No 9 THE QUESTION OF BALANCE

Gerald Foley CTC 8 October 2013

1. Today, I am going to talk about balance but before that I would like to tell you about a little article I came across in the *New Scientist* magazine. This is something that Walter Carrington used to do.
2. He was extremely interested in connections between science and the AT. He was a subscriber to the main scientific journal *Nature* which was always available in Lansdowne Road. He was also a member of the Royal Institution. Whenever he came across something of interest to us as AT people in *Nature,* he would tell us about it.
3. I myself find *Nature* a bit hard going but I do have a subscription to the more popular *New Scientist.* In a recent issue there was a short piece by the well-known AT teacher David Gorman in which he discussed the question of evolution, walking upright – called bipedalism – and its supposed relationship to back pain.[1]
4. There is a view which is shared by some AT people that humans have not yet fully evolved to walk upright and backache is result. The other and more plausible view is that backache is a result of our misuse of ourselves.
5. This was discussed by Nikolaas Tinbergen's in the 1976 Alexander Memorial Lecture in which he firmly dismissed the idea that we have not sufficiently evolved to walk upright. Tinbergen says our back problems are a result of misuse with which most of us would agree.
6. David Gorman summarises the debate in a neat and informative little article, written in a way that appeals to scientists. Towards the end, he slips in a reference to the way the Alexander Technique helped him deal with his own back pain problems and leaves it at that.
7. You might regret that he does not discuss the AT more fully but if he had done so, the *New Scientist* would have edited it out or not published the whole contribution. So this a quite clever piece of writing in the way it manages to bring in a nice reference to the Technique into an article in a very widely read scientific publication.
8. It is also the sort of thing that would appeal to a technically-minded pupil. I am putting it on the notice-board so anyone who wants to can borrow and copy it.
9. After that little digression, today's subject, is the question of balance, or, as it often more formally described, equilibrium. It is

[1] *New Scientist* 10 August 2013 p65

essential to our normal functioning in daily life and when it fails us we fall.

10. One of the distressing aspects of growing old is that our sense of balance deteriorates and we all know of elderly people who have suffered a "broken hip" as a result of a fall. A broken hip, incidentally, is a fracture of the neck of the femur, the bit that sticks out of the top of the femur and connects it into the acetabulum, the socket in the pelvis.

11. Balance is also at the heart of what we do as AT teachers. Unless we are in a state of easy balance, it is impossible for us to detect what is going on in our pupils. Instead of being able to show them how to free themselves to go up we can easily find ourselves leaning on them and pulling them down.

12. Walter used to recommend a book by his friend Tristan Roberts who was Reader in Physiology in the University of Glasgow. Roberts spent his whole scientific life studying the question of balance in human beings and animals.

13. He wrote a book called *Understanding balance: the mechanics of posture and locomotion.*[2] It is 350 pages long and while it tells you all you are ever likely to need to know about the mechanics of balance and a lot more, much of it is hard going even for a trained engineer.

14. So today I am going to try to simplify the question of balance down to some basic facts and show how they fit in with the work we do and with monkey in particular. I am going to skate gently round some of the more complicated technical issues but I can go into more detail if anyone wishes or we can discuss it by e-mail.

15. Gravity is at the heart of any discussion about balance. For our purposes, gravity is the force that pulls things towards the centre of the earth. It I drop an apple, it falls towards the centre of the earth as Newton is said to have noted.

16. Because of gravity, if I hang a weight on a string from my finger it is attracted to the centre of the earth. In other words the string is pointing towards the centre of the earth. This is what we call the vertical; it is a line that lies along a radius from the centre of the earth.

17. When a carpenter or someone doing wall-papering wants to get a vertical line, they make use of this. They hang a heavy weight from a long piece of string and line the wall paper up against it.

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[2] Roberts (1995)

18. This is called a plumb line. It is called this because the weight used by builders and decorators was usually made of lead for which the Latin word is plumbum.

19. So what does it mean to be in balance or equilibrium? It is surprisingly difficult to pin this down exactly but in a broad sense we can say that it means being in a steady state of resisting the downward pull of gravity.

20. But it is more subtle than that. Not all states of equilibrium are equal. We can distinguish between stable equilibrium and unstable equilibrium and we can also recognise that within the idea of stable equilibrium there are different degree of stability.

21. We can see this if we think of a pyramid. If we are very careful, we can balance it on its point but if we displace it even slightly, it falls over. We say it is in a state of unstable equilibrium when it is standing on its point.

22. If, instead, we put it on its base and displace it slightly, it goes back to its original position. We say it is in a state of stable equilibrium.

23. The same applies to us. If I balance on one foot – or one toe like a ballerina – I am in a state of unstable equilibrium, a touch displaces me from it. But if stand on my two feet I am harder to push over. I am in a state of stable equilibrium.

24. But I said there are also degrees of stable equilibrium. Let's look at this rectangular piece of cardboard. As I lean it over to one side, it becomes less stable than when it is flat on its base. Eventually it reaches a state of unstable equilibrium beyond which even a slight displacement makes it topple over.

25. We see the same thing in ourselves. If I am standing with my feet wide apart I am in a state of stable equilibrium. As I bring them closer together, I am in a less stable state of equilibrium. This is relevant to monkey and how we go about our work and I will come back to it later.

26. All of this is quite useful but it is a bit vague – more stable, less stable – how can we a bit more definite. There is a very useful concept called the centre of gravity which helps us get a more precise grasp of what is going on when we are discussing balance.

27. I wanted to get a precise definition and I looked it up in a physics textbook which said: *The centre of gravity is that point at which the whole weight of an object may be thought to act.*

28. If we take something apart or dissect a person we won't find an identifiable point called the centre of gravity – though you will see it marked on anatomical charts of the body. In that sense it does not

have a physical existence but, for certain purposes, it is useful to be able to think of objects as though their whole weight were acting through a particular point.

29. One of the implications of this is that if we hang an object from a support, we know that the centre of gravity, the point through which its whole weight may be thought to act, will be trying to go towards the centre of the earth. This means it will be vertically below the support, on the line from the support to the centre of the earth.

30. This gives us a way of finding the centre of gravity of an irregularly-shaped object like this piece of cardboard. I hang it from a hook and use a plumb-line to find the vertical. We know the centre of gravity must be somewhere on this line, vertically below the support.

31. Hang it from another point, check the vertical line and we know the centre of gravity must be somewhere on this line. Its precise location must therefore be where these two lines intersect.

32. Another feature of the centre of gravity is that it is the point around which the object balances. We can see this with our piece of cardboard.

33. Finding the centre of gravity of a human being is more difficult since it is not easy to hang them up from a hook to see where the vertical passes through them. Classical ballet goes part of the way when the male dancer supports the ballerina in a horizontal position. If he has his hand directly below her centre of gravity, she will not tip away from the horizontal.

34. Early performances of Wagner's *Rheingold* in which the Rhine maidens were supported horizontally in harnesses as they swam around in the Rhine could also be seen as ways of finding their centre of gravity.

35. But however it is done, and there are mathematical methods as well, the centre of gravity in a human is roughly in the centre of the pelvic girdle.

36. The importance of the centre of gravity is that it gives us a way of looking at the question of balance in a more scientific way. Experiments show that things go out of balance when the vertical line from the centre of gravity passes outside the base.

37. We can see this if we go back to a simple shape like a rectangle. When it is standing on its base, the line from the centre of gravity passes inside the base. When I displace it a little, the line is still inside the base and the piece of wood is still in a state of stable equilibrium. It goes back to its original position when I let it go.

38. I can lean it over a bit further so that the vertical line comes to the edge of the base. It is now in a state of unstable equilibrium and if I push it a little bit further it falls over.

39. In the case of three-dimensional objects, the base is the portion in contact with the ground. The interesting thing about the base is that it does not have to be solid or continuous. In the case of a stool or a chair the base is defined by the line around the outside of the legs. In the case of people, it is a line drawn around the outside of the feet.

40. Let us now look at a simplified two-dimensional model of a human being – something with a fairly narrow base tapering upward like this. It is a bit like an Egyptian mummy.

41. I have already located the centre of gravity of this model and it is about here. If I hang the model from a hook, we can see that the vertical passes through the centre of gravity.

42. This model has a very important ability that the pyramid and triangle did not possess. It can change its shape. But its shape-changing abilities are quite limited and it can only do one thing. It can stick out its arms.

43. If we look closely, we will see that when the arms goes out, the centre of gravity changes. If it sticks both arms out to the same side, the vertical from the centre of gravity passes outside the base and the model would fall over if I allowed it.

44. But that is all we have time for today. Next time, I will tell you about how we are equipped to detect when we are moving away from being in a state of stable equilibrium to a less stable one and putting ourselves in danger of falling.

45. I will also come back to how all of this relates to the way we go about our work and especially the question of monkey.

46. In the meantime, walk carefully and stay in balance.

REFERENCES

T. D. M. ROBERTS (1995) *Understanding balance: the mechanics of posture and locomotion* - Chapman and Hall, London.