The fossil Ainiktozoon is an arthropod

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fact, shift the expression of *mab-5* to the anterior of the embryo.

As both experiments of Cowing and Kenyon are open to alternative interpretations it seems premature to change our thinking about the expression of *Hox* genes[9].

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The fossil *Ainiktozoon* is an arthropod

The enigmatic fossil *Ainiktozoon loganense* Scourfield 1937 (ref. 1) from the Lower Silurian period of Lesmahagow, Scotland, has puzzled most who have studied it. We have examined several new specimens, some exceptionally well preserved and with soft tissues, from the type locality, and conclude that this fossil is an arthropod, not a protochordate, with affinities to the Thylacocephala.

Discovered in the late nineteenth century, *Ainiktozoon* was not described for nearly 50 years[2]. When Scourfield first published a detailed description[1], he concluded that it was probably allied with the Urochordata. Subsequent workers considered *Ainiktozoon* only with regard to the early history and origin of the chordates[3]. A chief difficulty in interpreting *Ainiktozoon* has been in the apparent lack of homology of its known features with those in other organisms. We report here on new specimens from the type locality in which three-dimensional soft tissues are preserved, including organic (probably cuticlar) structures and phosphatized musculature.

Ainiktozoon fossils are usually found as laterally flattened compressions on bedding planes of compacted laminated siltstones throughout the Jamoytius Horizon in the Patrick Burn Formation. Specimens, of which RMS 1996.31.1 (Fig. 1a) and RMS 1977.3.7 (Royal Museum of Scotland) are among the best-preserved examples, range in length from 25 to 240 mm. Scourfield originally drew the fossil with a fringe in a dorsal position, on what he termed a sac-like body[1], an attitude followed by Ritchie[2] (Figs 2 and 6 of ref. 2). Only after we turned these reconstructions upside down did we realize that *Ainiktozoon* could have arthropodan affinities.

In our new interpretation (Fig. 1b), these animals display an anterior carapace covering a segmented body which bears eight biramous, paddle-like limbs and short, terminal, caudal rami at its posterior end. These trunk segments are marked by longitudinal muscle fibres interrupted with segmental, connective tendons. Originating from these tendons are diagonally arranged limb muscles that insert into the paddle-like limbs. The 'capsule' of Ritchie[2], which lies anterior to the segmented region, emerges now as a highly muscular foregut. We reinterpret the various 'fascicles' noted by previous workers as phosphatized carapace adductor muscles, dilator stomach muscles and other soft anatomy associated with an arthropod cephalon.

The carapace apparently was rather thin in life and is usually only poorly preserved. In two specimens (RMS 1996.31.1 and RMS 1977.3.7) the carapace seems not to have the distinct bivalved form of other thylacocephalans but rather is splayed out with left and right valves revealed. Both of these specimens show pairs of compound eyes with hexagonal facets; typical arthropodan features. The eyes are among the smallest of any thylacocephalan but are otherwise similar to those found in other members of this group, as yet undescribed, from the Silurian of Waukeshau, Wisconsin[4].

Specimen RMS 1996.31.1 also preserves anteriorly a set of 'jack-knifed', superimposed, subchelate, raptorial limbs. The segments are rather large and armed with robust spines, and clearly resemble the anterior raptorial, subchelate limbs of the Thylacocephala. They are similar in form to limbs on the American Silurian material (mentioned above) as well as those seen on

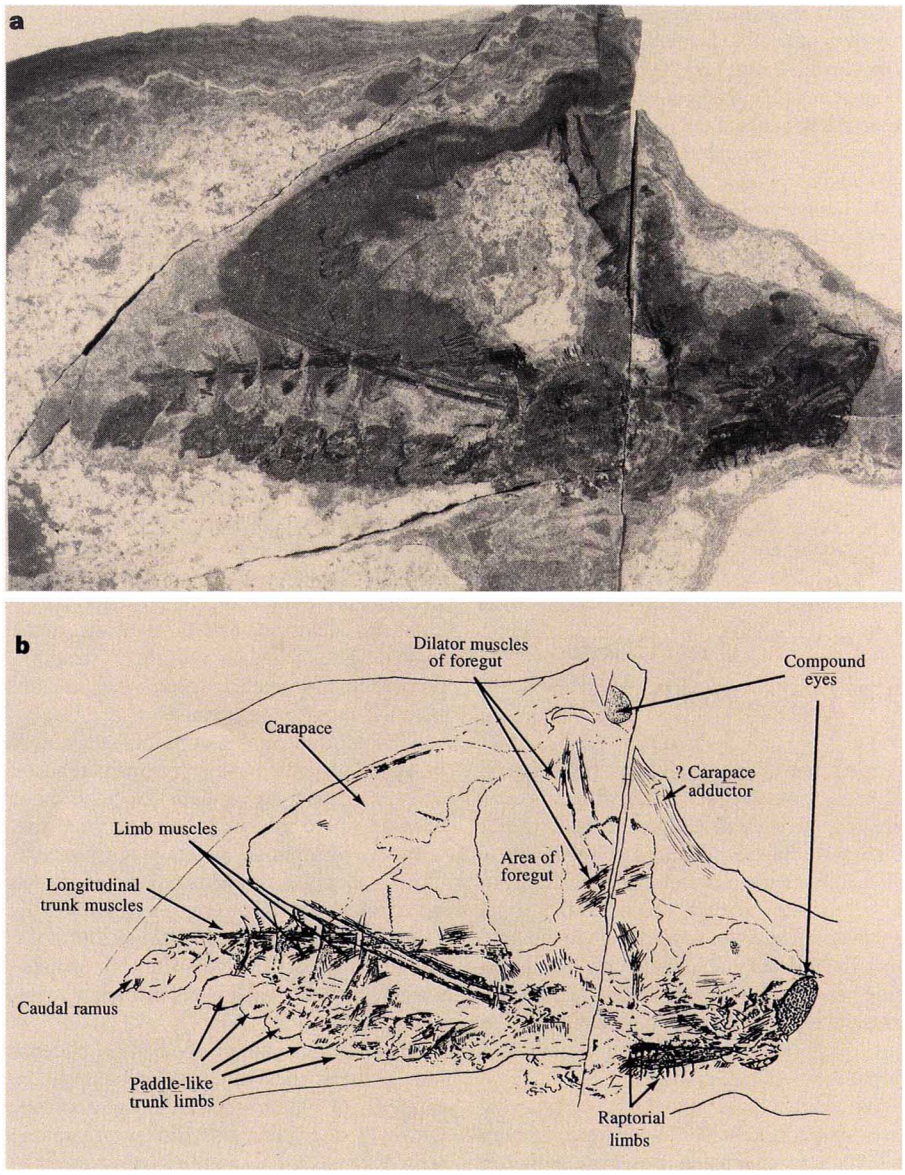

Figure 1 a, **New specimen of *A. loganense*, immersed in water, with preservation of non-mineralized tissues, including cuticle and musculature. Specimen RMS 1996.31.1.** b, **Camera lucida drawing of RMS 1996.31.1, with thylacocephalan arthropod features identified. The length of the specimen from compound eye to caudal ramus is roughly 18 cm.**

the Jurassic thylacocephalan *Dollocaris*[5]. Beneath the carapace on RMS 1977.3.7, pairs of gills with the same form and position of those of *Dollocaris* are visible.

All the pertinent features[6,7] of the Thylacocephala are present: large carapace, paired compound eyes, subchelate limbs on the anterior part of the body, large laminar gills beneath the carapace, and a segmented, posterior trunk with swimming limbs. If we have correctly interpreted these structures, then *Ainiktozoon* certainly resembles a thylacocephalan arthropod more than it does any known protochordate, a relationship previously only hinted at by Dzik[8].

Ainiktozoon also possesses several unique features (for thylacocephalans) related to the apparently flattened form of the carapace and the relatively small size of the eyes, and so may represent a new family within that group. All other features of these new specimens accord well with what is known of the Thylacocephala.

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D2 dopamine receptors and personality traits

Temperament, a person's basic behavioural patterns or personality traits, differs greatly between individuals. Experimental studies of animals have implicated the dopamine neurotransmission system in the initiation of behaviour, reward and motivational processes[1]. Here we report that in normal human subjects the density of D2 dopamine receptors in the brain correlates strongly with a detached personality — a trait that includes lack of closeness and warmth in personal relations.

We studied the brains of 24 normal Caucasian adults (aged 18–38 years, 14 men and 10 women) using positron emission tomography (PET). We determined the D2-dopamine-receptor density in the putamen, one of the basal ganglia, using a Scatchard procedure based on two PET measurements with the radioligand [^{11}C]raclopride[2]. The extent of [^{11}C]raclopride binding in the left and right putamen was averaged, and the most ventral part of the putamen was excluded to minimize a possible contribution from D3-dopamine-receptor binding in the ventral striatum. We measured personality traits of the subjects using the 'Karolinska scales of personality' (KSP), a self-report questionnaire[3].

The D2-receptor density varied between 18 and 37 pmol ml^{-1} (29.1±6.9; mean± s.d.). The density strongly correlated with the Karolinska scale of 'detachment' (one of 15 personality scales) with $r = -0.68$, $P < 0.001$ (Fig. 1), a correlation which remained significant even after a Bonferroni correction for 15 comparisons, and irritability ($r = -0.51$, $P < 0.01$). The 'detachment' scale includes the tendency to avoid giving and taking confidences and to avoid involvement with other people.

In a recent study[4], using the 'inventory for interpersonal problems', individuals who scored high on the detachment scale described themselves as cold, socially aloof and vindictive in their relationships, whereas those who scored low reported problems with being overly nurturing and exploitable. Thus both extremes of this scale describe individuals who may have considerable interpersonal problems in daily life.

Detachment can encompass social isolation, indifference to other people and lack of intimate friendships, traits included among the category of 'negative' symptoms that commonly characterize patients with schizophrenia[5]; a terminology derived from the assumption that negative symptoms represent a loss of function. Classical antipsychotic drugs block D2 dopamine receptors[6] and are effective for the treatment of positive schizophrenic symptoms such as hallucinations, delusions and thought disorders. In contrast, negative symptoms respond poorly, or may even worsen, when treated with D2-receptor antagonists[7].

PET studies on D2 dopamine receptors in schizophrenia have previously focused on neuroleptic-naive patients, who have been admitted to hospital for the first time, with predominantly positive symptoms[8,9]. Our finding of a strong association between detachment and D2-receptor density indicates that it may prove fruitful to look for a low density of D2 receptors in schizophrenic patients with predominantly negative symptoms.

Behavioural genetic studies on rodents indicate that individual differences in the number of dopamine-releasing neurons, within a dopamine cell group, are maintained across all dopamine cell groups in the brain (for review see ref. 10). This is reflected in a strong correlation between the reactivity of hormonal and behavioural indicators in different dopamine cell

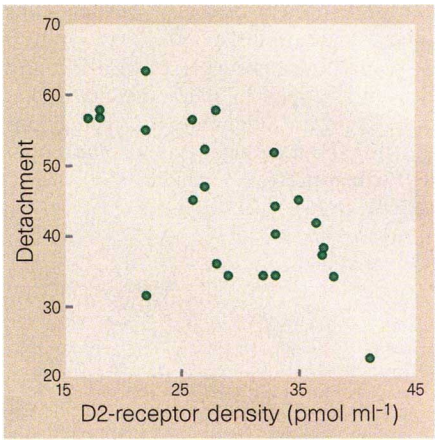

Figure 1 **Individual values ($n = 24$) for D2-dopamine-receptor density plotted against KSP detachment scores. To adjust for the effect of gender, the scores were transformed to T scores using normative data. The T scores have a mean (± s.e.m.) of 50 (±10) in the normal population.**

groups. We assume that the individual differences in D2-receptor density that we have found in the putamen are maintained in mesolimbic and neocortical regions.

Each of the five dopamine receptor subtypes (D1–D5) has a distinct pharmacological profile and a unique neuroanatomical distribution[11]. They may therefore be biological markers for different functional aspects of dopamine activity, and attempts have been made to associate polymorphic variants of dopamine receptor subtypes with features of human personality[12–14].

As yet it is unclear whether individual variability in D2-dopamine-receptor density is wholly genetically determined or whether it is subject to environmental influences. We propose that neuroreceptor density is a useful biochemical measure for relating the genetic endowment to human personality traits. This approach provides a new way to search for empirical biological correlates of personality in man.

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