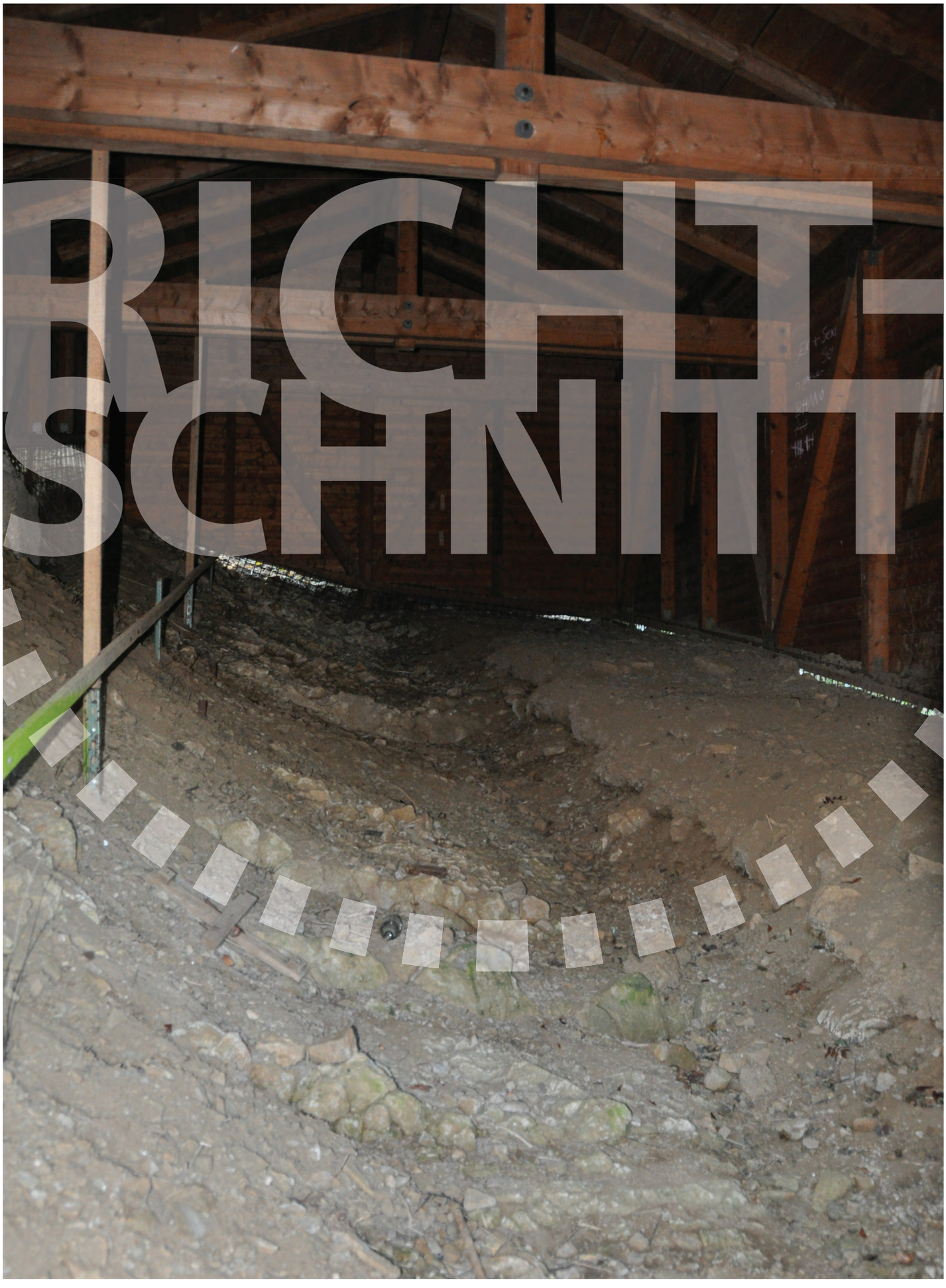


Richtschnitt. The interior of the cabin with the *Richtschnitt*, exposing the boundary at the base of the Eifelian Stage which lies roughly in the centre of the photograph.

Going green

The bare rock floor of a log cabin in Germany's Eifel Hills defines, by international agreement, the boundary between Lower and Middle Devonian rocks throughout the world. A path signposted Richtschnitt *winds through the fertile landscape up to this building.*

Robert W Williams, text and photos

The village of Schönecken lies in the valley of the river Nims, a trout-rich stream which meanders through the green hills of Rhineland-Palatinate on the western edge of Germany.

Only 1 500 people live in this charming hamlet, located on sedimentary rocks which produce rich soils to sustain the area's agriculture.

Its local bedrock is also important for deciphering the Earth's history at a key moment in the evolution of the biosphere.

The fossil succession encased in the rock strata under Schönecken holds the key to dating a significant event in planetary history – the beginning of the Middle Devonian epoch at precisely 397.5 million years before the present.

Tinted

It was in the course of the 12-million-year Middle Devonian that the colour green, tantamount today to all things environmental, first tinted the landscapes of the Earth.

This was when some species of small, rootless liverworts and mosses evolved into tall plants with stiff, water-conducting tissues and soil-anchoring root networks.

In time, they became the Earth's first trees. Forests spread across continents, their biomass became steadily denser, and they crept further inland. Combustible carbon compounds accumulated. The Middle Devonian saw the very first fires burn on the planet.

The Devonian is a fitting name for what must have been a time of stunning green landscapes, invoking as it does the pastoral serenity of the English county of Devon where this geological period was first identified in the early 19th century.

A gravel path a few hundred metres south of the cathedral in Schönecken leads to the sign reading *Richtschnitt* – a geological term meaning "key section" – at the edge of the forest. The track continues up the slope of a forested ridge.

Despite the message on the sign, however, no rock outcrops are to be seen. They are covered by vegetation in most of the Eifel. Iridescent green pastures and dense forests are nourished by the calcareous Devonian mudstone and fossil coral reefs which make up the bedrock.

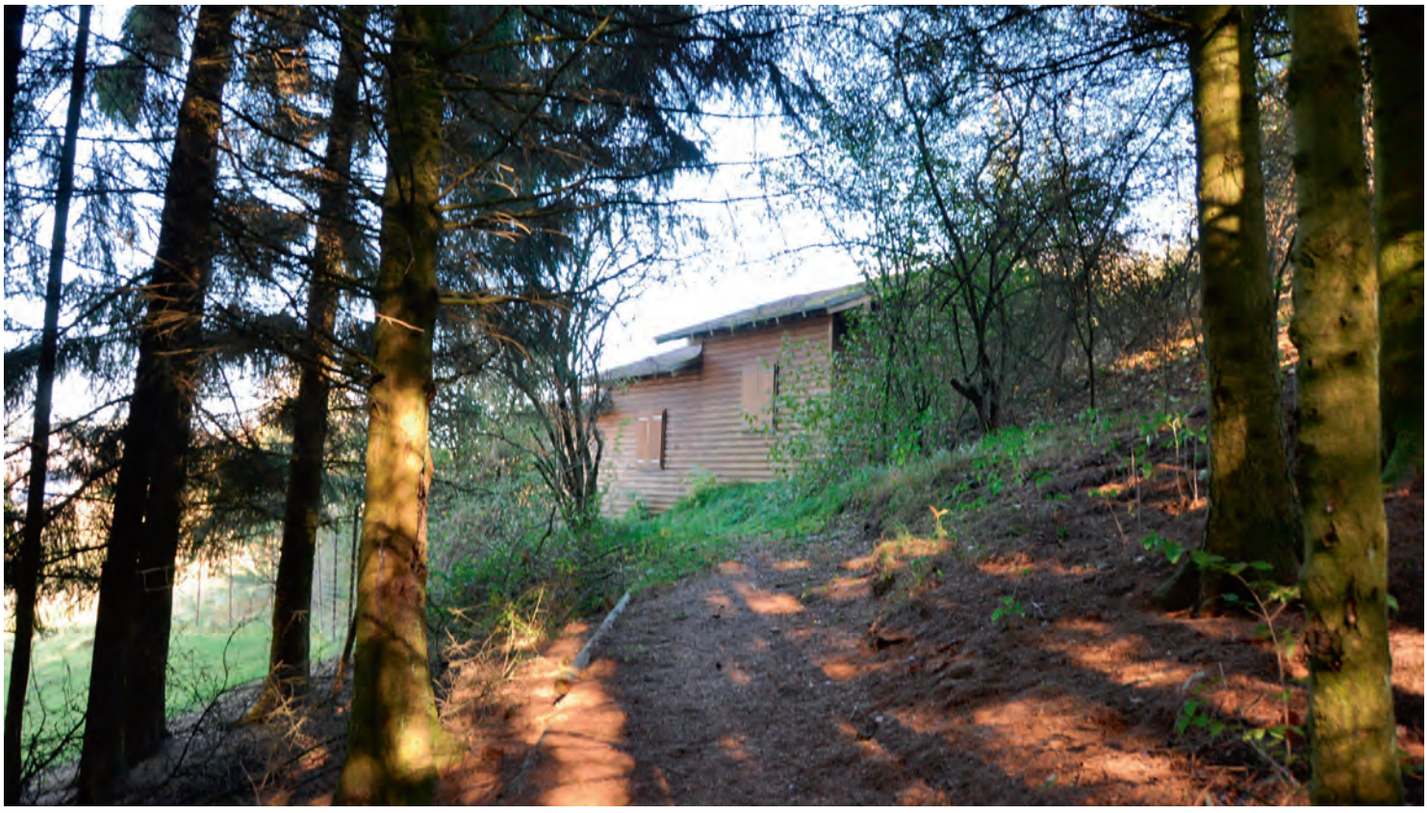
These rock layers are visible only in the occasional road cut or quarry. Pine forests, a modern remnant of Middle Devonian plant evolution, thwart geologists' access to the rocks which preserve fossils of distant cousins of these trees.

Longest

These rocks were once mud on the floor of a tropical sea 3 000 kilometres south of the equator and 1 000 east of the highest and longest mountain chain ever for-

This is the third article on global boundary stratotype sections and points, informally called "golden spikes". These define the boundaries in the geological time scale, which is divided into roughly 100 sections. Spread around the world, almost all of the spikes are due to have been fixed during 2012.

Previous articles are available at *www.npd.no/publications*:
Spiking the strata (*Norwegian Continental Shelf*, no 1, 2005)
Water world (*Norwegian Continental Shelf*, no 2, 2008)



Golden spike. This cabin protects the GSSP, or "golden spike", which marks the base of the Eifelian Stage in the geological time scale.

med on land, the Caledonians.

Just as the collision between India and Asia is raising the much younger Himalayas, north-west Europe and North America collided slowly and tortuously during the Silurian period.

That movement raised the Caledonian mountains, which extended northward from the south-eastern reaches of North America to Greenland and northern Norway.

Devonian forests created novel opportunities for natural selection. Species diversity increased in marine and freshwater habitats.

The Caledonians gave rise to myriad lakes, rivers and streams isolated from each other. As the biota on far-flung volcanic islands illustrate today, barriers to gene dispersal turbocharge the rate of biological evolution.

The evolutionary footprint of the Caledonians on terrestrial fauna can be appreciated by examining the architecture of the organs and four limbs of all terrestrial vertebrates (even snakes have four limbs coded, but turned off in their genomes).

Thanks to the Caledonians, all people descend from a single species of freshwater lobe-finned Middle Devonian fish. These mountains are imprinted in human bones.

The Caledonians were eroded down to a shadow of their former glory just a few tens of millions years after their birth. They were a victim of the climate-controlling effect which mountain chains exert on atmospheric circulation and weather systems.

Mountain chains ensure their own destruction by increasing the intensity of erosion of their surfaces. As a result, they boost the transport of material towards lowland sedimentary basins and continental shelves.

The first sediments deposited on the NCS are the legacy of the once majestic Caledonian mountains. These sediments are an extension of the rusty red rocks which Victorian geologists labelled the Old Red Sandstone.

Contorted crust in Norway, the British Isles, Greenland and the eastern USA, together with the enormous volume of Devonian sedimentary rocks spread over these lands, attest tellingly to the historic immensity of the Caledonians. These rocks are a testimony to the colossal power of continents in collision.

Protected by distance, the Eifel region avoided the Silurian mountain-building drama which took place in slow motion beyond its western horizon.

During the Devonian, the Eifel was a quiet sea floor which received only the finer-grained debris eroded from the Caledonians.

What is now hilly farmland and forest was then part of the continental shelf off the eastern shores of Euramerica, as the composite continent of the Devonian is now called.

This ancient geographical setting helps to understand the elusive *Richtschnitt* path. The forest trail ends in a grassy clearing overlooking the quiet, slate-roofed houses of Schönecken. Across the valley, the grey ruins of a 12th century castle loom above the village.

A curious log cabin stands in the clearing. The solidly built wooden hut seems at first glance to be some sort of storage facility.

It is an unusual three-tiered, floorless structure, clearly designed to follow the sloping terrain. The rocky floor within is visible through an iron-barred opening in the wall.

A placard by the padlocked entrance door explains the building's true purpose: to protect a 15-metre-long shallow trench which geologists from Frankfurt's Senckenberg Institute excavated in 1982. It boldly states "Inside this hut lurks a world attraction for scientists."

Transition

The Senckenberg Institute dug the trench in order to study the transition between sediments deposited during the Early Devonian and Middle Devonian Epochs.

These rocks have worldwide significance because a portion of their fossil fauna, tiny teeth from a small eel-like creature, occurs worldwide in marine deposits.

In addition, there is no hiatus at the boundary layer here in Schönecken. In other words, sedimentation continued uninterrupted during the transition from Early to Middle Devonian.

What is more, airborne volcanic ash is interspersed throughout the rock section. The ratio of potassium to argon in the ash indicates that its particles solidified 397.5 million years ago.

Fortunately, the rock exposure inside the hut exists in a politically stable country with an infrastructure which allows geologists easy access.

For all of these reasons, the International Committee on Stratigraphy awarded the global boundary stratotype section and point (GSSP), informally called the golden spike, to the rock outcrop in Schönecken in 1985.

The Schönecken site won the GSSP in competition with other candidate sites throughout the world. This age in Earth history will forever be called the Eifelian.

Like the castle on the other side of the Nims valley, this little brown cabin is also a fortress of sorts – a fortress of shadow.

The enemy which must be repelled is photosynthesis. The darkness inside is keeping invading vegetation at bay.

It is protecting an outcropping of sea floor sediments that mark the base of the Eifelian Age, which initiated the Middle Devonian Epoch.

The flora, fauna and landscape of that time coloured our environment and shaped our bodies.

Robert W Williams is a palaeontologist at the NPD. His grandfather, Heinrich Joseph Willms, and at least 10 preceding generations, were all born in the Eifel region on Middle Devonian limestones.

Middle Devonian events:

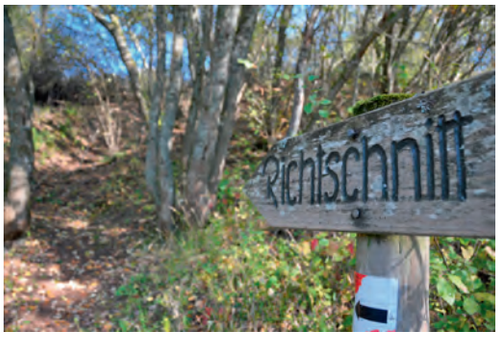
- jawless ostracoderm fish in decline
- jawed fish increase in diversity
- lungfish appear
- club mosses appear
- early ferns appear
- progymnosperms appear
- land arthropods diversify
- with no herbivorous land animals yet evolved, forests shaped the landscape.

Conodonts

Most ages of the Palaeozoic Era, such as the Eifelian Age of the Middle Devonian Epoch, are defined by the earliest occurrence of various marine species of phosphatic microfossils called conodonts.

More than 1 500 known fossil species exist, many of which may be different kinds of teeth belonging to one animal. For 200 years, only the teeth of these enigmatic animals were found.

The body morphology of one species came to light in 1980, when fossil impressions of soft tissues were found in museum specimens in Scotland, and later in outcrops both in Scotland and South Africa. It was a tiny marine animal which resembled an eel.



Richtschnitt is a geological term meaning "key section".

Schönecken Castle, originally called Clara Costa, was built around 1230 on the river Nims. The village of Schönecken is in the foreground.

The small **Devonium Museum** in Waxweiler, near Schönecken, displays an impressive collection of fossils from the Devonian of the Eifel Hills.