

**From:** Paul Younger  
**Sent:** 13 November 2014 18:47  
**To:** [REDACTED]  
**Subject:** RE: Fracking  
**Attachments:** Fracking water boreholes in Scotland 2007 QJEGH.pdf; mu030611paul1.jpg

Dear [REDACTED] (if I may)

Thank you for getting back to me and apologies for delaying in responding once more – I have been busy 9-6 with visitors and PhD student supervisory meetings. All good stuff – no fracking in any of it thankfully!

My heart goes out to you with your anxiety, and I would be happy to talk with you by 'phone if you felt that would be helpful. In the meantime, let me underline a couple of key points that seem to be lost in the noise of the debate, and which may be of use to you:

1. Experiences from the USA are no real guide to what we can expect here. This is because, in a disgraceful type of politics that does not exist here, when Dick Cheney became US Vice-President under Bush he was allowed (as their custom allows) a single bill through Congress unopposed. He was just then at the end of a term as Senior Vice-President (i.e. a senior executive) of Halliburton, one of the major oilfield service companies. He decided that his law would be one that exempted the nascent shale gas industry from almost all existing environmental legislation. In my view, it didn't need it, but it did open the floodgates to very poor site management practices, secrecy and carelessness – and most of the horror stories that have ensued relate to these three sins. In contrast, in the UK and the EU, there is absolutely no chance of any exemption from our environmental laws for shale gas developers. They must either comply or not proceed. That is the key finding of the joint Royal Academies report, and the report for the Scottish Government. Existing UK regulations on water, air and soil pollution are the best in the world and need no adaptation for shale gas. However, there were no regulations on induced seismicity associated with borehole operations (as opposed to mining and quarrying) before Preese Hall, which was a gap that needed filled – sadly, they were filled in a very amateur way, which is what our paper is criticising. These regulations would never survive judicial review, and if that happened we would have no regulation. Far better that we have sensible regulation that will provide full protection (as for quarry blasting) and be immune to challenge in judicial review. The regime we propose meets that criterion.
2. The notion that the drilling rigs are going to be noisy and leaking methane all over the place is mis-placed in the UK, as we have the tightest borehole regulatory regime in the world. I have never drilled for oil or gas, and never plan to but I have often drilled for water and several times for deep geothermal energy – and the rules governing that drilling are the same as for oil and gas. As regards noise, modern rigs are so quiet that the drilling crew do not need to wear ear defenders these days. In 2011 we drilled for geothermal in central Newcastle, 24-7 for 6 weeks, to a total depth of 1,821m, with our rig only 100m from the nearest houses (see picture attached) without a single complaint from the residents about drilling noise (or anything else). (The rig we used is the same model as was used at Preese Hall). As regards methane leaks, before we drill we have to assess the worst-case scenario – i.e. what happens if we hit a massive pocket of maximum-possible pressure gas right at the bottom of the hole and it surges up the borehole? Once we have calculated the maximum pressure that we could encounter (and multiplied it further to make sure it is a totally safe estimate) then we have to drill the borehole with a blow-out preventer rated to exceed the maximum possible gas pressure (this is a device with three independent locking mechanism - a triple belt and braces), and whenever we install and cement casing in the borehole we have to pressure test it to make sure that our job has achieved the same pressure as the blow-out preventer. If not, we can't proceed and must cement the hole back to surface and abandon it. Even if it does pass the test, we have permanent, continuous methane monitoring around the well head and elsewhere on site, set up to automatically set off alarms if any methane is detected. If it is, the sirens go off, all staff have to evacuate to a safe point (established on all sites before we start) and call in specialist contractors to "kill" the well. We have to do this as otherwise the people in the most immediate danger are the drilling crew (who are human beings with families like everyone else). I can't think of an onshore well where the alarms have ever been

triggered. So I can assure you that wells do not leak methane everywhere – it is a mortal danger to the crews, and they take all steps to ensure it never happens.

3. The lurid stories in some of the press about people living near rigs getting incessant headaches, nosebleeds, nausea etc make no sense: the human beings that work on the rigs could not work if that were the case. There is nothing we use in drilling (or fracking) that would cause such things. Anxiety can, though, and that is why I am so concerned about over-exaggerating the risks. People are literally becoming ill with (mis-placed) worry. That is very real, but it is caused by rumours about drilling, not by the drilling itself.
4. It frustrates me that people don't realise that well drilling for utterly benign purposes, such as water wells, is every bit as "industrial" as it is for gas. For instance, we routinely use fracking to develop drinking water wells in Scotland – see attached paper. Far from it being an inherently dangerous, poisonous technique, fracking has actually delivered pristine clean water to Highland communities that previously had only brown, peaty surface water. We often inject concentrated sulphuric acid or hydrochloric acid down drinking water wells after drilling to improve their yield by dissolving the rock – this is far more extreme than any fracking chemicals; yet when we are done pumping the spent muck fluids back from the borehole we end up with pure drinking water.

Having said all that, I seriously doubt that shale gas will ever really be big in the UK, because the most prospective parts of our country are simply too densely populated, notwithstanding any of the points I have made above. I also have a string hunch that the US shale gas industry is a 'bubble' – over-hyped like a Ponzi scheme, and reckless in its disregard for production longevity issues. If that house of cards tumbles as I suspect it might, then the UK industry will never get off the ground.

However, I still think it is important that people understand the truth about drilling and fracking, as we will need them (albeit in a far less aggressive form) for geothermal energy – one of our only big hopes of replacing gas with something renewable for domestic heating, which is most of energy use in the UK.

Feel free to call if it would help to talk.

Once again, thanks for writing and I do hope (and expect) that your fears will not be realised.

Best wishes

Paul Younger

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**From:** [REDACTED] [mailto:[REDACTED]@hotmail.com]

**Sent:** 12 November 2014 23:13

**To:** Paul Younger

**Subject:** RE: Fracking

Dear Mr. Younger,

Thank you for your prompt and most complete reply.

The interview you gave did give details of who funded your report and also sent out a clear message that fracking is completely safe. It must be, if you, someone with a wealth of experience and pertinent knowledge, have absolutely no concerns about fracking taking place under your home!

Along with you, I too am only interested in truth and honesty, much of which I agree is sadly lacking in the shale gas industry.

I am comforted to hear that there can be little doubt regarding the size of the tremors that occurred in 2011 at Preese Hall. However I do believe that Cuadrilla were indeed aware of these but that they knowingly continued fracking. After all I, and I am sure many others, would not think that even this industry would be allowed to undertake such operations without having to monitor seismic activity? I understand that their excuse for non reporting of the tremors was they understood there was no requirement to do so as the well remained uncompromised? ( Although they appear at present to be having serious problems abandoning this well! applying for yet another extension?)

I am very worried that using a formulae you can categorically state that the damages caused to property here were not caused by the tremors. Don't get me wrong I am not doubting the formulae. Still it leaves questions for me. There are numerous properties here that I know of, no doubt there are a considerable amount more that I don't know about, that were damaged. Along with the damage to property and to give you an idea of the effects, I personally know young children that were woken and were thrown half out of bed, others that were thrown off the toilet. Some cases Cuadrilla has already paid out compensation for? others are still going through the courts. This isn't drama this is fact.

Maybe there is some other activity relating to fracking that would cause such events?

[REDACTED]. We are campaigning for our lives as we know them, we have spoken with people who have experienced fracking in America and Australia. A particular lady originally from Pennsylvania who broke down in tears in the street when she heard they were planning to frack here, because they, as we will, have had to leave their homes because of methane leakages into the drinking water and the fumes from the flaring. This is fact. Definitely many sites in America appear reasonably safe at the moment but who knows when leakage will occur or the long term effects on children's health? You may be happy for fracking to proceed under your family home but I certainly am not taking that risk. My children will have to leave their home and school([REDACTED]) [REDACTED] we will not be able to sell, that is already apparent. House prices have already dropped approx 50% that is if you can sell at all.

I, as you do, find it unacceptable that some people, particularly the elderly are forced to risk their health and life because they cannot afford to heat their homes during the winter. It is shocking that the Government allow this. We undoubtedly have an energy crisis but that does not make it right to extract fuel at any cost either to the human life or the ecology.

The shale gas industry is not an honest one and not one that I can trust with the health of my children, unfortunately the Government are so entangled, that to me, they are almost one in the same. It is very difficult to find true independent well informed opinions on this subject.

Sincerely  
[REDACTED]

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From: [Paul.Younger@glasgow.ac.uk](mailto:Paul.Younger@glasgow.ac.uk)  
To: [REDACTED]@hotmail.com  
CC: [Robert.Westaway@glasgow.ac.uk](mailto:Robert.Westaway@glasgow.ac.uk)  
Subject: RE: Fracking  
Date: Wed, 12 Nov 2014 09:56:12 +0000

Dear [REDACTED]

Thank you for taking the time to write to me. I can understand that you are anxious about 'fracking' and all that goes with it, not least because of the steady diet of uninformed comment and misinformation – on both sides of the argument - which has dominated the debate so far.

Let me preface my response with two caveats:

1. I was interviewed for about 5 mins, but as I do not live in NW England I have no idea how much (and which bits) of what I said was cut out in what they actually broadcast. Hence what you think my message was might well not be the same as what I intended. This is a perennial danger with doing pre-recorded pieces for TV news, but due to University and family duties I could not appear live at the time they desired, so I had to run that risk.
2. I have spent my career in protecting the environment from pollution, subsidence and other impacts arising from the extractive industries – in particular the mining industry, which routinely causes seismic events way beyond anything fracking could ever achieve. In all of that work, I took a preferential option to work "on the side" of affected communities, but ALWAYS with this proviso: if the evidence supported the community's grievances I would not hesitate to say so. However, if it did not, I would in no way make unsubstantiated statements just to help the community campaign. This used to infuriate activists at times, but as a professional scientist and engineer, and as someone aspiring to be a Christian, it is clear to me that my principal duty is to honesty, objective facts (insofar as these can be ascertained) and fairness – which includes being fair to others with whom I might not otherwise agree (e.g. mining companies being secretive and careless). I have done such work all over the world, most recently on behalf of Caritas International (in Honduras) and Amnesty International (in Guatemala), and it received the accolade of award of the Queen's Anniversary Prize for Higher Education in 2006 (see attached document). It is in the same spirit – siding with the disadvantaged insofar as the facts allow – that I approached my duties on the UK joint Royal Academies' panel on shale gas (2012; see <http://eprints.gla.ac.uk/69554/>) and the Scottish counterpart (which reported in June 2014; see <http://eprints.gla.ac.uk/95518/>). It was in the line of that work that I realised nonsense was being talked about seismic risks, by people who could have taken the time to inform themselves better. (The comments of Cuadrilla and iGas yesterday – which you will note were at odds with our own – would suggest that they still do not grasp the basic physics behind impacts from induced seismicity, which is depressing given all the time they have had to learn ...).

Now to what the key message from our paper (attached) actually is. All of the detailed argument and mathematical modelling simply support the following conclusion: it is illogical to regulate fracking-induced seismicity on the basis of the magnitude of the induced event at the point it occurs. Rather, as for quarry blasting, coal mining, RAF over-flights and other nuisances, the thing that should be regulated is the vibration affecting property. The physics of this is very well known, and the correlations between local event magnitude and distance to a sensitive receptor (e.g. somebody's house) are readily calculable and unequivocal. Therefore, while I must take your word for it that you have friends with damaged properties, in all honesty I have to state that this cannot reasonably be attributed to events of the magnitude you specify, which occurred 2.5 km below ground at Preese Hall. Don't take my word for it – the necessary equations and parameter values are in our paper, so you can calculate this yourself.

There are many things that can cause cracking in properties. In coastal Lancashire (whence part of my family hails) a common cause is, for instance, differential swelling or shrinking of lacustrine clays in the shallow subsurface – some of which may be caused by local land drainage practices. I cannot say whether this applies at Weaton St Michael's. Any good engineering geologist or geotechnical engineer could make such an assessment, and I would advise your friends to seek such professional guidance if they are considering making a claim for damages against the local drainage board or some other organisation. What I would NOT advise them to do is to presume that any problems they are experiencing are attributable to those modest events at Preese Hall. This is simply not consistent with the laws of physics, and they would lose badly in any court case based on such an assertion.

Now to your point about a magnitude 3.6 event. If such an event occurred in the shallow subsurface, it could cause significant damage. If, however, it occurred at a depth of 2.5 km or so, nothing more than cosmetic damage would be predicted. There are mountains of data to substantiate this from all over the world – much of it cited in our paper – and it is well-established in the UK coalfields, where major first-breaks on longwall faces often generate events of such magnitude, typically within a few hundred metres of surface. But the key point of our paper, and what I told the BBC, is this: to regulate by magnitude is meaningless unless you also include depth and distance to properties – in other words, unless you regulate according to the long-established principles by which we regulate quarry blasting to avoid damaging vibrations (i.e. excessive peak ground velocities (PGV)) at people's properties. Let me spell this out further: we are NOT recommending increasing the threshold to  $M_L$  3.6 – rather we are saying you shouldn't use  $M_L$  at all, but regulate according to the resultant PGV at people's properties (in most cases, the nearest building to the fracking operation, though making allowance for local geological nuances).

So did I make a false statement on TV? No. As I explained above, my first commitment is to truth, my second to helping the disadvantaged. I suspect from your comments that the BBC did not broadcast the part of the interview where they asked me whether my research is funded by shale gas fracking companies – the answer is “absolutely not”. I have no vested interest to protect other than honesty and public good. And with regard to the latter, the priority for me is those in fuel poverty. In Scotland, 82% of the population rely on gas for their heating and hot water. Those who have access to the gas grid still have a 1-in-4 chance of being in fuel poverty, whereas those who don't have a more than 2-in-3 chance. It is therefore clear that availability of reasonably-priced gas is a front-line defence against fuel poverty. As the UK is importing more and more gas each year, the price will go up and fuel poverty will worsen. Furthermore, we are already starting to see Russian gas supplementing Norwegian gas in our imports, and the long-term political consequences of depending on Russia for our heating do not bear thinking about. So I am of clear conscience that (i) I did not lie, and (ii) I have remained true to my long-standing principles.

Did Cuadrilla make false statements back in 2011? I can profess no detailed knowledge of their every public pronouncement, but I have the impression they at first denied causing the recorded seismic events to which you refer, but later admitted it when the British Geological Survey (BGS) made public their monitoring data. My view is that Cuadrilla were genuinely taken by surprise, though that is not a very good excuse for poor public communications. So it was the BGS, not Cuadrilla, that identified the earthquake magnitudes (1.5 and 2.3) and focal point depths etc back in 2011. This means that those statements were made by an independent scientific body, not by Cuadrilla. The data have since been pored over by so many people – including ourselves – that I think there is no doubt that the largest recorded event had a  $M_L$  of 2.3. So again, I do not think there were any lies told about the magnitude of the 2011 events. What I do think – and what we can demonstrate conclusively using the formulae in our paper - is that any damage to your friends' properties in Weaton St Michael's was not caused by those events. Again, as I said, please don't take my word for it: the relevant equations are there in our paper, and you can calculate this for yourself.

Thanks again for writing to me, and I hope this email has gone some way to dispelling the confusion you felt.

Best wishes

Paul Younger

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**From:** [REDACTED]@hotmail.com  
**Sent:** 11 November 2014 19:38  
**To:** Paul Younger  
**Subject:** Fracking

Mr Younger,

Having just watched the interview you gave tonight on BBC North West Tonight relating to Fracking, I am left confused by your answers.

You inferred that the seismic regulations currently in place for fracking are set too high and that they should be relaxed in line with quarry regulations. That 3.6 on the richter scale would cause practically unnoticeable cracks in residents properties.

So please could you explain to me why a number of my friends living in the Weaton St Micheals area where earth tremors, measuring only 1-2.5 on the richter scale, caused by fracking in 2011 left considerable damage e.g. highly visible cracks the entire height of their house ?

I can think of only two explanations for this, either;

- the recorded level reported by Cuadrilla at the time was false ? or
- the statements that you have just made on TV are false ?

Could you please confirm that the professional opinions you gave on TV tonight are indeed accurate and that an earth quake measuring 3.6 would cause practically unnoticeable damage.

Sincerely

[REDACTED]