

Limestone Conversations

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A long time ago – when I was drawing cross-sections of blast furnaces for metalwork A-Level – I noted the existence of crushed limestone as part of the iron-making process. I was never very clear what it was doing there – something about acting as a flux to take the impurities into ‘slag’ that floated on top of the liquid iron, allowing it to flow. But the main characters in the drama always seemed to be the iron ore and the fuel (coke). Limestone always seemed like an after-thought; a bit-part actor.

Years later I was teaching in an agricultural community – and one of the regular routines of the farming year was ‘liming’; basically spreading lime to neutralise acid soils and enrich them before planting. The main characters in the farming drama were always the crop and the farmer and all that wonderful machinery. Once again the lime was reduced to bit-part status...just a conditioning agent for the soil. But so important was it, that the British countryside is liberally dotted with the ruins of 18th and 19th C lime-kilns for reducing crushed limestone to ‘quicklime’. Countless millions of hours of hard labour went into the processes of building them, feeding them, firing them and extracting the powdery product. And agricultural tenancy agreements often still contain the requirement for the tenant to undertake regular liming.

Caesarea - on the northerly strip of the Mediterranean coast of what is now Israel – was originally built in about 90 BC, but around 25 BC Herod the Great rebuilt it and renamed it in honour of the Roman Emperor Caesar Augustus. The rebuilding involved a deep-water harbour with lots of amazing underwater Roman technology – including the first ever use of concrete. Vitruvius, in his ‘Ten Books of Architecture’ (25 BC) details the composition of concrete for specific purposes – including underwater. He specified a ratio of 1 part lime to 3 parts pozzolana (volcanic dust/sand) for cements used in buildings and a 1:2 for underwater work, essentially the same ratio mixed today for concrete used at sea. Anyone visiting Caesarea today cannot fail to be excited by the astonishing story of the city. But few will realise that the whole enterprise was built upon an understanding of the properties and behaviour of lime.

The Victorian theatre in England was a thriving place, flourishing from the expansion of the middle classes during the second half of the 19th C. Many new theatres



were built and plays commissioned, including by the likes of Oscar Wilde, JM Barrie and Bernard Shaw. But lighting was a bit of a problem...basically candle-power. Until the advent of lime-light. An intense illumination is created when a flame is directed at a cylinder of quicklime which can be heated to more than 2,500°C before melting. The brilliant white incandescent light was a Godsend for the theatres who rapidly adopted it to spotlight leading characters. But once again – while the lavish theatres, and the play-writes, and any number of actors gloried in the limelight – the source of that limelight, the limestone, remains a footnote in the story.

My first house was a little cottage in Devon; a typical two-up, two-down workers cottage. It was one of thousands of the type, with thick walls made of cob (a medieval mix of mud/straw/gravel) and with a thatch roof. Cob is a great building material; a terrific insulator and easy to modify. But if you don’t keep the water out – it just washes away. So every year the cottages got whitewashed to keep the surface waterproof. Whitewash (lime-wash) cures through a reaction with carbon dioxide in the atmosphere to form calcium carbonate. When the paint initially dries it is uncured and has almost no strength. It takes a few days, depending on climate, to harden and form an impervious waterproof layer. The fact that it also has mildly antibacterial properties adds to its value on farms – especially for dairies. So all those picture-postcard scenes of white Devon farmhouses depend on limestone.

What an astonishing material. I could go on and on listing

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the amazingly diverse uses of limestone – and they are all (or at least *were* all) central to the lives we lead. Making fertile soil, water-proof homes, quality iron, brilliant white light, cement and concrete. And yet nothing in our language and literature celebrates this ubiquitous bounty. We talk of ‘precious metals’ and of ‘king coal’, but never of legendary limestone. It’s the workhorse; not the racehorse. The bridesmaid; never the bride. Too useful to be glorious, and perhaps because it is so plentiful. If it was scarce we might value it a bit more.

I have thought about this matter a few times – that something so ordinary and commonplace can be so important and so valuable. And suddenly I find myself inside another research venture where exactly the same phenomenon is in evidence. Where the everyday and the commonplace is magically morphed into the liberating and the transformative.

I’m talking about *talking*. A few years ago I was in a school in Cornwall – with a Year 12 group undertaking a D&T project that we had devised. They were all getting on OK when the class teacher eased up to me and pointed out two boys in the back corner of the room. “They’re arguing” he said...“but they are arguing about their work”. He then went on to make the comment that launched a whole new research venture. “If we could hear what they are saying, we’d know so much more about what they are doing – and thinking – and planning”

That was all before we ran project e-scape in TERU – which readers may know was all about using hand-held digital technologies to build web-portfolios of performance. And, invariably, one of the most interesting parts of those portfolios is the sound files in which learners talk to us about what they are doing – and why – and what they think are the strengths and weaknesses of it. Over and over again I have been impressed by the extent to which conversation is an aid to sorting out ideas. It’s not that the person you are talking to has all the answers. It’s rather that in the process of putting my thoughts into words – it becomes clearer to me what I ought to do. The process of organising and formulating my thoughts – and expressing them as words to another – enables me to see things more clearly. So problems become less problematic and plans take shape.

But there is an additional dimension to the current conversation project. It’s all very well to have a conversation with learners about their work – but we all know that the limiting factor in this one-to-one exchange is *time*. There are 25 students in the class – so I have to scoot about quickly with eyes in the back of my head to

ensure that things remain OK. Extended, probing conversation with individuals is not really viable.

But, since learners’ comments are digital (voice or text), what if we create a digital system powered by artificial intelligence that can respond to what learners say without the intervention of the teacher and present them with probing responses/questions? This was our starting point and with an AI tool that uses Latent Semantic Indexing we built a prototype.

Our first task was to study the nature and structure of the conversations typically undertaken in classrooms. The AI question-prompts for conversations are intended to be open and procedural (i.e. not carrying specific subject content) and we progressively teased out an idealised framework of open questions – designed to highlight three elements of performance. Starting from ‘Tell me about your project’, the conversation might subsequently move into any of the three strands: ‘What is special/exciting about your ideas so far?’ ‘Who are you designing for?’ or ‘What will your ideas need to do to be successful?’ From this framework we produced a script of numerous, branching, procedural questions.

And – astonishingly – it works. In the latest school trials we have succeeded in modelling a single branching question exchange powered by Semantic Indexing and we have shown that as a more comprehensive data set of responses is available we can improve the precision of the follow-on questions. From the interview feedback it is clear that learners can also see how access to a personal, digital, ‘project coach’ could develop their own project development capabilities and make timetabled classes more productive.

The informal exchange of questions, ideas and comments that comprise a conversation might seem an unlikely focus for a technology research project. And maybe it seems a bit far-fetched to claim that such conversation – in itself – can be a tool to promote individual creative performance. That’s why I liken it to the limestone matters with which I began this piece. Who would have dreamt that a bucket full of very ordinary crushed limestone could produce all the astonishing things that it does? It is the premise of our project that conversation – externalising and exchanging ideas – can be equally and astonishingly productive.