MINERALS LECTURE.doc
March 05 Science week``
(good specimens in cellar cupboard with Hinchliffe items eg clear block, man made crystals from smelting etc

1Intro

Minerals have had many uses and long held a fascination for humans.
They are often very beautiful and long collected. Inspiring. Various uses decorative, as jewellery and very useful for manufactured items.
I was interested from a young age collecting on family holidays in Britain. So started my interest in geology. Britain ideal as more geological variety in our small area than anywhere else in the world
Mineralogy a particular
Hope to demonstrate ways in which you can identify your finds or minerals you own., help you to describe them in mineralogical terms , to classify , use simple test, so you can ubderstand books

Mineral books are daunting- include Rutly The bible but no pictures. Pictures not helpful. Hope you will understand the meaning of such books and terms used at end .

In text books Minerals are classified into groups. Most of this is based on their chemical comp aie the atoms of the chemical elements they ara made of. This can be by main economic element eg all lead, zinc, minerals together. Or by chemistry eg sulphides, carbonates, silicates. Thr latetr means lead minerals are split up and galena the lead sulphide and associated lead carbonate cerrusite are on different pages!

2 MINERAL NAMES

Mineral Names – mention here
There are over 1200 known minerals like quartz from earths crust (book with list)

– some scientific names very old and from other cultures.
Quartz and amethyst from greek
Ite/means like = calcite
Lite = lithos = sodalite;

3 DEFINITION OF MINERAL

Minerals are defined as

- a substance occurring naturally in earths crust (rules out manufactures)
- have a definite chem. comp (cant separate out the ingredients or chem. elements.)
- have a definite molecular structure (internal arrangement of atoms)

Given a CHOICe can you sort? (quartz, rock, glass, sand,coal, plastic)

"*naturally occurring*"
In nature crystalisation from the **evaporation of sea water** do not occur that often . particles in solutions can crystalise out eg seas drying out and leaving beds of salts (Cheshire salt, Billingham anhydrite, Ripon to *Sherburn gypum)* ~~Large crystals can form if there is a cavity or space.~~ ~~*(lava)*~~

Particles in **a melt cool** and lose energy leaving crystalline rock *(granite coarse)* or *lava/basalt*
(fine))use magnifying glass)

Most crystals from rocks of earths crust form from **cooling of hot steam and gases** under great heat and pressure eg when mountains form of volcanic activity. Much o f it events millions of years ago.(Shap Granite 400 mya) eg quartz.

"chem. comp"
Quartz is made of Si = OOO. This compound repeated many times in the structure

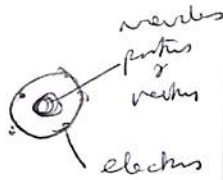
4 CHEM COMP .
Don't need to know a of chemistry to look at minerals.
In the rocks of earths crust the commonest chemical elements are oxygen, silicon, aluminium, iron, calcium and a few others, so this is what most stony material is made of.

ATOMS
Atoms are the tiny particles all matter is made from.
Atoma are invisible to eye.(2oth C work)
There are only over 90 natural occurring known chemical elements in our solar system and universe.
You will know of many eg gold, oxygen (some you cannot see!)
Show list *of elements*

AND Compounds
However elements are not usually found on their own. They combine with other chem elements to make new substances with entirely different properties. Unlike a mixture (chromatography demo?) you cannot easily separate out the ingredients again.
A bit like making a cake- If you mix together certain compounds (of eggs flour fat sugar) you end up with a new compound called cake! It is quite unlike its ingredients.
Calcite mineral or Lime or calcium carbonate (found in nature) for example is made up of three chemical elements (Ca+ C+3O) (our bones, sea shells too)

Most chem. elements therefore bond with one or two other elements to form a special combination called a compound . Quartz is silicon and oxygen, salt is sodium and chlorine, Water is H2 + O.*hydrous oxide*

(make up atomic models to show)
Concl; minerals are made up of atoms and compounds



AND Bonding of the atoms is the force that holds all this together-
Atoms have a nucleus and shells of electrons. Atoms are electrically neutral when stable.
The electrons that spin around their nucleus (of protons and neutrons) keep them that way.
But if atoms lose electrons to other atoms they become positively charged, and atoms that gain electrons are negatively charged. These opposites attract and this force/energy holds compounds (of two or more elements) together.

DEMO- We can see a similar kind of energy with static electricity. Rub ballon and jumper – some of jumpers electrons (+) rub off onto balloon giving ballonn a negative (-) charge and jumber positive . Opposites attract – our whole world is electric down to the smallest particles!
Concl- Its this neg- and pos+ energy, or force, which bonds the tiny atoms of chemical elements together – in crystals as well as everything around us. Not unique to crystals.
Surface tension a force that pulls together molecules on the surface of liquid eg drips, top of glass. It will support insects , neele etc. Pond skaters. . (Detergents reduce this)
The molecules on the surface are further apart and this strengthens the forces between them.

bubbles.

Bubbles are mathematicaly improbable yet they occur in nature.

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5 MINERALS HOW THEY GROW – Before looking at crystals need to consider how units join, shape.
From LIQUID TO SOLID

In air, (a mixture of gases oxygen, nitrogen and some carbon plus water vapour plus some helium etc) and in water and liquids , the molecules move about freely. There are no crystals .
But if the water or gas is cooled then crystals will form by becoming an ordered arrangement eg ice from water. Jack frost .
Instead of moving about the molecules arrange themselves, ordered,

I can demonstrate this with balls. Gases and hot materials move about.freely like balls in a tray.
When mixture cools. they begin to become an ordered arrangement and grow in a regular shape/ pattern. (Confine balls to a shape they become ordered.) Some atom are attracted to others and bond firmly
Concl; So this is what has happened as minerals formed. Man made and natural.
Ice, sugar, salt, quartz. An ordered arrangement at the tiniest level begins and seed crystals begin

Demo of loose balls

Minerals therefore form when a chemical compound passes from a liquid/gas state to a solid one

Crystals start on outside and spred out like ice? *Different minerals crystallise out at different temperatures often forming layers of different minerals and crystals.*
*Banding caused by solidifyin g from outside first eg *bluejohn and veins., agate*

Demo-*Grow acrystal of salol (melt in test tube the sandwicj on microscope slide and let it grow.*
Candle wax on glass jar – cools on outside first

*Good large crystals need space to grow eg natural cavity in rock or gas bubble cavity in lava.

Crystal size
The size of crystals will vary depending on speed/rate of cooling . Largest in world? (invisible crystals if cool fast, large if cool slowly) (examples to show of granite as seen)
AND if they have space.
**Agates* –space or infill. Massive or crystals. (*rose quartz and white quartz)*

LOOKING AT MINERALS

6 CRYSTALS and CRYSTASLLOGRAPHY SYSTEMS

Looking at crystal shape helps identify it.

Crystals are Solid, have Definite shape, flat surfaces, Regular form not just a lump
Show plastic models of quartz shape
Quartz has 6 sides
Pyrite-cubes; prisms Six sided, (show plastic models)
Scientific study of crystallography shows just how mathmatically perfect is the miniscule worls of crystals and atoms. structure,) If the Atom structure in the crystal has great symmetry, this is reflected in the amount of symmetry of the crystal shape. Cubic crystals have greatest symmetry eg salt crystals (natural or manmade).

Scientists group crystal shapes into 6 groups- based on mathematic symmetry/geometry. This is based on three imaginary axes passing through them though them.

To give you a taster of crystallography,
Cube(model) has the greatest symmetry (or greatest number of similar faces)
Stretched cube or prism(book) has less symmetry! So that's the basis

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7 GROWING STRUCTURES eg twins and offsets

The fascinating world of crystal growth
Easiest to show gallery! What evidence is there of the crystal's growth
Not perfect and full of defects but perfect angles ,
*eg *seed crystals grow bigger smothering earlier* ones.

hillocks, parallel growth, coating, phantoms, offsets, twist, hopper.
Internal striations, inclusions, pseudomorph replacements,
aggregates eg fibrous, botryoidal , rosette and other habits,
cavity lining,
twins sharing atomic structure
Spiral growth eg tornaline
* Leaves *ledges on faces in quartz.- battle of growth/faces forming side or termination*
**Offsets eg fluor*
**Twins and intergrowths share their structure (to find)*
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8 FORM AND HABIT
A)Crystallised (crystals) as opposed to massive
B) Crystalline- aggregate eg granite (iron or glass)

Describe the character eg Acycilar, amygdaloidal, bot, columnar, dendrirtic, radiating, tabular,, nodular

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9 OPTICAL PROPS-COLOUR, lustre transparency
10 <u>Light rays /optical properties</u>
The physics of light and what light does to crystals in important in how we see crystal colour, lustre, transparency etc.

COLOUR Minerals often have traces of other elements eg iron, manganese . Quartz occurs in many colours. Smoky quartz has radioactive damage to the moleculer structure.

About light- *Light travels in straight lines and makes up part of the electro magnetic spectrum. *Isaac Newton (b 1642) first split up light and found it is made up of rays of the colours of the rainbow(different wave lengths)
**Disk spin – when all rays mixed together looks white.*

Colour
- The Crystal's structure and surface interacts with light waves, giving the colour, lustre etc. we see
If light passes through a strongly bonded crystal and no light rays are absorbed it will appear colourless..
If light energy is absorbed by the crystal structure , it will appear black or coloured . transparency or opaqueness depends on light getting through.

*The colour we see is about how our eyes and brain works (we get visual impressions)plus what the structure of the mineral is doing to light rays
(light filters – In a red filter (if it were a crytal) all the red/ yellow colours are absorbed and so we can see only blues and greens – see mug) Diffrerent materials interfere with light differently)

11 OPTICAL- LUSTRE

*Lustre- -
light reflecting back off surface (smoother the surface the more lustrous)
eg Metallic; non metallic eg glassy, waxy,dull ,
Non metallic vitreous, pearly, resinous, silky, dull. Glistening
sheen – pearly, silky,

12Other optical Transparency- translucent. Opaque

aventurescent –spangled, many reflections
**Optical properties -Tiger eye, silky sheen – hair like inclusions reflect. labradorite, opal - interference colours reflecte dback from inside schiller where light reflects off platey inclusions eg (items for demo)*

PHYSICAL PROPS
This is due to the invisible molecular structure

13FRACTURE & CLEAVAGE

Conchoidal, uneven, hackly
& octahedral, cubic, rhombic
eg cleavage and fracture, *(calcite, mica, feldspar –splits- rose qu -fractures)* Some are better bonded than others and will not braek.

14Tests- HARDNESS
eg physical, hardness,
hardness due to atom structure (*calcite, quartz,) TEST demo*
OHP- Moh 1-10

15STREAK
streak *(gold, galena /zinc streak) TEST demo*
-
16 SG
= is the ratio of Weight of the body/item to an equal weight of the volume of water it displaces. Archemides 210 BC weighing gold for king in ancient Greece?

Need to weigh it in air and then in water. SG= Devide the weight in air X difference between weight in air and water

Or;
Weight in air

Weight in air and water

17 OTHER PROP
Other properties
Magnetism
Radioactivity
Taste eg salt, feel greasy, odour arsenic garlic

Fluorescenc in display – reaction of structure to U/v light bombardment. Electrons and energy. (some in cellar to take to glass?)
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18 MICROSCOPE
Using a petrological microscope – polar colours
A petrological microscope inviolves a special lens which channels all the light rays in a particular plane. Thin sections of rock allow some light through
(collection)The reaction to polarized light helps identify the crystals of minerals in a rock
Look at this sample

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19 USES

Those from earths crust are defined as naturally occurring substances

12.1***Pigments**-lapis for ultra marine blue; red ochre, yellow ochre, cinnabar for vermillion red, malachite and azurite etc. Impure and crushed up *(paint box)*

12.2* In **industry the** properties of crystals have been exploited and modern life could not be without them.
In past for microscopes
Crystal wireless sets,
mica stove windows (flat heatproof & transparent)
Today *silicon chip powers many items (tiny wafers of quartz, for quarzt watches, Synthetic gemstones,light emitting digital clocks,*
Liquid crystal displays in watches and on screens in calculators etc(works by electric charge and blocking light) solar panels, microwave devices. All rely on the properties of special crystals to make them work.(when electricity from battery applies to quartz it vibrates at a precise rate .)
Image intensifiers for war, thermal imaging for rescues, lasers and fibre optics and other electronic technology,.

GEMS_
Some of the most popular uses of crystals are as Gems and precious stones-
what makes them precious?- rarity, beauty, colour. Durability *ruby, sapphire.*
Also fashion consumerism eg jet for costume jewellery .
(What is <u>not</u> a mineral – pearls, corals are CaCo3 but grown by animals, although used a precious materials.)*Amber and jet* are fossils but still made of mineral matter.
Gem cutting(*cellar glass)* enhances the natural character by reflecting light into the stone or enhancing colour
Chalcedony opal crypto crystalline quartz and cabochoned for colour

<u>Gems in bible in three</u> places a.s lists. Translated (but varies with translation) thought to be - ruby peridot emerald, sapphire and lapis diamond sardonyx agat4e amber, amethyst beryl jasper
Fashions- jet and onyx victorians
Commercial gem names eg Arizona ruby for garnet or brazillian diamond for clear quartz
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20Mystical properties

Humans have given supernatural powers to some stones. – Goes back thousands of years and is ancient belief and still current

Some stones thought to protect eg from plaque, or tell the future, or make you wise, or even have curative properties etc

Beliefs in planetary influence and stones is thousands of years old – and still used. Our maths and astronomy came from ancient Babylon – where the unit 12 was common in Babylonian maths. Our annual time measurements include 12 months of year. Geometry of 360 degrees (12 X 30 = 360) 12 inches in a foot

Even today the 12 zodiac signs have a stone ,as do birthstones based on 12 months and in past anciently stones representing 12 apostles and Jewish 12 angels .. Days of the week even had stones and 12 parts of the human anatomy.

The use of special stones is widespread in the world featuring in Jewish, hindu , Arab and Persian muslim cukture a nd, Chinese and European culture..

Much was written about stone properties in the Rennaissance of medieval Europe as ancient science from Greeks and Misddle East (Iran/Iraq) was re-discovered.

11 thc bishop of rennes wrote on talisman stones. A time of lack of understanding of any science from diseases to chemistry. As populations rose and crashed through unexplainable plaques medieval superstitions continued, so not surprising that books survive from the 1500s on the meaning of stones. Amazing that in 17th C craftsmen in India could cut material as hard as diamond and produce facets to enhance its colour without knowing anything abiut molecular structure.

Superstition about stones carries on today , enhanced by availability of some stones which have curiously changed properties to fit modern complaints and needs!

Currently- pearls lucky or not (france and Germany)

; coral for baby Granny though exploiting tprecious rare coral) to extinction.

; opal bad luck – breaks?;

Some examples from book (see it) -

Agate health and wealth. 1502 europe. Cured insanity if drunk with water, remedy for heamorrage,kidney trouble muslim

Amethyst sincerity. Protective and sharp intellect 1502 europe. Pliny Egypt born greek antidote to drunkrness and protected from locusts,Protection

Curative medicine – often reflecting colour of organ eg red stones for kidney.

Precious stone

Amethyst from uraquay brazil. Much cut n germany- fashion

Quartz

12th c dysentery cure

1503 med Europe cures thirst

1605c cure for gout

19th c use in e usa

modern and ancient crystal ball or crystal bt mystics and astrologers. Witchcraft and unexplained of med and 18th c masons

hindu cooling remedy for poisoning

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21 Tour around gallery?/summary

Behind the scenes the museum holds in trust a large mineral collections. A good proportion on display.

Museum has used the wealth of the collections in its of stones from the stores – crystals and massive colourful lumps tp show how you can identify stones in Molecules to Minerals.

You can use the physical propertied like hardness, weight , splitability and even colour –though as we have seen this varies. We have tried to show how crystals are made up of atoms of different chemicals tightly bonded together which give them the physical characteristics and why their crystals are the shape they are.

I hope you will have a look at the display and its fine crystals . Ask questions???

end

In search of Addingham's Geology

Chairman L & G

Last year did talk on Local mineral resources ^ → history of extraction
Deliberately steered away from geology ∴ thought would frighten folk away. hope it will be with regret afterwards
However, asked ^ to talk about geology only =
not going to get too technical ∴ a) serious ^ image ^ of geol has put folk off.
— no tv. progs ∴ editors don't want to turn TV screens
b) ^ when preparing realised Chosen huge subject for just an hour. Hundreds of slides
Drastically edit

Title "in search of geology in Addingham"
Doing ^ shapes field work – a real 'search'. Landscape forms are prominent but aspects eg. rocks ^ outcrops are scarce
∴ overgrown
grass infilled

intro to my subject ∴ lots of unfamiliar words
Geology = Earth science = study of Earth's crust
ie rocks, fossils etc. worn out!
Layers

Geologists studied layers & worked out history of earth & where oceans & conts. were. events.
Time scale – name to each time period.
Carb. 350–290 m.y. ago (60m yrs)
If not familiar with geology terms it's a word I'll be using a lot.
All I'll say for now.

Survey 1873. Map.

Royal commission on Coal 1866.

Feat bright obsolete now
a) land ice v. (flood/submergence) 1870s 80. [above: flood or deluge establishment]

b) Marine bands & correlation of sst.

1822 Longbeare & Phillips term 'Pennines'
Geol Survey c 1830

1935 Penning

1924 - Bisat's - Carb gon. of these N of Eng & other gen.
Note sst & shale, faults, - local names.
Thwaites & Russell different coals.

for map: - photographed

Annotated notes.
Broken sst. - W. Valley fault

View - summit of Addingham

Nitty grit. MG rock above Shepherds Hill.
Distant limestone, Embsay Moor, Barden Res.

Carb world map.

Developing coral reefs. Structural block of Dales
Deep sea here. Equatorial - River later after sea

Haw Bank Q

Lst nearby. fold here. Lst & shales. [above: core]
One of oldest rocks of E Carb period.

Sandstones

Rough Rock

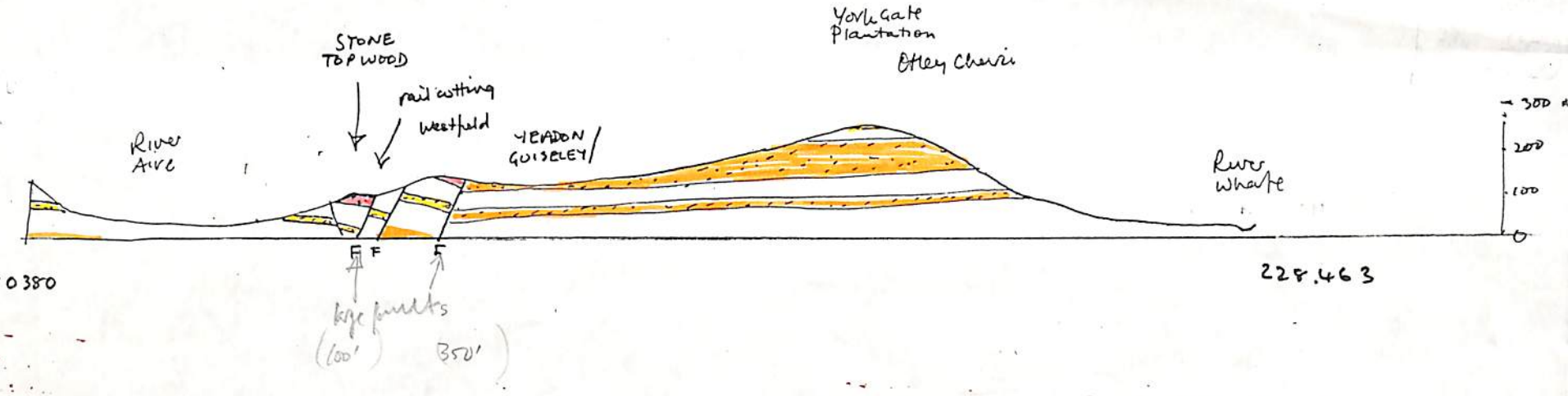
WR

QQ

coal

EC / WR

Eshalt Meadow



SECTION SHOWING STONE TOP WOOD (Mediaeval quarry site)

0 1 2 Km.

looking NE

Talk on the Collection

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GEOLOGY COLLECTIONS in Bradford

The fossil and rock collections come from world wide and British sources and taking into account the inclusion of scientific type material, illustrated / published material, historical value and, as suggested by some, display value, then the collection is of national importance. Figured material is both old and the result of recent research

Collections derived from the Bradford Philosophical Society

The remains of this collection include type material of Carboniferous age, bone cave material and the unusual survival of an 1810 mineral collection complete with catalogue. In recent years fossil material from this collection has been used for published and unpublished research on fossil freshwater bivalves, fossil plants and a fossil amphibian.

The BPS reached its golden years in the late 19th C and it is from this phase that most of the older material probably relates although a number of fossil and rock specimens were collected before 1850. By about 1900 its remaining collections which had been on loan were acquired by the public museum to form the basis of the geology collections. The BPS minute books give a tantalising glimpse of its once superb geology collections and how much has now been lost . Foe example in 1865 purchase of Mr Richardson's (of Northowram) geology collection for £350 "primarily of interest to local inhabitants of district" and "As a private collection it is unsurpassed." and "fossils are superb..rare..unique.... of singular beauty and perfection...valuable minerals.....rich in specimens"

In 1866 was purchased Mountain limestone fossils of Wetton for £35 "finest of the kind in England" and "many specimens are unique"

In 1868 Richard Mawson (the famous Bradford architect) extensive collection of building stones.These now form much of the general fossil collections originating from Bradford s Museum.

Type material includes a large fossil amphibian Pholiderpeton scutigerum Huxley which was collected from a local coal pit by the young BPS curator, L C Miall , in 1868. It was sent to Prof T H Huxley (flamboyant traveller biologist, populariser of science, supporter of education for all, and namer of Archaeopteryx the feathered reptile and dinosaurs) who declared it a genus and species new to science and named it. (see QJGS Vol xxv 1869) Recent research has included accounts of the finding of the fossil and meeting TH Huxley in London. Scientific work on the fossil in the 1880s by Dr A Panchen and Dr Jenny Clack (Cambridge University) showed that as well as parts of the fossil turning up in the Natural History Museum and USA, the fossil had the first middle ear bones known to science from this group of amphibians, the first complete front legs and shoulder girdle and was also the oldest in Britain and Europe. (It has since been overtaken by a Scottish find but could still be called the oldest in England.) J Clack says Pholiderpeton represents " the most completely preserved of the British embolomeres and has provided important new information about the skull, palatoquadrate, braincase, cervical region shoulder girdle, forelimb and most significantly , the stapes of the eogyrinids." (unpublished abstract)

Raygill fissure

A very little material from Raygill fissure near Skipton is included and a lantern slide of bones from the Keighley collection.

This was excavated by the YGS in 1880 and is important as one of only three interglacial mammal sites in Yorkshire .

Fossils from Creswell Crags

The site in Derbyshire is now/proposed? a World Heritage site.

It was excavated in the later 19th C and includes Late Glacial bones and Neanderthal tools. Bradford's small but "significant collection" (Dr R Jacobi, Nottingham University) has recently given successful ESR dating of bone material by Dr Rainer Grun (Cambridge) The horse teeth (30,000 years),woolly rhinoceros (50,000 and a terminus post quem) and hare scapula with tool marks (12,340 ya.) being particularly important.The hare scapula has been imaged for the Creswell Crags web site.

Dawson mineral collection

One of first purchases in 1885 by BPS was the Dawson mineral collection of one of its 1808 founder members, Rev Joseph Dawson(1740 -1813) who was a partner in a flourishing Ironworks in Bradford in 1791 and founder of the Yorks and Derbyshire. Iron founders Association.
The collection is a "rare survival" (quote to find ....Dr H Torrens) because of its early date and the remarkable catalogue dated 1810, showing mineral specimens from all over the world and reflects the knowledge of mineralogy and history of science at the time. Dawson was well read using the latest books including Thomsons Chemistry of 1808 for classifying his collection. Recent research (A Pacey and likely to be published) shows the importance of this collection to the history of science at a time when neptunist and plutonic theories of the earth abounded. Dawson taught himself a good deal of science and was tutored by Joseph Priestley the chemist, another Yorkshireman and non conformist minister . Samuel Hailstone, a local solicitor and botanist (whose plant and fossil collections are now at York) and whose brother was Prof of Geology at Cambridge may have begun his interest in geology and indeed there are specimens from Saxony which may have come from him when he went to hear Prof Werner (who argued a neptunist theory in formation of Earth) lecture. More research is needed but there is a growing interest in the history of science with many scientific societies now having a "history" section.

Geology collections other than BPS

MacLandsborough Coal Measures fossils (bequest 1900)
This may have at one time bee part of the BPS collections. Plant material has been used for recent research by Thomas and by Pearson and includes the holotype type of Anabathra thomasiana

The Charles Croft (1836-1914) collection contains specimens figured in T Davidsons Monograph on the Brachiopoda, 1883-85 The specimens of Orthis crofti (a fossil named after croft now called Saukrodictya philipi) and Strophomena bipartita are also figured in recent paper.

John Holmes fossil goniatite collection may contain paratypes but most of the type material is in The Natural History Museum and Sedgwick Museum in Cambs. Holmes helped Bisat with field work which was to result in Bisats major papers on zoning the Millstone Grit rocks in Britain in 1920s

2.a Hinchliffe collection of display minerals
These 900 large display specimens were purchased from a local man with Science Museum grant in 198.. since our own material lacked large specimens suitable for display. It became the basis of the "Molecules to Minerals" display. Many of the specimens however lacked data which devalued the collection in scientific terms, although some could be given a likely provenance. However the interest in the display quality from the likes of Fred Dunning, retired head of the Geological Museum and former MGC Commissioner suggests it does have much value. He writes in March 2002 that " Molecules to Minerals is probably the best as regards the range and quality of its minerals and its design outside the major national museums"

Knell and Taylor.in "Museums on the Rocks".(Museums Journal Vol 91 No1 1991) remark that Cliffe Castle in Keighey is one of a handful of modern geology displays in Britain.
Prof Bruce Yardley Head of Earth Sciences at Leeds University was excited to see one specimen which in his opinion is a rare piece of Earths mantel rock. It is not known if this collection will match Designation criteria.

2.a.5.archives?support
Lees notebooks, Shackleton diaries
library

Archive material includes collectors field note books, letters, diaries and maps, record cards, catalogues, original illustrations, author annotated books, printed books from the 17th to 19th century, lantern slides, glass negatives, local Bradford Naturalists Society archive going back to 19th C, and preparations of local and natural sciences interest.

Heritage of local natural science and scientific societies represented in the museum collections
(how collections developed from private and Society collections)
VERSION FOR GEOL GROUPS

Introduction

As a venue for this weekend, Keighley is not inappropriate for it has s*trong tradition, not only of textiles and engineering, but of learning;* including the first Carnegie public library in Britain, a Mechanics Institute of 1825, which before 1850 had a geology collection displayed in a museum, whilst H I Butterfield (the builder of the mansion of Cliffe Castle now the museum we are in) enabled a new Keighley Borough Council to purchase old Eastwood House for the town's first public museum in 1891.

Around this time (the late 19th C) collections of the once flourishing scientific societies and private collectors began to come on the market, so the first public museums, like that at *Keighley soon acquired large collections of natural history and geology,* some of these collections already old, and this material is a huge resource today offering much scope for researchers at all levels.

*Many of you will already have used museum collection*s and know that researchers are welcomed. The *history of collecting and collectors, and their contribution to the history of science and scientific thought is however a field still largely ignored but of increasing interest, and it can give further value to collections.* Curators however still tend to value their collections on the number of scientific type specimens held or the number of academic researchers visiting. It is the collectors, how and why they collected which illustrate the history of scientific collecting and my talk aims to elaborate on some of this as regards the collections here and there will be a chance to view these reference collections in the stores later

Museum collections today (displays and stores)

Museums are still *defined* as institutions that collect objects, although today adding that these collections are also safeguarded and made accessible . *Because of the size of collections only a small proportion is on display. Rest are stored.*

It is remarkable that any old collections have survived at all as interest waned in geology at the end of the 19thc, and collections were resigned to various basements where storage conditions would have led to pyrite disease, pest attack, mould and damp shattered bone material and illegible labels.

19th C collections were made exclusively for individuals or for groups/institution (The Bradford Philosophical Society was re-founded in the 1830s with the intension of forming a museum.)Their purpose was for learning, a function still strong today, and nearly everything was displayed. (Collecting specimens in great numbers for no particular reason, such as birds eggs, was a type of collecting carried on into the 20th C and condemned by the Keighley curator as far back as 1906? but this applied less to geology) The needs of society has changed and gone are the crammed museum cases with r**ows of objects** with lots of informative educational text which typified all museums into the 20th C . A more **visual** and interactive approach is now taken with themed displays of selected specimen with the majority stored as reference material. Display/interpretation of specimens has become sophisticated, as research shows how people learn and what they do as they wander around displays. The reference collections however are securely stored in environmentally monitored conditions but available for any one to see and research.

As we shall see later, behind the scenes are **reference collections** of petrology, palaeontology, mineralogy, herbaria, entomology, conchology, and study skins and mounted specimens of birds and animals many collected a century ago when the public museums began. (You can find out more details about the natural science collections in Yorkshire and Humberside on the website www.man.ac.uk/fenscore)

Today these collections still have a scientific role and providing researchers of all levels (science experts to student projects) with a valuable resource of material which is otherwise largely no longer available. The fossil amphibian on display found in 1868 was removed for research for several years in 1980s and yielded amongst other things the first middle ear bone and complete shoulder girdle known to science from this group of amphibians. Collections help not just with learning but with identification, for comparing species losses and gains in the area, for voucher specimens of records and for checking accuracy of records, for DNA and other sampling. The colls represent part of the natural heritage

Collecting ; the local background

So where did the older collections inherited by museums come from and why were they made? Collecting mania in natural sciences continued throughout the 19th C with Naturalists clubs began in the 1840s . Geology were still a relatively new science and there was still scope for discovering and naming. From the 17th C the likes of Martin Lister was collecting, classifying and studying specimens, plants and fossil, in the local area as were other educated gentlemen like the Rev Miles Gale the Rector of Keighley into the early18th C

Fieldwork collecting and recording, was an essential part of naturalists societies which began in 1840s and the YNU founded in 1861. The latter had a geol section and began a Yorkshire Boulder Committee (mapping glacial erratics from the drift deposits which had been recognised further north and which was to contribute to understanding the movement of land ice although the submergence theory -floating ice- continued on) ***Geol interest*** **grew further** in 1870s especially with interest in Yorks Coalfield and its mineral resources.The YNU Fossil Flora Committee began studying fossil plants, abundant from the many working pits .(fossil plants had possible economic benefits in relating the stratigraphy of the coalfield) A copy of their 1878 publication is seen here. West Riding Geol and Poly technic Soc (now YGSoc) was formed particularly to study coal. In 1868 Geology of the Yorks Coalfield published some years before the Geol Survey began mapping in 1870s (Resurvey not until 1930s).In 1870s Leeds School of Science opened with geology classes that further popularised the subject.
(See fine The Naturalist publications on the tables)

Joseph Dawson's interest in **exploration** for mineral resources in the late 18th C may have provoked his urge to understand more about minerals which would help with his enterprises . Collecting in the 19thC was however a **gentlemans intellectual activity** and the Phil Socs tended to be exclusive and largely gentlemans clubs, made up of well-to-do manufacturers and professional men (a few women later) and collecting or seeing other peoples colls, helped them improve their own knowledge. Mechanics Institutes largely failed to attract the lowliest workers although there was a Female Improvement Soc in Kly in 1848 attached to Mech Inst.

The Bradford nat sci collections illustrate the **trend** in the establishment of public museums in the late 19th C and acquisition of older collections.These public museums took over science colls of ailing Sci Socs and private colls thus securing their future.All three late 19th C public museums , from which the colls housed here originated, were typically strongly biased to natural sciences, in particular, and antiquities.
In the early 20th C there was a shift to collecting social history and fast disappearing domestic industry items. (CC has Timmy Feather loom of 1912 and unique coll of hand woolcombs.) Throughout the 19 and into 20th century was an increasing role of colls and museums for education rather than science.
Growing civic pride and urge to show cultural supremacy in 19thC as well as Museums Acts helped

establish public museums
Even today the survival of nat sci material could be at risk from political decisions makers.

Bradford MDC established in 1974 and the new museum service amalgamated the three **former borough** council museum services of Keighley, Ilkley and Bradford.

ILKLEY COLLECTIONS
Ilkley was a tiny settlement which grew as a fashionable cold water spar from 1840s where Darwin stayed in 1858 (just as Origin of Species was published which was to rock the establishment). Ilkley attracted the well-to-do who became aware of prehistoric and Roman remains and natural history during their healthy walks on the moor and hills.
In 1890 the Ilkley Museum and Antiquarian Soc was founded and by 1892 opened a private museum in old chapel (now garage). Although strongly archaeological, in 1891 it purchased **Ellison of Steeton collection for the large sum of £**100. Ellison's coll consisted of geol specimens, fossils and marine objects. He was described as a shoemaker, self-educated and seems to be typical of the time, collecting local fossils and purchasing and exchanging to increase the range. 6000 items including.....

As the Soc declined Council took over he museum colls in 1895 moving to a cramped room in the new lib 1907 . The colls were rapidly added to by items of all kinds loaned or given as people returned from abroad. eg..... and by 1925 was likened "to a walk round an old curiosity shop" Ilkley decided to concentrate on antiquities and in 1928 sells Ellison Coll for £15 to kly public museum where geology was still strong and the coll had data. (Badly curated as labels found in roof of present Ilkley manor house museum to which museum moved in 1961.)

KEIGHLEY
The town showed similar trends in establishing museum colls. Museums began in town with one belonging to the Mech Inst then another of the CLASS(founded 1881 and said to be one of few with Science before Literary) With Borough status granted in 1882 there was increasing clamour for a public museum to reflect new civic pride. . In 1886 the Jesse Miller coll of insect,lepidoptera came up for sale and was bought by public subscription for £100 with no museum to put it in (handloom weaver b 1801 (numbering thousands so another type of coll)) The offer of Jabez Bancroft (a local wine? merchant) large stuffed bird collection in 1897 (1700 nat hist items little data and useless) plus the loan of CLASS colls provoked the council into founding a permanent museum.
This was also a time of many empty country houses and Eastwood House down the road (Leisure Centre opp Beeches house) came on the market and was purchased for the town in 1891 with money from butterfield of cc. This fine 1830 Chantrell designed fine Greek Revival merchants house had a central courtyard which was to be covered to form the museum and a
1893 Science and fine art temporary exhibition was held to raise money .
1899 public museum finally opened employing Hutchinson a taxidermist to set up all the stuffed birds on the model of the Booth museum in Brighton founded by Mr booth in 1874. Booth museum displays much copied, as the first to use naturalistic backgrounds (see Hutchinson displays in bird gall) However Booths aim was to shoot and acquire an example of every kind of bird in British Isles. Although the museum closed again in 1900 as no visitors came to see the bird displays,. in 1903 SL Mosley of Huddersfield was appointed as part time Kly curator and natural sciences were to flourish. He disapproved of mass slaughter of wildlife and overfilled un naturalistic display cases. He must have learnt his taxidermy from his taxidermist father and when you look at Mosley cases (see in museum) you can see they are not filled for example with a whole nests of young kingfishers like Hutchinsons So conservation and education and "nature study"was a message Mosley strongly promoted with teacher training sessions, teacher packs, loan specimens and a student reference collection room with Alex Kly microscope,, aquaria very little new today.