

# *SEM Diaries - 39*

## *It weren't broke, but I did fix it - twice, plus new features*

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Fig. 1: Contradictory indications on the UPS

I am sure most readers will be familiar with the old British saying “If it ain’t broke, don’t fix it”. This is a sentiment to which I subscribe sometimes, but not at other times. For example, if my car tyres only have around 1,000 miles worth of legal tread left on them at MOT time, I might decide not to replace them then, but see out the remaining life before visiting my local tyre and battery centre. On the other hand, if I was told that my brake pads only had 1,000 miles life left on them I would opt for immediate replacement. The consequence of running pads to the limit could be the need for new discs in addition to the pads, or if braking failed, a new car might be needed!

I was faced with a similar dilemma with respect to my SEM recently. Among the ancillary equipment supplied with the SEM is an uninterruptible power supply (UPS). This powers the entire SEM, including the electronics, the PC and the pumps. The reason for having it is that with the type of electron gun used on the SEM (a Schottky field emission type) any sudden loss of power would destroy the gun resulting in a very large repair bill. In addition to the cost of the hardware there would be a protracted service visit, first to

replace the hardware and then to “burn-in” the new gun for 36 hours before the system could be up and running once more.

The UPS is located within view of the SEM desk and one day I noticed a new warning on its display: “Warning: Battery End of Life” (Figure 1 left). Now the messages on this display cycle through various pages, and observing the sequence I noticed the one shown in Figure 1 right. This says that the battery condition is “100%”, and that in the four years since I had the SEM installed it had only operated on battery power for two hours (most notably when I tripped the breakers to my lab by overloading my garden waste shredder).

Consulting the TESCAN service engineer I discovered that the UPS had been programmed to display the warning message after four years, hence why it had started being displayed at this juncture. They did admit that the battery was probably fine, but the consequences of ignoring it could lead later on to a UPS failure with the attendant destruction of the gun. So, I opted to replace the batteries at this stage. To do this I would

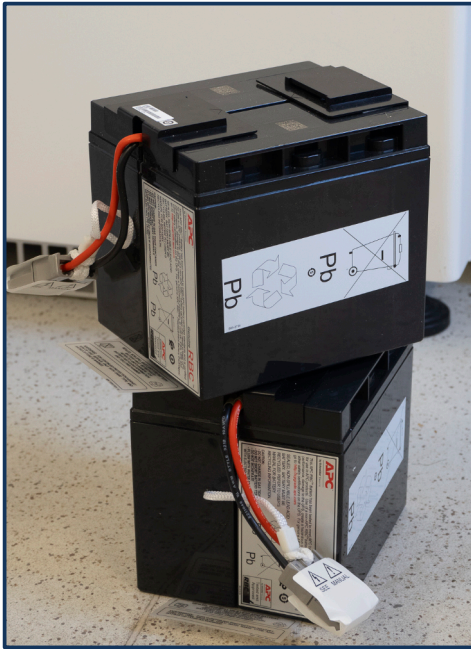


Fig. 2: The two replacement lead-acid batteries for the UPS - cost £630

still be required to shut down the electron gun, using a particular process before isolating the UPS, swapping over the batteries and re-starting the gun. I was told that I could do all this under telephone instruction from an engineer, thus avoiding the cost of a service visit.

The second “preemptive strike” that I decided upon was to replace the Windows 10 PC that controls the SEM with one running Windows 11. I had already determined that my current PC was not suitable for Windows 11 because it did not have the required Windows 11 compatible hardware. I felt that with Microsoft support for Windows 10 ending in 2025 and the subsequent lack of further security patches, it would be advisable to upgrade, especially as the PC is left running 24 hours a day and is continuously connected to the Internet.

Another email to TESCAN Service came up with various options for new PCs, or I could save money by buying one from any suitable supplier. TESCAN would provide their software and a license. For various reasons I opted for one of the TESCAN options, and booked a day of engineer

time to visit and carry out both the battery swap and PC exchange, and also while at my premises he would carry out the annual maintenance check.

The engineer duly arrived on the date of the appointment and carried out the agreed work. I am very glad I opted to request and pay for a service visit. I think their confidence in my being able to successfully carry out what was required using just telephone support was somewhat greater than my own!

In fact the engineer ran into a bit of difficulty of his own at one stage. Following the battery replacement he carried out a check to ensure that the UPS provided the appropriate warning that the mains supply had been disconnected. This is a high pitched audible tone, combined with an orange lamp on the UPS. He pulled out the mains plug, but the alarm did not sound. Strange.....! Much examination of the UPS menus followed, with no obvious explanation for this malfunction being found. Eventually the reason did, indeed become obvious. The engineer was pulling out the wrong mains plug!

As mentioned in earlier editions of SEM Diaries, I enjoy a very good relationship with TESCAN. In fact I would go so far as to say that despite my “amateur” status they bend over backwards to support me. On several occasions I have identified features I would like to have in the software that is not currently present and they have listened to me (although not always fully grasping the reasons I might need what I was asking for). On one occasion they set up a video conference between me and the senior applications engineer at TESCAN, and he was able to explain that the very facility I was asking for was, indeed, already built into the software.

On another occasion, after I had driven my SEM stage straight up and into my Backscattered Electron Detector (fortunately without damage other than bending it a bit) I requested that the ESC key be programmed for the operator to press for an emergency stop (as implemented on my first SEM). The engineer’s reply to this was that there is already an emergency stop - you just point your mouse over a soft key on the screen and click when you want to stop.

The trouble with this approach, as I found to my cost, is that when concentrating on watching the progress of the stage using the in-chamber camera it is easy for the mouse arrow to move out of the screen area occupied by the soft key. I am happy to say that at MMC2023 the same applications engineer who had helped me on the first occasion announced that the software had been updated exactly as I

had requested. I await their news on the third feature that I have asked for!

At the end of October 2024 I came across a new “desirable feature”. I am collaborating with a local palaeontologist who has taken possession of some fossil material consisting of numerous small shells embedded in a mineral layer. I have been carrying out chemical analysis of the various constituents and creating SEM images. One request I received was

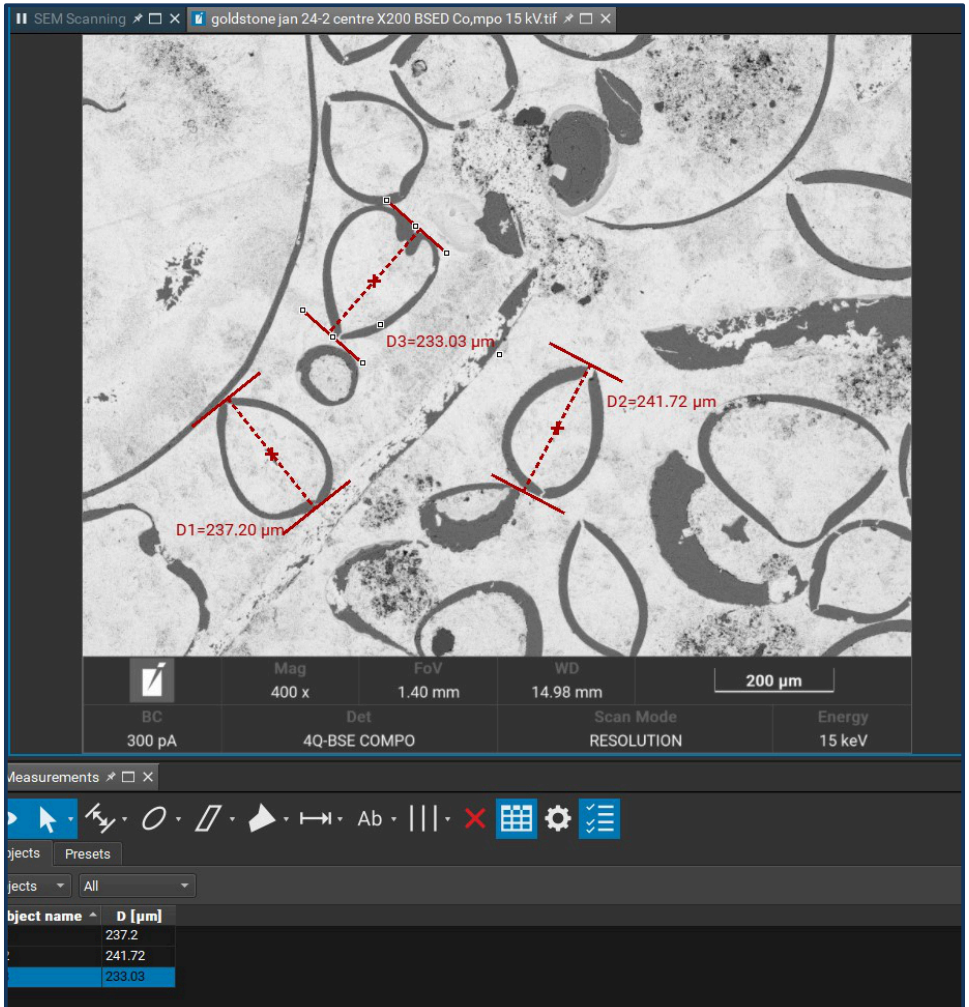


Fig. 3: A simple example of the use of the TESCAN measurement tool. Note that the length dimensions are displayed not only on the image but also as a list in the bottom window.

to measure the size of the various shells. I already knew that this was possible. There is a “Measurements” tool (Figure 3) that permits not only the linear measurement of features, but also calculation of areas and so on. So, all that is needed to measure a linear dimension is to click at one end of the feature, then click at the other end and a display is superimposed on the screen showing the linear dimension in (usually)  $\mu\text{m}$  and the boundaries between which the measurement was carried out. Multiple measurements can be made on the screen with the dimension being identified on-screen as D1, D2 .... etc.

Wouldn't it be good, I thought, if instead of noting the measurements on the screen and manually entering them into an Excel spreadsheet the SEM software could be made to save them automatically. To cut a long story short, I soon discovered that this was, indeed, possible. Not only that, but I can also download statistics such as the mean and standard deviation!

For the simple example of Figure 3 it would have been no hardship manually to transcribe the readings into a spreadsheet. However, I and my collaborator wanted to carry out an analysis of three images each having in excess of 100 individual shells on them. The ability to save the individual values direct to Excel was a great time saver, and also removed the risk of transcription errors. An example of one of these measurement exercises is shown in Figure 4 (on the following page). Imagine transcribing each of those measurements by hand!

It is amusing to reflect on how I became interested in palaeontology and mineralogy in the first place. As explained in SEM Diaries issues 30 and 31, I am as much interested in what the SEM is able to do as I am in looking at particular subject matter. So, I decided to acquire EDS (Energy Dispersive Spectroscopy) more to find out what it was all about than with any specific subject matter in mind. Once I had the kit it made sense to get to know some geologists and learn a bit about the subject. Since then, the interest has grown quite rapidly.

I mentioned in SEM Diaries - 34 that I was collaborating with Chris, a friend who was studying material found in Kimmeridge clay. He is a volunteer at the “Etches Collection”, a superb museum of fossils in the tiny Dorset village of Kimmeridge. The museum and its curator, Steve Etches, had featured in a programme called “Attenborough and the Giant Sea Monster” at the beginning of 2024 on BBC Television. This told the story of the discovery and recovery of the head of a pliosaur, sometimes described as the “Tyrannosaurus Rex of the Sea”.

Chris had been creating A0 sized posters, sometimes featuring SEM or macro images I had taken in my lab, for display at the museum. Despite this work having been started quite some time ago, and having seen the outside of the museum in Kimmeridge several times, I had never been inside.

To cut a long story short I ran into Chris at a geological exhibition in a local church hall one Saturday and mentioned that I would be visiting the Etches Collection the following day, as it was about time I did! He said he would be volunteering that day and perhaps I could bring my book of SEMs to show to Steve in case he was there. I duly turned up just after opening time, to be greeted like royalty! I was forbidden from paying an admission fee and given a guided tour by Chris. This included viewing the pliosaur head featured in the TV programme and now the centrepiece of the museum. Steve Etches was, indeed, at his museum that day, so I showed him my book of SEM images with Chris vociferously pointing out possible applications for palaeontology! It could be I am asked again to collaborate, and receive free admission.

I also took the opportunity to visit Kimmeridge beach (Figure 5). This photo clearly shows the cliffs with layers of shale and Kimmeridge clay, similar to the environment in which the pliosaur head was found. I picked up a few stones, not so much with a view to splitting them in a search for fossils, but more to make flat sections of them for imaging and analysis using my SEM, in the same way that I did with my rocks from Snowdonia in August. At the time of writing this edition of diaries, this remains “work in progress”.

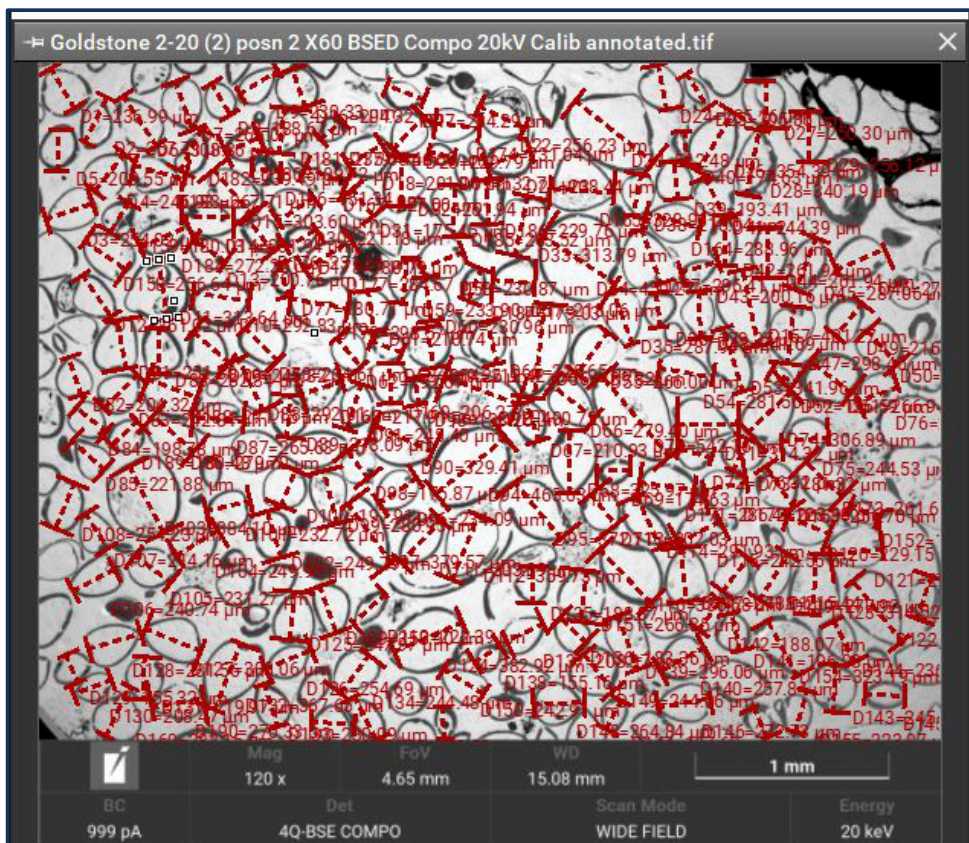


Fig. 4: An image with 190 individual measurements superimposed on it. This shows the impossibility of transcribing the readings by hand and the enormous benefit of having a facility to automatically save the readings to Excel.



Fig. 5: Kimmeridge beach, showing the cliffs of clay and shale