

No 17 Rudolph Magnus (1873-1927) (II)

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1. Last time, I introduced you to the neurophysiologist Rudolph Magnus. Today, I am going to continue with him.
2. I told you how, after spending his Easter vacation in 1908 working with Sir Charles Sherrington in his laboratory in Liverpool, he devoted most of the rest of his tragically short research life to working out the neuroscience of posture.
3. What we know from our AT experience is that posture is a complex and subtle activity involving the whole neuromusculature. How we stand and sit and use ourselves is influenced in three basic ways:
 - 1 Our innate characteristics. A cow and a duck and a human are born with a set of automatic ways of sitting, standing and moving. These built-in automatic ways of using ourselves are usually called reflexes.
 - 2 What we learn about posture from our parents, siblings and companions. Most of this learning is unconscious mimicry and leads to the formation of habits. The important thing is that a habit is like reflex in the sense that it happens without thinking about it.
 - 3 The other major influence on our posture is our conscious will, our decision to do things in particular ways. We can decide to stand, sit or move in a particular way and if we do it often enough, it leads to the development of habits.
4. Magnus and Sherrington were interested in exploring the underlying mechanisms of posture – the innate reflexes which determine animal posture.
5. In terms of our AT interests, it might be said they were interested in the basic question of how does the neuromusculature of posture work naturally before we start to interfere with it.
6. The practical question Magnus and Sherrington faced was how to isolate and examine the reflexes involved in posture – how to separate the reflex from the learned and the deliberate:
 - We need to look inside the skull to see what is involved. The upper part of the brain consists of the two cerebral hemispheres, the right and the left. These two hemispheres are covered by the cerebral cortex.

- The cortex is the area of the brain that does the thinking. There have been various studies on which hemisphere is responsible for which functions and considerable arguments whether there are significant differences between boys and girls. Luckily we can ignore that for our purposes today because we are concerned not with the thinking brain but with the reflexes.
 - Below the cerebral hemispheres there is a layer in the brain called the *corpus callosum* that separates them from the lower part of the brain. This lower part of the brain is referred to as the subcortical part of the brain and is where automatic and reflex functions are controlled.
 - The subcortical part of the brain consists of the midbrain and below that the brainstem which connects directly to the spinal cord.
7. This lower part of the brain is also called the reptilian brain, since it emerged in fish and reptiles during the early stages of vertebrate evolution hundreds of millions ago. The cortex is sometimes referred to as the neocortex because it emerged much later in evolution; the cortex and the neocortex are the same thing.
 8. If, as Magnus and Sherrington did, you want to study the action of the reflex muscle system you need to be sure that the thinking part of the brain, the cerebrum, is not interfering with how the muscles are working. The way Magnus and his team went about it, involved very precise and skilful brain surgery.
 9. They went into the brain and either surgically removed the cerebrum or made sure it was not in contact with the lower part of the brain. That way they could be sure that whatever was happening in the musculature did not involve the thinking part of the brain.
 10. The animals they used in these experiments were referred to as decerebrate preparations. The thinking part of their brain had been eliminated and the researchers could be sure that whatever actions a decerebrate preparation did were inbuilt or reflex rather than learned.
 11. Between 1908 and 1924, apart from the years of the First World War, Magnus and his team carried out hundreds experiments on cats, rabbits, guinea pigs, dogs and monkeys to see what was involved in posture and how the brain non-thinking part of the brain controlled it.

12. The full study report was presented in German in *Körperstellung* which was published in 1924. The first public airing of Magnus' findings was 1925 in the Royal Society Croonian Lecture. It was entitled *Animal Posture* and had Sir Charles Sherrington in the chair. Magnus was an important scientist and this was about as prestigious a scientific occasion as one can get.
13. In this lecture, Magnus looked at posture under four headings. As AT teachers we can relate to them easily. They are the sort of things we explore in quite a few of our games. I do not know to what extent they influenced Walter Carrington when he was systematising the practical aspects of teacher training practice after the Second World War. But he would have read the Croonian Lecture and I am sure he had them in mind.
14. In the Croonian Lecture, Magnus said that every movement starts from and ends in some posture. But for the purpose of the lecture he would just look at four aspects of posture.
15. The first of these he called "*Reflex Standing*". About this, he says:
- In order to carry the weight of the body against the action of gravity, it is necessary that a certain set of muscles, the 'standing muscles' should have by reflex action a certain degree of enduring tone, to prevent the body falling to the ground.¹*
16. You remember that "*tone*" or *tonus* is the level of tension in a muscle when it is keeping its shape but not actively doing something. If I am simply standing, there must be a sufficient level of tone in the standing muscles to resist the downward pull of gravity so that I do not collapse in a heap on the ground. This is, as we say, "*allowing standing to happen*".
17. The second aspect of posture Magnus called "*The Normal Distribution of Tone*". He says:
- In the living animal not only do these standing muscles possess tone, but also the other muscles of the body, especially their antagonists, the flexors. Between these two sets of muscles a certain balance of tone exists so that neither set of muscles gets too much or too little tone.²*

¹ Magnus (1925)p339

² Ibid.339

18. In other words, standing properly is not just a question of being in the upright. There should also be an appropriate balance between the extensors and the flexors. They should not be competing madly with each other. They should be doing just enough to keep the body in a nicely relaxed state of balance.

19. The third aspect of posture Magnus called “*Attitude*”. About this he says:

*The position of the different parts of the body must harmonise with each other; if one part of the body be displaced, the others parts also change in posture, so that different well-adapted attitudes, evoked by the first displacement, will result.*³

20. If I move a bit of me – lift my arm, or twist my head – my reflexes will bring about an automatic adjustment of all the other parts of my body so that my overall posture comes into a balanced and harmonious state. Posture is dynamic.

21. The fourth aspect of posture Magnus called “*The Righting Function*”. About this he says:

*If by its own active movements or by some outside force the body of an animal is brought out of the normal resting posture, then a series of reflexes are evoked, by which the normal position is reached again.*⁴

22. This is a more dynamic aspect of posture. He meant that if someone comes and gives me a push, or if I do something which takes me out of my balanced standing posture, the righting function takes me back into the balanced posture again.

23. In normal posture these aspects take place together and interact with each other. But it was useful for Magnus, and for us, to think of them separately as well.

24. Magnus also looked at the influence of movements of the head on the rest of the neuromusculature. The animals were suspended in a supporting harness and he found that when he moved the head of one of them up, down or sideways, this had an automatic effect throughout the whole of the musculature.

³ Ibid.340

⁴ Ibid.340

25. He said:

*The mechanism as a whole acts in such a way that the head leads and the body follows.*⁵

26. This gives us a reasonable picture of the working of the inbuilt or reflex postural mechanisms in the body. But, of course, it is not as simple as that.

27. At the same time as the brain is sending out the signals to the muscles that control these aspects of posture, there is a huge amount of sensory data coming into the nervous system. This comes from the various sensing systems and organs throughout the body. These are called proprioceptors and tell the nervous system what is going on in the various parts of itself.

28. These proprioceptors include the vestibular apparatus in the inner ear which responds to changes in the position and movement of the head. There are various organs in the joints and muscles – muscle spindles, tendon organs and different kinds of pressure sensors – which respond to change in the tension and pressures in the various parts of the body, especially the muscles and joints.

29. Nor must we forget the skin which responds to a wide variety of external conditions such as temperature. It is also sensitive to different kinds of pressures from something as delicate as an insect walking on it through to the kind of things that happen in the Piccadilly Line during rush-hour.

30. We have a particularly large number of pressure-sensing organs in the soles of our feet – the plantar sensors – which respond to changes in the way our weight is carried on our feet – for example, whether it is forward on our toes or back on our heels.

31. All of these, remember, are working below the level of consciousness. They are doing their job without any involvement by the conscious brain which the experimenters had removed or disconnected.

32. Once we bring in the upper part of the brain, the cortex, we have what Sherrington calls the teleceptors, the sensors which tell us about things outside the body. Magnus did a certain amount of experimenting with the cortex in place.

⁵ Magnus (1926b)p588

33. For humans, the most important teleceptors are the eyes, but for dogs, the nose is equally if not more important. Other animals which are active in the dark depend much more heavily than we do on their sense of hearing.
34. So the picture now is that the brain is automatically sending signals to the various muscle areas in our body adjusting their tone and attitude, while at the same time, floods of impulses are also coming into it from the proprioceptors and the teleceptors.
35. This means there is a huge data-processing task involved in handling and harmonising all these data flows coming into and going out from the brain so that the body is automatically maintained in a continuing state of harmonious posture.
36. What Magnus said was that:
- The result of the present study is that in the brain stem, from the upper cervical cord to the midbrain, lies a complicated central nervous apparatus that governs the entire body posture in a coordinated manner. It unites the musculature of the whole body in a common performance.*⁶
37. This posture-regulating central apparatus is in the brainstem. In other words, all this brain-processing relating to posture is, or can be, carried out without any involvement by the cortex, the conscious thinking part of the brain.
38. In the next talk I am going to look at where exactly Magnus discovered the control systems for the postural reflexes are located in the brainstem. I will also explain why it is so important that they are in the brainstem rather than in the thinking part of the brain.
39. I will look at question of the “primary control” and the widespread misunderstandings that have grown up around it. I will also look at what Magnus called the *physiological a priori* and the remarkable extent to which it parallels Alexander’s concept of faulty sensory appreciation.
40. And I will also explain why I think Walter Carrington’s one-line summary of the essence of the AT back in 1950 has stood the test of time and is hard to better. He said:

⁶ Magnus (1924)653

The whole basis of Mr Alexander's Technique is the teaching of how to eliminate interference with the autonomic functioning of the organism.⁷

41. In the next talk, I will tell you more about the importance that Magnus attached to the fact that the postural control nerve centres are located in the brainstem rather than the cerebrum. I will also look at the rather complicated and much-misunderstood question of what has become known as "*the primary control*". I will also look at what Magnus called "*the physiological a priori*" and the remarkable extent to which it parallels Alexander's concept of faulty sensory perception.

References

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⁷ Carrington (1994)p52