

## Palaeontology

# Three-eyed lizards are not uncommon. Four-eyed ones are a novelty

*They had languished in a museum drawer since the 1870s*



Getty Images

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UNLIKE invertebrates, most of which have at least four eyes, vertebrates usually have only two. Yet, there are exceptions. Some fish, amphibians and reptiles have a third, so-called parietal, eye. This organ, a modification of a brain structure called the parapineal gland (itself an associate of the better-known pineal gland, which regulates an animal's body clock), is usually covered with skin and sits on the top of the head, as the picture below shows. It helps those creatures that possess it to detect low-level illumination, and so aids navigation by moonlight or starlight.

For vertebrates to have four eyes, however, is unusual in the extreme. The only ones known that are so endowed are the lampreys. These have two conventional eyes and two parietals, one derived from the parapineal and the other from the pineal. But lampreys' exceptionalism in this respect has just been challenged. This week

Krister Smith, a palaeontologist at the Senckenberg Research Institute, in Germany, reports in *Current Biology* that, 49m years ago, the four-eye club had another member—a lizard called *Saniwa ensidens*.

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The specimens which led Dr Smith to this conclusion have languished in Yale University's palaeontology collection since their discovery in Wyoming in 1871. Initial examination of them revealed an odd extra pair of holes in the skulls behind the eye sockets. But, since these holes were roughly a tenth the size of the eye sockets, the examiners concluded that they were passages for blood vessels and the

strangeness of the lizards was soon forgotten.

Dr Smith stumbled on the specimens while conducting a study on lizard diversity. He found it hard to accept that the extra holes were for blood flow, reasoning that if they were, indeed, there to permit the passage of blood vessels, then re-entry holes of a similar size would exist elsewhere on the skulls for the blood to return to the rest of the body. But none such could be found.

What he did find, by comparing the locations of the holes with the skulls and brains of 179 living lizard species, was that they would have been above *Saniwa*'s pineal and parapineal glands. Moreover, when he used computerised tomography, a sophisticated form of X-ray scanning, to study the insides of the fossil skulls, he discovered within each hole a cup-shaped structure with a stalk behind it. This anatomical arrangement is characteristic of eyes of all types. The cup is the retina. The stalk carries the retina's nerve connections and blood supply. Given all this Dr Smith and his colleagues argue that *Saniwa*'s extra skull holes were the sites of pineal- and parapineal-derived eyes of the sort possessed by lampreys. If so, they have discovered a first—a four-eyed terrestrial vertebrate.

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