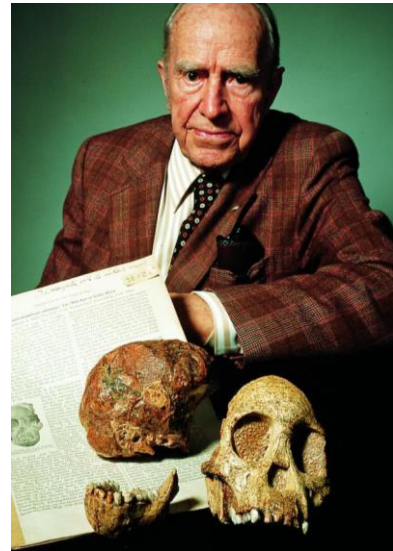


# Raymond Dart Remembered

(1893 – 1988)

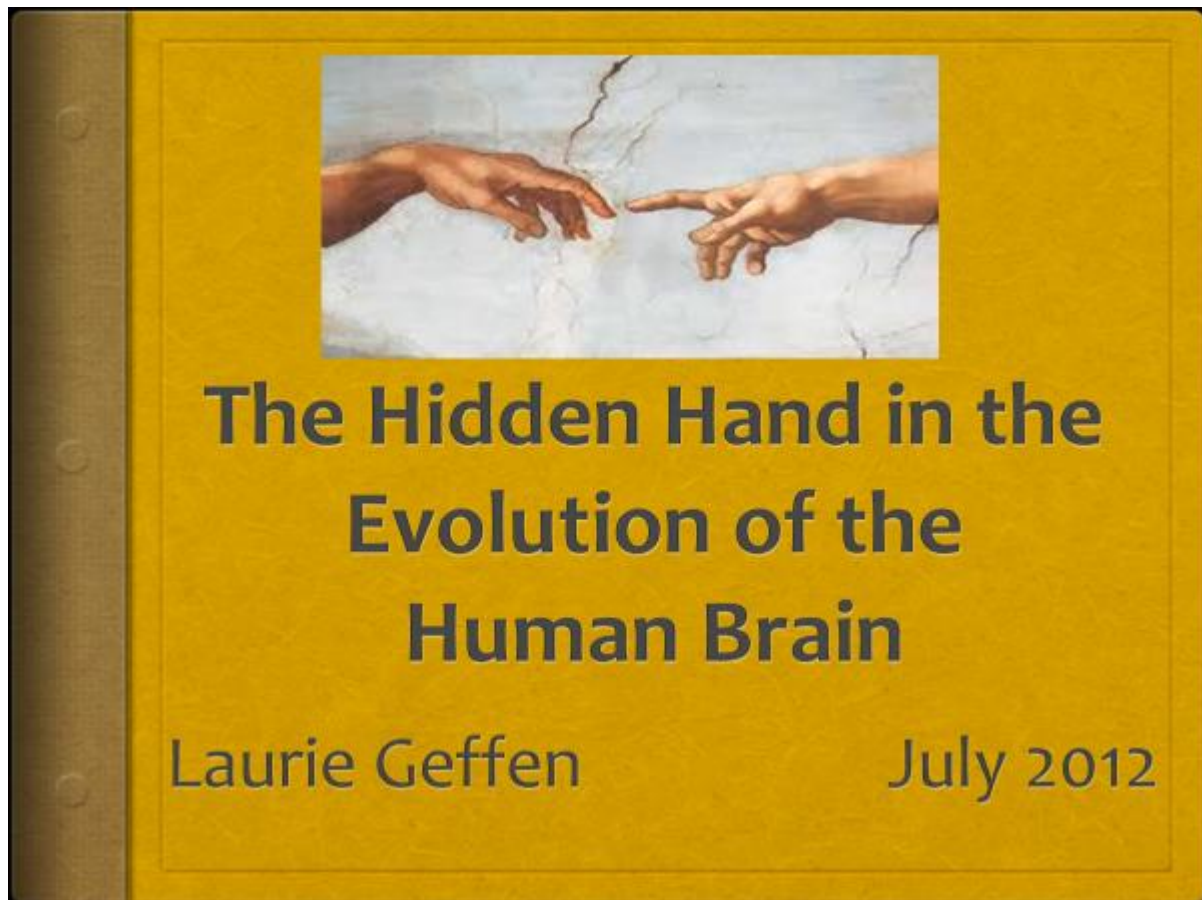
*Professor of Anatomy*

*Palaeontologist*



*This appreciation of Raymond Dart is based on Professor Laurence Geffen's inaugural address in 1991 as Dean of the Faculty of Medicine, University of Queensland (Dart's Alma Mater) in Brisbane (Dart's birthplace), and on an expanded version delivered to the Royal Australian and New Zealand College of Psychiatrists in 2012.*

(Circulated to the Class of 1960, as Newsletter #11 – Raymond Dart [Newsletters](#))



The human brain is the most complicated known kilogram of matter in the universe. There is much debate about the evolutionary forces that directed the development of this marvellous organ, the understanding of which constitutes the ultimate frontier of biological research.

As my title implies, I will focus on one of these forces, the dynamic interaction between that equally marvellous manipulative machine, the human hand, and the evolutionary development of the brain, an interaction facilitated by the adoption by our hominid ancestors of an upright, bipedal posture several million years ago.



Let me state at the outset that the hidden hand in my lecture title does not refer to divine intervention, as portrayed in this iconic masterpiece by Michelangelo on the ceiling of the Sistine Chapel that depicts the hand of God reaching out to that of newly created Adam on the sixth day of Creation. Instead, it refers to the cryptic role that the manipulative properties of the human hand have played in guiding the evolution of the human brain.

That is the background against which I wish to focus on the contribution of Raymond Arthur Dart, a Queenslander by birth, who migrated from Australia via the UK to South Africa to become Professor of Anatomy as a young man of 30 at the University of Witwatersrand in Johannesburg. There, for the next sixty-three years, he worked as a paleoanthropologist and medical educator, achieving world-wide fame and notoriety as the discoverer of *Australopithecus africanus*.

In the mid-1950s, I studied anatomy and physical anthropology in Dart's department before making the reverse journey in the 1960s from South Africa to Australia also via the UK. Although I never saw him again, I maintained some written contact with him until he died in 1988 aged 93.

### **Raymond Dart's early years in Brisbane (1893-1914)**

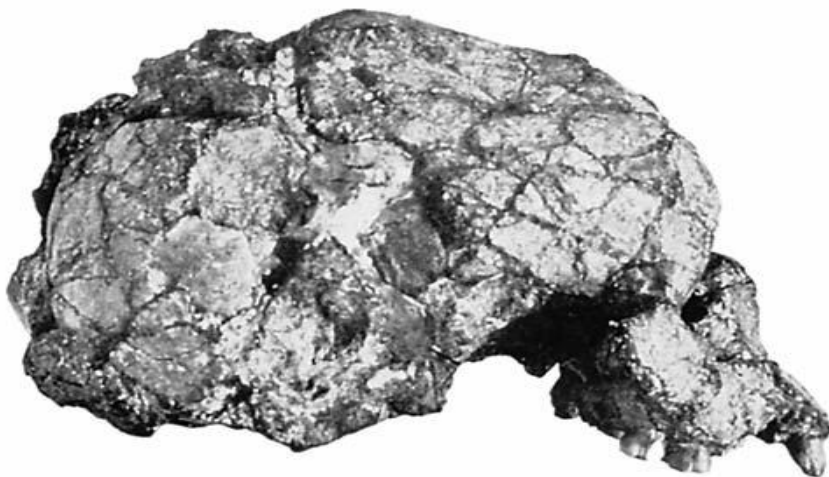
Raymond Dart was born in Brisbane on 4 February 1893, the year of disastrous floods that washed away the Victoria Bridge and deposited ships in the Botanic Gardens. It also washed away the plantation and sugar mill that his grandfather William had built on the St Lucia site of what is now the University of Queensland. It is said that the infant Raymond was floated out of a second story window of their inundated house, presumably like Moses in a reed basket.

Six years later, his parents who were devout Baptists, moved to a bush farm at Blenheim, in Queensland to remove their children from the temptations of city life. There Raymond Dart had a typical Australian farm boyhood. However, at boarding school he soon showed his brilliance and in 1911, on receipt of a scholarship he became a Foundation student at the nascent University of Queensland, where he took his BSc degree with Honours in 1913 and his MSc two years later.

### **Postgraduate years in Sydney, London and New York (1914-1923)**

Despite, as he put it, 'the discrepancies between fundamentalism and the facts of evolution' he intended to become a medical missionary in China. He enrolled in Medicine at Sydney University in the fateful year 1914, and soon fell under the influence of the Professor of Anatomy, J T Wilson, an authority on the comparative anatomy of the marsupial brain. 1914 was the year in which the British Association for the Advancement of Science held their first ever congress outside the British Isles, arriving en masse by ship in Sydney.

At the Congress Dart attended lectures by such luminaries as Sir Grafton Elliot Smith, an Australian who had become a leader of British anthropology, who gave a series of lectures on Ancient Egypt and the Dawn of Civilisation. At one of these lectures in 1914, the Talgai skull, a fossil excavated in South East Queensland and the oldest to be discovered in Australia, was exhibited by Professor Wilson. Dart was hooked!



The Talgai Skull (pictured left) seemed to confirm that the earliest humans already had large brains. (it was later found to be relatively modern being about just 10,000 years old)

When World War One broke out, the entire congress packed up and set sail for England. Dart finished his medical degree in Sydney, and then served briefly in military medical service in

France. In 1918, he joined the Anatomy Department at University College, London (UCL) under the distinguished Australian neuroanatomist, Sir Grafton Elliot Smith. Dart's interest in developmental neuroscience flourished at UCL for the next five years, with an illuminating interlude in the US on a Rockefeller Fellowship. Before he could establish himself, however, he was reluctantly shipped out to the colonies in 1923 as Professor of Anatomy of the fledgling Medical School in Johannesburg. He was one of the twenty protégés of Elliot Smith, who were to occupy chairs of anatomy around the world!

### **Professor of Anatomy, University of Witwatersrand (1923-1958)**

Within two years of his arrival in Johannesburg, Dart had identified the Taung skull as a 'missing link' in hominid evolution. The consequences of this discovery were to preoccupy him for the rest of his life. This skull ranks as one of the most important hominid fossils ever found, not because it was the oldest or most complete, but because of its critical position in the transition to hominid status. Dart's recognition of this radically altered our concept of human ancestry and the forces at play in the evolution of upright posture and the development of the brain. But Dart's insight was not fully accepted for decades and was subject to derision by his peers.

### **The Taung skull**

The circumstances surrounding the discovery and publication of the Taung fossil are fascinating and revealing of the character and temperament of this pioneer. When he arrived, Dart was appalled by the lack of facilities in his new Department of Anatomy (barely 5 years old). He was dismayed at the absence of an anatomical museum, having just come from one of the great collections in London and seen some in America. He therefore urged his students to look out for fossils that might form the basis of a collection.

Within a year he had struck, not gold, but limestone. The limestone was being extracted by a blasting operation at the Northern Lime Company near a remote village called Taung, in what was then the Northern Cape Province of South Africa. Embedded in the limestone were large numbers of primate and other fossils.

Dart's attention was drawn by one of his enthusiastic students, Ms Josephine Salmons, to a fossil baboon skull with a neat hole in the top as if it had been struck by a sharp implement. She had obtained it from a miner, Mr De Bruyn, who had collected many such fossils as a hobby, with no knowledge of their significance.

Through the intercession of a colleague, two crates of bone-bearing limestone were dispatched by rail to Dart's home in Johannesburg. Within minutes of opening one of the crates, Dart had found two astonishing pieces. One was a brain-shaped lump of agglomerated sand, the other a piece of breccia that appeared to contain a skull. The two pieces articulated. Using his wife's knitting needles as chisels, he carefully cleaned the promising block of limestone and the 23<sup>rd</sup> day it is said the rock parted to reveal the face of the Taung child.



Dart was to write in his popular book "Adventures with the Missing Link": 'I knew at a glance that what lay in my hands was no ordinary anthropoidal brain. The skull cavity was three times larger than that of a baboon and considerably bigger than that of an adult chimpanzee, [but] it was not big enough for primitive man.' In his report, submitted to *Nature*, Dart claimed that the skull was 'humanoid' rather than ape-like, and that this early human, named *Australopithecus africanus*, 'had walked upright, with its hands free for the manipulation of tools and weapons . . . providing clear evidence that Africa was the cradle of man.'

When Dart published his paper describing the Taung child fossil in 'Nature' in 1925, entitled, 'Australopithecus africanus: the man-ape of South Africa', he stated that 'it is manifest that we are in the presence here of pre-human stock, neither chimpanzee nor gorilla, which possess a series of differential characters not encountered hitherto in anthropoid stock...' He further suggested that the expansion of the brain followed the adoption of an upright posture which had first freed the hands to become specialized for manipulation. However, it took a long time before his theories were accepted because it was the antithesis of the prevailing view that the expansion of the brain preceded a fully upright posture.

### **Darwin's statement**

To understand the reactions of both the British public and scientific establishment to Dart's assertions about both the African origins of early humans and their form, I need to digress to another young man with a very different temperament to Dart, Charles Darwin. Sixty-six years earlier, Darwin, in his classic work '*On the Origin of Species*' written in 1859, had cautiously made one solitary reference to the human species, stating. '*Light will be thrown on the origin of Mankind and his History*'. I will not recapitulate the creationist controversies that followed and forced Darwin into seclusion and reticence. It took a further 20 years before he again wrote with exemplary caution, '*It is somewhat more probable that our early progenitors lived on the African continent than elsewhere.*'

In 1925, when Dart's paper was published, the reverberations of Darwin's statement were still being felt in the public arena, with teachers such as Scopes in Tennessee on trial for teaching evolution in schools. And the anthropological establishment was still in ferment over the interpretation of the discovery in 1912 of what came to be known as Piltdown man.

## The Piltdown Fraud

When, by the start of the 20th century, the anthropology establishment had fully accepted Darwin's theories, it sought a European origin for mankind, preferably British. They had found what they were looking for some fourteen years before Dart's discovery – in Piltdown man!



The amateur archaeologist the Reverend Charles Dawson, in collaboration with one of the doyens of British anthropology, Sir Arthur Keith, claimed they had discovered the 'missing link' saying that they had unearthed fragments of a jaw, a cranium and some teeth of apparent great antiquity in a quarry in Sussex called Piltdown.

Dawn Man.

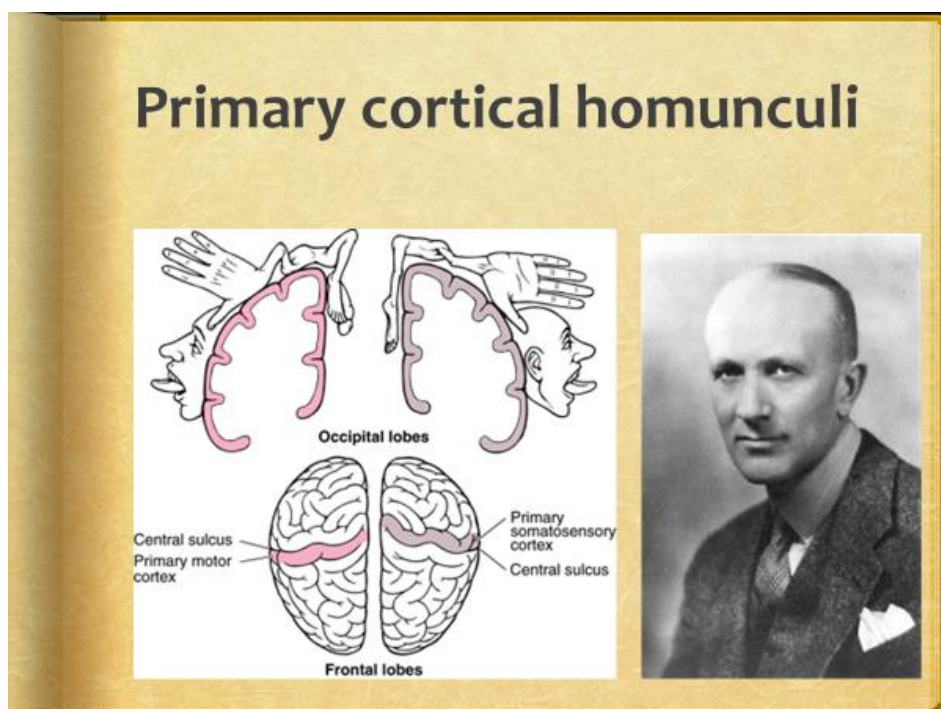
The Piltdown fossils suggested a hominid with a large brain and an ape-like face. It was named *Eonanthropus Dawsoni*, New

Piltdown Man turned out to be one of the biggest scientific frauds ever perpetrated. Sadly, it set back anthropology nearly 50 years. This was because it reinforced the preconception that it was the expansion of the human brain that had preceded the development of other human characteristics such as upright bipedal posture, and that this had determined the subsequent course of human evolution.

Under the influence of Piltdown, Dart was pilloried in the scientific as well as popular press and it took until 1953 to establish that the Piltdown fraud consisted of a doctored modern human skull and an ape jaw. Dawson, Keith and even Conan Doyle, Sherlock Holmes' creator, who lived nearby have all been implicated but not proven as the perpetrators.

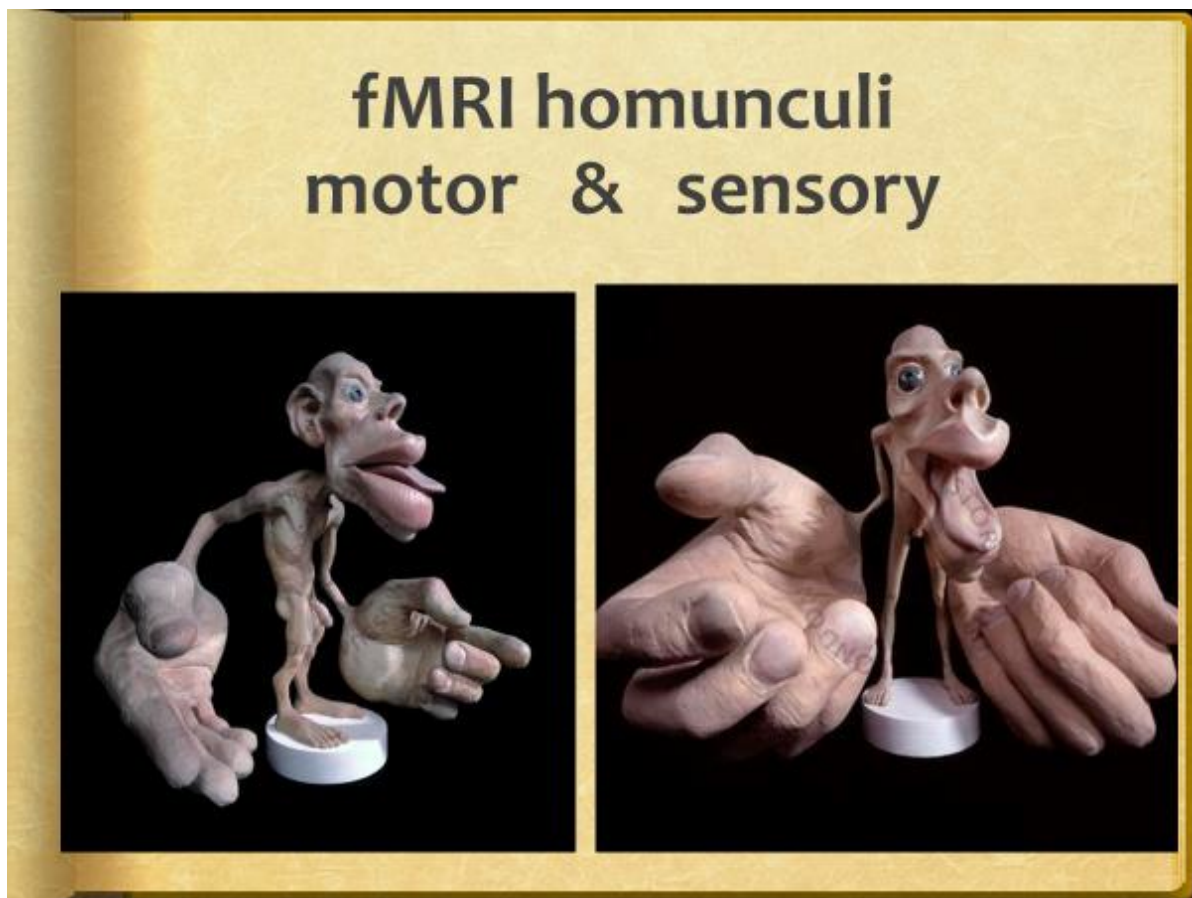
## The Hidden Hand

Dart's views that the size of the human brain went 'hand-in-hand' with the potential that walking upright gave to the development of the human hand, and that Africa was the 'Cradle of Mankind' were both eventually vindicated.



The 'hidden hand' in my title refers to the expanded areas of the brain given over to the control of the manipulative hand. These lie hidden in our brains as proportionate maps representing the amount of cortex devoted to sensing and moving our different body parts. These primary sensory and motor homunculi were mapped in the 1950s by the neurosurgeon Wilder Penfield (pictured above) in patients during awake brain surgery.

The disproportionately large representation of the hands in both motor and sensory cortices is obvious. Since then, functional brain imaging by magnetic resonance (fMRI) has revealed even more massively disproportionate areas of secondary and tertiary association cortex devoted to the hand (motor on the left – sensory on the right)



One glance at these models (above) is enough surely to indicate that the development of hands and brain must have been intimately linked in human evolution.

## Vindication

In the late 1930s, adult specimens of Australopithecines were discovered at Sterkfontein, only 30 miles west of Johannesburg. The eccentric Dr Robert Broom, a Scottish physician who had come to South Africa earlier, supported Dart's theories and was an enthusiastic if sometimes difficult collaborator.

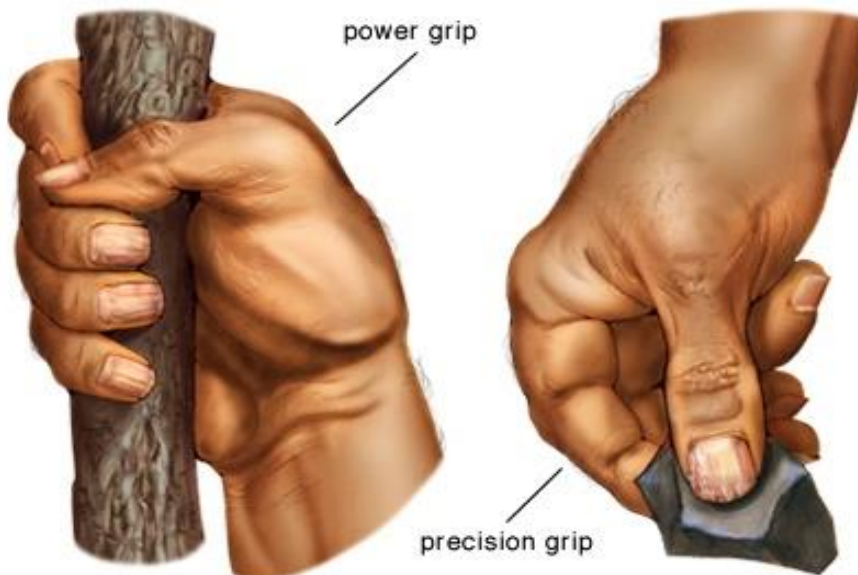
As early as 1938 Dr Gregory of the American Museum of Natural History after an inspection of the Australopithecine finds declared 'It is the missing link no longer missing. It is the structural connecting link between ape and man'. And as late as 1957, in a letter published in Nature, Sir Arthur Keith confessed 'I am now convinced on the evidence presented by Dr Robert Broom that Professor Dart (right) was right, and I was wrong'. Over the next 50 years Dart was to be further vindicated by numerous further discoveries of up to four species of Australopithecines, some associated with evidence of tool using, and possibly tool making.



## The co-evolution of the human hand and brain

I return now to my main theme, Dart's insight into the role of upright posture in revealing the hidden potential of the hand that in turn liberated the expansion of the pluri-potential human brain.

### The Power Grip and the Precision Grip



There are many biomechanical differences between the hands of the apes and humans. The most fundamental is that, freed of the necessity to walk and to brachiate (swing from hold to hold by the arms), the human hand had evolved two primary grips. These are the

power grip that pounds and turns, and the precision grip that cuts and writes that have enabled the use of sophisticated tools. This is not to deny that other primates use their hands to utilize tools. However, apes use tools that are at hand to perform simple tasks, whereas humans use



tools that are fashioned either for specific or general purposes, that are limited only by their imaginations.

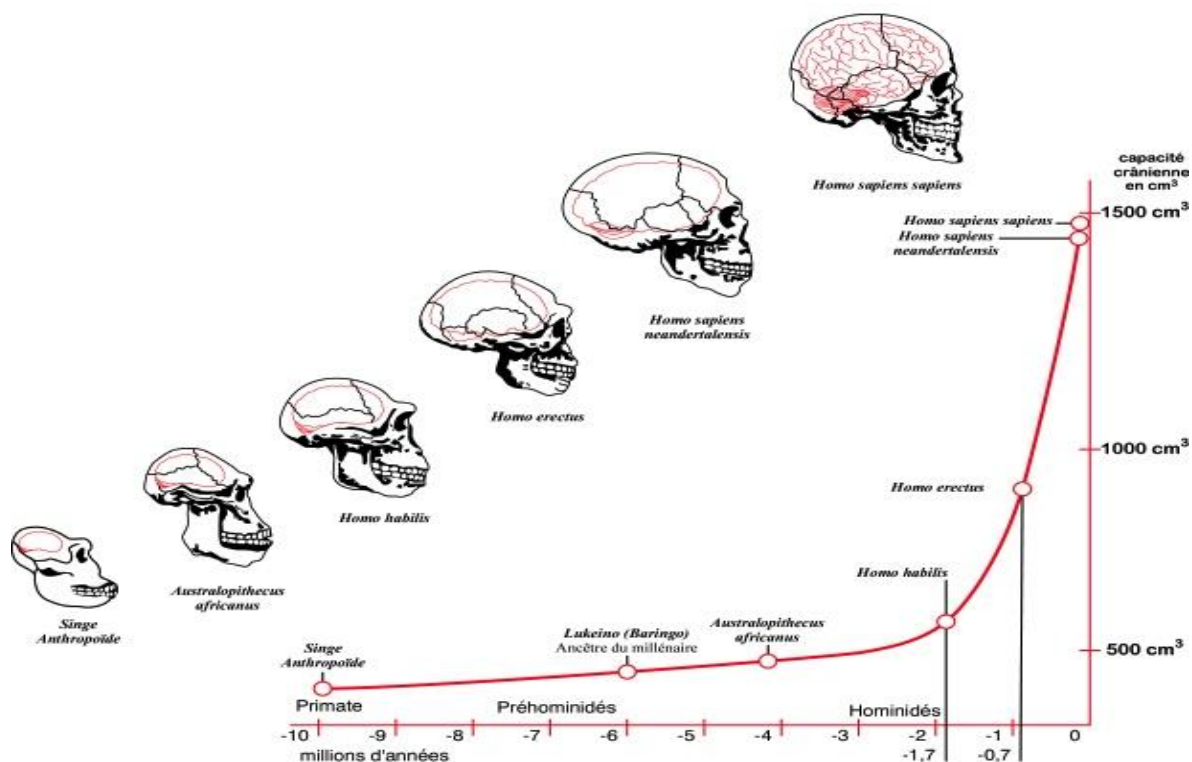
## Speculations on the carnivorous antecedents of homo sapiens

Imagination is a function of the cerebral cortex and in particular its frontal lobes, and it is the cortex and in particular its unspecialized association areas, that have shown the most spectacular expansion.

Dart's imagination was very fertile, and he wondered why the Australopithecine remains were not associated with stone tools, however primitive. Perhaps the rather small, brained creatures had not yet developed sufficient imagination to see in the random shapes of rocks the shapes to which they could be sculpted and the uses to which these imaginary shapes could be put. On the other hand, the biologically determined shapes of the bones of their prey would have more immediately obvious utility.

From an analysis of the fragments of bones of other species such as antelopes that were found in abundance in the fossil containing caves, Dart concluded that the Australopithecines had a pre-lithic osteo-donto-keratic culture whereby they fashioned the **bones, teeth and horns** of their prey into weapons, tools, daggers, scrapers and axes which they used not only for hunting but also, for intra-species aggression including murder. Dart noticed that several Australopithecine skulls had depressed fractures that seemed to fit the 'knuckles' of antelope bones. He even took the evidence to the Professor of Forensic Medicine, who exclaimed, '*I've seen men hung on less evidence than that*'.

## Growth of the human brain



Since Dart's paradigm shifting insight in 1925, that our ancestors included small brained, bipedal African apes, enough fossil evidence has accumulated to demonstrate there was subsequently an exponential increase in brain size beginning over 2.5 million years ago (MYA) during which hominid brains have tripled in volume from about 500 ml to nearly 1500 ml.

This raises two obvious questions: What drove the relatively small-brained Australopithecines that had roamed the African Savannah for the previous 3 MY to suddenly evolve into the larger brained Homo erectus 1 MYA and the even larger brained Homo sapiens about 200,000 YA?

And, what will set the future limits of this brain expansion? Will we eventually end up, as science fiction writers have imagined, as a different sort of homunculus dangling as appendages to our huge heads?

Whether the author Primo Levi ever read Dart I do not know, but he has expressed Dart's insight with great elegance in his story 'The Wrench', writing '*They (the engineer Faussone's hands) had reminded me of distinct readings of Darwin, of the artificer's hand that, making tools and bending matter, stirred the human brain from its torpor and still guides and stimulates and draws it ahead, as a dog does with a blind master*'.

## **Dart as a mover and shaker**

During all of this anthropological controversy, Dart held the position as Head of Anatomy at the Witwatersrand University Medical School. He held this post for 35 years, from 1923 to 1958. The site was still under construction when he had arrived, and he threw himself into developing facilities and running the department with characteristic energy. He created the medical library and museum and took his students out making life and death masks of all the peoples of Africa he could come across. These lined the anatomy halls of our medical school.



Dart was also appointed **Dean of the Faculty of Medicine** a post he held for nearly 20 years from 1925 to 1943. His versatility was depicted in a student magazine showing Dart as a many armed Hindu deity, sitting on top of the medical school.

### **Dart: the retirement years (1959-1988)**

When I first met Dart as my anatomy lecturer in 1956, he was in his sixties; small, balding, wiry, with an agile posture.



He had piercing blue eyes, and a very resonant voice that could strike fear into the hearts of his pupils. I will remember Raymond Dart as a great teacher who imbued all who were privileged to be his pupils with a love of science and a suspicion of received truth.

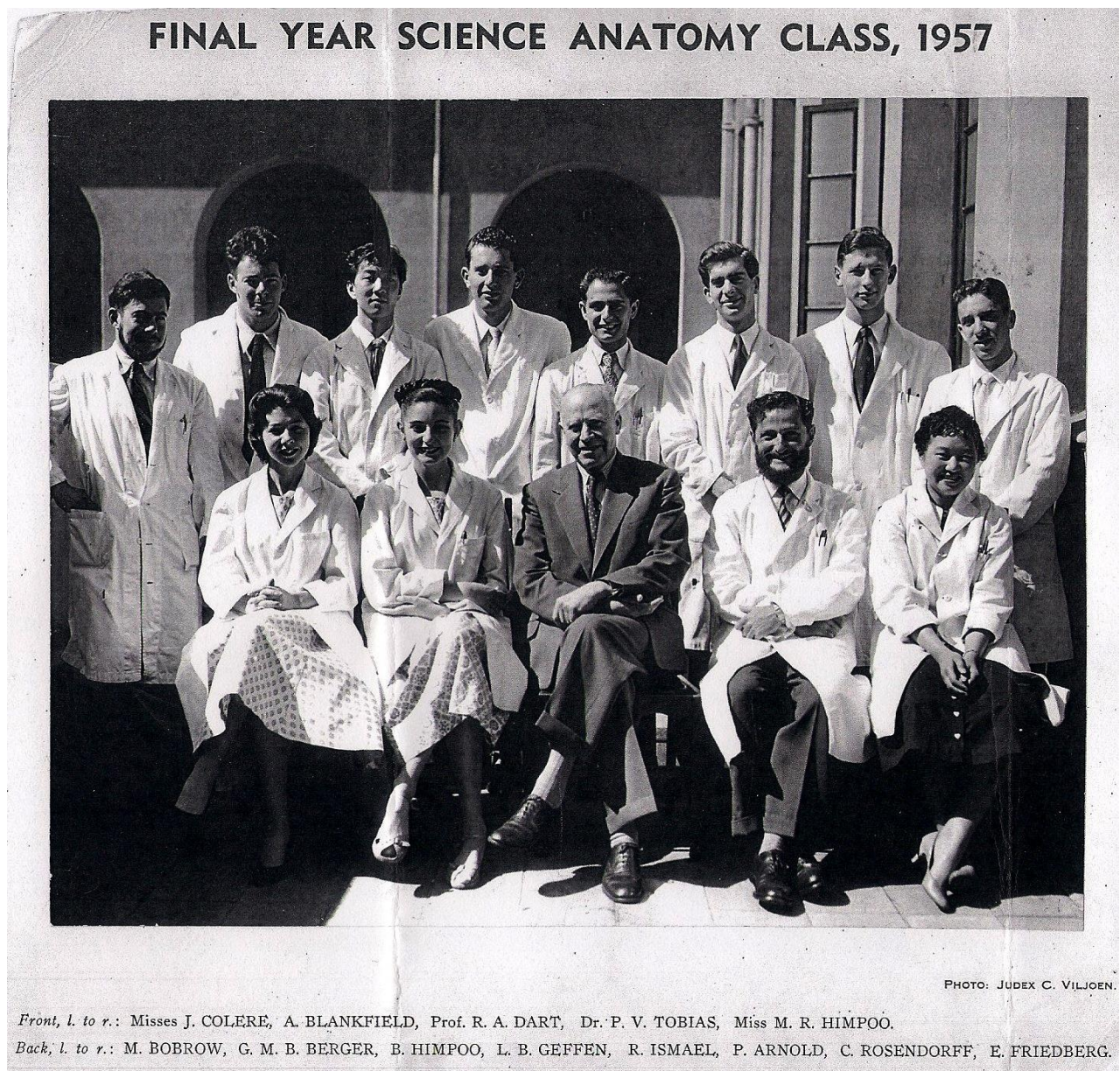
He was a larger-than-life character who was at times **the terror of the dissection hall**, bemoaning the fact that millions of years of evolution had produced such clumsiness in second year medical students. At other times he transfixed lecture audiences with graphic demonstrations of how reptiles emerged from swamps onto dry land (by his famous crocodile crawl) or of how primates descended from an arboreal to a savannah habitat (by brachiating along the service pipes in the ceiling of the lecture theatre).

To my knowledge he made only two visits to Australia, both at the invitation of the University of Sydney, in 1950 and again in 1972. He was invited on a third occasion in 1981, again to Sydney, but had to cancel due to failing eyesight at the age of 88.

He died in Johannesburg in 1988 at the age of 95. He was survived by his second wife Marjorie, his daughter Diana and son Galen. His memory is revered in his adopted country and was actively perpetuated by his equally famous pupil and successor, Phillip Tobias. I visited Johannesburg in 1991, to join in with Tobias's retirement celebrations.

There I was allowed for the first time to hold the precious Taung skull that I had gazed at so often in Dart's hands. I swear an electric shock passed up my arm as it was taken out of the safe and handed to me by Tobias.

Imagine Raymond Dart's feelings as he gazed into the empty sockets of the child who died at such a tender age in the African veldt several million years ago and realized the ancestral link. It is no ordinary fossil – and Dart was no ordinary man.



I am fourth from the left in this picture above, with Professor Raymond Dart and Anatomy lecturer (and Dart protégé) Phillip Tobias and the other students of the Medical BSc class of 1957.

## **Dart Centenary Memorial lecture, University of Queensland, Brisbane**

Here I am introducing our special guest, Phillip Tobias, during the Raymond Dart Centenary Exhibition at the University of Queensland, Brisbane (1992-3).

(Tobias' talk was delivered with the same passion, fluency, erudition and theatricality that I remembered from his lectures at Wits Medical School, nearly forty years earlier.)



---

### ***Raymond Dart Remembered,***

by Professor Laurence Geffen, AM (Member of the Order of Australia)  
BSc (Hons 1), MB BCh, MSc (all Wits) BA (Hons 1) DPhil (both Oxon)  
MD hon (Flin) FRACP (hon) FRANZCP  
Brisbane, Australia, August 2020

Read Laurence Geffen's tribute to Phillip Tobias [Tobias, Professor Philip](#)

Read Laurence Geffen's biography here: [Geffen, Laurence](#)

*Edited by Geraldine Auerbach MBE, London, December 2020*