In 1881, Sherrington who was in his second year at Cambridge, attended a medical congress in London at which

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<sup>1</sup> Eccles and Gibson (1979)p1

the working of the nerves was discussed. One of the key speakers was a German physiologist called Friedrich Goltz who had been working on the nervous system in dogs and had produced some controversial ideas.

18. Sherrington became very interested in the questions Goltz was raising and started working on them in Cambridge. His first published scientific research paper was in 1884.
19. He qualified as a member of the Royal College of Surgeons in 1884 and obtained a medical degree from Cambridge in 1885. He was quickly appointed lecturer in physiology in St Thomas's and got a research fellowship in Cambridge.
20. A few years later, in 1891, he became the Physician-Superintendent of an animal research centre called the Brown Institute in the University of London.<sup>2</sup> In the four years he spent there, he continued to produce scientific research papers and according to Eccles and Gibson, *to build the foundation on which modern neurology is based*.<sup>3</sup>
21. Because of the high quality and originality of these papers his scientific reputation grew steadily. He was elected to membership of the Royal Society in 1893.
22. The Royal Society was founded in 1660 and is said to be the oldest scientific society in the world still existing. Christopher Wren and Isaac Newton are former Presidents.
23. Being admitted as a Fellow of the Royal Society, you get to call yourself FRS, and this is a sign that you are in the very top rank of scientists.
24. Sherrington became Professor of Physiology at Liverpool University in 1895. During the next ten years, there was a flood of high quality scientific papers from his laboratory in Liverpool.
25. Because of his growing scientific fame, he was invited to give a series of six lectures in Yale University in 1904. These were published in 1906 as *The Integrative Action of the Nervous System*.
26. This book is widely regarded as the founding document of modern neuroscience. It has been compared in its importance with Newton's great work on the Mathematical Principles of Natural Philosophy.

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<sup>2</sup> Cohen (1958)p7

<sup>3</sup> Eccles and Gibson (1979)p5

27. In 1913, he was appointed Professor of Physiology at Oxford and remained there until he retired in 1936 at the age of 79.
28. He was elected President of the Royal Society in 1920. Being President is as high an honour as you can get in British science. He got the Nobel Prize in 1932.
29. Even after he retired, Sherrington remained intellectually and professionally active and he published a book called *Man on his Nature* in 1940 when he was 83. This is based on a series of guest lectures called the Gifford Lectures which he gave in Edinburgh University. This book is less technical than his earlier books and in many ways it summed up his life's work while putting it in a broader philosophical and historical context.
30. He was especially interested in the life and work of a 16th century French physician called Jean Fernel whom he saw as a key figure in the early emergence of the scientific attitude. Fernel, for example, was far in advance of his time in abandoning astrology.
31. Sherrington's last work which was published in 1946, when he was 89, was a life of Fernel and was called *The Endeavour of Jean Fernel*. This is a formidable work of scholarship for an old man, involving researching original manuscripts in Latin, Old French and other languages.
32. But he was not quite finished his professional activity. *The Integrative Action of the Nervous System* was published in a new edition in 1947 as a tribute to him on his 90<sup>th</sup> birthday and a copy was presented to every delegate at the XVII International Congress of Physiology in Oxford that year.
33. Despite his age, Sherrington wrote a long new introduction to the book which showed how little the intervening forty years had dimmed his interest and intellectual capacities.
34. Through all this research, he was also interested in wider issues, particularly to do with science and education. In 1916, he was urging that women be admitted to the medical school in Oxford.
35. During the 1<sup>st</sup> World War, he was asked by the War Office to produce a report on fatigue among armaments workers. The best way to research that, he decided was to go to work in a factory himself. So for three months of the summer vacation from Oxford he worked as an ordinary worker in the Vickers-Maxim shell factory in Birmingham.

36. He worked seven days a week, from 7:30 am to 8:30 pm, with early days off at 6:30 pm on the weekends and lived in a workman's hut. His report said shorter hours and better living conditions gave greater productivity. He was speaking from experience.
37. He was pleased that his foreman told him he could mention his name if he ever needed a reference.
38. He seems to have been almost universally liked and admired. At the first International Congress of Neurology in Switzerland in 1931, when he was introduced,  
*...the whole audience of 2000 members stood and cheered unceasingly until Sherrington, overcome with emotion, signalled them to be seated.*<sup>4</sup>
39. Every account of him at a personal level, describes him as altogether an engaging, modest, generous, friendly and cultured person. He published a book of poetry called *The Assaying of Brabantius* in 1925.
40. He also had phenomenal powers of observation and one little story about him that I like is told by a student of his in Oxford. The student and a friend were walking to lunch in the Parks at Oxford on a spring day.
41. There had been rain but now the lawns were steaming in the sunshine. They met Sherrington, who was then in his seventies. He smiled at them and said *"Have you noticed that all the earthworms this morning are crawling in the same direction? Phototropism or what?"*<sup>5</sup>
42. Sherrington died in 1952 at the age of 94. He had been awarded about every national and international honour that a scientist could get.
43. I will now try to give you some idea of his work. The main focus was on the nervous system in vertebrates, and especially the workings of the reflex system. Starting in the 1890s, he made a variety of fundamental discoveries.
44. These were all based on detailed laboratory work. Right to the end of his teaching career, he was renewed as a meticulous and ingenious laboratory experimenter.

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<sup>4</sup> Cohen (1958)p13

<sup>5</sup> Granit (1966) p6

45. At the time, he was beginning his research, many scientists believed the nerves in the body formed an interconnected web or network along which nerve impulses flowed.
46. But from his experimental results, Sherrington worked out that nerve cells, to which he gave the name neurons, could not be directly connected with each other. There had to be a tiny gap, to which he gave the name “synapse”, across which nerve cells communicated chemically with each other. He was absolutely right but it was another fifty years before microscopes were powerful enough to identify these synapses.
47. This insight of Sherrington’s fundamentally changed the way scientists thought about the nervous system. It led on to the whole science of neurotransmitters: substances with names like dopamine, noradrenalin and serotonin.
48. He studied proprioception – the way the body knows what is going on inside itself. It was he who worked out that the muscle spindles detect the amount of stretch in muscles.
49. He had very interesting things to say about inhibition, by which he meant the process by which the nervous system stops or prevents the activity of muscles.
50. An example of inhibition in Sherrington’s sense which I mentioned in the talk on muscular mechanics is the way the nervous system automatically inhibits the action of the opposing muscles when we activate particular muscle groups. If I flex my arm, the muscles on the other side automatically relax.
51. This is known as Sherrington’s law or the law of reciprocal innervation. His Nobel acceptance speech is all about inhibition but is very technical.
52. Apart from these fundamental discoveries, the other side of his genius was in the way in which he was able to start with the simple reflex arc and build up an ever more complex picture of the workings of the nervous system.
53. If we look at the vertebrate nervous system, we have the brain at the top, in the head, with the spinal cord carrying nerve impulses to and from it. Between the vertebrae, there are gaps out of which sensory and motor nerves emerge and serve the sensing and moving bits of the body – including the sciatic nerve which runs down the leg.
54. There is a high degree of democracy in the working of the nervous system. A lot of the functioning of the body involves

just the sensory and motor nerves at a particular level in the spinal cord.

55. But there are lines of communication which run up and down the spinal cord so that if one bit of the body acts, the necessary compensatory acts are organised by the appropriate other levels in the spinal cord.
56. When we walk, for example, each step involves changes in virtually the whole of the rest of the body. For the most part these coordinated changes are automatically organised – on a reflex basis.
57. And right at the top, is the brain, allowing all this coordination to go on but with the capacity to organise interventions of all kinds.
58. This conceptual view of the functioning of the nervous system, building upwards from the simplest reflex arcs to the great unifying functions of the brain is essentially what *The integrative action of the nervous system* is about.
59. Within that overall picture, there are various aspects of the functioning of the nervous system which are of real interest to us as AT people. Sherrington gave a lot of thought to balance and posture, the way an animal holds itself when it is walking or standing. In *The Integrative Action*, he said:

*...much of the reflex reaction expressed by the skeletal musculature is postural. The bony and other levers of the body are maintained in certain attitudes both in regard to the horizon, to the vertical, and to one another...Innervation and co-ordination are as fully demanded for the maintenance of a posture as for the execution of a movement.*<sup>6</sup>
60. It was Sherrington who inspired Rudolph Magnus to his work on the postural reflexes – which crystallised Alexander's idea of the primary control which we will talk about later.
61. There is absolutely no doubt about Sherrington's place in the development of neuroscience. Reading him, as AT teachers, we can find his work illuminating what we do in a variety of ways. It also helps us understand what is happening and express it in ways which are more easily understood by scientists and medical people.

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<sup>6</sup> Sherrington (1906)p339

62. So even if we just looked at what Sherrington had to say about the working of the nervous system, especially the reflexes, we would gain a variety of useful insights into our work. But there are also some closer and more direct links between the AT and Sherrington. I will tell you about them the next time.

## References

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