

# The Laryngeal Nerve of the Giraffe: Does it Prove Evolution?

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Supplement to the paper:

## The Evolution of the Long-Necked Giraffe (*Giraffa camelopardalis* L.) – What Do We Really Know?

(Part 1)

<http://www.weloennig.de/Giraffe.pdf>

As for Part 2 of the article of 2007 see

<http://www.weloennig.de/GiraffaSecondPartEnglish.pdf>

**The recurrent laryngeal nerve:** Much ado has been made in recent years by evolutionists like Richard Dawkins, Jerry Coyne, Neil Shubin, Matt Ridley and many others about the *Nervus laryngeus recurrens* as a "proof" or at least indisputable evidence of the giraffe's evolution from fish (in a gradualist scenario over millions of links, of course). Markus Rammerstorfer has written a (scientifically detailed and convincing) synoptic critique on this old and, in fact, already long disproved evolutionary interpretation of the course of this nerve in 2004 (see Rammerstorfer <http://members.liwest.at/rammerstorfer/NLrecurrens.pdf>). There are some main points which I would like to mention here:

As to the evolutionary scientists just mentioned: A totally nonsensical and relictual misdesign would be a severe contradiction in their own neo-Darwinian (or synthetic evolutionary) world view. Biologist and Nobel laureate Francois Jacob described this view on the genetic level as follows: "The genetic message, the programme of the present-day organism ... resembles a text without an author, that a proof-reader has been correcting for more than two billion years, *continually improving, refining and completing it, gradually eliminating all imperfections.*" The result in the Giraffe? Jerry Coyne: "One of nature's *worst designs* is shown by the recurrent laryngeal nerve of mammals. Running *from the brain to the larynx*, this nerve helps us to speak

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and swallow. The curious thing is that *it is much longer than it needs to be*" (quoted according to Paul Nelson 2009). And: "...it *extends down the neck to the chest...and then runs back up the neck to the larynx*. In a giraffe, that means a 20-foot length of nerve where 1 foot would have done" (Jim Holt in the *New York Times*, 20 February 2005: <http://www.nytimes.com/2005/02/20/magazine/20WWLN.html>). "Obviously a ridiculous detour! No engineer would ever make a mistake like that!" – Dawkins 2010 (see below) (All italics above mine.)

Apart from the facts that the nerve *neither runs from the brain to the larynx nor extends down from the neck to the chest* ("On the *right* side it arises from the vagus nerve in front of the first part of the subclavian artery;..." "On the *left* side, it arises from the vagus nerve on the left of the arch of the aorta..." – Gray's Anatomy 1980, p. 1080; further details (also) in the editions of 2005, pp. 448, 644, and of 2008, pp. 459, 588/589), the question arises: *why did natural selection not get rid of this "worst design" and improve it during the millions of generations and mutations from fish to the giraffe onwards?* Would such mutations really be impossible?

2. The fact is that even in humans in 0.3 to 1% of the population the *right* recurrent laryngeal nerve is indeed shortened and the route abbreviated in connection with a retromorphosis of the forth aortic arch. ("An unusual anomaly ... is the so-called 'non-recurrent' laryngeal nerve. In this condition, which has a frequency of between 0.3 – 1%, only the right side is affected and it is always associated with an abnormal growth of the right subclavian artery from the aortic arch on the left side" – Gray's Anatomy 2005, p. 644.; see also Uludag et al. 2009 <http://casereports.bmj.com/content/2009/bcr.10.2008.1107.full>; the extremely rare cases (0.004% to 0.04%) on the left side appear to be always associated with *situs inversus*, thus still "the right side"). Nevertheless, even in this condition its branches still innervate the upper esophagus and trachea (but to a limited extent?). Although this variation generally seems to be without severe health problems, it *can* have catastrophic consequences for the persons so affected: problems in deglutition (difficulties in swallowing) and respiratory difficulties (troubles in breathing) (see Rammerstorfer 2004; moreover "dysphagia (if the **pharyngeal and oesophageal branches** of nonrecurrent or recurrent inferior laryngeal nerve are injured)" – Yang et al, 2009: <http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=5868576>).

If mutations for such a short cut are possible and regularly appearing even in humans (not to mention some other non-shorter-route variations), – according to the law of recurrent variation (see Lönnig 2005: <http://www.weloennig.de/Loennig-Long-Version-of-Law-of-Recurrent-Variation.pdf>, 2006: [http://www.weloennig.de/ShortVersionofMutationsLawof\\_2006.pdf](http://www.weloennig.de/ShortVersionofMutationsLawof_2006.pdf)), they must have occurred already millions of times in all mammal species and other vertebrates taken together from the Silurian (or Jurassic respectively) onwards. *And this must also be true for any other* (at least residually) *functionally possible shorter variations of the right as well as of the left recurrent laryngeal nerve*. Inference: **All these 'short-cut mutations' were regularly counter-selected due to at least some disadvantageous and unfavourable effects on the phenotype of the so affected individuals** (including any such mutants in the giraffes). Hence, they never had a chance to permeate and dominate a population except for the above mentioned very small minority of the (right) 'non-recurrent' laryngeal nerve, which is perhaps already accounted for by the genetic load ("The embryological nature of such a nervous anatomical variation results originally from a vascular disorder, named **arteria lusoria** in which the fourth right aortic arch is abnormally absorbed, being therefore unable to

drag the right recurrent laryngeal nerve down when the heart descends and the neck elongates during embryonic development." Defechereux et al. 2000: <http://www.ncbi.nlm.nih.gov/pubmed/10925715>). Thus, even from a neo-Darwinian point of view, important additional functions of the *Nervus laryngeus recurrens* should be postulated and looked for, not to mention the topic of embryological functions and constraints.

3. However, just to refer to one possible substantial function of the Nervus laryngeus recurrens sinister during embryogenesis: "The vagus nerve in the stage 16 embryo is very large in relation to the aortic arch system. The recurrent laryngeal nerve has a greater proportion of connective tissue than other nerves, making it more resistant to stretch. It has been suggested that *tension applied by the left recurrent laryngeal nerve as it wraps around the ductus arteriosus could provide a means of support that would permit the ductus to develop as a muscular artery*, rather than an elastic artery" – Gray's Anatomy, 39<sup>th</sup> edition 2005, p. 1053.

4. Yet, implicit in the ideas and often also in the outright statements of many modern evolutionists like the ones mentioned above is the assumption that the only function of the *Nervus laryngeus recurrens sinister* (and *dexter*) is innervating the larynx and nothing else. Well, is it asked too much to state that they should really know better? In my copy of the 36th edition of Gray's Anatomy we read (1980, p. 1081, similarly also in the 40<sup>th</sup> edition of 2008, pp. 459, 588/589):

"As the recurrent laryngeal nerve curves around the subclavian artery or the arch of aorta, it gives *several cardiac filaments to the deep part of the cardiac plexus*. As it ascends in the neck *it gives off branches, more numerous on the left* than on the right side, *to the mucous membrane and muscular coat of the oesophagus; branches to the mucous membrane and muscular fibers of the trachea* and some filaments to the inferior constrictor [Constrictor pharyngis inferior]."

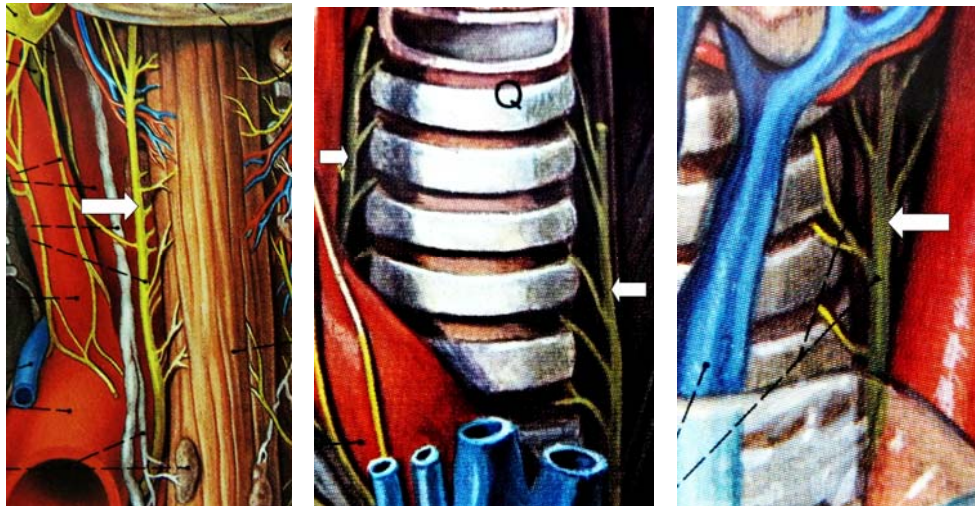
Likewise Rauber/Kopsch 1988, Vol. IV, p. 179, *Anatomie des Menschen*: "Äste des N. laryngeus recurrens ziehen zum *Plexus cardiacus* und zu *Nachbarorganen* [adjacent organs]." On p. 178 the authors of this *Anatomy* also mention in Fig. 2.88: "*Rr.* [Rami, branches] *tracheales und oesophagei des* [of the] *N. laryngeus recurrens*." – The mean value of the number of the branches of Nervus laryngeus recurrens sinister *innervating the trachea und esophagus* is **17,7** und for the Nervus laryngeus recurrens dexter is **10,5** ("Zweige des N. recurrens ziehen als Rr. cardiaci aus dem Recurrensbogen abwärts zum Plexus cardiacus – als *Rr. tracheales und esophagei* zu oberen Abschnitten von Luft- und Speiseröhre, als N. laryngeus inferior durch den Unterrand des M. constrictor pharyngis inferior in den Pharynx. An der linken Seite gehen 17,7 (4-29) Rr. tracheales et esophagei ab, an der rechten 10,5 (3-16)" – Lang 1985, p. 503; italics by the author(s). "Er [der N. laryngeus recurrens] benutzt als Weg die Rinne zwischen Luft- und Speiseröhre, **wobei beide Organe Äste von ihm erhalten**" – Benninghoff und Drenckhahn 2004, p. 563).

I have also checked several other detailed textbooks on human anatomy like *Sobotta* – *Atlas der Anatomie des Menschen*: they are all in agreement. Some also show clear figures on the topic. *Pschyrembel* – Germany's most widely circulated and consulted medical dictionary (262 editions) – additionally mentions "Rr. ... bronchiales".

To innervate the *esophagus and trachea* of the giraffe *and also reach its heart, the recurrent laryngeal nerve needs to be, indeed, very long*. So, today's evolutionary explanations (as is also true for many other so-called rudimentary routes and organs) are not only often in contradiction to their own premises but also tend to stop looking for (and thus hinder scientific research concerning) further important morphological and physiological functions yet to be discovered. In contrast, the theory of intelligent

design regularly predicts further functions (also) in these cases and thus is scientifically much more fruitful and fertile than the neo-Darwinian exegesis (i.e. the interpretations by the synthetic theory).

To sum up: The *Nervus laryngeus recurrens* innervates not only the larynx, but also the esophagus and the trachea and moreover “gives several cardiac filaments to the deep part of the cardiac plexus” etc. (the latter not shown below, but see quotations above). It need not be stressed here that all mammals – in spite of substantial synorganized genera-specific differences – basically share the same *Bauplan* (“this infinite diversity in unity” – Agassiz) proving the same ingenious mind behind it all.



**Left:** Detail from a figure ed. by W. Platzer (enlarged, contrast reinforced, arrow added): In yellow beside the esophagus (see arrow): *Nervus laryngeus recurrens sinister* running parallel to the esophagus on left hand side with many branches innervating it (dorsal view).<sup>(1)</sup>

**Middle:** Detail from a figure ed. by W. Platzer (enlarged, contrast reinforced, arrows added): Now on the right because of front view: *Nervus laryngeus recurrens sinister* and on the left *Nervus laryngeus recurrens dexter* (arrows) sending branches to the trachea.<sup>(2)</sup>

**Right:** Detail from a figure ed. by W. Platzer (enlarged, contrast reinforced, arrow added): Again on the right (arrow) because of front view: *Nervus laryngeus recurrens sinister* (as in the middle Figure, but more strongly enlarged), sending branches to the trachea.<sup>(3)</sup>

Fig. (1), (2) and (3): All three figures (details) from Werner Platzer (editor) (1987): *Pernkopf Anatomie, Atlas der topographischen und angewandten Anatomie des Menschen*. Herausgegeben von W. Platzer. 3., neubearbeitete und erweiterte Auflage. Copyright Urban & Schwarzenberg, München – Wien – Baltimore. Fig. (1): Detail from *Das Mediastinum von dorsal*, 2. Band. Brust, Bauch und Extremitäten, p. 83, Abb. 79. – Fig. 2: Detail from *Die prae- und paravertebralen Gebilde nach Entfernung des Eingeweidetraktes in der Ansicht von vorne*, 1. Band. Kopf und Hals, p. 344, Abb. 396, drawn by K. Endtresser 1951. – Fig. (3): Detail from *Topic der Pleuralkuppeln und des Halseingeweidetraktes in der Ansicht von vorne*, 1. Band. Kopf und Hals, p. 333, Abb. 388, drawn by F. Batke 1951.

As to the giraffe, direct evidence for more functions of the laryngeal nerve than just innervating the larynx and nothing (or hardly anything) else, was quite unintentionally provided by Richard Dawkins and Joy S. Reidenberg on YouTube (17 March 2010, but the more inclusive film on the giraffe was first shown at its full length of 48 Mins on British TV, Channel 4, in 2009) in their contribution *Laryngeal Nerve of the Giraffe Proves Evolution* (<http://www.youtube.com/watch?v=0cH2bkZfHw4>) showing directly some of the branches of the *N. laryngeus recurrens* innervating the esophagus and the trachea (see 2:09):



The Nervus laryngeus recurrens obviously displaying some of its branches innervating the esophagus and trachea in *Giraffa camelopardalis*. Photo of detail from the YouTube video of Dawkins (2010) *Laryngeal Nerve of the Giraffe Proves Evolution*: <http://www.youtube.com/watch?v=0cH2bkZfHw4>: 2:07/2:09 (arrow added; study, please, especially carefully the sequence of the pictures from 2:07 to 2:11).

Note, please, how Dawkins at 0:28 and later the anatomist Joy S. Reidenberg are unwarrantedly **equating the vagus nerve with the laryngeal nerve** in the video. Dr. Reidenberg in her explanations starting at 1:17 first says correctly about the N. laryngeus recurrens: "...It actually **starts out not as a separate nerve, but as a branch coming off of a bigger nerve called the vagus nerve** and this [*the vagus*] is going to keep running all the way down the body, so you can see it again over here all the way down the neck, on both sides. ... And this [*the vagus*] is going to wrap around the great vessels coming out of the heart. ... **So here is the vagus going down and here is the vagus continuing.** And **right over here**, there is a **branch**, right there [namely *the N. laryngeus recurrens* very near the great vessels coming out of the heart]. So it's looping and coming back, doing a U-turn all the way down here [*at that point she seems to start equating the laryngeal with the vagus nerve*]. So it [*actually the vagus, not the laryngeal nerve*] has travelled that entire distance to make a U-turn [*and now concerning its new branch, the laryngeal nerve:*] to go all the way back again.\* And so we can follow it back up again. So we follow this branch. And if we look we see it again over here. Here it is. Like that [2:07; see above]. And here you see it going up, this is the voice box, the larynx. ...also coordinating breathing and swallowing in this area [*yet, not only in this area!*]. So this is a very important nerve. Interestingly, where it [*the laryngeal nerve*] ends is pretty close to where it started" [*wrong; it really started near the vessels coming out of the heart – see above*]. Reidenberg continues: "It started here coming out of the brain [*totally wrong; this is where the vagus nerve started*]. It really needs to go about two inches. But it [*the vagus nerve really*] went all the way down and it [*the laryngeal nerve*] came all the way back." Dawkins: "It is a beautiful example of historical legacy as opposed to design." And then Joy Reidenberg again: "This is not an intelligent design. An intelligent design would be to go from here to here."

Following that, an intelligent point was raised by Mark Evans, the veterinary surgeon and presenter of the film *Inside Nature's Giants: The Giraffe*, which was first shown at full length (48Mins) on Monday 9pm, 20 July 2009, on Channel 4 (a UK public-service television broadcaster): "It does kind of beg the question, even in an animal that might have been many millions of years ago with its head down here: why the route 'round the blood vessels, **unless there's a reason they were there to enervate something else.**" This implicit question ("to enervate something else") was unjustifiably denied by Dawkins answering: "Well that was in earlier ancestors, then it was the most direct route. In fish." Etc. – followed by the typically inconsistent neo-Darwinian explanation (evolution 'continually improving, refining and completing the genetic message, eliminating all imperfections' (see above), yet stretching the laryngeal nerve for absolutely no functional reasons almost endlessly instead of ever finding a short cut etc.).

\*To repeat: the vagus and not the laryngeal nerve has travelled all the distance and it is **its entirely new branch, the laryngeal nerve** (not the vagus) that goes all "the way back" innervating with many branches the heart, the larynx and the esophagus on its way]. [Comments in brackets and footnote added by W-EL].

So is the recurrent laryngeal nerve really an “Obviously a ridiculous detour” etc. as Dawkins stated in the TV show 2009 and YouTube video 2010?

Wilhelm Ellenberger and Herrmann Baum sum up the multiple functions of that nerve in their *Handbook of Comparative Anatomy of Domestic Animals* as follows (only in German 1974/1991, p. 954, italics by the authors):

“Der N. recurrens führt die Hauptmasse der Vagusfasern für das Herz (HIRT 1934) und gibt sie vor Austritt aus der Brusthöhle an den *Plexus cardiacus* (s. unten und Abb. 1409). Er gibt außerdem Zweige an den in der präkardialen Mittelfellspalte zwischen Trachea und den großen Blutgefäßen gelegenen *Plexus trachealis caud.* Und steht mit dem Ggl. cervicale caud. des N. sympathicus in Verbindung. Nach seinem Austritt aus der Brusthöhle gibt der N. recurrens im Halsbereiche jederseits Zweige ab, die einen *Plexus trachealis cran.* bilden und *Rami oesophagici* und *Rami tracheales* an Muskulatur und Schleimhaut von Speise- und Luftröhre schicken. Im Kehlkopfbereich verbinden sich dünne Zweige von ihm mit solchen des N. laryngicus cran. (siehe dort).“

For me, personally, it is really impressive, how evolutionists like Dawkins, Coyne, Reidenberg and other 'intellectually fulfilled atheists' inform the public on such scientific questions in contrast to the facts cited above.

May I suggest that a scientifically unbiased anatomical examination of the laryngeal nerve of the giraffe would have – as far as possible – included attention to and dissection of all the branches of the nerve, including the queries for the “several cardiac filaments to the deep part of the cardiac plexus”, the many “branches, more numerous on the left than on the right side, to the mucous membrane and muscular coat of the oesophagus” as well as the “branches to the mucous membrane and muscular fibers of the trachea” and perhaps even the “Rr. bronchiales”. So, when the opportunity arises, let’s do such a more comprehensive dissection of that nerve all over again – and add, perhaps, the research question on an irreducibly complex core system concerning the route and function of that nerve.

This seems to be all the more important since some of the observations by Sir Richard Owen made on the dissection of three young giraffes – two of them 3 years old and one about 4 years of age (one had died in the gardens of Regent’s Park and two at the Surrey Zoological Gardens) – seem to deviate from those of Dr. Reidenberg. Although the great anatomist Owen also made some mistakes in his work on other organisms (mistakes, which especially Thomas H. Huxley liked to stress), Owen’s findings on the giraffe should not be dismissed too easily. He writes (1841, pp. 231/232; italics his, bold in blue added as also the comment in brackets):

“From the remarkable length of the neck of the *Giraffe* the condition of the recurrent nerves became naturally a subject of interest: these nerves are readily distinguishable at the superior third of the *trachea*, but when sought for at their origin **it is not easy to detect them or to obtain satisfactory proof of their existence** [this comment seems to be in disagreement with what Dr. Reidenberg demonstrated by her dissection – she had no problems to detect it/them from the very beginning; also Owen’s following observations seem to disagree with those of Reidenberg’s to a certain extent]. Each nerve is not due, as in the short-necked *Mammalia*, to a single branch given off from the *nervus vagus*, which winds round the great vessels, and is continued of uniform diameter throughout their recurrent course, but it is formed by the reunion of **several small filaments derived from the *nervus vagus* at different parts of its course.**

The following is **the result of a careful dissection of the left recurrent nerve**. The *nervus vagus* as it passes down in front of the arch of the *aorta* sends off **four small branches**, which bend round the arch of the *aorta* on the left side of the *ductus arteriosus*; the **two small branches** on the left side pass to the *oesophagus* and are lost in the oesophageal *plexus*; **the remaining two branches** continue their recurrent course, and ascend upon the side of the *trachea*, **giving off filaments which communicate with branches from the neighbouring oesophageal nerves**: these recurrent filaments also receive twigs from the oesophageal nerves, and thus increase in size, and **ultimately coalesce into a single nerve of a flattened form**, which enters the *larynx* above the cricoid cartilage and behind the margin of the thyroid cartilage.” – (Similar comments by Owen in 1868, p. 160.)

Nevertheless, Owen’s observations of filaments, which are given off by the recurrent nerve(s) are obviously in agreement with what Joy S. Reidenberg found, yet failed to mention and draw attention to explicitly (see above).

I have to admit that – the more deeply I am delving into the harmonious complexity of biological systems – the more elegant and functionally relevant the entire systems appear to me, even down to 'pernickety detail' (to use one of Dawkins' expressions), including the *Nervus laryngeus recurrens sinister* and the *Nervus laryngeus recurrens dexter* with their many branches and functions also in the giraffe and their correspondingly appropriate lengths.

Incidentally, Graham Mitchell’s slip of the tongue or perhaps better his formulation from his innermost feelings in connection with his investigations of the giraffe’s lungs and mechanism of respiration appears to be rather revealing (even if meant only figuratively): “It couldn’t have been more beautifully designed ... [after a little pause] ... evolved” [laughter]. See this captivating dissection and investigation of the giraffe’s lung here: [http://channel.nationalgeographic.com/episode/inside-the-giraffe-4308/Photos#tab-Videos/07902\\_00](http://channel.nationalgeographic.com/episode/inside-the-giraffe-4308/Photos#tab-Videos/07902_00)

“Design should not be overlooked simply because it's so obvious” – Michael J. Behe 2005. May I repeat in this context that even from a neo-Darwinian perspective it would be very strange to assume that only the laryngeal nerve(s) could be “more beautifully designed” in contrast to all the rest which already is (see Francois Jacob above).

As to further discussions, including the quotation above of Jerry Coyne according to Nelson, see Paul Nelson (2009): [Jerry, PZ, Ron, faithism, Templeton, Bloggingheads, and all that — some follow-up comments](#).

## Notes added in Proof

(29 September 2010 and 19 October 2010)

- a) The recurrent laryngeal nerves and most probably also some of their many branches usually missed/overlooked by leading neo-Darwinian biologists today, have been known *for more than 1800 years* now. See, for instance, E. L. Kaplan, G. I. Salti, M. Roncella, N. Fulton, and M. Kadowaki (2009): *History of the Recurrent Laryngeal Nerve: From Galen to Lahey* <http://www.springerlink.com/content/13340521q5723532/fulltext.pdf>.

“...it was Galen [ca. 129 to about 217 A. D.] who first described the recurrent laryngeal nerves in detail in the second century A. D.” “He dissected these nerves in many animals – even swans, cranes, and ostriches because of their long necks...”

“Because of Galen's fame and the spread of his teachings, the recurrent laryngeal nerve was discussed by many surgeons and anatomists thereafter.” – Kaplan et al. 2009, pp. 387, 389, 390.

The keen observer Claudius Galenus [Galen] – having discovered, concentrating on and meticulously dissecting the recurrent laryngeal nerves of many different species of mammals and birds<sup>1</sup> – must necessarily also have seen at least some of their branches leading to other organs as well. Yet, in agreement with Lord Acton's verdict that “The worst use of theory is to make men insensible to fact”, not only many of today's neo-Darwinians but also Galen himself missed the altogether some thirty branches of the RLNs due to his own peculiar ‘pulley-theory’ (see again <http://www.springerlink.com/content/13340521q5723532/fulltext.pdf>). Margaret Tallmudge May comments in her translation of *Galen on the Usefulness of Parts of the Body* (1968, p. 371, footnote 62) on his assertion that “both [recurrent] nerves pass upward to the head of the rough artery [the trachea] without giving off even the smallest branch to any muscle...”:

“As Daremberg (in Galen [1854], I, 508) intimates, **Galen is being ridden by his own theory here**. The recurrent nerve does, of course, give off various branches as it ascends.”

However, accepting the fact of the many branches given off by the recurrent laryngeal nerves innervating several other organs as well would have completely disproved Galen's own ‘pulley-theory’<sup>2</sup> as it currently refutes the “ridiculous detour”-hypothesis of Dawkins and many other neo-Darwinians.

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1 See some points written by Galen in the English translation of *On Anatomical Procedures, The later Books*, Translated by Duckworth (1962) under <http://books.google.de/books?hl=de&lr=&id=P508AAAAIAAJ&oi>, pp. 81-87 and especially pp. 203 ff.

2 There are, however, several hints that he saw more than his theory allowed: “And when it [the Nervus laryngeus recurrens dexter] is extending upward after the turn, Nature stretches out to it from the sixth pair **the handlike outgrowth** which binds it to the large nerve and makes both its turn and its ascend safe. The portions of the nerve on the two sides of the turn are supported on both the right and left **by the outgrowths** [rami cardiaci inferiores? Comment by M. T. May] of the sixth pair which it makes to the parts of that region” (May: *Galen on the Usefulness of Parts of the Body* 1968, II, p. 694). “When immediately after the turn these [recurrent] nerves are mounting straight upward, **the large nerve extends to them an outgrowth**, as if reaching out a hand, and by means of this it draws and pulls them up” (May I, pp. 370/371). Margaret T. May comments in her footnote 61 to *The Seventh Book of Galen* (I, pp. 370/371):

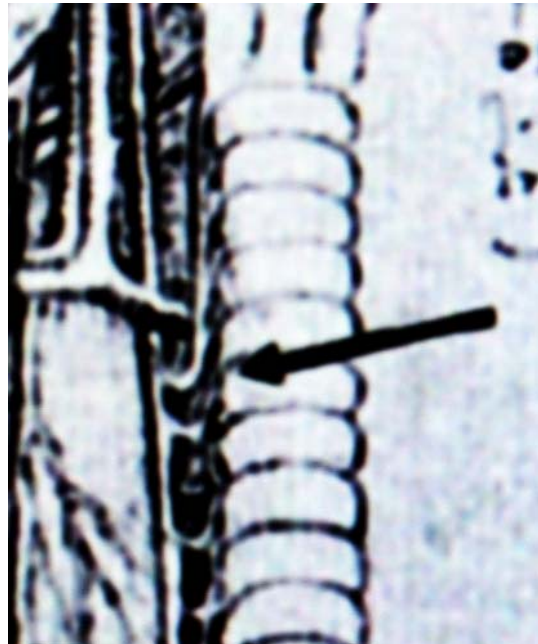
“The large nerve mentioned here is certainly the vagus itself; for in chapter 4 of Book XVI he mentions this helping hand extending to the recurrent nerve again and says that it comes from the “sixth” pair. Since no mention is made of it in *De nervorum dissectione* and no further light is ever shed on it either here or in *De anat. admin.*, XIV (Galen [1906, II, 189; 1962, 207]), where it is described once more, I have been unable to determine what may have misled Galen. Neither Daremberg (in Galen [1854, I, 507]) nor Simon (in Galen [1906, II, 344]) has a satisfactory explanation. The former suggests “the superior cardiac nerves, or perhaps the anastomotic branch”; the latter says that it may be “**certain connecting twigs** which Galen had seen at the point of reflection, going from the recurrent to the vagus.” I cannot find these connecting twigs described elsewhere. Dr. Charles GOSS, however, tells me that “the vagus in the neck of a pig in a recent atlas is labelled vagosympathetic trunk. This gives ample opportunity for communicating fibers.” Cf. Ellenberger and Baum (1926, 874).”

So, whatever Galen meant in detail by the “the handlike outgrowth which binds it to the large nerve” etc. – he must have seen “**certain connecting twigs**” going out from and to the recurrent nerves. But perhaps also a word of caution: Of the extant codices of the work of Galen, the *codex Urbinas* “dating from the tenth or eleventh century, is the oldest and also the best of the lot” – May 1968, I, p. 8. Nevertheless on p. 362 she argues as follows:

“The following description of the discovery of the recurrent laryngeal nerves and their function is a classic. In his splendid article, “Galen's Discovery and Promulgation of the Function of the Recurrent Laryngeal Nerve,” Walsh (1926, 183) says that he has no doubt that it embodies the actual lecture given by Galen and taken down stenographically on the occasion when he demonstrated publicly the structure of the larynx, the muscles moving it, and their innervation. As for the importance of the discovery, Walsh (*ibid.*, 7751) says, “This discovery established for all time that the brain is the organ of thought, and represented one of the most important additions to anatomy and physiology, being probably as great as the discovery of the circulation of the blood.””



Interestingly, additional branches of the right recurrent laryngeal nerve to the trachea were indeed noted and drawn by **Leonardo Da Vinci in 1503**, see the following detail from Fig. 3 of Kaplan et al. 2009, p. 388:



- b) According to Dietrich Starck – one of the leading German evolutionary anatomists of the 20<sup>th</sup> century – the recurrent laryngeal nerves are missing in the suborder Tylopoda (family Camelidae with camels, lamas and vicuñas), see Starck 1978, p. 237. However, Hans Joachim Müller, who published the results of his careful dissections on *Camelus bactrianus* and *Lama huanacus* [*guanicoe*] in 1962<sup>3</sup>, found that – although in fact, the innervation of the larynx by the Nervus laryngeus inferior is exceptional<sup>4</sup> in these animals – there still is a **ramus recurrens sinister**, which arises from the vagus nerve near the heart and ‘curves around the arch of aorta’ in order **to ascend** at the latero-dorsal (and during further development at the more dorsal) part of the trachea, but does *not* innervate the larynx. Müller writes (p. 161):

“Beim Überkreuzen der Aorta verlassen mehrere Äste den Nervus vagus und ziehen zum Herzen und zum Lungenhilus. Einer der Äste („**Ramus recurrens sinister**“) umschlingt den Aortenbogen und **steigt rückläufig am latero-dorsalen Rand der Trachea auf**. Im weiteren Verlauf liegt er mehr auf der Dorsalseite der Trachea, verbindet sich **mit entsprechend rückläufigen Ästen des rechten Nervus vagus** zu einem Nervenkomplex und anastomosiert schließlich mit dem absteigenden Ramus descendens n. vagi.”

The fact that the *ramus recurrens sinister* does *not* innervate the larynx in the Camelidae, but still takes the ascendent course of the normal recurrent laryngeal nerve of all the other mammal families (so much so that J. J. Willemse thought he had even found a *normal* Nervus recurrens in a young camel<sup>5</sup>), yet to eventually anastomose with corresponding recurrent branches of the right vagus

<sup>3</sup> *Beobachtungen an Nerven und Muskeln des Halses der Tylopeden*; Zeitschrift für Anatomie und Entwicklungsgeschichte **123**: 155-173

<sup>4</sup> „Seit etwa 60 Jahren [in the interim more than 100 years] ist bekannt, daß der Nervus laryngeus inferior [the part of the recurrent laryngeal nerve near the larynx] beim Lama (v. Schumacher 1902) und beim Kamel (Lesbre 1903) einen eigentümlichen Verlauf nimmt. Seine Fasern gelangen auf direktem Wege über einen absteigenden Ast des Nervus vagus zu den inneren Kehlkopfmuskeln.“ Außerdem fehlt bei dem Tylopeden der periphere Nervus accessorius.

<sup>5</sup> “[I]n the young camel we dissected a very normal n. recurrens was present“ – Willemse 1958, p. 534. „Die Feststellung von Willemse (1958), daß bei einem jungen Kamel ein normaler Nervus recurrens vorhanden war, dürfte wohl nur im Hinblick auf die topographischen Beziehungen dieses Nerven getroffen worden sein.“ – Müller 1962, p. 167.

to take part in the formation of a special network of nerves, *also implies important and indispensable functions of that route*. As for similar observations on the *ramus recurrens dexter*, see footnote below<sup>6</sup>. To discover or deepen our understanding of these necessary and probably further vital functions will be a task of future research<sup>7</sup>

- c) I have now checked two additional (and again several further) research papers, which clearly imply that the last dissections of the giraffe **did not take place in 1838** (as stated by Mark Evans on public TV in England; see the link above), but were performed shortly before 1916, 1932, and 1958 and also between at least 1981 and 2001. (It could, perhaps, be a special task for historians of biology to find out whether further dissections and anatomical studies of the giraffe have taken place between 1838 and 2009, and especially to what extent such studies were relevant for the routes and functions of the RLNs.)

**H. A. Vermeulen (1916):** *The vagus area in camelopardalis giraffe*. Proc. Kon. Ned. Akad. Wet. **18**: 647-670. (Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen.)

He introduces his work on the giraffe as follows (1916, p. 647): "I [...] found several remarkable relations, particularly of vagus and accessorius nuclei of Camelidae which roused in me the desire to examine what the circumstances might be in the giraffe. I was able to to examine one part only of the central nervous system of this class of animal, and was enabled to do so by the courtesy of Dr. C. U. ARIENS KAPPERS, Director of the Central Institute of Brain Research, at Amsterdam, who kindly placed **part of the material at my disposal. This consisted of the brain stem and a piece of the first cervical segment of one specimen, and the first and second segment of another specimen.** In the latter preparation the nervi accessorii Willisii could be seen perfectly intact in their usual course between the roots of the two first cervical nerves, so that in this respect the giraffe differs here at least, from the Camelida." However, Vermeulen could not dissect and investigate the laryngeal nerve itself of the giraffe. He only writes on p. 665: "...one might conclude, judging from the strong development of the nucleus at this place [the nucleus ambiguus spinally from the calamus] in the giraffe, that **the nervus recurrens, even in this animal in spite of its long neck, well deserves its name,** in which case the highly exceptional conditions of this nerve in Camelidae have wrongly been connected by LESBRE with the unusually long neck of these animals."

**J. J. Willemse (1958):** *The innervation of the muscles of the trapezius-complex in Giraffe, Okapi, Camel and Llama*. Arch. Néerl. Zool. **12**: 532-536. (Archives Néerlandaises de Zoologie.)

Willemse 1958, p. 533 and p. 535: "ZUCKERMAN and KISS (1932) made an attempt to obtain certainty about the spinal accessory nerve of the giraffe. [...] **The dissection of two giraffes, carried out by**

6 As to the *Ramus recurrens dexter*, Müller notes p. 162: „Der rechte Nervus vagus gelangt nach Trennung vom Truncus sympathicus ventral der Arteria subclavia in den Thorax, wo er die Trachea zum Lungenhilus begleitet (Abb. 7). Noch vor Passieren der Arteria subclavia verläßt ihn ein kleiner Ast, der, neben ihm verlaufend, ventral die Arteria subclavia kreuzt, um dann auf der Rückseite **rückläufig zum Truncus sympathicus aufzusteigen. Caudal der Arteria subclavia** gehen mehrere Nerven Zweige vom Nervus vagus ab und beteiligen sich an der Bildung des beschriebenen Nervenplexus auf der Dorsalseite der Trachea. Es läßt sich ein etwas stärkerer Strang durch das Geflecht verfolgen, der sich in den Ramus descendens n. vagi der rechten Seite fortsetzt (= **Ramus recurrens dexter**) (Abb. 7).“

7 I earnestly hope without doing harm or being cruel to the respective animals. There are now many alternatives to animal experiments: [http://www.vivisectioninfo.org/humane\\_research.html](http://www.vivisectioninfo.org/humane_research.html) (I do not, of course, subscribe to everything these people say or do). We must, nevertheless, for many scientific and further reasons assign different values to humans and animals, but definitely without being incompassionate to either of them.

Concerning dissections: If an animal – like a mammal or bird – has died, but was not killed for studying its anatomy, it appears to be fully okay to me. On the other hand, I remember well the *Zoologische Praktika*, where we, i. e. the students, had the task to dissect fish, frogs and rats and that we were admonished to do our best especially because the animals had to die for these studies. My impression was that the lecturers (understandably) were not all too happy about killing these creatures. Although being fascinated by anatomical studies (I even taught [theoretical] human anatomy for nurses for a while), I later focussed on plant genetics for my further research to avoid killing or doing harm to sensitive animals myself (but there were also additional reasons for this choice). For a more differentiated comment on animal pain, including insects, for which several authors doubt that they are able to feel pain, see <http://www.weloemig.de/JoachimVetter.pdf>.

A word on Galen's vivisections: I am of the opinion that they were cruel. In this context one may also raise the question: What about Darwin and vivisection? Rod Preece has stated (2003): "In the first major ethical issue that arose after the publication of Darwin's *The Descent of Man* – legislation to restrict vivisection – Darwin and Huxley stood on the side of more or less unrestricted vivisection while many major explicitly Christian voices from Cardinal Manning to Lord Chief Justice Coleridge to the Earl of Shaftesbury – demanded the most severe restrictions, in many cases abolition." [http://muse.jhu.edu/login?uri=/journals/journal\\_of\\_the\\_history\\_of\\_ideas/v064/64.3prece.pdf](http://muse.jhu.edu/login?uri=/journals/journal_of_the_history_of_ideas/v064/64.3prece.pdf). See also: [http://darwin-online.org.uk/EditorialIntroductions/Freeman\\_LetteronVivisection.html](http://darwin-online.org.uk/EditorialIntroductions/Freeman_LetteronVivisection.html) and [http://darwin-online.org.uk/pdf/1881\\_Vivisection\\_F1793\\_001.pdf](http://darwin-online.org.uk/pdf/1881_Vivisection_F1793_001.pdf) (as to the latter link: It seems that Darwin could also be very compassionate to animals as shown by the quotation of T. W. Moffett). However, in the second edition (1874 and 1882), Darwin added "...unless the operation was fully justified by an increase of our knowledge, ..."

**Zuckerman and Kiss themselves**, indicate that the muscles of the trapezius-complex were supplied, as in other Ungulates, by branches from the spinal accessory and from cervical nerves.

**The dissection of a giraffe at our own laboratory** gave results which resembled those of ZUCKERMAN and KISS very much. [...] Some twenty years ago anatomists showed that in the giraffe a n. accessorius is present, but the nerve is lacking in camels and llamas. Recent investigations are in accordance with these facts." – However, unfortunately no new information on the laryngeal nerves of the giraffe is given in this paper.

For some further dissections and anatomical studies of the giraffe, see the papers by Kimani and his co-workers (1981, 1983, 1987, 1991), Solounias 1999, and Sasaki et al. (2001) in the references in Part 2 for the present paper

<http://www.weloennig.de/GiraffaSecondPartEnglish.pdf>.

- d) The verdict of Nobel laureate Francois Jacob quoted above that natural selection has been correcting the genetic message "for more than two billion years, *continually improving, refining and completing it, gradually eliminating all imperfections*" is not an isolated case but describes, in principle, an important and constitutive part of the general state of mind of neo-Darwinian biologists, which can be traced back to Darwin himself. The latter states – just to quote a few examples:

"As natural selection acts solely by the preservation of profitable modifications, each new form will tend in a fully-stocked country to take the place of, and finally to *exterminate, its own less improved parent-form and other less-favoured forms with which it comes into competition*. Thus extinction and natural selection go hand in hand."

Or: "...old forms will be supplanted by new and improved forms." And on the evolution of the eye that natural selection is:

"intently watching each slight alteration" ... "carefully preserving each which...in any way or in any degree tends to produce a distincter image." And "We must suppose each new state of the instrument to be multiplied by the million; each to be preserved until a better one is produced, and then the old ones to be all destroyed." And: "In living bodies, variation will cause the slight alterations, generation will multiply them almost infinitely, and **natural selection will pick out with unerring skill each improvement.**"

In the same manner and context of eye-evolution (including necessarily the entire innervation and corresponding parts of the brain in complex animals), Salvini-Plawen and Mayr regularly speak of "evolutive improvement" (p. 247), "eye perfection", "gradually improved types of eyes", "grades in eye perfection", "the principle of gradual perfecting from very simple beginnings", "regular series of ever more perfect eyes" (1977, pp. 248 – 255; see please <http://www.weloennig.de/AullNeAb.html>).

Applying this kind of reasoning to the recurrent laryngeal nerve leads us directly into the contradiction in the neo-Darwinian world view pointed out above, to wit, that the "**unerring skill**" of natural selection – that exterminates every "less improved parent-form and other less-favoured forms", which picks out and preserves "each improvement...", which should also produce 'regular series of ever more perfect nerves' and which is, above all, "gradually eliminating all imperfections" – results in "one of nature's worst designs", the "ridiculous detour" etc., of the recurrent laryngeal nerve.

If I understand anything at all, the testable scientific theory of an intelligent origin of life in all its basic and often also irreducibly specialized forms is the superior explanation.

For further aspects on the laryngeal nerves, see Casey Luskins' post (15 Oct. 2010) *Direct Innervation of the Larynx Demanded by Intelligent Design Critics Does exist* ([http://www.evolutionnews.org/2010/10/direct\\_innervation\\_of\\_the\\_lary039211.html#more](http://www.evolutionnews.org/2010/10/direct_innervation_of_the_lary039211.html#more)), explicating the role of the superior laryngeal nerves (**SLNs**) innervating the larynx directly from the brain, especially their cooperation with and complementation of the recurrent laryngeal nerves (**RLNs**). In his post of October 16, 2010 on the topic of *Medical Considerations for the Intelligent Design of the Recurrent Laryngeal Nerve* ([http://www.evolutionnews.org/2010/10/medical\\_considerations\\_for\\_the039221.html#more](http://www.evolutionnews.org/2010/10/medical_considerations_for_the039221.html#more)), he sums the former point up as follows:

“There is dual-innervation of the larynx from the SLN and RLN, and in fact *the SLN innervates the larynx directly from the brain*. The direct innervation of the larynx via the superior laryngeal SLN shows the laryngeal innervations in fact follows the very design demanded by ID critics like Jerry Coyne and Richard Dawkins. Various medical conditions encountered when either the SLN or RLN are damaged point to special functions for each nerve, indicating that the RLN has a specific laryngeal function when everything is functioning properly. This segregation may be necessary to achieve this function, and the redundancy seems to preserve some level of functionality if one nerve gets damaged. This dual-innervation seems like rational design principle.”

**Markus Rammerstorfer** said... <http://www.valdosta.edu/~stthompson/>

To your question: "Why should there not be some species, even if humans are not one of them (or giraffes another), in which a direct path did not prove best? Common descent can explain this:..."

Well, there are some species. See Lönnig's Notes added in Proof: "b) According to Dietrich Starck – one of the leading German evolutionary anatomists of the 20th century – the recurrent laryngeal nerves are missing in the suborder Tylopoda (family Camelidae with camels, lamas and vicuñas), see Starck 1978, p. 237. However, Hans Joachim Müller, who published the results of his careful dissections on *Camelus bactrianus* and *Lama huanacus* [guanicoe] in 1962, found that – although in fact, the innervation of the larynx by the Nervus laryngeus inferior [the part of the RLN proximal to the Larynx] is exceptional in these animals – there still is a ramus recurrens sinister, which arises from the vagus nerve near the heart and ‘curves around the arch of aorta’ in order to ascend at the latero-dorsal (and during further development at the more dorsal) part of the trachea, but does not innervate the larynx. Müller writes (p. 161):

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[November 1, 2010 9:48 AM](#) 

**Markus Rammerstorfer** said...

„Lönnig offers no actual evidence that variations in the path of the recurrent laryngeal nerve are mutations rather than developmental aberrations“

Doing my own research on the RLN I indeed think that it is most likely a developmental aberration, not heritable (at least in humans the direct route can also cause problems so we don't want to inherit it...), not (directly?) caused by any mutation. That of course does not refute Lönnig's point or as you put it: „it seems very likely that some mutations could affect the path of the nerve“ - therefore evolution \*could\*

have changed the path of the nerve as those variations illustrate.

The variations of the RLN also give a hint towards something more important for the discussion here: The route of certain nerves do not follow an exactly specified blueprint. In this regard it's not comparable to the wiring human constructions. Nerve growth follows a certain logic, it seems to be a very flexible and adaptive process. Consider possible requirements in development as well: Could an organ like the larynx develop properly if not innervated by a nerve at the right time? Unless there is a good understanding on such questions – ultimately on the ontogenetic development of complex animals - how could we ever judge on the quality of the route that a specific nerve or vessel takes?

And is the similar route of the RLN in so many diverse animals really a surprise considering that they share the same basic vertebrate body plan? Should the route of the RLN be interpreted as a special case of an evolutionary relic (suboptimal on top) that could not be changed over the course of millions of years (save some possible exceptions)? Or isn't it just a consequence of the same basic body plan, the same logic of nerve growth and a few developmental constraints in complex animals ('an organ must be innervated by its nerve early in development in order to develop successfully')? In this case it would just be another feature showing similarities between species.

Granted: If someone thinks that the exact route of each and every nerve and vessel in our body is specified in a blueprint and executed in a manner that is similar to wiring a car than the standard route of the RLN (and certain vessels) must seem pretty odd (unless he finds a certain functional advantage of the route). But that's not what we are dealing with here and that seems to me the real message of those variations of the RLN (as well as of many other variations in the anatomy of organisms). Calling certain features 'odd' or 'stupid' might serve the need for quick ammunition against creation but it does not inspire biological research.

[November 1, 2010 9:49 AM](#)

For the *References*, see Part 2.

See, please  
for Part 1 of the entire paper:

**The Evolution of the Long-Necked Giraffe  
(*Giraffa camelopardalis* L.) –  
What Do We Really Know?**

<http://www.weloennig.de/Giraffe.pdf>

As for Part 2 see

<http://www.weloennig.de/GiraffaSecondPartEnglish.pdf>

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