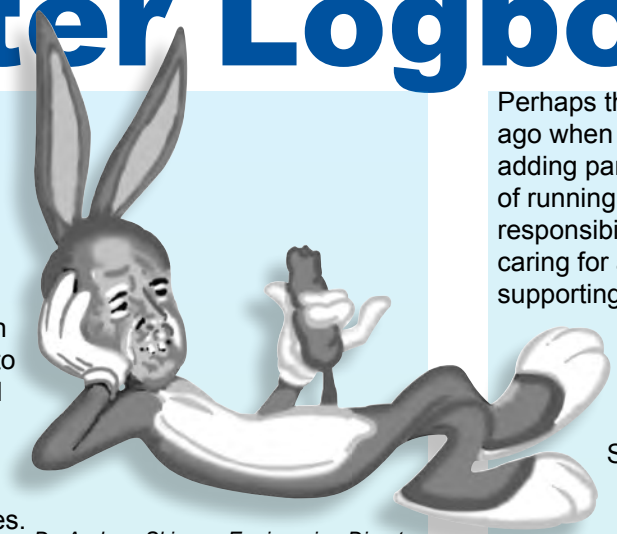
MEA

Measured by Experience

Winter Logbook 2010

What's up, Doc?



Dr. Andrew Skinner, Engineering Director

My father, John Skinner (1923-1983), left school after Grade 7 to train in the hard school of engineering in a country garage in the Western Australian wheat-belt town of Merredin. He went on to build up a highly-regarded custom engineering firm in SA capable of building specialist machines for industry and universities. Sadly, he never lived to see his eldest son do the same in the field of measurement engineering. But he did leave me the skill in my hands, an imagination tuned for building gadgetry, and the sense that with hard work anything is possible.

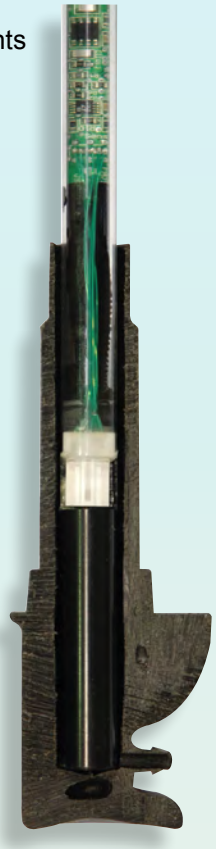
Dad never really got over the fact that his parents couldn't afford to pay for him to receive some higher education. This showed up in odd ways – when it came time for me, his eldest son, to go off to high school, he fought a losing battle with Mum to get me sent off to learn a trade instead. Similarly, having completed five years of high school, the next logical step for the only one of his six children to have inherited his mechanical aptitude was to go off to the Institute of Technology to study engineering. This caused further mutterings, along the lines of 'getting your hands dirty' and 'what's the good of a piece of paper?' Once again, Mum prevailed.

From all this, one would expect that the old chap would still be grumbling when I graduated. Yet surprisingly, I heard through others (never directly from Dad) how proud he was to have a son who was a qualified engineer. By the time I returned to Australia from working as a professional engineer overseas in Papua-New Guinea and Canada, Dad was struggling with health and marital issues, leading to his untimely death at the age of 59 years, only a few months after my return.

Perhaps some of his feelings of inferiority stemmed from this supposed 'lack of education'; he seems to have left some of that with me too. It is only now, after 35 years as a working engineer, and 26 years during which MEA has grown to maturity, that I feel I can relax a little around the idea that 'I just don't know stuff!'

Perhaps this also explains the rash step I took over a decade ago when I decided to put myself through the 'third degree', adding part-time PhD studies to the already volatile mix of running an engineering business full-time, community responsibilities, home renovations, raising three sons, caring for ageing parents and a large vegetable garden and supporting my long-suffering wife's own studies and small business start-up.

Then, a week before Christmas in 2009, a letter turned up in the mail from the Dean of Graduate Studies at the University of Adelaide, congratulating me on the completion of said doctorate and on the very favourable comments made by the examiners… Could it be that I wasn't such a dummy after all?



Whatever, some of the half-dozen instruments to come out of that doctorate are already in production at MEA – sensors for the measurement of thermal stratification in reservoirs and for automatically measuring salinity in the soil. Another of these sensors is receiving the concentrated attention of the MEA R&D team, as we work on developing plant water status tools for irrigation scheduling. MEA was awarded an AusIndustry Grant for $0.25m towards this work, and will chip in the same amount again from our own funds to bring this product to market.

And what have I learnt after spending a decade on the fringes of academia? Simply this – that there is a vast body of really useful knowledge out there if you know where to look. For those of us already in industry, there's no impediment to commercialisation and taking Australian ideas straight to the tough testing ground of putting real products in the hands of Australian farmers and researchers.

I can just hear the old man muttering on about *that*!

Apologies

I've been so buried in writing the aforementioned PhD thesis that I've had little energy for churning out the bi-annual MEA Logbook. Now the 'MEA girls' are coming back from their travels to various field days and exhibitions up and down the country with the message that folk are wondering whether they've been dropped from the MEA mailing list, as the Logbooks have stopped arriving… OK, so I'm back, and so is the Logbook after a one year gap. My apologies – Andrew.

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River Buoys and Thermistor Strings – Technical Stuff!

One of the special areas of environmental measurement in which MEA has found a niche is that of measuring the thermal stratification of reservoirs, rivers and the ocean.

Our SDI-12 based Thermistor Strings consist of up to thirty or more 'smart' temperature sensors hanging down through the water column on a three-wire rubber cable, making digital temperature measurements under control of the data logger mounted on a floating 'buoy' on the water surface. For all that temperature sensors are 'old hat', these can resolve temperatures of 1/1000th of one degree (0.001°C), and are 'super-matched' to within ±0.006°C of all the other sensors on the string. This high degree of matching allows these strings to spot even the very weakest temperature stratification in a water column up to 90m deep.

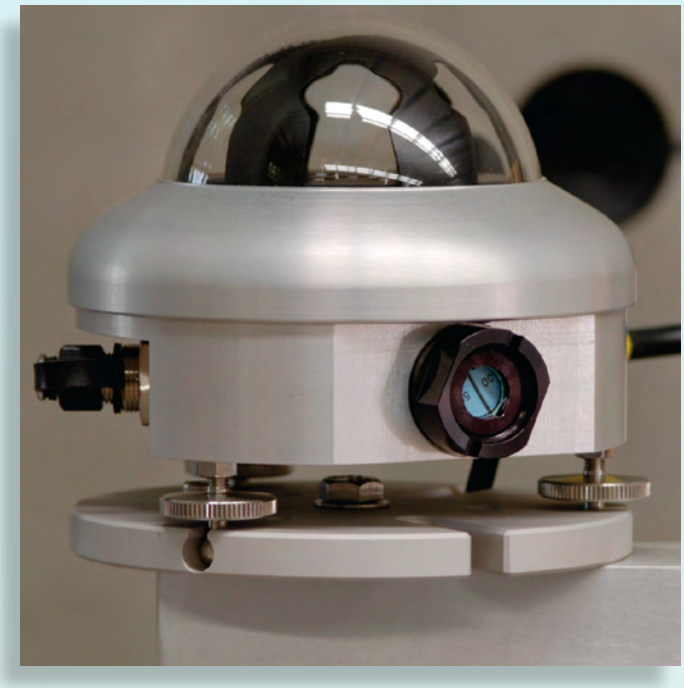
MEA has built over 1000 of these sensors, and MEA Thermistor Strings are now deployed in many of Australia's reservoirs and are being used off-shore on the Great Barrier Reef. For more information please visit http://www.mea.com.au/products/tempstrat-thermstring

MEA can build complete Thermal Stratification systems that include all the power, telemetry, meteorological and water quality monitoring systems that a customer needs, with software to support it.

EXTRA! MEA Saves Little Old Ladies!

Sometimes, though not very often, MEA builds sensor systems that don't record stuff – they just do stuff! And so it was that we undertook a small job for the local transport authority running our suburban trains; spherical mirrors on the platforms are used by train drivers to make sure all the little old ladies have tottered safely onto the platform clear of the train before it pulls away. This works fine unless the mirrors fog up under cold conditions, when heaters must be switched on to clear them. Rather than heat the local countryside from the mirror heater at all times, a thermostat measuring air temperature has traditionally been used for this job, but doesn't really cut it in today's energy-conscious world. Enter 'dew-point sensors', which combine air temperature and relative humidity sensors to predict that lower 'dew-point' temperature at which the air will dump its water content onto the mirror and endanger the sweet old ladies. (Relative humidity sensors tell you how much water the air is holding at the current temperature, relative to the maximum amount it can hold). Now, when the air temperature drops to just a few degrees above the dew-point temperature, the heaters switch on to push the mirror surface temperature back into the 'clear' region.

Measuring Solar 'Beam Power'

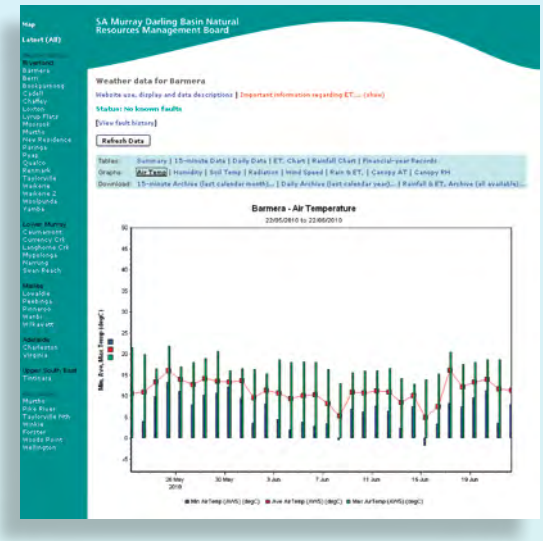


Solar thermal power stations focus the direct normal incident (DNI) beam of the sun onto heat exchanger elements using reflectors. To measure the solar power available to such systems special solar sensors called pyrheliometers are pointed directly at the sun to separate the 'focusable' solar radiation in the 5° direct beam angle from the 'un-focusable' diffuse radiation back-scattered from the hemisphere of the sky. The sum of the diffuse radiation and the cosine of the direct radiation is known as global solar radiation ($W.m^{-2}$). Standard pyranometers, consisting of flat horizontal black plates having high radiation absorbtivity, measure global solar radiation and provide valuable input power measurements for photovoltaic (PV) solar power systems. However, separating the direct solar component from the diffuse radiation component requires more complex three-dimensional solar trackers capable of pointing the pyrheliometer at the sun through all seasons to an accuracy of better than 0.5° as the sun moves across the sky. (More on these solar trackers in the next MEA Logbook).

For remote locations and preliminary surveying for solar thermal power plants, a less-expensive static pyranometer from Delta-T in Cambridge UK called an SPN1 can be used to measure the global and diffuse radiation without any moving parts. MEA's engineers have created a working algorithm for our Magpie software that computes the power in the direct

solar beam using these two solar components plus the cosine of the zenith angle, which is in turn calculated from latitude, longitude, and time of day.

Chasing the BoM…



The Bureau of Meteorology (the venerable 'BoM') is a massively-funded federal government institution with weather stations all over Australia, so I don't reckon they're really too concerned that little old MEA is panting along behind them trying to rival them in the size of our weather station networks. Nevertheless, MEA does quietly continue to expand our Weather-to-Web presence on the Australian mainland. All our data is also free to anyone with a computer equipped with a web browser. With over 100 stations pushing up-to-the-hour climate, ETo and rainfall data to the web, many folk on the land need no longer purchase their own weather stations if an MEA one is somewhere nearby. An index of links to all these stations can be found at http://www.mea.com.au/products/weatherevap-aws. The computer hosting and backing up all this excellent weather data is located within the BoM's Adelaide office. Thanks guys!

Solar PV Panel Monitoring

Solar photovoltaic (PV) panels are appearing increasingly on Australian rooftops as a means of reducing power bills and injecting small amounts of power back into the electrical grid, essentially storing any energy surplus in the 'load' rather than in expensive battery systems. Larger systems are being located on our public buildings, such as airports and museums, as Governments become more conscious of the need to use renewable energy sources for their daily needs. Just how efficient are these panels at turning sunlight into electricity? Are newer solar panel technologies worth the extra complexity in the manufacturing process? To answer these and other questions, MEA was asked by a major utility to build suitable monitoring systems to compare different panels one against the other. So MEA built special solar monitoring stations to make high accuracy solar measurements, and special calibrated 'shunts' to measure the short-circuit currents of the panels-under-test; this is the classic method of determining the energy output of PV panels. A number of these MEA systems were located around the country to test the panels under different solar insolation regimes.

Cute *and* Clever at MEA…

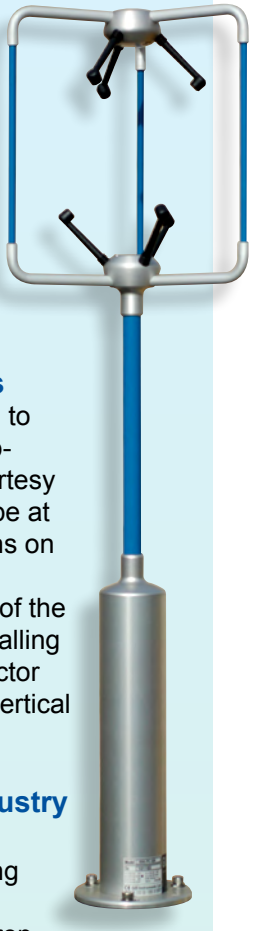
MEA's not the sort of engineering company where three-quarters of the staff have dirt under their fingernails. But nearly every one of us has a tertiary qualification or trade-training of some sort or another, and now you can check us all out on the MEA web-site at http://www.mea.com.au/about.

MEA's staff numbers recently hit 20, which takes us (magically) from being a small business to being a 'medium' business. So who's new? Look up Terry, Monique, Anthony and Sonja for starters…

MEA Radio's 10th Birthday

A decade ago, MEA built Australia's toughest little radio for use by Australian irrigators and folk doing environmental measurements. Built like the proverbial 'brick shithouse', it runs independently for a year on a single battery pack, obviating the need for solar panels to keep it running. It can handle all manner of signals, from voltages, currents, pulses and digital data such as SDI-12 instruments. It can work alone or integrate its data from up to thirty sites into an MEA telemetry-equipped weather station. Uniquely, the MEA radio system is totally robust – take out 29 of those 30 stations with flood, lightning strike, animal or machine damage and the last one will keep plugging on pushing data back over a radius of several kilometres. Operating on the 433MHz UHF band, MEA radio signals curve over gentle rises to the central base station, jump crops and roads and pipes and punch through sheds and buildings and tank farms to get the data home. MEA's loggers, telemetry and software systems integrate radio-linked data seamlessly from literally hundreds of sensors into a single file of record. Not the cheapest radio out there, but certainly the most robust – ten years since product launch, MEA Radios have a fine record of continuous recording under all conditions.

Pakistan AWS on 9m Tower



Mines use weather data for records and dust monitoring – even in remote places on the other side of the world. Australian technology from MEA – custom built to meet the mine's requirements and the difficulties of erecting it in a far-off location by local staff – was handled effortlessly by MEA's technical staff, thanks to decades of experience training in the school of 'hard knocks'.

Calibration of 3D Sonic Anemometers

MEA anemometers supplied on our systems to the Australian wind energy industry have top-class MEASNET calibration certificates, courtesy of specially-accredited wind tunnels in Europe at point-of-origin. Just to keep those Europeans on their toes, we recently managed (after many weeks of effort) to get them to calibrate one of the new 3D sonic anemometers that we are installing on specialist wind towers to measure the vector components of wind in both horizontal and vertical planes. Just ask MEA for more detail.

MEA Wins a $0.25m Two-Year AusIndustry Grant

Australian irrigators must manage diminishing water resources more effectively, not just because we have less water, but because crop quality depends on it, and so therefore do farm returns under increasingly difficult conditions. However, progress in building measurement tools to help manage these scant water resources has stagnated; where are all the new ideas that will revitalize a market that sees only replication of the same tired old ideas of how to measure soil water and climate?

All these soil moisture sensors flooding the market are really only a surrogate for what irrigators really want to know, which is essentially 'how's my crop doing?' Sure, soil moisture sensors tell you what's in the cupboard, but not what's on the table, or whether the guests will rise satiated and satisfied or stressed and surly. We need a sensor to tell us about 'plant water status', a simple 'stress index' that tells us whether plants are recovering their equilibrium after a hard day's work.

Scientists have spent decades trying to understand how plants work, using sensors such as dendrometers, sap flow sensors, infra-red reflectance, porometers and 'pressure bombs' to measure leaf water potential. Yet none of these devices have found their way into irrigated agriculture as standard tools – they are too complex or fragile under field conditions.

So MEA's engineers have embarked on a two-year product development program to create just such 'plant-based' measurement sensors. After all, each plant in a crop occupies a huge volume of soil, integrates climate effects and canopy size and age into an effective machine for transpiring and growing and setting fruit. Why not let the plants do the talking? AusIndustry – the federal granting body for Australian industry – also recognises the risks MEA is running to develop this new generation of technology and has chipped in half of the expected bill of half-a-million dollars. We're underway…

Where the Heck? - GPS on SDI-12

Most MEA systems are cocked and locked in one place for life, but sometimes they drift around on the oceans or get mounted on vehicles, so we recently developed a loggable global-positioning system (GPS) and electronic compass that can be read by MEA loggers (on the SDI-12 digital data bus) to record just where the gear has fetched up on the face of the planet. The electronic compass gives direction of travel or 'heading', even when the system is stationary but rotating on its axis, such as on moored buoys used for oceanographic or limnological applications. We can also tell the time to within tiny fractions of a second, thanks to those atomic clocks on the satellites that tell the GPS unit where we are.

While MEA does not sell these devices to other manufacturers, we do custom-build them into our own systems when needed.

Dendrometers for Tree Growth Monitoring

Dendrometers are cute little sensors that track the growth and daily expansion and contraction of tree trunks or stems; this is useful for logging a tree's well-being. Built by UMS in Munich in Germany, and available from MEA, these can be integrated into MEA Radio or logging systems for continuous recording.

Beaut New Stuff on MEA Wind Systems

MEA keeps on making quiet improvements to our wind energy monitoring systems. Many of these small changes are not apparent to the end customer, but are designed to make the life of the riggers and service personnel easier. Among these refinements are 'pluggable' disposable lightning cartridges that protect your sensors and data against electrical disasters; the lightning protectors take the hit, and can now be simply unplugged and replaced by local staff to get stations back on air, reducing downtime. New universal head brackets for mounting cross-arms allow riggers hanging off towers in high winds to install weighty galvanized steel poles one-handed. All MEA wind systems are now being shipped in stainless-steel enclosures, as after many years of operation, we've noticed a few rusty corners appearing in the older standard coated-steel enclosures. MEA wind systems are now available on 100m masts; our attention to detail sees our cable systems encased in tough flexible steel conduit to prevent damage from sun, birds and weather. Most MEA wind systems are now shipped with our packet data terminals. There's no need to worry about forgetting to download data – MEA wind systems automatically push data hourly up to ftp servers, ensuring four layers of safe data storage (logger, server, PC, backup). Your data is always somewhere, and 'gettable'.