W. F. Daniell (1817–1865) and the discovery that cola-nuts contain caffeine

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In 1850, Dr WF Daniell, a surgeon in the then Army Medical Department and an honorary member of the Pharmaceutical Society of Great Britain, was posted to the Gold Coast for a tour of duty as a medical officer. Although the role of medical officer was primarily to administer to the troops, they frequently took a keen interest in the health of the native population, and, with few effective medicines at their disposal, native remedies were often resorted to. For example, in the garrison at Fort Christiansburg (Accra), Daniell found that a common and troublesome problem among the troops was a form of diarrhoea, for which there was an effective native remedy derived from cola-nuts, namely "... a decoction of the fresh seeds..."

1 Use as a stimulant

Cola-nuts (seeds of the tree *Cola acuminata*) were also used by the African natives as a stimulant. In fact, the seeds are so active in this respect that they had come to play a prominent role in African customs and etiquette, as Daniell describes (Daniell 1864).

> Should a white trader, or native personage of rank, visit any chief, whether of ceremony, or otherwise, the presentation of a few seeds, or even the half of one, constitutes the highest compliment he could receive, as conveying an assurance of friendly welcome, and protection.
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> If a chief or man of property residing at some distance from another, felt inclined to perform an act of courtesy to the latter, the transmission of a few Kola-nuts was esteemed as the most grateful indication of friendship, and was almost invariably reciprocated by a similar exchange or acknowledgement.
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> In countries where the Kola-tree was not indigenous, and the fruit therefore difficult of attainment,being more restricted to the chiefs and higher inhabitants, no business could be transacted without a few of the nuts being previously eaten; and so high was their appreciation, that formerly no marriage gift of the bridegroom to the father would be deemed acceptable for the purchase of his daughter, unless it comprised a considerable amount of Kola-seeds.... Again, on the departure of any guest, the host was bound to bestow on him a farewell gift of Kolas. To not a few of these visitors, induced by commercial, or political objects, to traverse great distances, no present could be more deeply valued; for experience had already demonstrated, that their use not only supported the strength, allayed an inordinate appetite, assuaged thirst, and promoted digestion, but in fact rendered them more capable, of sustaining the fatigues of their homeward journey, than any other product that could be obtained.

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The seeds were best when fresh, as Attfield indicates (Attfield 1865).

> . . . for all purposes, it was in the fresh state that the nut was generally employed, portions being chewed, the juice swallowed, and the solid part ejected from the mouth. If the nuts became dry, they were considered to have deprecated in value, and were then only chewed by the lower classes of the natives.

The usual method of keeping the nuts moist was described by the botanist Charles Barter (Barter 1860) in a letter to Sir William Hooker:

> Cola-nuts are not much carried in the pod—this method is too cumbersome; but as it is necessary to keep them moist, and protected from the dry winds, the baskets are well protected with leaves of a species of Phrynium, which keeps moist and does not readily decay.

Interestingly, Daniell was familiar with the then genus Phrynium, having already discovered a new African species, *Phrynium danielli* (Daniell 1854) which had been named after him by his friend and botanist J.J. Bennett (Bennett 1854). That species has however since been reclassified as *Thaumatococcus daniellii* Bentham (Hutchinson and Dalziel 1954).

2 Sleepless nights

Thirteen years later, during a subsequent posting to Jamaica (1862–64), Daniell fell ill with diarrhoea, and treated himself with the same cola-nut remedy he used to prescribe in Africa. However, sleepless nights and a significant discovery ensued, as Daniell describes (Daniell 1864).

> . . . much to my surprise, on taking the medicine late, two evenings in succession, found that I was deprived of sleep, during the remainder of the night. Uncertain whether this insomnia proceeded from some temporary constitutional idiosyncrasy, or an inherent peculiarity belonging to the fresh seeds, I intermitted taking the decoction for a few days, and with the intermission, the natural rest returned; on again continuing the medicine in the evening, I invariably found its administration attended, more or less, with loss of sleep. I was then reminded how practically verified (after the lapse of two centuries), were the quaint remarks of Dapper, one of our enterprising African voyagers, who announced that the seeds, 'as experience teacheth, eaten in the evening hindereth sleep' (Ogilby 1670). This singular and well-developed phenomenon, the the result of a powerful stimulant on the brain and nervous system, produced by some elementary principle analogous to caffeine, or theine, led me to infer from physiological induction, that an analysis of the seeds would readily determine this point in the affirmative. Following the process commonly in vogue for determining theine, from other plants, viz, by mixing with a strong decoction of the fresh nuts, acetate of lead to precipitate the astringent principle, and then transmitting sufficient sulphuretted hydrogen, to remove the excess of lead, after the gradual evaporation of the liquid, numerous long needle-like crystals, became deposited on the glass. These, on comparison with with a large sample of this alkaloid in Kingston, proved to be identical. As, however, it was deemed desirable to have a more elaborate chemical examination of the ultimate constituents of these seeds, and also to determine fully the character of the theine previously procured, a quantity of the broken dried nuts, were placed in the hands of a practical chemist, Dr Attfield, at the same time intimating to him, that I had already obtained theine as one of the chief elements; and the result of his labours hitherto, has been to establish the validity of my discovery, and the correctness of the estimate I had formed respecting the true nature of this alkaloid.

Attfield's analysis of cola-nuts (Attfield 1865) showed that they contained 2·13 per cent by weight of caffeine (coffee beans contain about 0·5–2 per cent and leaf tea about 0·5–3·5). Daniell's cola-nuts were donated to the Museum of Materia Medica of the Pharmaceutical Society, which is now housed in the Economic Botany Collection at the Royal Botanic Gardens, Kew.

3 Paper to the society

Daniell described his discovery in a paper (Daniell 1864) which was read before the Pharmaceutical Society on January 4, 1865. Unfortunately, however, Daniell was too ill even to attend the meeting, and the paper was read instead by his friend Professor Robert Bentley. In fact two weeks later, Daniell mentioned his poor health to Professor Bentley in a letter (Daniell 1865) regarding the exact title of this paper, which was due to be published in the March issue of the *The Pharmaceutical Journal*. Daniell writes

> ...I have been confined to bed the greater part of the last five days and am so ill that I dare not venture out of house.

Daniell died on June 26, 1865, and was buried in Kensal Green cemetery, London.

4 Acknowledgements

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