Microscopic examination of samples taken from the "Holy Well" in Green Meadow Woods. Cwmbran. September 2011.

The well clearly derives from a natural spring issuing from the ground at the head of a deep dingle in the woods which would appear to have been formed over many years by the water flow,

This natural spring has been man-modified at some time in the past by using very large stones to form a structure of approximately rectangular shape. The structure is now very damaged but would seem once to have enclosed an area of approximately 12 square metres. See Fig. 1, which is a map of the area indicating where the samples were taken for microscopic analysis and Photo. 1. which is how the well appeared after partial excavation.

Two short cores were take from the well area, Core 1 in the clay at the base of the well after superficial clearance and Core 2 on the adjacent southern bank taken through the surface leaf mould. These are indicated on Fig. 1, a further core – Core 3 was taken diagonally beneath the nearby wall.

All of these cores are much too short to give any long-term analysis:

Core 1 – 21 cm. or 8.25 inches. approx. ST 2763 9561

Core 2 – 18cm. or 7.0 inches. approx. ST 2763 9561

Core 3 – 20cm. or 8 inches. ST 27333 95663

I did not take the cores but I understand that they penetrated much further but became compressed in the process. At Gwaun Nant Ddu (Ref. 5) the cores were some 1.32m. or 42 inches and taken near the edge of the bog through the surface vegetation and into the old lake bed. The original lake was approximately some 10m. or 30 feet deep near the centre and is now a nearly level, relatively firm, surface.

Microscopic examination.

Method.

From each of the three cores samples were taken – one from the top, one from the centre and one from the bottom. These sub-samples were stored in sealed sample tubes and from each of these smaller samples of approximately 1 cubic centimetre were placed in boiling tubes with 50 ml. of 10% Potassium Hydroxide, dispersed and simmered for one hour in a water bath. This is a very satisfactory method for dissolving peat but was much less satisfactory in this case due to the high mineral content.

After removal from the water bath the samples were allowed to settle and the liquor decanted off, and subsequently subjected to repeated dispersion and settling with water to remove the KOH. At this stage it could be seen that the larger mineral grains settled out fairly rapidly but the finer one, some of micron or sub-micron size, were very slow (A micron or micrometre is one thousandth of a millimetre).

Typical settlement patterns can be seen in Photo. 2. and it is very noticeable that whereas most are of a yellow-brown colour that taken from the reddish clay at the centre of the well (core. 1) is of a distinctly pink hue (Third from the left in photo.).

The samples were subsequently slightly acidified with hydrochloric acid and Safranine stain was added to colour any pollen grains.

Slides were prepared for microscopic examination using cover slips of 22 by 50 mm. and mounted in glycerine jelly. Scanning the slides for pollens is exceedingly laborious as it entails using a vernier micrometer stage traversing mechanism to scan the slide in overlapping passes at a low power of 170X each of approximately 0.4 mm. Any objects of interest were recorded and returned to for close examination at a higher magnification of approx. 800X.

On samples of high organic content, such a peat, the process used is very effective but in these samples there was a high content of fine minerals even after settlement, typically of particles from approximately 20 microns down to sub-micron. These particles frequently obscured and distorted any pollens making identification difficult – a university or commercial laboratory would overcome this by using hydrofluoric acid to dissolve the siliceous material but this is an extremely dangerous material and not available to me. As a result of this detailed identification was sometimes difficult and, in some cases, impossible – this meant that the pollen photographs were disappointing.

The pollens were identified by using the keys in Faelgri and Iverson,s “Textbook on pollen analysis.” (Ref. 1), Moore, Webb and Collinson,s “Pollen Analysis” (Ref.2), the on-line section on Quaternary Pollens at Upsalla University, specimen pollen slides from laboratory supplies, such as Phillip Harris, and samples taken from the wild after careful identification by means of text books such as “Flora of the British Isles” (Ref. 3), and “The Illustrated Flora of Britain and northern Europe” (Ref. 4). Ferns, Mosses and Fungi were identified with other specialised books.

If pollens are very clear such as from freshly collected specimens identification is usually straightforward but if the grains are damaged or obscured it might only be possible to identify the genus with a fair degree of certainty but the species or, particularly, the variety is increasingly less certain. If identification is of great importance, as in a forensic case, then a scanning electron microscope can show very fine detail which may provide conclusive results.

The samples taken from the cores from Green Meadow Wood were very difficult because of the fine mineral and other insoluble material that pollen grains were obscured and distorted so that while direct visual examination using high power usually enabled an identification to be made photography was difficult. For this reason I have supplemented the photographs taken from the cores with some made previously from samples from Gwaun Nant Ddu (Ref. 5) and from specimen pollens from Phillip Harris. This will, I hope, show the sort of features used for identification. See Photos. 3 to 10.

Results of microscopic examination.

Core 3.

This can be dealt with first because it was largely featureless. Apart from the top sample taken from the core, where there were a few pollens, both the centre and the bottom samples had hardly any. The sample comprised mainly clay and a high proportion of this material was very fine being some 5 microns or less. This means that the samples when dispersed in water took a very long time to settle as a substantial proportion was very fine and colloidal (Photo. 11). Those few pollens which were seen in the top sample were typically those to be found in the area today e.g. Alder (Alnus Glutinosa), Hazel (Corylus Avellana), Common Lime (Tilia probably T. Vulgaris), Scots Pine (Pinus probably Sylvestris), Heather (Caluna Vulgaris), Thistle (Probably Lactuceae bu perhaps Sonchus), Moss (Most probably Polytrichum Commune i.e. Common Hair Moss or Sphagnum Papillosum, Fern (Aspidium Felix-femina) or Common Polypody (Polpodium Vulgare). Various grasses.

The lower samples had very few pollrns, and those few also very unclear. This result is perhaps not unexpected as it would have been normal practice to remove the topsoil to expose the clay on which to build the wall. The few pollens in the top sample can be attribute to the method of taking the core which by coring diagonally from the base of the wall towards the centre so that the top core was on the present surface and the lower ones in the clay bed.

Core 2.

All the samples i.e. top, centre and bottom gave a similar range or pollens..

This sample had an abundance of a wide range of pollen typical of damp woodland and heath/moorland. In addition to Larch, Lime, Prunus (probably Blackthorn), Scots Pine (or variants), Hazel, Heather (probably Cinereae – Bell Heather, Crowberry (Empetrum Nigrum) and Whin (i.e. Bilberry. Vaccinium Myrtillus or Uliginosum), Hazel (Corylus avellina), Bracken (Pteridium aquilinum) fungal spore cases.

In addition it had smaller numbers of Goats Beard (Tropagon Praetensis), A Solomons Seal (probably Polygonatum multiflorum), Hedge Woundwort (Stachys Sylvatica), some Lactuceae probably Goats Beard (Tropogonum Praetensis) or similar, a Rhinanthus probably R. Minor, i.e.Yellow Rattle, Holly (Ilex Aquifolium), Adders Tongue Fern (Ophioglossum Vulgatum), Lady Fern (Athyrium Felix-femina), Reed type (Juncus type), Ragged Robin (Lychnis flos-cucculi), Hornbeam (Carpinus Betulis), Maidenhead Fern (Adiantum Capillus-veneris), Devils bit Scabious (Succisa Praetensis)

There were others difficult to identify with much precision but other interesting finds such as several nematode worms (Photo. 12), impossible to specify which as over 28,000 species are recognised, and a cluster of eggs again probably nematode (Photo. 13), but also most important in estimating the date of the sample were hollow glassy spheres (Photo.14). I have identified them previously in the surface sample from Gwaun Nant Ddu (Photo. 15) as industrial fall-out from blast furnaces and I also collected samples still falling in Tredegar in an atmospheric trap over a period from October 1994 to March 1995. This has been reported in “Assorted Archaeology – Ref.6 and “Industrial Archaeology News, No. 94, Autumn 1995. Ref. 7.). Whether these particles were from a source such as a blast furnace or coal powered power station is not clear – I have suggested that an electron microprobe might well be able to provide an analysis enabling their origin to be determined. The precise conditions at which these frothy, hollow spheroids form is not fully established but seems clear that the temperature of formation was sufficiently high so as to cause the silica to become very fluid. Similar formations having a mix of clear silica and carbonaceous particles, such as is shown in Photo. 16, might possibly have been formed similarly but at a lower temperature.

This is uncertain but could be important in distinguishing a nearby low temperature furnace from a higher temperature source which could be many miles away. Photo. 17 is of a fragment of charcoal produced by such as an open fire or perhaps burning grassland or woodland while Photo. 18 is more typical of a tarry condensate from such as a contained fire – just possibly charcoal burning but much more work would be required to clarify this.

As the core was taken from the exposed present surface the range of pollens is not unexpected but the recent date of the sample is emphasised by the presence of fibres. The wool (Photo.19) is not really dateable but some synthetic monofilaments (Photos. 20 and 21) clearly post-date approximately 1950.

Core 1.

This core was taken from the bottom of the well after superficial clearance of the surface debris although it is uncertain how deeply this clearance was carried out. The top sample, not surprisingly, contained some pollens but the centre and bottom samples contained little or no pollens. The centre sample had an indistinct possible Goats Beard or similar (Tragoponon) and a possible Lesser Bulrush or similar (Angustifolium). From this it would appear that the reddish clay was very old and probably glacial with a few intrusive pollens due to disturbance or caused by the coring process.

As a general observation the colour of the liquor from Core 1 (Photo.2) was intriguing and it seemed to be a reflection of the reddish colour of the clay. Because of this I took a fresh sample and, after moistening this with plain water, tested its pH. It gave a result of pH 6, which is sufficiently acid as to preclude the presence of limestone. Both Core 2 and Core 3 were neutral at pH 7. With the vague suggestions of a "Holy Well", and such ideas are often buried deeply in local folklore, I would suggest that the water is subjected to expert analysis of its mineral content. It is obvious that at some time in the past it was considered to have been of sufficient relevance to warrant constructing a containment structure.

I have added two further specimen pollens i.e. Birch (Photo.21) and Elm (22) for general interest in the context of the present day flora of the area and, perhaps, also to show that good quality images can be produced.

It would seem that the pollen analysis per se does not add a great deal to the understanding of the site in that nothing was found which could not be found today or in the last 100 years. How the water flow has been affected by the considerable surrounding housing development is not clear. It would depend upon how much of the water emerging is from a deep source and how much from surface drainage.

It would seem that the non-pollen microscopic finds, such as the synthetic fibres and the furnace emissions, reflect that the surface is generally greatly modified by activities in the early industrial and more recent events.

Bibliography.

1) "Pollen Analysis", D. D. Moore., J. A. Webb., M. E. Cullinson. Blackwell Scientific Publications., ISBN 0-632-02176-4.

2) "Textbook of Pollen Analysis"., Faelgri, Iversen.

3) "Flora of the British Isles", A. R. Clapham, T. G. Tutin. E. F. Warburg. Cambridge at the University Press. 1962.

4) "The Illustrated Flora of Britain and Northern Europe". M. Blamey, C. Grey-Wilson. Hodder and Stoughton. ISBN 0-340-40170-2.

5) "Gwaun Nant Ddu. A Study of an Ancient Lake Site.", K. A. Martin.

6) "Assorted Archaeology". K. A. Martin.

7) "Airborne Particles from Industrial Sources", K. A. Martin. Industrial Archaeology News. 94. Autumn 1995.

Fig. 1. Map of Green Meadow Woods. Cwmbran.

Photo. 1. Partially cleared well.

Photo. 2. Colour of fine particles in suspension during processing.

Photo. 3. Alder (Alnus glutinosa) from well Core 1.

Photo. 4. Alder (Alnus glutinosa) from Gwaun Nant Ddu.

Photo. 5. Hazel (Corylus avellina) from Core 1.

Photo. 6. Hazel (Corylus avellina) from Gwaun Nant Ddu.

Photo. 7. Lime (Tilia prob. vulgaris) from Core 1.

Photo. 8. Lime (Tilia prob. cordata) from Gwaun Nant Ddu.

Photo. 9. Lady Fern (Aspidium felix-femina) from Core 1.

Photo. 10. Common polypody fern ((Polypodium vulgare) fromCore 2

Photo. 11. Very fine clay from bottom of Core 3.

Photo. 12. Nematode worm.

Photo. 13. Nematode eggs.

Photo. 14. Glassy spheroid from the bottom of Core 2.

Photo. 15. Glassy spheroid from Gwaun Nant Ddu.

Photo. 16. Carbonaceous/siliceous particle.

Photo. 17. Carbon fragment.

Photo. 18. Spherical carbonaceous particle.

Photo. 19. Wool fibre.

Photo. 20. Synthetic fibre.

Photo. 21. Synthetic fibre.

Photo. 22. Beech. (Betula pendula) Phillip Harris specimen.

Photo. 23. Elm. (Ulmus glabra) Phillip Harris specimen.

Sample 1. **Sample 2.** **Sample 3.**