Conglomerates of Cwmbran Their Genesis and Uses

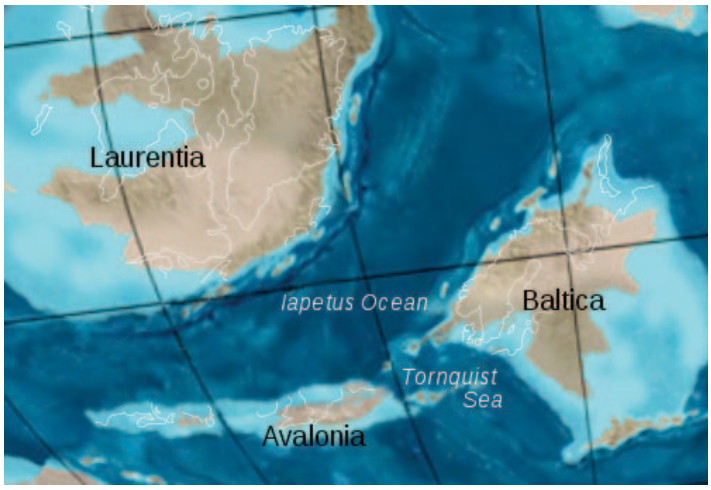
Conglomerate boulder
Found 500m west of Llanderfel farm near the outcropping quartz conglomerate seam, which runs alongside the Cistercian Way footpath.

All around Cwmbran large rocks known as quartz conglomerates, weighing up to an estimated three tons can be found on the hillside, at strategic points throughout the town and more sparsely in the woodlands and surrounding area.
Huge, irregular shaped conglomerate rock boulders measuring over a metre square can be found on the side of roads, as features in landscapes and as foundations, boundary markers and building blocks for houses. They are also found in seemingly random and obscure places such as Greenmeadow and Thornhill woods, where there are clues that conglomerate rocks have been used as prized building materials with the indigenous communities, for possibly, many thousands of years. It seems the early civilisations that lived in the area may have utilised this very hard and robust building material.
In days gone past, the tough quartz pebbles may have been extracted from conglomerate rocks, then cut, polished and carved following age old traditions and understandings that crystals aided protection and healing.

This investigation is an exploration of the Cwmbran area terrain, to determine if the conglomerates exposed at the surface around the town, but especially in the areas of Greenmeadow Woods and Thornhill Woods are from a locally outcropping seam (autochthonous), or if the conglomerates have been moved from their original location (allochthonous) and if so, from where.

Origin of South East Wales Conglomerates

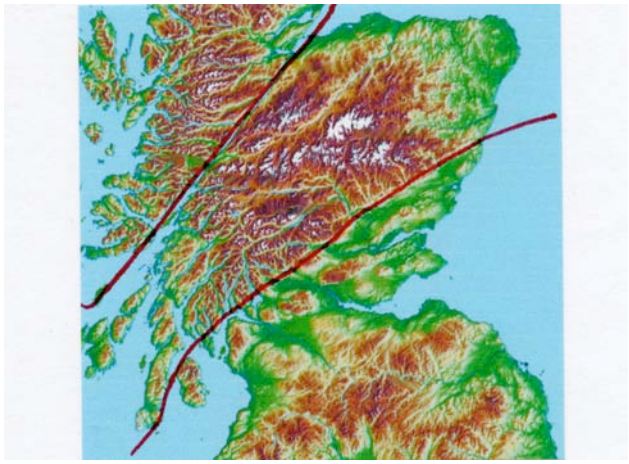
Current scientific understanding from different geological disciplines, including the study of plate tectonics, observation of rocks and strata that tie in with other continents, of the fossil record and from the study of the earth's magnetism in rocks, has determined, that during the Devonian Period of Earths history, 417 to 354 million years ago, Britain was situated 10□-15□south of the equator in the Southern Hemisphere, experiencing a dry continental, fairly arid climate with sparse vegetation.
A new range of mountains had been formed at this time in an event called the Caledonian Orogeny, or mountain building episode. Three continents, Laurentia - North America, Baltica - northern Europe and Avalonia - including southern Britain, that had been separated by an ocean called the Iapetus, slowly, over millions of years, collided and the earth's crustal, tectonic plates were forced upwards, creating a new mountain range as large as the Himalayas, called by geologists the Caledonian Mountains.



Three continents on a collision course
Finally come together to form a new continent called Pangaea. **Laurentia** with Scotland and N Ireland, **Avalonia** with Wales England and S Ireland **Baltica** with northern Europe.

During the later stages of this collision, the last two parts of northern Britain slid into place with southern Britain, being united for the first time. The Northern Highlands joined with the Grampian Mountains along The Highland Boundary Fault and a later event, sutured The Great Glen Fault to northern Britain.

The Great Glen Fault



The Highland Boundary Fault

Scotland relief map showing two major fault sutures created by the closure of the Iapetus ocean.

Erosion of the Caledonide Mountains followed, which directed vast quantities of sedimentary rocks into the southerly regions, to produce a repeating association of conglomerates and sandstones, known as ‘molasse’ deposits.
The 55 million year old Alps are a good example of molasse deposits from more recent geological history, where, a ‘Molasse foreland basin’ stretches over 1000 kilometres along the north facing axis of the Alps mountain range, passing through France, Switzerland, Germany and Austria.
The Old Red Sandstone rocks, or ‘ORS’ of Cwmbran and Southeast Wales can be considered molasse deposits, but from a much earlier time. Our deposits occurred a little distance from the Caledonide foreland basin at the foothills of the eroding mountains, but in a secondary basin further south called The Welsh Basin, where an accumulation of rocks from further erosion of the Caledonian Mountains created another tectonic basin.
Finally, by late Devonian times, around 370 million years ago, the geologically, newly emerged mountains had slowly eroded away and deposited the sediment we know as the Old Red Sandstone across virtually the whole of Britain.
Because of the collision, Southeast Wales along with most of southern Britain had become part of an inland, continental environment, with braided and meandering, river and stream channels and tributaries over alluvial plains, which prograded, or deposited sediment load southwards.
Towards the end of this period our conglomerates came into being.

What is Conglomerate Rock

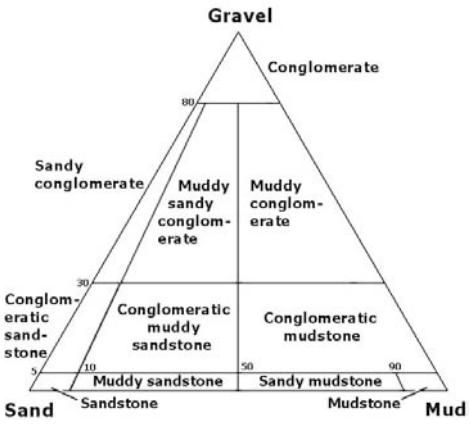
The term conglomerate is used in geology to describe rounded clasts - pebbles, naturally cemented together to form rock, basically cemented gravel with varying sized clasts. Millions of years are necessary to complete the transformation from loose unconsolidated sediment into hard or lithified, sedimentary rock.
When seeing conglomerate rock for the first time it can often look like concrete, not surprising as the process is much the same.
There are many different types of conglomerate depending on the method of formation and of the clasts (pebbles), matrix and cement involved. Conglomerate can form in rivers and streams, estuaries and beaches and further out to sea where slopes underwater create turbid flows of this type of sediment. Conglomerates also form at the surface from glacial tillites and eskers (rock piles dumped by glaciers), from aeolian, wind blown conditions such as desserts, from earth movement fractures and from the slow transgression of the sea onto land. The last one of which describes generally, how our conglomerates were formed.

Quartz Conglomerate Group

The Cwmbran and Thornhill area conglomerates are of the Quartz Conglomerate Group. A geological term used internationally, to describe rocks laid down some 365 million years ago, after a period of erosion of the land.
Our conglomerates are considered fluvial in origin, laid down in a gravelly, graded stream or alluvial fan system. Many conglomerate deposits of the quartz conglomerate group are considered to have been laid down on sloping banks of pebbles.
These rocks formed just before the end of the Devonian Period, when the last of the Old Red Sandstone (Upper ORS) was being deposited, during a time called the Fammenian and consequently, our conglomerates are often called basal conglomerates in text books.
Just below the south eastern outcrop of the South Wales coalfield that runs around Mynydd Maen and Mynydd twyn glas, the Upper Old Red Sandstone is represented by our basal conglomerate - The Quartz Conglomerate Group. It forms a narrow exposed band around the coalfield escarpment in the hills above Pontypool, Cwmbran and Machen, with small outliers of this hard resistant rock also found capping the Sugar Loaf, Abergavenny, Beacon Hill east of Trellech and Table Mountain, Crickhowell.
Our quartz conglomerate therefore correlates, or was laid down at the same time as the Quartz Conglomerate division of the Chepstow and Monmouthshire districts.

Conglomerate Classification

With vein quartz pebbles, silica matrix mineral composition and mostly silica cement, our conglomerate would have formed from surficial sand, gravel and pebbles then got cemented into a hardened mass by silica, after being deposited from a moderately high energy, waning, estuary load, or intertidal environment.
The geological term for quartz conglomerate is a silica cemented silicate conglomerate, or silcrete for short. Unlike other conglomerates which have a calcium carbonate, mudstone, iron oxide or gypsum matrix, our quartz conglomerate has a sandy matrix of tiny quartz grains, which makes it the hardest and most weather resistant conglomerate.



Conglomerate Classification Diagram
Quartz conglomerate is at the top of the compositional diagram, marked ‘Gravel’.

Around the shore of the Severn Estuary, conditions necessary for the development of conglomerate rock can be found today. Any rock shingle beach, with moderately well rounded or oval pebbles sitting in a sandy matrix could become quartz conglomerate rock in millions of year's time.

Cwmbran Quartz Conglomerates

The rounded or oval, vein or milky quartz, granules and pebbles within the matrix of our conglomerate are determined to be older than the rock itself, or 'extraformational' and conjectured to be derived from earlier Cambrian volcanism in mid Wales dating the quartz pebbles at nearly half a billion years old. Rare clasts have been found in the conglomerate of red jasper, rose quartz, quartzite and unrecognisable igneous rock, with various other substances such as lithium, sodium or titanium also found in small quantities. However, as the vast majority of pebbles within the rock are of vein/milky quartz, the rock is termed a monomict conglomerate, due to its singular pebble composition.

From a preferred orientation of clasts, the pebbles within our conglomerate indicate the alignment or imbrication of the sediment when it was laid down all those many millions of years ago. In that they lie parallel to the flow direction of the waterway as they were being laid down. Alignment patterns in conglomerate at the surface cannot be relied upon however, due to the possibility of either natural or human intervention.

The pebble size variations of these quartz rich rocks indicates that they are moderately well sorted and that similar sized clasts, or pebbles are grouped into lightly layered bands in a process called 'graded bedding'. This shows how heavier pebbles in a fluvial environment were laid before lighter ones, in a rhythmic and waning, cycle of repeating deposition to around 20 to 30 centimetres in depth. See picture below.

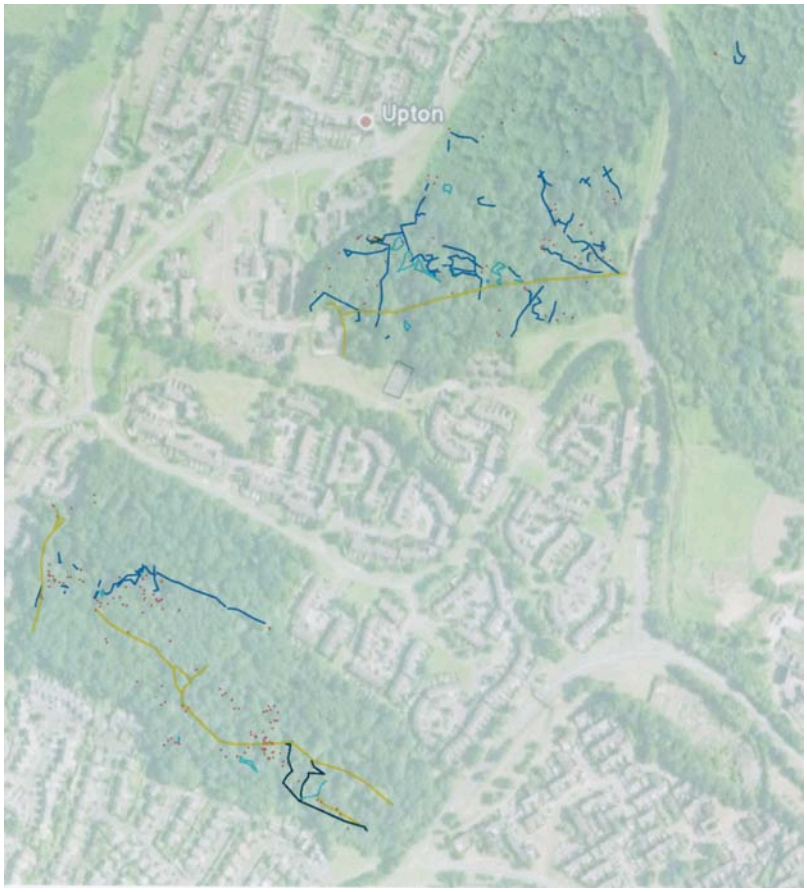
Large conglomerate boulder at the rear of Thornhill community centre
Repeating cycles of large to small pebbles form layered bands from left to right in the picture.

The rock above also shows score marks made by glacial action from the last Welsh glaciation, or more likely, earlier ice ages which were more severe, revealing how glacial action grinds down rock, creating striations or groves and shearing off quartz pebbles.

Results of Conglomerate Survey

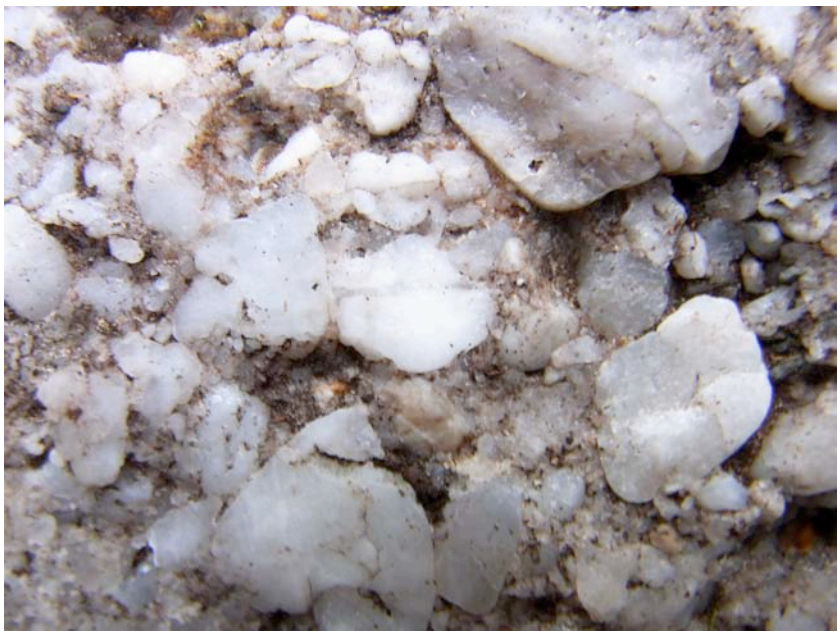
The conglomerates location survey conducted by 'Ancient Cwmbran' is shown below and indicates that glacial erratics, or dispersion of boulders moved by ice, during a period of glacial advance had little influence on the location of our quartz conglomerate boulders.
Glacial advance would have been generally from the north, from the top of map, shown below and in the case of Upper Cwmbran, the ice sheet would have come down the valley from the north east. Glacial action from the northeast would have moved the rock in a south-westerly direction, in this case, along the hillside. Our quartz conglomerate boulders would have moved further down the valley towards Ty Canol and Henllys.

A recessional moraine forms from a retreating glacier, which produces transverse ridges of unconsolidated glacial debris, or piles of rock left behind by a thawing glacier as it shrinks in size. The image below shows conglomerate rock piles or ridges that could have been formed by a recessional moraine. The red dots and blue lines form in a general orientation that would indicate this possibility, as a glacier would have retreated or melted, leaving behind rock ridges in the same orientation, NW – SE, perpendicular to the ice flow as it retreats.
However, the volumes of singular large conglomerate boulders are more numerous in this area, indicating their proximity to their allochthonous origin, on the escarpment of Mynydd Maen (mountain of rock) and Twyn glass, all indications that the rock was brought down from the near hill side using other methods.
The Cwmbran quartz conglomerates show glacial striations on many of the very large boulders, indicating how much of this rock was exposed at the surface and formed part of its outcrop, in situ, whilst being gauged by ice, during glacial movement, meaning that the quartz conglomerates have been moved **since** the glaciation periods.



Sitescan Archeological Image
Dark blue lines - banking or walls of conglomerate.
Light blue lines - stone piles, some scattered, various sizes up to 2 ton.
Yellow - footpath of concrete in Thornhill, or track in Greenmeadow woods.
Red dots - individual boulders, 1 to 6 ton weight.

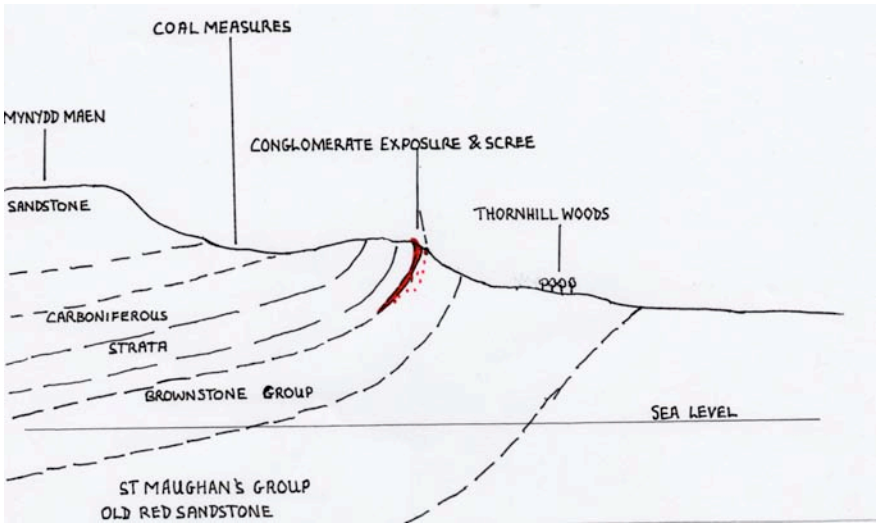
Much of the conglomerate around the town and on the hillside shows signs of glacial action or rock fracture, through cleanly sheared off pebbles, in either, glacial striations, or fault gauge on boulders.



Coarse Quartz Conglomerate Thornhill Woods
Quartz pebbles within the matrix have been cleanly sheared by glacial action or rock fracture movement.

Stratigraphy

This is the branch of geology which investigates the earth's crustal layers or strata and in the case of our conglomerates, can tell us where to locate them within the Old Red Sandstone layers.
From the study of rock layers we can also piece together evidence of the environment of deposition and whether tectonic movements have affected the rock layer since deposition.
The quartz conglomerate above Thornhill and Greenmeadow woods, dips into the flanks of Mynydd Maen at an angle of around 60□, ℐ𝕆 the beds which were originally laid horizontally have been upturned to nearly vertically dipping beds. The conglomerates then protrude as a prominent scarp - or raised hill section and runs along the hillside, until reaching the northeast shoulder at Upper Cwmbran, where it dips less severely at around 45□.
Along this ridge, the conglomerate bedrock has been uniquely exposed as a craggy outcrop of very hard, white or pale grey quartz conglomerates interbedded with similarly coloured quartzites and thin red, green or grey silty marls and marls (microcrystalline limestone and clays).
These conglomerates have resisted the tests of time, in that they have not eroded greatly is testament to their ubiquitous presence throughout Cwmbran. See geological cross section below.



Stylised Cross Section
Conglomerate running northwest to southeast, from Mynydd Maen to Thornhill woods.

The Acadian Unconformity

Our conglomerates, being of late Devonian age are found to lie stratigraphically on rocks of early Devonian Age, with no middle Devonian age deposits recorded.

The Quartz Conglomerates of Cwmbran sit on the reddish brown impure sandstones of the Brownstone Group rocks, laid down around 405 million years ago, in the early Devonian Period. As our conglomerate rock is known to be around 365 million years old, laid down during late Devonian times, this leaves 40 million years of deposits unaccounted for. This break in the sequence is called an 'unconformity'.

A gap in a sequence of rocks or strata represents a change in environment. When the rocks show a marked change in type of deposit, or where a layer sits at a different angle, to the stratum below it, this is generally an indication of a break in deposition, otherwise known as an unconformity. Around Cwmbran no gap has yet been found in the normal sequence of deposition due to poor exposure of the rocks below the conglomerate, but other parts of South Wales and many places throughout the world, such as The Appalachian Mountains, USA, show a major time lapse in rock deposition for this interval in Earth's history.

It is considered that a during the last phase of the Caledonian orogeny, a final period of uplift and erosion commenced which created a major unconformity between the Brownstone Group rocks and our Upper ORS quartz conglomerates.

Only when we reach the last part of the Devonian Period, around 365 million years ago, when the sea transgressed onto the land does normal deposition continue, in the form of our quartz conglomerates and the last of the Old Red Sandstone, called the Upper ORS.

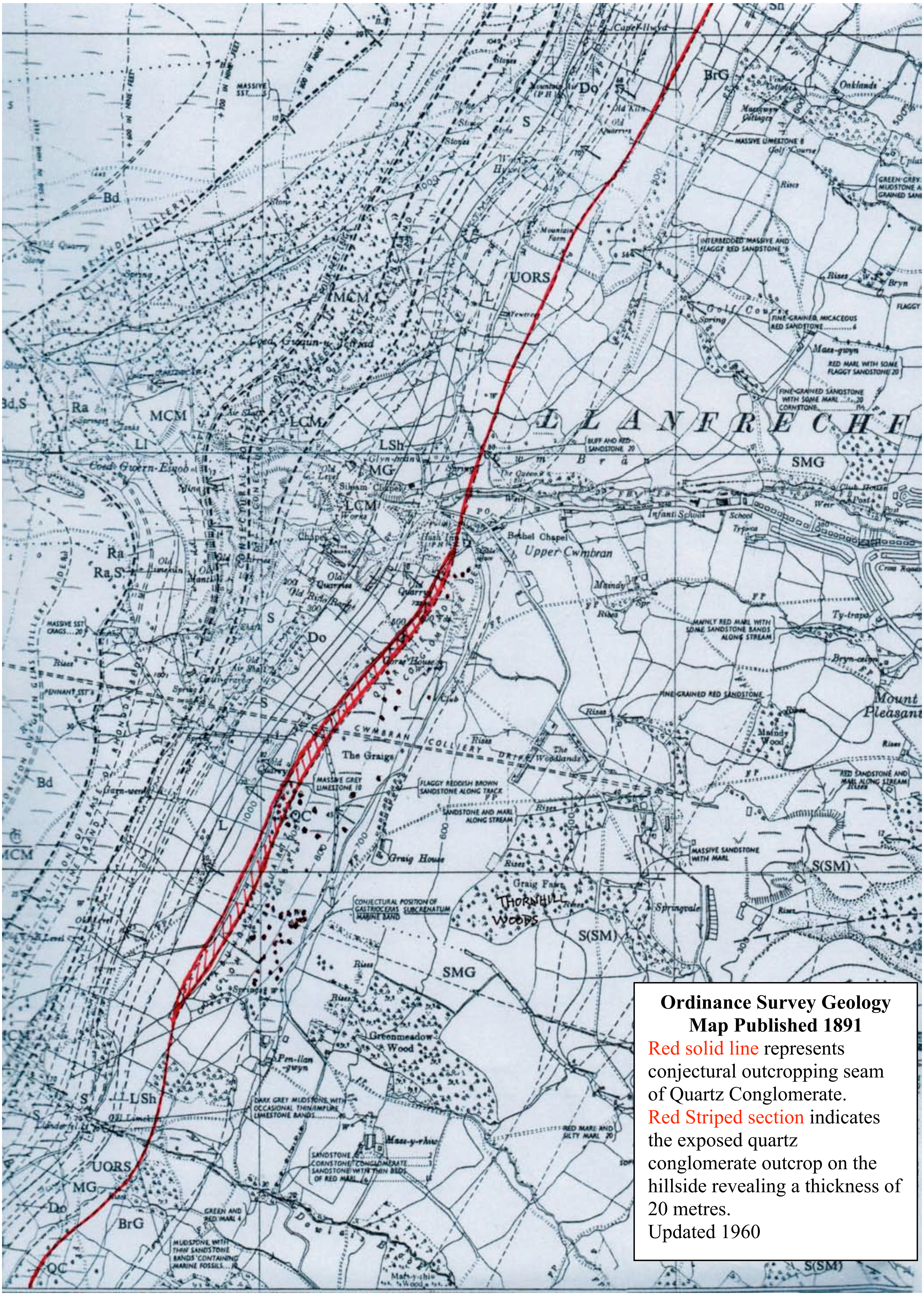
Quartz Conglomerate of Cwmbran

The conglomerate rocks of the area are formed from one to several, thick layers, interbedded with Upper Old Red Sandstone rocks and forms a scree covered ridge down hill from the escarpment of Mynydd Maen. Exposed conglomerate runs from northeast of Greenmeadow Woods to Upper Cwmbran along the ridge. This large volume of erosion resistant rock would have been very prominent on the hillside in days gone by.

The OS map of Cwmbran on the next page was published in 1891 and shows the conglomerate seam as a red line, with the striped section indicating exposure of the rock of up to 20 metres wide. On the Cwmbran side of the conglomerate seam, abundant conglomerate scree and quartzite is noted on the hillside, a fact not entered on later maps possibly because this rock, which was very suitable as a free source of building material got reduced in volume by a growing population.

From Belle view Lane, Upper Cwmbran southwards; quartz conglomerate crops out extensively around the hillside. The road is built on Upper ORS and our quartz conglomerate can be found at multiple exposures south east of the house.

Boundary wall built of quartz conglomerate rock
Belle View Cottage, Upper Cwmbran.
The house foundation is of quartz conglomerate, as are the rendered walls of the house in the background.


L L A N F R E C H F
Upper Cwmbran
Bethel Chapel
Infant School
CWMBRAN COLLIERY
The Graigs
Graig House
THORNHILL WOODS
Greenmeadow Wood
Mount Pleasant
The Woodlands
Springvale
Golf Course
Coed Gwern-Esgob
Coed Gwaun-y-Jerwad
MASSIVE GREY LIMESTONE 10
FLAGGY REDDISH BROWN SANDSTONE ALONG TRACK
SANDSTONE AND MARL ALONG STREAM
CONJECTURAL POSITION OF GASTRIOCERAS SUBCRENATUM MARINE BAND
MASSIVE SANDSTONE WITH MARL
FINE-GRAINED RED SANDSTONE
MAINLY RED MARL WITH SOME SANDSTONE BANDS ALONG STREAM
INTERBEDDED MASSIVE AND FLAGGY RED SANDSTONE
FINE-GRAINED MICACEOUS RED SANDSTONE
DARK GREY MUDSTONES WITH OCCASIONAL THIN IMPURE LIMESTONE BANDS
GREEN AND RED MARL 4
MUDSTONE WITH THIN SANDSTONE BANDS CONTAINING MARINE FOSSILS
MCM
LCM
MG
SMG
UORS
BrG
QC
S(SM)

Ordinance Survey Geology Map Published 1891

Red solid line represents conjectural outcropping seam of Quartz Conglomerate.
Red Striped section indicates the exposed quartz conglomerate outcrop on the hillside revealing a thickness of 20 metres.
Updated 1960

Our Quartz Conglomerate, which has been used by the indigenous communities to form boundary walls, dwellings and structures, has been extracted from the thick conglomerate ridge and boulder scree that follows the periphery of the South Wales coalfield basin.
The conglomerates in Greenmeadow, Thornhill Woods and area are derived from this quartz conglomerate outcrop.
There is at present no section of the conglomerate exposure more than seven metres wide, yet from the geological survey map of 1891, a twenty metre wide thickness of strata is identified and recorded above the woodlands of Thornhill and Greenmeadow. Therefore it is reasonable to assume that the exposed rock has become less and grown over in the last hundred years.
The erosion resistant quartz conglomerate boulders found throughout the area, occurred originally in the strata of the Quartz Conglomerate on the hillside, which makes the rocks allochthonous to the area.

Modern Day Conglomerate Delta

An example of conglomerate deposits forming today would be from the Ganges River India which creates the earth's largest delta system of submarine sediment, as it flows out into the Bay of Bengal.

Satellite view of the rivers and shoreline of the Ganges River Fan. Parts of which, have been creating conglomerate deposits for million of years.

Plant Life Genesis

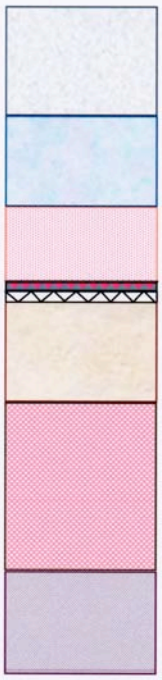
During the early Devonian Period, plants similar to mosses, liverworts and lichens survived with a height of 30 centimetres, but by the time of our conglomerate formation, plants had developed deeper and more efficient roots due to an improved vascular system, which allowed them to grow to heights of around 30 metres, a hundred times higher. Deeper roots also allowed plants to move away from surface water, as underground water could be tapped, allowing plants to colonise inland for the first time.
Old Red Sandstone and conglomerates formed the bedrock for the plant life proliferation which followed this Period. The much warmer Carboniferous Period rocks, from which the South Wales coalfields are derived, can be found outcropping on the upper of the Cwmbran hills, Mynydd Twyn glas and the more southerly Mynydd Maen.

Sequence of Rocks in the Cwmbran Area

The Cwmbran area sequence of rocks, from Llantarnam Abbey to the summit of Mynydd Maen, has been laid down over a period of 100 million years, from around 420 to 320 million years ago.
A stylised cross section of the sequence, the type of rocks laid down in the area and where exposed sections can be found is shown on diagram 1 on the next page.
Also on diagram 1, the St Maughan's Group rocks in pink, state that conglomerates and cornstone conglomerates can be found in this type of rock. Yet no other conglomerates other than quartz conglomerates, from the Mynydd Maen hillside have been found in either woodland or surrounding area.

Diagram 1 Stratigraphical Column

Vertical Cross Section of The Carboniferous And Old Red Sandstone Rocks of The Cwmbran Area To An Approximate Relative Scale and Colour with the Geological Map



COAL MEASURES - MILLSTONE GRIT, COAL & PENNANT SANDSTONE. Exposed along the upper flanks of Mynydd Maen. The ground beneath your feet turns dark grey to black when this layer is reached. Deposited around 325 million years ago.

CARBONIFEROUS LIMESTONE SERIES first limestone & mudstone, then dolomite and limestone. Can show up as white rock, escarpment.

UPPER OLD RED SANDSTONE - SANDSTONE Deposited around 355 million years ago. Forms eroded levelled terrace from conglomerate scarp

QUARTZ CONGLOMERATE GROUP Deposited around 365 million years ago

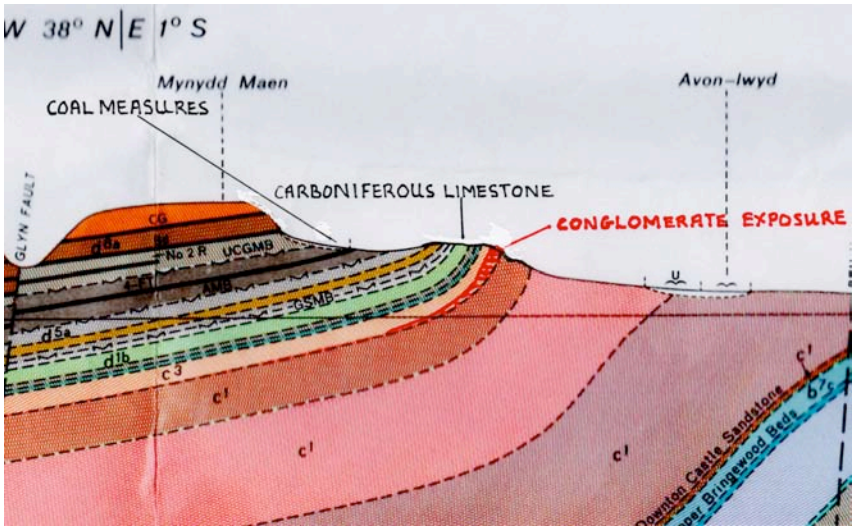
Unconformity *A major break in deposition*

BROWNSTONE GROUP - SANDSTONE. First part of Cistercian Way From Craig Road, up the side of the hill. Deposited around 405 million years ago

ST MAUGHANS GROUP - MARLS, SILTY MARLS, SANDSTONE, LIMESTONE, CONGLOMERATES, & CORNSTONE CONGLOMERATES
Deposited around 415 million years ago Thornhill Woods Sits on this bedrock

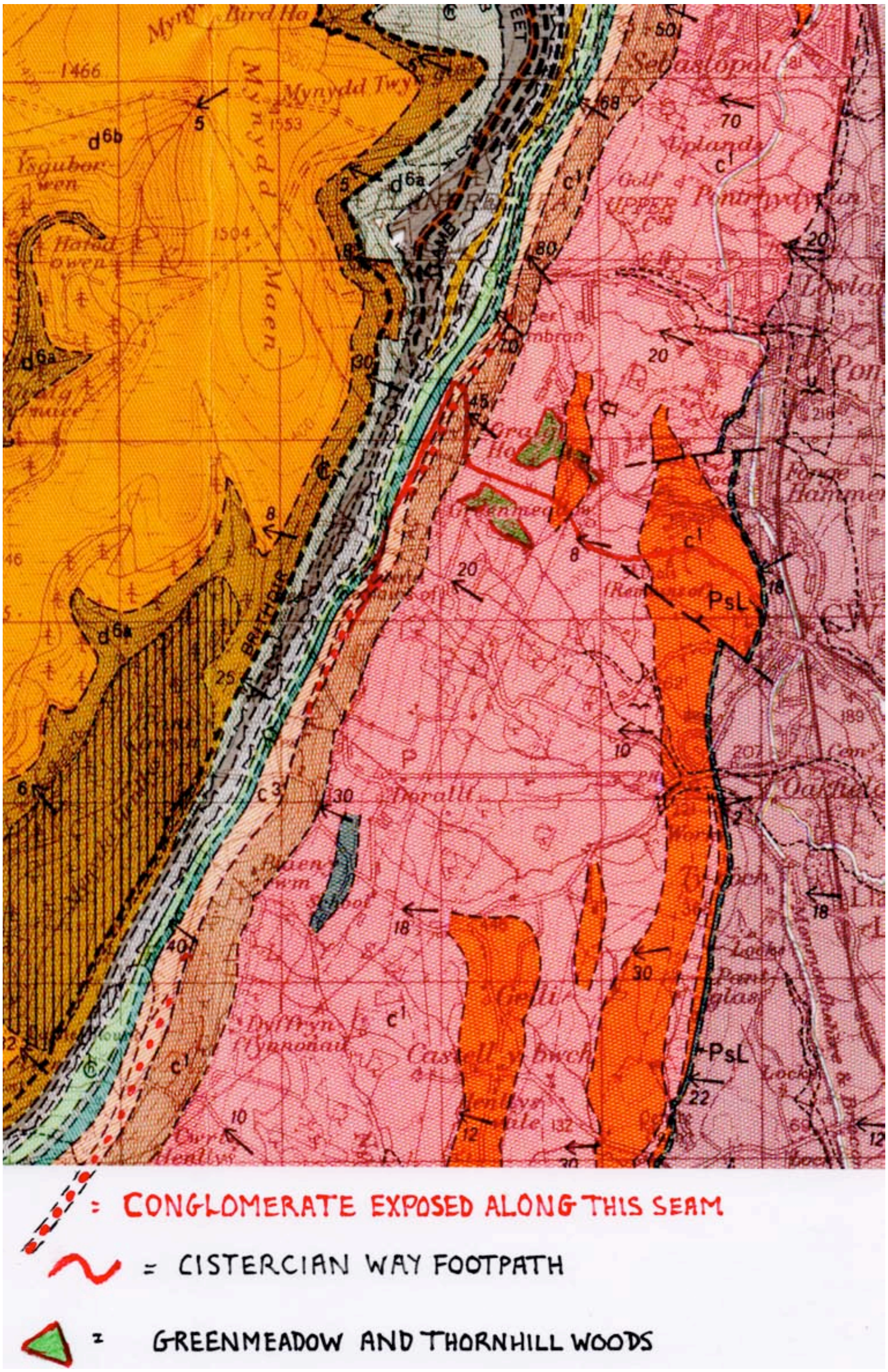
RAGLAN MARL GROUP - RED MARL & SILTY MARL
Upper Silurian. The oldest rocks in the area, deposited around 420 million years ago. Llantarnam Abbey and its grounds sit on this bedrock

Mynydd Maen Cross Section Showing Exposed Deposits

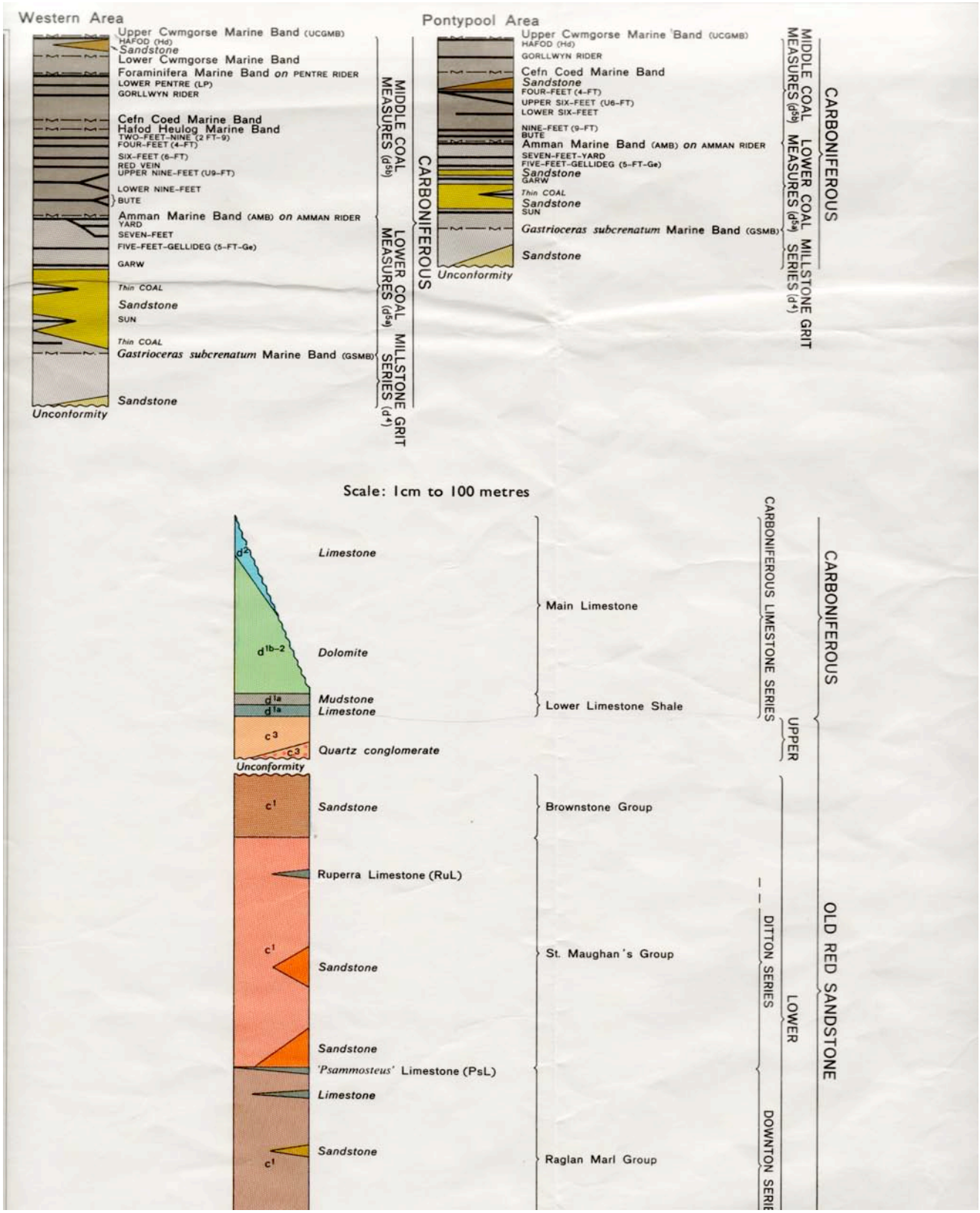


The stylised cross section above runs through the north of our area, on the flanks of Mynydd Maen from east to west or reverse. It shows the steeply dipping nature of the Carboniferous limestone and Upper Old Red Sandstone, in which our conglomerate resides. The eroded and levelled terrace back from the escarpment of the prominent quartz conglomerates strata, also shows beds dipping steeply - overturned through tectonic forces, since the Caledonide upheavals of the Devonian.

This Geological Bedrock map shows how the Brownstone type Old Red Sandstone marked C□, in brown to the right of the conglomerate, forms the first steep incline of Mynydd Maen. The Cistercian Way path from Graig Road traverses this rock on its way to the top of the first part of the hill, where it meets the road, about 300 metres. Just before the top of this first hill, the conglomerate seam crosses under the path.

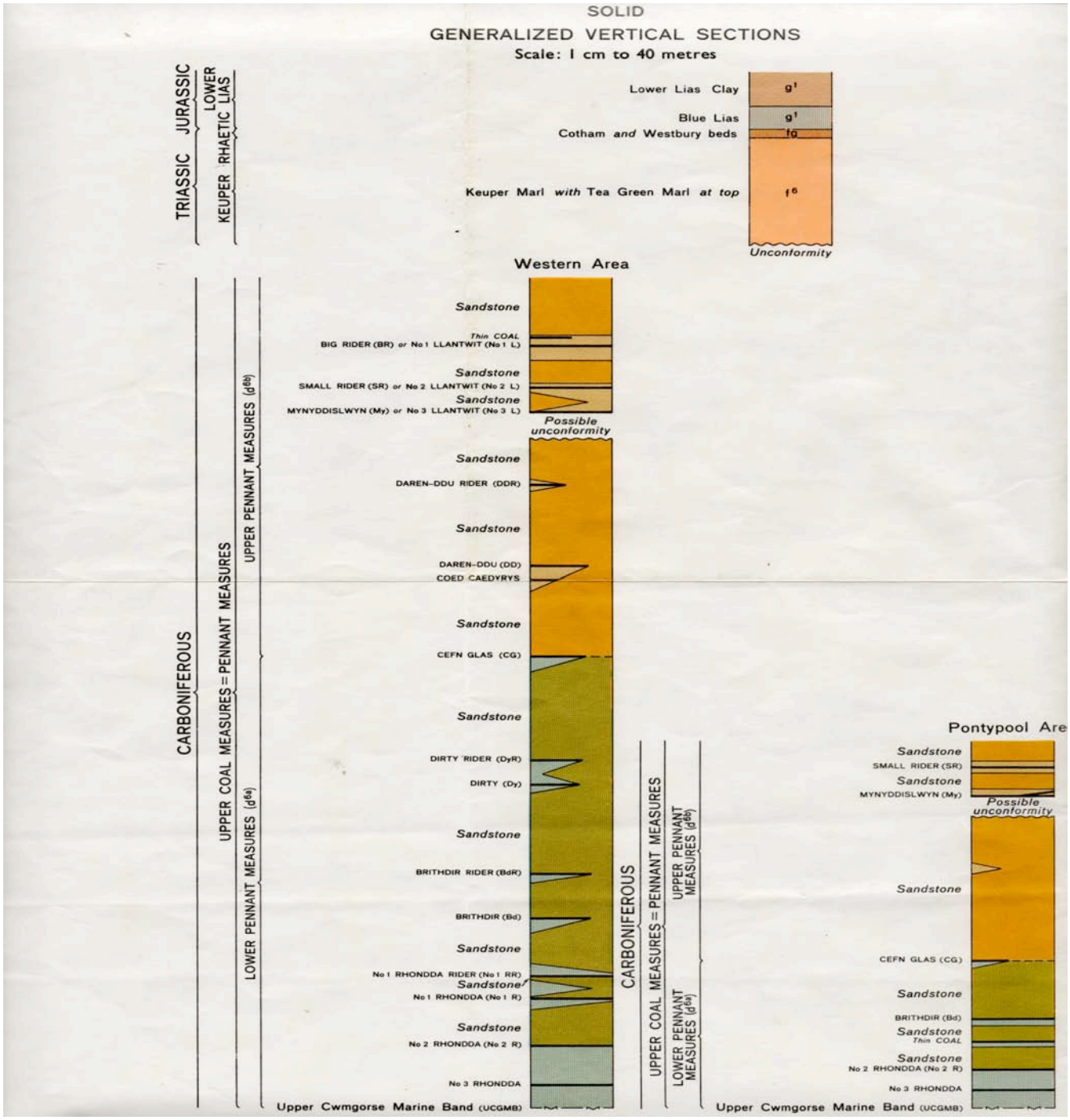


Vertical sections show the Rock Formation and Stratigraphy of the Mynydd Maen cross section on Page 9 and of the Geological Map on Page 10



Apologies for the printed colour variation, which shows these vertical sections as being less vivid colours than the map and stylised cross section.

Vertical Cross Sections for the Carboniferous Coal Measures of the Area



General Facts
The last great supercontinent of Pangaea, formed at the same time as our conglomerates 365 million years ago.
The world's tectonic plates are still being thrust together in places, producing the Alps and the Himalayas.
One of the largest conglomerate deposits in the world can be found in Olean, New York, USA.
Above conglomerate the soil is generally thin, highly acidic and low in nutrients. Soils on top of shale and limestone are thicker, less acidic and more fertile.
The end of the Devonian Period, some 370 million years ago, is one of five major extinction intervals in the history of life on Earth. We know mass extinctions occurred, because life forms that have been found as fossils in earlier dated rocks are never found again in more recent deposits.

House built of quartz conglomerate at the American Gardens, Pontypool. This rock is from the same seam as our quartz conglomerates on the Mynydd Maen hillside.
Much of the exposed quartz conglomerate strata in this area was utilised in the building of the house.

The Welsh Basin
A large basin was formed during the Devonian period, through crustal rifting associated with post Caledonian tectonic extension across much of South Wales, including Pembrokeshire to the west, Powys to the north and Monmouthshire, Herefordshire, Gloucester and north Devon. This land was transgressed by the sea at times, through oscillations of the sea floor, creating more conglomerates.

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Victor Middleton BSc Exploration Geology
March 2011