Such Stuff as Dreams Are Made on - - -

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***Abstract**: What of dreams? It seems reasonable to believe that every human individual has dreams, which we can divide into two categories. There's the night-time excursions which we may (or may not) remember when we awaken, and which are supposed to originate somewhere in our subconscious. Then there's the daydreams, some sort of wishful thinking, perhaps of futures we would wish to enjoy "if we had our druthers". What are such dreams, among engineers? What dreams might engineers have? Dreams for Australia?*

Introduction

This paper has been inspired by this author remembering one he presented at the 8th AAEE Conference in 1996, and this is, essentially, a follow-on from that earlier paper with some extended reasoning.

The principal inspiration and foundation of that paper was a book by Willy Ley, an American of German descent, born in Berlin in 1906, died in the USA in 1969. He attended the Berlin University and also the one at Konigsberg where he graduated in journalism in 1924 (www.willyley/ley). (Curiously, the reference does not state his degree so one can only assume it was the German equivalent, at that time, of our Bachelor of Arts.) He moved to the USA in 1935 where he became established as a very fluent writer, presenting science and technology in a manner having exceptional clarity.

The book, titled "Engineers' Dreams", was first published in 1954 and a revised edition was published in 1964 (Ley, 1964), a copy of which is held by this author. That second edition contains eleven projects (two more than in the first edition; the last two 'dreams' below are only in the 1964 second edition) which Ley considered to be feasible. As this is a rarely available reference (this author has found very few who know of it) a brief outline of these now follows (from the earlier paper with some minor additions) (Ward, 1996).

Ley's Dreams

The Channel Tunnel

The idea of a channel tunnel has been around since at least 1802, and several attempts were made to get approval up to the date of writing this book. The work was actually started at least once, and by now has been completed. When planned in the mid-1950s it was to take six or seven years and cost around $US400m. This is the only "dream" which has reached full reality, it's interesting to note that when completed in 1994 it had cost about ten *billion pounds*, some eighty percent over budget

Mid-Atlantic Islands

The idea of placing artificial islands in the Atlantic, to provide refuelling stops for passenger and freight aircraft, was introduced in the 1920s, shortly after the first trans-Atlantic flights. During World War 2 there was a fairly firm intention to proceed as soon as labour and materials were available, but the idea faded out as aircraft range was extended to give non-stop trans-Atlantic flights.

Geothermal Power

The use of underground heat, one way or another, has a history of over a hundred years. The most obvious use is for space heating, but late last century there was an experimental power plant in Italy which generated electricity by feeding a steam engine with volcanic steam. The idea of using subterranean heat for feedwater heating in some local power plants has been floated.

Jordan Valley Hydro
The Jordan Valley is well below sea level. Sea water could be pumped to the top of the rise west of the valley and allowed to run down into the Dead Sea, generating more power than the pumps would require. This would also compensate for both natural and industrial evaporation from the Dead Sea.

Central Africa Lake
Damming a large African river would form a lake in the Congo area, overflowing north into the Sahara. The flow of water from the dam would generate power, and the presence of the large inland body of water would improve the climate and general fertility of the area.

Gibraltar Dam
If the Gibraltar Strait and the exit from the Black Sea were dammed the level of the Mediterranean could be allowed to fall about 100 metres by evaporation. Measurements show the inflow through Gibraltar is sufficient to balance the evaporation from the reduced area, and the flow would generate power. In addition, new land area and a bridge from Europe to Africa would be provided.

Solar Power
Attempts to use solar power go back centuries, but development of a system to make steam by solar heat and drive a steam engine is relatively recent. Systems of that type have been built in several countries, including USA and Australia, and although the use of photo-voltaic cells has been widened in recent years solar power is still in its infancy.

Ocean Temperature Difference (or Wave) Power
The temperature difference between the warm top and colder bottom of the ocean can be used as source and sink for a heat engine, if a suitable working fluid is selected, as proved by experiments. Wave motion can be used, also, and so can the tides in places where there is a large difference between high and low tide.

Wind Power
Wind power has been used for centuries in Europe, mainly for grinding grain, and has been used in Australia for pumping water from underground sources. Generating electricity from wind power is more recent, and is being developed in parts of Europe and Australia, so this is in the “developing in progress stage”.

Reclaiming Land from the Ocean
The Netherlands have been doing this for some hundreds of years, and the process could be extended to other parts of the world, as suggested with the Gibraltar Dam project above, and the Caspian Sea project below.

Caspian Sea Hydro
This is a project somewhat similar to the Gibraltar Dam, but on a smaller scale. It would generate hydro-power at, and reclaim some land around, the Caspian Sea.

Space Travel
In this book Ley had little to say about this possible project because he dealt with it extensively in other works; however, it's evident that he supported what was to happen.

Atomic Power
The main coverage given here to this topic was how atomic energy happens, what makes atomic energy work. Reading between the lines, one gets the impression that he was, in the 1960s, favourably inclined to the concept of nuclear power. Several nuclear power stations have been built since the first edition was published, and we are opening debate on introducing them here in Australia.

Some Comments on Ley’s Dreams

What a stimulating collection of ideas! Why have so few been developed? One or two have been fully, and two or three of the others are being tried.

How could a non-technical person think of those ideas, all having technical aspects? The answer to

that, this author conceives, is at least two-fold. One answer is that Ley was probably not only a thinker but also a listener, so by mixing with many others he was stimulated by them and absorbed ideas from them. Another is he was not burdened by technical-engineering education, Ley's education and working life contained none of that.

The unfortunate feature of technical-engineering education is it delivers facts into the student's mind, generally of how and why things work, why we do certain things in certain ways, and very little in any other direction, so that the professional engineer is, generally, severely limited in producing ideas.

(There are exceptions, of course, but in general that seems to be so - - - this author admits that's a personal opinion, based on many decades of observing engineers, including self, and was expressed in some detail in a previous paper (Ward, 1991).)

The result of that factual training is engineers are very good problem-solvers; give an engineer a problem and it's like the proverbial red rag to a bull, given the problem there's no difficulty finding the engineers to drive the process to a solution. An example: about fifty years ago Sydney had a problem, the need for a larger water supply. Engineers were put together, a suitable location was found, the design process was entrained, construction went ahead, and Warragamba Dam was the result. But none of that went ahead until the problem was stated.

Student Dreams

Right or wrong, the impression engineering students communicate of themselves to society is that they are only interested in hardware, software, and enjoying themselves. This could be summed up as bits (in this author's student days that would have meant engineering hardware parts, physical things; nowadays it can refer to computers), booze, and broads. Of course, this opinion is not necessarily isolated to engineering students alone, but is, generally, applied to them.

Who should be doing the dreaming in this country, of directions which might be taken to make us more successful nationally through centuries to come? The answer is: anyone. But if we concentrate our thoughts in applying technology then the ideas should come from engineers and scientists.

Can anything be done to stimulate idea-production among engineers in this country? There is an old rule, said to be used by one religious denomination and by Germany in the 1930s, that if training in an ideology is to be successful it must begin very early in the life, but our primary-secondary education system seems to be too limited to allow such intervention. So what can be done at the tertiary level to get students producing ideas?

This author tried two approaches to that in the 1990s, in two subjects which directed students towards speculation, one producing ideas and one encouraging development from a suggestion. The first was a subject involving speculative fiction, in which students learned the basics of writing and critiquing fiction, and as a concluding exercise each wrote a short story, generally with a technical background. The one which resounds in this author's mind was a satirical item set in a university, with sufficient detail to identify the establishment as the one he was attending. The subject may not have increased their power of imagination to a truly great extent, but it appeared to have made *some* improvement.

The second was a subject designed to give students an introduction to engineering-as-a-business, so after covering topics such as break-even and return-on-investment groups were given projects to be examined for feasibility, from both the technical and financial aspects.

Three of those deserve comment here. One was a trans-continental power grid, through which power could be fed to the eastern states for their morning peak period, then a few hours later to the west for their morning peak. The basis of the idea was having read that at least two other countries (the USA and Russia) have similar systems, being wide enough to have some hours of time difference from one side to the other, and although Australia is not as wide as Russia it seemed to be a good idea. Unfortunately, although the student group (which contained employees from power-production organisations) was able to do the basic engineering design and the costing for the project they were able to show the population on the west coast was not sufficiently large to justify the necessary expenditure. As an extension of that, a later group included the construction and operation of a large

power station located (more or less) at Spencers Gulf, in a nicely central place to feed power both ways. Altogether, it was a very nice "dream", but perhaps a generation or two too soon.

The second was a water collection and storage system in the Darling Downs area, where there are rivers at present not dammed. This group did a very thorough investigation of how that might be done with an equally thorough examination of the cost, based on updated historical figures. They were unable to give a clear statement of the benefit of the (relatively astronomical) expenditure, but based on the general shortage of water we experience it looked worth while - - - this work was performed, by the way, about ten years ago before the recent drought conditions hit our east coast. Part of the justification of such a project was the American experience of building a large dam in the west, bitterly opposed by the Federal Government because "no-one lives there", but with water available people moved in with agriculture and industry.

The third was the "Simpson Desert Power Station", a solar power collector in part of Australia where there's plenty of sunshine. The idea was, simply, a square kilometre or more of solar cells, that's at least ten thousand square metres of cells, powered by virtually cloudless sunlight. The students were asked to play with the possible area and the types of cells, go through the costing of building it and maintaining it, and taking the power to where it might be used. It's perhaps surprising this one came out looking as if it might be a worth while one. The only conceivable problem was its daylight-only operation, conventional power stations would still be needed for more than half the day.

So there's three "dreams" which have been considered by a teacher, and by students, given some encouragement.

Other Australian Dreams?

There's an extension of the transcontinental power grid. Given a very large power station (perhaps nuclear?) in South Australia we might see a problem with reduced power usage for eight to twelve hours per day, and knowing that turning down such a unit reduces efficiency what can we do with the available power? Well, it could be used to pump sea water into the Lake Eyre district, creating the "inland sea" which was expected by early explorers. Having evaporation from such a relatively large and permanent body of water in that part of our country would improve both the climate and the weather over much of the inland, and would provide salt production by the evaporation.

Other ideas related to water? Now that we can see the severe and increased need for water in the greater-Sydney region is exceeding supply it's reasonable to remark the country was settled in the wrong place, the First Fleet should have landed much further north up the east coast or, perhaps, over on the north-west coast, where there's more rainfall. But knowing it's too late to correct the history of colonisation what can we do to correct the distribution of water supply? Can we run a pipeline from either north Queensland or the north-west to Sydney?

Down south we have a state which is disembodied from the mainland, a delightful island named Tasmania. Could a water pipeline be laid across Bass Strait, so the mainland could get the benefit of the water available in Tasmania? Similarly, would it be feasible to run a high-voltage cable from the mainland to Tasmania, so electrical power could be shared between that island and the mainland? These may be two slightly preposterous propositions but discussing them could lead to more useful ideas.

Combining water with a power generation idea, tides in the north-west around Broome are said to rise and fall thirty feet; can this flow of water be used to generate power?

One Australian dream, one which did get as far as publicity and some government attention, was the proposal for a Cape York Space Station. This was floated about twenty years ago, perhaps more, maybe fifteen years back, and a nicely printed document was published with technical details and some drawings showing the proposed installation of tanks and other facilities. (This author has had a copy several years ago but it's apparently been begged, borrowed or stolen; it can't be located in the personal library.) There's still a considerable amount of information available at either www.capeyorkspacestation or www.capeyorkspaceport, which suggests the dream is still alive. It's also discussed by Paltridge, 1992.

Another Australian dream , which, like the above, had considerable publicity when originally discussed in the 1980s, was the Very Fast Train project, to link Sydney-Canberra-Melbourne by rail, with the Sydney-Melbourne trip taking about three hours. The ultimate expressed intention was to extend the connection all the way up to Brisbane, various routes were proposed, and before long the whole idea faded out, all covered by Houghton, 1992.

Of course, we have had some successes in both water and rail projects, the Snowy Mountains scheme of fifty-or-so years ago was one, and more recently we've had the rail line completed from Adelaide to Darwin. But where do we go, what do we do, after those?

An Engineering Dream Which Hasn't Progressed

Back in the 1950s and 1960s proposals of generating solar power in the twenty-four-hour orbit (42,000 kilometres out from our planet's centre, say 35,000-36,000 km above ground level) were floated around, the idea being there's plenty of sunlight "out there" (even more than in the Simpson Desert) and the power could be transmitted to ground level by microwave, to receivers located in places such as the Sahara Desert (or the Simpson Desert, of course).

One wonders: what happened to this? The best guess is: we now know how hard it is to get out to an orbit of only a few hundred kilometres and that knowledge has frightened even the enthusiasts away. We can put small communication satellites into the twenty-four-hour orbit fairly easily, but not a large one, manned by an operating crew, such as proposed fifty years ago for power generation and transmission. But (a word which should get tossed more often into no-can-do arguments) if we can put those communication satellites up into the twenty-four-hour orbit, and we have the technology to make control systems almost as good as human operators (or perhaps better?) which could make the power-generation station an un-manned unit, is there now anything to prevent putting up such a solar power station? Apart from financing the cost? The arguments in favour are very compelling, particularly with all the current fuss about greenhouse-causing emissions. So why not?

An Extreme Engineering Dream

One might regard the Gibraltar Dam as an "extreme dream", and, yes, it certainly is. Can we go further? Seeking an illustration of an extreme engineering dream this author seizes upon one from an item of speculative fiction by Harry Harrison, a prolific American writer through about the last fifty years. The particular item from his extensive output is titled "*A Transatlantic Tunnel, Hurrah!*", which (as the title suggests) is about the construction of a traffic tunnel across the Atlantic. The novel was set, appropriately, in Victorian times, before the days of air travel and even before fast steam ships were crossing that ocean, the time when the Atlantic crossing took literally weeks with exposure to storms, icebergs, and like hazards, hence it was when a crossing by road would have made the journey so mush more agreeable. And, probably (apart from what tolls might be charged, not mentioned in the book, as far as this author recalls,) cheaper.

What's significant about this work is Harrison dealt with the economic and political problems of the project and restricted his characters (and, of course, himself) to the engineering technology available over one-and-a-half centuries ago when he applied that technology to the difficult task of laying the tunnel across the ocean, including bridging the underwater chasm in that ocean's bed. Could that project have been carried out in Victorian times? Probably not, but not for the same reason as the Channel Tunnel didn't go ahead at that time, that was stopped by England fearing a French invasion through the tunnel if it existed. But possibly? One may say probably not, but maybe given the right circumstances, it might have. Today? Yes, it probably *could* be done, but there's no incentive, ships cross the Atlantic in a few days and aircraft go over in a few hours.

But it's a good story of an "engineering dream" and relates slightly obliquely to Ley's dream of mid-Atlantic islands. Incidentally, there's a significance in Harrison's setting it in Victorian England, that was a time and place of boundless enthusiasm for development and innovation, factors which seem to be in short supply today.

Did Harrison have a technical background, any education or training which helped him to imagine a

Transatlantic Tunnel? No, he studied art in New York, served in the Second World War as a machinegun instructor, returned to art studies after the war and became a commercial illustrator, progressing to art director and editor for various New York magazines. All that's worth noting as it relates to the belief expressed above, that engineers are unlikely to be strong on imagining what might be, and non-technical people are more likely to have that ability.

Why is it so?

Why are engineers unlikely to be strong on imagination? There is a possibility that the reason comes from the way we are built, in ourselves, not in our stars, as remarked by Cassius in conversation with Brutus. The significant part of the human construction, in this context, is the brain, which is divided into two hemispheres, each of which contain upper and lower layers, hence there's four parts. The research indicates that people who prefer logical and rational thinking styles tend to favour use of the upper left side, and those who prefer organising and planning favour use of the lower left side (Millar, 1985). Both of those thinking style describe the way engineers' minds function.

Some of that could be hereditary, passed on through generations. However, this author's review back through what's known of his family tree sees nothing to suggest that, so that one example suggests that in some cases the engineer's mindset may be a chance mutation, the result of random tossing of the dice, a shuffling of the DNA cards, when the components were assembled. But, altogether, it does appear that engineers think in a particular manner.

Some Discussion and Suggestions

Having outlined some "dreams" from literature, and tossed up a few which spring to the author's mind (some of which have been explored by students) we come to a question: can anything be done to stimulate our engineering students to become active "dreamers"? Or more directly, what can be done?

There are difficulties in dealing with those questions. One is that solving one problem can interact with other factors. Here's something to illustrate that: it's reasonable to agree that electric-powered cars would be good to have, that is, not hybrids, but real electrics, which would be battery-powered. Well, that's quite feasible, indeed, way back in the 1920s Electric Broughams were running around Sydney. But if we replaced all the petrol-fueled cars with electrics the demand on our power stations would be increased, which means more coal (or whatever) would be burned - - - or use of that fuel would be replaced by some other electric-power generating system. Which means solving one problem can lead to another, which (quite likely) involves another, such as battery manufacture, and so on.

Another difficulty is fitting material into our tertiary education system to encourage "dreaming", Frankly, this author can't see what can be done, there's a limit to how many subjects can be fitted into an overall course, and as knowledge expands there's more and more essential material to be fitted in.

But before all the above difficulties there's the fundamental problem, that engineers' minds may not be built for dreaming, if the left-brain-right-brain research is correct and engineers favour use of the left side. And against that, there's the mild success this author has had in getting students to use their imagination - - - suggesting some switching thinking from left to right is possible.

To make progress society needs the combination of dreamers producing ideas and drivers who will take the ideas to actualities. We have the drivers in the form of competent engineers. An increased supply of political will-power might help, too, instead of overpowering won't-power. What the ideas are isn't important, necessarily, what's important is their generation, so there's items for discussion, and for the engineers to consider. And, remember, crazy ideas sometimes lead to ventures ultimately worth while. Consider Columbus, with his idea of sailing west to reach the east - - - a truly nutty idea, but it opened, literally, a new world. Engineers' ideas could likewise steer us in new directions.

The Only Conclusion

The only conclusion offered here is that something needs to be done. Perhaps more research into the imaginative ability of engineers? Perhaps introduce subject matter to encourage imagination? Or,

taking an opposite point of view, perhaps we should leave engineers as they are, as good solid drivers for getting things done, and encourage other occupations to generate ideas?

However, we conclude by hoping this paper will encourage those still in tertiary education to expand the production of ideas in the minds of the next generation of engineering students.

Why?

Having expressed the above conclusion then to carry on with more commentary is rather like a prosecutor re-opening the case after having obtained a conviction, but here, after all the above, seems to be the appropriate place to question why the idea of getting engineering students to "dream" should be pursued, why it's is worth while.

The author is compelled to fall back on the profoundly-held personal opinion, already mentioned above, and illustrated, that engineering education is very factual and therefore tends to limit an engineer's thinking. Of course, that doesn't apply to all, there must be some engineers who can "dream". But think about the imaginative writing available in the bookshops: how much is by engineers? There's plenty by lawyers, there's some by doctors, there's a lot by non-technical people. From that, can we infer that (a) engineers lack imagination, and (b) as suggested above in discussion of Ley's work that the nature of engineering education inhibits, perhaps stifles any ability to imagine, that is, dream?

Indeed, we probably need some research into how many are inhibited by the nature of formal engineering education, and how that happens. At this time the author only has observation of some sixteen years of student classes and believes that inhibition is fairly prevalent, and dispelling it can only benefit the individual persons, the profession, our nation, and the world in general.

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