Australian Institute of Geoscientists

AIG NEWS

Quarterly Newsletter • No 108 • May 2012

Skills Shortage in Mining Industry

Louis Hissink

THE OBVIOUS technical skills shortage in the Australian mining Industry has prompted the Minerals Council of Australia to propose the creation of national associate degrees in mining and geosciences, as reported in the Australian Financial Review on the 30th of April, 2012, in the Education Section.

But what specifically will an Associate Degree, based on two years study, mean? And what is the real skills shortage, in any case?

At the recent Western Australian Geological Survey's Open Day held in Fremantle during February this year, the general opinion was that Australia is in an iron ore mining boom, not a general mining boom. This means that the skills shortage is specific to the iron ore industry and not necessarily to the industry in general. One factor affecting the skills shortage may lie in the anarchic nature of the exploration geologist mind-set that avoids the OS&H dominated regime of modern mining operations, instead preferring the excitement and challenges of greenfield exploration of precious metal or metalliferous deposits where OS&H regimes are less intrusive.

However Gavin Lind, of the MCA's Minerals Tertiary Education Council, pointed out that there would be a shortage of about 350 mining engineers and 600 geologists a year from 2010-2015.

The skills shortage seems to be in the area of exploration and resource drilling geologists, though the cause of the skills shortage may not be as easily identified as many might think. There is a general perception in the exploration industry that after graduation most geologists expect to be in a senior position after about five years in the industry, and are, heaven forbid, no longer required to do the hard yards of sitting on a drilling rig at some god-forsaken prospect in the middle of nowhere. There is also the hard commercial fact that working as a drilling rig geologist is not the highest paying job around, and few therefore seem to be attracted to it.

A close inspection of the institutions running these associate degrees shows that, in the case of Western Australia, this move is being made via Polytechnic West, formerly Swan TAFE. This actually means that the goal of the associate degree is not to produce individuals inculcated in the scientific method, but appropriately skilled geological technicians. Such individuals would indeed be well qualified to supervise production drilling of known resources but the disadvantage lies in the necessary specialisation for a particular commodity.

An associate program in mining is slated to start next year with the University of Southern Queensland, TAFE South Australia, Polytechnic West in Western Australia and CQUniversity in Central Queensland. Apparently CQU already has mineral-related associate degrees, and the course content is detailed on page 2, Associate Degree of Geoscience.

Not really a replacement for a drilling rig geologist though it is interesting to note that in the career opportunities one position is described as "support geologist" which, given the course content, would be hard to justify.

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The problem reduces to the industry differentiating the geoscience department into geologists as scientists sensu strictu, (those who understand and practice the scientific method), and geological engineers, those who implement their geological knowledge in the mapping and logging of rocks. In this case it seems clear that the associate degree seems to define what a geological engineer would be expected to know and do without getting into the esoteric and arcania of petrological subtleties of ore deposits.

The question for AIG is whether such associate degree holders will be skilled enough, over time, to be able to be classed as a "competent person" as we presently understand it, and whether such degree holders should be admitted as full members or otherwise. ▲▲

Associate Degree of Geoscience

CQUniversity's Associate Degree of Geoscience will provide you with a sound geo-scientific understanding in combination with up-to-date technology so that you can develop sustainable practices for communities, society and the environment in general. On graduation, you may work in support of professional geologists or geophysicists in order to provide an understanding of geological resources below the surface – metals, minerals, coal, oil and gas, and construction materials.

You will learn how to classify and interpret the major geological structures and assist in the development of the mechanisms of accessing and extracting the geological resources. As a result of your studies, you will also be able to assess the validity of undertaking geophysical surveys at a site and interpret the results of such a survey, design a geophysical survey and apply the appropriate geophysical methods (seismic, magnetic, gravity, nuclear, electrical, and electromagnetic) to a survey design.

Duration	4 years part-time
Mode of Study	Distance Education
Recommended Study	English, Maths B and Science Subjects
QTAC	Distance Education: 851615

What am I studying?

Mining involves the exploration and extraction of minerals and is one of Australia's most important industries, providing growth in employment and contributing to Australia's wealth. A career in mining offers great income potential and can also equip you with the skills and experience to work anywhere in the world.

The mining industry is one of the most technologically advanced industries in Australia and gives you the opportunity to work with the latest tools and equipment.

Another characteristic of this industry is flexible rosters, allowing you to balance work with family and leisure. If you're interested in working in an industry that is innovative, recognised on a global scale, offers generous pay and a flexible lifestyle, then a career in mining may be for you.

Why Study Associate Degree of Geoscience at CQUni

CQUniversity offers programs in mining including the Associate Degree of Geoscience, the Associate Degree of Mine Operations Management and the Associate Degree of Mine Technology. Our suite of mining programs is available by distance education and part-time, giving you the unique flexibility to study from where you want and the ability to remain in the workforce while you study to gain valuable industry experience.

Programs are based on the project-based learning philosophy which offers the opportunity for students to learn in context. This approach is designed to produce work-ready graduates with industry-relevant skills.

Career Opportunities

On completing an Associate Degree of Geoscience, you will be qualified to find employment in national and international public and private industry sectors, including the mining, geophysical exploration, energy, transportation, construction, and education industries.

Geoscience associates typically work in positions like geological field technician, drill supervisor, strata control technician, support geologist, geotechnical engineer and other technical professions with skills in open-pit and underground mines, controlling the grade of the ore mined and locating extensions to ore deposits and defining the ore limits at the mine based on economic considerations, high wall mapping, underground mapping and data gathering.

From Your President

(AIG President Andrew Waltho attended a one day short course on changes to, and compliance with, Canada's NI 43-101 for exploration results, resource and reserve reporting recently in Canada).

The past year has presented AIG with a range of challenges that have taxed the resources of the Institute and placed a heavy workload, at times, on the volunteers that it depends on for its ongoing, effective support of its members.

Professional standards and professional recognition have dominated the work undertaken by the AIG Council throughout the year, comprising:

- dealing with changes to reciprocal recognition by Canadian Securities agencies for resources and reserves reporting in compliance with Canadian National Instrument NI 43-101;
- proposed changes to Canadian securities reporting, to require the use of Canadian based agents by overseas professionals; and, most importantly,
- the review of the JORC Code and ASX Listing Rules.

AIG members continue to enjoy the ability to provide technical reports of exploration results, mineral resources and ore reserves for companies listed on Canadian securities exchanges. This constitutes recognition of thorough membership application review processes by external bodies involved in international accreditation of professional geoscience societies. Maintenance of AIG's membership admission standards has not been straightforward. The Institute's Articles of Association has proven to be a wonderfully robust document that, whenever challenged in the face of changes to the profession, largely due to it's progressively more global character, has proved to be remarkably well designed. At the core of obtaining membership of AIG is the ability of an applicant to be proposed and supported by two existing members. All applicants must also be able to demonstrate that they possess Tertiary geoscience qualifications, equivalent to a degree from an Australian university and at least five years relevant industry experience of which two years have required the applicant to exercise professional discretion and judgement.

An increasing number of membership applications are being received from overseas applicants, with no obvious connection to Australia that is attributed to an increasing number of geoscientists working for ASX and Canadian listed companies in countries where there are no professional geoscientific societies and institutes with reciprocal reporting arrangements. In such instances, the requirement for applicants to be proposed and seconded by existing members stands, and the qualifications of applicants are verified using a database established and maintained for this purpose by the Australian government. AIG also continues to maintain a strong, enforceable Code of Ethics, that each member agrees to be bound by and each membership applicant receives as part of their membership application kit so that they are fully aware of the requirements and obligations associated with it.

The Council is not aware of any outcome regarding proposed changes to Canadian securities reporting requirements that would have required overseas professionals submitting technical reports to be represented by a Canadian agent who, in turn, could be contacted by securities regulators with any questions relating to reports. The proposal was strongly opposed by AIG. The lack of a response to date leads us to assume that the matter is still being considered.

The JORC and ASX issues papers, to which responses were sought by the end of January this year, both received a large number of responses from both individual geoscientists and industry. The responses to the JORC issues paper are currently being considered by the JORC Committee, which is also working closely with ASX to maintain the existing links between the ASX Listing Rules and the JORC Code during the revision process. The work in progress currently will lead to proposed amendments to the JORC Code being provided to AIG, AusIMM and MCA members later this year, and introduction of a new version of the JORC Code, hopefully, before the end of 2012. A review of the VALMIN Code has also commenced, but substantial progress is not planned until the JORC review is completed due to the links between the two codes.

2011 has also been a year in which we have seen increasing government regulation of access to land for exploration across Australia and increased economic imposts on mining companies, all at a time when the ability of companies to raise capital to fund exploration and project development has become increasingly difficult. Australia's capital markets are now ranked fourth, globally, behind the TSX, TSX-V and the London Stock Exchange as sources of capital for exploration and mining projects. This highlights the need for effective measures to help maintain investor confidence, such as the JORC and VALMIN Codes. There is also an ongoing need to remind governments in Australia of the global nature of the exploration and mining industries and the need to ensure that they remain internationally competitive. Australia competes with many countries for exploration activity, but competes against only a few, developed countries for the generation of capital, all of which are arguably subject to similar economic and social pressures affecting the development of their local exploration and mining sectors and dealing with those issues in a manner that does not create perceptions of sovereign risk or unduly lengthy and complex administrative projects that ultimately drive investment off-shore. AIG regularly monitors geoscience employment trends in Australia through regular surveys which depend on member contributions and provides a more rapid measure of trends in the sector than official statistics. The importance of sustained investment in our resource industries is clearly a message that needs to be continuously delivered in a concerted manner throughout the coming year by both industry and professional representative bodies.

AIG is two years into a five year plan to help focus the continued development of the Institute. Over the past year, we have experienced solid growth in membership, and retention of existing members, which provides the fundamentals for the development of Institute activities. AIG has also developed a strong student membership base by offering student membership free of charge to undergraduates studying at Australian universities and establishing positions for university student representatives on local branch

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Draft Senior Secondary Curriculum – Earth and Environmental Science

AIG NEWS HAS RECEIVED the latest draft of the proposed high school curriculum and it is interesting to discover that geology has disappeared as a subject and is now part of "Earth and Environmental Science". Biology, Chemistry and Physics retain their former status as separate subjects. The curriculum may be accessed at (http://www.acara.edu.au/curriculum/development_of_the_australian_curriculum.html).

Why geology has disappeared as a specific subject and sub merged into environmental science seems to have been politically motivated rather than anything else.

The units themselves are revealing, especially the wording that emphasizes Earth "spheres"; One wonders whether this means a sphere of influence or a physical sphere, but it's obvious that it means the former. However, the emphasis seems biased towards environmentalism rather than geology per se.

The organization of content is via three interrelated strands, "Science Understanding, Science as a Human Endeavour and Science Inquiry Skills". If AIG members are starting to realize that what is being described here is couched in "post-modernism", then that seems correct. Here's how the draft describes "Science as a Human Endeavour": *"Through science, humans seek to improve their understanding and explanations of, and ability to predict phenomena in, the natural world. Since science involves the construction of explanations based on evidence, science concepts, models and theories can be changed as new evidence becomes available, often through the application of new technologies. Science influences society by posing, and responding to, social and ethical questions, and scientific research is itself influenced by the needs and priorities of society,*" and

" This strand highlights the development of science as a unique way of knowing and doing, the communication of science, and the role of science in decision making and problem solving. In particular, this strand develops both students' understanding of science as a community of practice and appreciation that science knowledge ***is generated from consensus within a group of scientists*** *and is therefore dynamic and involves critique and uncertainty. It acknowledges that in making decisions about science practices and applications, ethical and social implications must be taken into account".*

Science is not consensus and this view needs to be critically examined by AIG members. It seems there is a specific effort to slowly eradicate geology as a science by submerging it in environmental science that is dominated by a consensus approach, and this approach has to viewed as alarming for it heralds the debasement of the scientific method as it has been practiced since the enlightenment. As there are few geology departments in the nation's universities, it is likely that the profession of geology might be headed towards extinction if this trend of post-modernist science is not stopped. ▲▲

Louis Hissink

From Your President

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committees. The aim of this initiative is to demonstrate the value of professional engagement throughout all stages of every geoscientist's career.

The Institute has adopted a model of cooperation with commercial conference organisers for the development and delivery of major events, without compromising on the principle of ensuring that attendance at major seminars and conferences remains affordable without compromising on event quality, both in terms of technical content, relevance and venues. Recent events delivered under this model include highly successful Exploration Technology and Resource Evaluation conferences held in Perth, soon to be joined by the Structural Geology and Resources 2012 conference in Kalgoorlie this September, in conjunction with SEG. Planning for a major Australasian exploration and mining conference to be held in Bali in May 2013 is at an advanced stage, which will be AIG's first conference held outside Australia. The series of after-work and one day seminars held throughout Australia has also been enhanced with regular events in Perth, Brisbane, Ballarat and Sydney throughout the year which underline the importance of AIG's state branches in the delivery of benefits of membership at a local level. This increase in activity has been supported by the engagement of administrative and commercial assistance, particularly with branch administration and event organisation on a contract basis, where event revenue covers the cost of providing much needed assistance to the valued work of the volunteers who form AIG's branch committees. AIG has also played an active role in preparations for the International Geological Congress to be held in Brisbane this August, which will showcase Australia and Australian geoscience globally.

During 2012, the Council took the step of making all Institute publications a benefit of membership by providing publications in electronic form, free of charge to members, while maintaining sales to non-members. Developing the range of publications available to members will receive continued focus, particularly over the next few years.

A third element of the strategic plan is to foster increased member engagement in AIG activities. One of the initiatives endorsed by the Council in this area is the formation of technical specialist groups within AIG, covering any field of geoscientific practice, where members with a common interest can exchange ideas and promote both professional and technical development in particular disciplines, with the support of the Institute. Engagement by members in Institute affairs is also key to ensuring that AIG remains relevant and focussed on members' professional interests and needs. This focus has been at the core of AIG's success in the past and will remain so in the future. All members are encouraged to express their views, or initiate debate on any issue affecting our profession at any time. Contact details for Councilors appear in every edition of AIG News. The Secretariat office in Perth can also be used as a point of contact for any issues of concern. In many instances, the office will not be able to resolve problems that are not related to administrative matters, but will certainly be able to ensure that any enquiry receives prompt attention. There are any number of ways that members raise topics for discussion with colleagues, from a letter in AIG News, to the AIG group on Linkedin or the AIG web site where any member who is logged in to the site can access the forum pages or even comment directly on any article published on the site. AIG News, our web site, www.aig.org.au, and branch newsletters are recognised as being critical to the timely provision of information to members. We are open to suggestion as to how these information sources can be added to or improved in order to ensure that members are well informed regarding developments in our profession.

Continued professional development, (CPD), is also central to AIG's strategy and vision for the future of our profession. Participation in CPD is a fundamental component of being considered to be a professional. Conferences, seminars, after-work talks are all important means of delivering CPD opportunities that have been used since the Institute's inception. During the past year, AIG entered into a relationship with Edumine to establish an AIG Campus, providing members with very low cost access to high quality CPD resources on-line.

The AIG Student Bursary program also continues to be generously supported by both corporate and individual sponsors through our Education Foundation which is a registered deductible gift recipient for taxation purposes. The program provides valued support for both undergraduate and postgraduate students at Australian universities each year and in doing so, assists students with the first steps in their professional geoscientific careers.

This year marks 30 years since AIG was founded. Celebrating 30 years as an anniversary may seem somewhat odd - 25 and 50 years are more traditionally celebrated anniversaries. 30 years is, however, in modern Australia the average length of many careers and the anniversary, fortuitously, coincides with the IGC in Brisbane later this year. The anniversary is being marked by the presentation of special commemorative certificates to foundation members of the Institute throughout the year.

The continued development and success of AIG throughout the past year would not have been possible without considerable work by dedicated members forming our State Branch committees, committees dedicated to the improvement of professional practices, and the Institute's Council. These members have devoted considerable effort to both the delivery of networking opportunities and technical events throughout Australia, worked to enhance AIG's developing relationships with other professional societies and industry associations both within Australia and, increasingly, internationally, the continuous improvement of professional standards and, most importantly, the perception of Australia's geoscience profession in Australia and, increasingly, throughout the world. There is never any shortage of opportunities for all members to join in these activities. Several Councillors are stepping down at this AGM. Amongst them, Jillian Irvin deserves special recognition for many hours of work in maintaining the integrity of AIG's membership application processes throughout a period of sustained and strong membership growth.

The continued development of AIG will bring new challenges as it proceeds. The Institute will, however, act at all times to remain focussed on the interests of members first and foremost, responsive on issues affecting all sectors of the geoscience profession.

Andrew Waltho, President

Australian Institute of Geoscientists

From the Editor

THE YEAR 2012 started with rather worrying developments concerning proposed government regulation of the news media, as well as internet blogs that exceed a specific "hit rate".

The original impetus for this interest stemmed from the Rupert Murdoch owned News of the World phone hacking scandal in the UK which then led to calls for an investigation into the Australian Murdoch press by the Greens. Last year Murdoch press journalist Andrew Bolt was found guilty of causing offense via his political blog published by the Herald Sun, widely interpreted as an assault on free speech under an obscure section of the Racial Discrimination Act. All these events finally led to a government commissioned review of the media as the Finkelstein Report which handed down its recommendations at the beginning of this year, and among some of its conclusions was the judgement that we, the people, are not able to make up our minds about matters of technical import such as climate change. The Finkelstein report caused a furious reaction among the conservative policy organisations like the IPA (Institute of Public Policy) that inevitably resulted in a less draconian Convergence Review that was about how government could regulate the mainstream media and its "convergence" with the internet. Given that AIG News could fall into the jurisdiction of the proposed media regulations, I thought it was time this issue was alerted to the members of AIG.

As editor I have some editorial discretion and after thinking at the time about the ramifications of the soon to be released Finkelstein Report, taking in consideration the political motivation behind it, it slowly dawned on me that another problem was coming over the horizon – that of not presenting an editorially balanced exposition of some current topic "du jour" of interest to AIG members. That meant that not only had AIG News to be seen to be balanced, but also to be balanced in its coverage of issues, and as an initial effort at "balance", a metaphorical dipping the toe into the water say, AIG News thus published a recent article by Guy Bertault that was sure to affect the sensibilities of some AIG members; It did and the article caused two reactions from AIG Members, one who penned a letter which is published elsewhere in this AIG News, and another who wrote to AIG President Andrew Waltho, keeping me in the loop via email, and whose deliberations won't be published since those were not written as a letter to the editor in the first place. The article also caused minor flak in Perth, but which sputtered ineffectually when it was pointed out that quite a few members of the AIG may actually be sympathetic to the ideas expressed by the French Connection.

AIG Members should also realise that AIG News undergoes a fairly rigorous editing and content review after the first draft is completed and sent to AIG Communications Committee for review. Often provocative articles are pulled at the 11th hour and replaced with other, less provocative, ones. Occasionally approved op-eds are so offensive to some AIG members that calls for the editor's decapitation are occasionally demanded, though to date this outcome has been avoided by countering those demands with fairly explicit rebuttals in language not considered suitable for a family oriented publication.

However the ramifications of the proposed legislation seems to not have been well thought out, though it has become clear, over time, that one purpose of the proposed media regulation was to silence climate scepticism, specifically Murdoch journalist Andrew Bolt whose coverage of the issue could not be described as "balanced" in any reasonable sense of the word. However it hardly needs mentioning that Bolt is paid to be provocative – the idea is to sell newspapers and the advertising, after all. Did I mention that two AIG members expressed a reaction to the Bertault article – well apparently a third member contacted Andrew Waltho on a related theological issue and Andrew's summary confirmed my suspicions that if the Finkelstein Report was to be implemented, then compulsory balanced publication would have the potential to cause quite some problems for AIG News.

The risk to AIG News is that if someone reading an article in AIG News becomes offended by that article, then under the new proposed media regulations there is a good chance that AIG News will be legally compelled to publish a balanced view. Under the present system any complaints are limited to the writing of letters to AIG Council who then deliberate. Under the new proposed system government will be arbitrating what might, or not, be published in AIG News.

In case I haven't totally made the point, being forced to offer a balanced reporting of an issue, publishing both sides of the argument, as it were, would require AIG News also publish Creationist Articles in equal proportion to non-creationist ones, climate sceptical articles balanced by climate alarmist articles, and heaven's knows what else would require balanced publication. However there is another fact to be considered – freedom of expression.

One might think that the watered down proposals in the later Convergence Review might be acceptable but according to the IPA in a recent op-ed,

- The Convergence Review recommends establishing a government-enforced regulator 'to enforce a media code aimed at promoting fairness, accuracy, and transparency in professional news and commentary.' (!)
- The government-enforced regulator will be 'an independent self-regulatory news standards body'. It's called 'independent' but the government will force all large media companies to belong to it. The regulator will have the power to force companies to censor news and commentary.

Now a small professional organization like the AIG could hardly be expected to be part of the monolithic mainstream media in Australia, but then as an incorporated professional entity, company law does apply to us and it could be argued that anything AIG publishes, whether on the AIG web site or via AIG News, could be interpreted to require us to have "fairness, accuracy, and transparency in professional news and commentary".

AIG Members might think about these matters and write us?

In this issue long standing AIG member Ian Levy has written an interesting geostatistical analysis of Australia's long term temperature record as the scientific basis for a letter he wrote to the CSIRO which is not republished here, but CSIRO's reply is.

Finally AIG News republishes a fascinating summary of central banking by economist Jeffrey Herbener as his submission to the Subcommittee on Domestic Monetary Policy of the U.S. House of Representatives recently; it's important members understand the connection of mining to the fundamentals of economic policy and this summary is one of the best. ▲▲

Letter to the Editor

Sir.

It was with growing perplexity, followed by growing horror, followed by overwhelming relief and laughter, that I read the opinion piece by Guy Berthault. I must admit, without a preamble or post-script framing the content, it was unclear that this was a satire of the highest caliber: To imagine that I thought for a moment that the journal of the Australian Institute of Geoscientists would publish an article by a young earth creationist about scientific illusions.

I must say, seeing this in my first copy of the quarterly newsletter did make me wonder about the nature of the organisation that I had just joined. Instead, I offer you my heartiest congratulations on a truly Swiftian effort. I look forward to receiving the next edition.

Dr. Gerald Hartig, AIG student member

School of Earth Sciences, University of Queensland

(Thank you, and I hope we will not disappoint in the future - ed.)

Production of Money on the Market

Written Testimony by Jeffrey M. Herbener Professor of Economics Grove City College Before the Subcommittee on Domestic Monetary Policy and Technology Committee on Financial Services U.S. House of Representatives, May 8, 2012

IN A SEMINAL ARTICLE published in 1920, Ludwig von Mises demonstrated that there is only one test of whether or not production of something conveys a benefit on society at large.[1]

It must be shown that resources have greater value when used to produce a good to satisfy the preferences of some people than when they are used to produce a different good to satisfy the preferences of other people. Production left to the market satisfies the profit and loss test of socially beneficial production. For Tim Cook to obtain computer chips, glass screens, labor and other resources to produce iPads, he must bid them away from other entrepreneurs who would have used them to produce other goods. By incurring the costs of production, Apple Inc. compensates the owners of resources for the value of the other goods they could have produced to satisfy a different group of consumers. Apple then uses the resources to produce iPads, which consumers of its products value more highly as demonstrated by their generating enough revenue for Apple Inc. to more than cover its costs.

The profit and loss test applies to all production in the market, including mining gold and minting coins. A gold mining company will produce when the revenues from the sale of its output exceed the costs of buying its inputs. The company moves labor, mining equipment, land, and other resources away from uses consumers find less valuable into gold mining, which consumers find more valuable. A minting company will produce when the revenues from the sale of its service in certifying gold exceed the costs of buying its inputs. The company moves labor, minting equipment, land, and other resources away from uses consumers find less valuable into minting coins, which consumers find more valuable.

Like the production of all other goods, production of money left to the market is regulated by profit and loss. Additional money is produced when demand for money increases or demand for other goods produced by the same resources decreases. If the demand for money increased, the value of gold coins would rise. Minting companies would increase production to capture the profit. As they increased the supply of certification service, its price would decline and as they increased their demands for resources to certify gold, resources prices would rise and the profit would dissipate. If demand for other goods declined, input prices would fall. Minting companies would increase production to capture the profit and, by doing so, eliminate profit from further production. In this way production of money in the market is socially optimal.[2]

The profit and loss test also applies to the production of money certificates in the market.[3] Money certificates are titles of ownership to money issued by banks that serve as money substitutes. People may find convenience and safety in using checking account balances instead of commodity money when making trades. Banks will produce and maintain checking accounts for customers if they are willing to pay fees to banks that generate revenues sufficient to cover the costs of managing the accounts. If the demand for checking accounts increased, then banks would expand them to capture the

profit. As they increased their supply of checking account services, the fees would decline. And as they increased their demand for the resources to manage checking accounts, their prices would rise. As a consequence, profit would dissipate and additional production would cease at the socially optimal point.

The profit and loss test also applies to financial intermediation. Banks perform a middleman function in credit markets by borrowing from savers and lending to investors. They provide the services of pooling the savings, checking the credit worthiness of investors, and bearing the risk of loan defaults. If customers of banks find these services valuable, they will be willing to accept lower interest rates for lending to banks than investors will be willing to pay banks to borrow. Banks will provide financial intermediation services, if the revenues earned from the interest rate differential are large enough to cover the costs of producing the services. If demand for these services increases, banks will increase production of them. Their increased demand to borrow from savers and supply to investors will reduce the interest rate differential. Their increased demand for the resources will raise their prices. Profit will dissipate and additional production will cease at the socially optimal point.

By subjecting all production, including that of money and banking, to the test of profit and loss, the market renders an integrated system of production that economizes the use of all resources for society at large.

Monetary Inflation and Credit Expansion

An elastic currency breaks the integration of production on the market by being an element foreign to the test of profit and loss. An elastic currency has two characteristics: a central bank empowered to issue fiat paper money and commercial banks empowered to issue fiduciary media.[4] The production of fiat paper money cannot be regulated by profit and loss. It is always profitable to produce more. In 2011, the average cost of the 5.8 billion Federal Reserve Notes produced was $0.091.[5] So a profit of around $4.90 is made by printing and spending a $5 bill. If the Fed continued order the printing of FRNs as long as it was profitable, then eventually prices of inputs would rise so that it cost more than $5 to print a $5 bill. Then the Fed could order the printing of $50 bills instead and so on indefinitely as we have witnessed in hyperinflations like Zimbabwe's. To avoid destruction in hyperinflation, production of fiat paper money must be regulated by policy, by a rule that is arbitrary with respect to economizing production for society at large.

The production of fiduciary media cannot be regulated by profit and loss.[6] Fiduciary media are redemption claims for money which are fractionally backed by a reserve of money. Banks issue fiduciary media by creating loans. For example, a customer applies at his local bank for an auto loan of $25,000. If the bank agrees to extend the loan, it just writes a $25,000 balance into the customer's checking account. The loan generates interest revenue for the bank while the cost of issuing fiduciary media is nominal. It is always profitable for the bank to create another loan by issuing fiduciary media. If a bank issues more fiduciary media by creating credit as long as it is profitable, it will become illiquid and insolvent and end in collapse. To avoid such destruction, a bank must regulate its issue of fiduciary media via credit creation by policy, by a rule that is arbitrary with respect to economizing production for society at large.

Advocates of an elastic currency realize that its production cannot even be subjected to, let alone pass, the profit and loss test. As F.A. Hayek wrote, "There is no justification in history for the existing position of a government monopoly of issuing money. It has never been proposed on the ground that government will give us better money than anybody else could."[7] Advocates of an elastic currency merely assert that it can achieve a desirable outcome that a system of commodity money and money certificates cannot. There are three such claims for an elastic currency. First that it can keep the price level stable. Second, that it can prevent price deflation. And third, that it can accelerate economic growth.

Maintaining Price Stability

There is no social benefit from keeping the price level stable. The alleged benefit is that price stability prevents wealth transfers between creditors and debtors and between workers and capitalists. But such transfers assume that entrepreneurs fail to anticipate changes in money's purchasing power. Entrepreneurs can earn profits and avoid losses by anticipating these changes just as well as changes in prices of other goods. If they anticipate rising prices for goods overall, then they will increase their demands for resources today bidding up wages today. Likewise, lenders will insist on higher interest rates today. An elastic currency adds another dimension of uncertainty to changes in money's purchasing power. It makes the task of entrepreneurs more, not less, difficult. In extreme cases, an elastic currency can result in wildly unstable prices that paralyze entrepreneurial decision making and destroy production on the market. Being regulated by profit, production of commodity money responds only to changes in people's demands. If money demand

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Production of Money on the Market

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rises, the resulting increase in money's purchasing power would bring forth more production of money and moderate falling prices. The modest price deflation over time in a market economy is an integral part of its economizing production.

Moreover, in practice the advocates of price stability aim at price inflation of around two percent per year. But, if entrepreneurs can adjust their expectation to cope with a two percent per year price inflation in an elastic currency system, then certainly they can properly anticipate and deal with a two percent per year price deflation under a commodity money system.[8]

Finally, two of the periods of most rapid economic growth in U.S. history were from 1820-1850 and 1865-1900. In each of these periods, the purchasing power of the dollar roughly doubled.[9]

Preventing Price Deflation

There is no social benefit from preventing price deflation. There are two claims to the contrary. The first alleged benefit is that if prices begin to fall, then people form expectations that they will fall further and they put off spending today which pushes prices down even further which re-enforces deflationary expectations. The collapse of spending discourages production and employment. But, the downward spiral of prices is merely the logical implication of assumptions about expectations within formal economic models. If you assume that the agents operating in an economic model suffer from expectations that are self-reinforcing, then the model will produce a downward spiral. But, people in the real world can only obtain the services of goods by buying them. They choose at some point, to buy a good even if they expect its price to fall further. This happens every day in markets for consumer electronics as people buy tablet computers, cell phones, and so on knowing that prices will be lower and quality higher in the future.

Because there is demand for goods and hence prices, whether people expect prices to increase, decrease, or stay the same, speculation earns profit and avoids loss by accurately anticipating the level of future prices. If people anticipate a significantly lower price for a good in the future and withhold their demands for it today, the price quickly falls to the level they anticipated and then they buy the good. Speculation moves prices before they would move without speculation, but not further than they would move without it. This happens every day in financial markets as speculators move prices up and down without generating upward or downward spirals.

The second alleged benefit is that price deflation pushes down output prices but input prices are sticky; therefore, profits evaporate and entrepreneurs cut production and fire workers.

But entrepreneurs choose the degree of price stickiness that their customers and employees prefer. In many cases consumers prefer prices of goods to remain more stable from day to day or hour to hour or minute to minute instead of fluctuating with every increase and decrease in demands. In other cases, buyers prefer complete flexibility in prices. Entrepreneurs can earn profits and avoid losses

by catering to these preferences. In many cases, workers prefer to have their wages set over a period agreed upon with the entrepreneurs instead of having them move daily or hourly with the movements in demand for the goods they help produce. In cases where workers desire more flexibility in their compensation, an entrepreneur will make stock in the enterprise part of their compensation. When circumstances change, it is in everyone's interest to modify the normal arrangements. Entrepreneurs offer deep discounts of their goods when demand permanently falls. They renegotiate contracts with workers and other input suppliers when losses accumulate. In this way, the degree of price stickiness in markets can be changed to avoid adverse effects.

Moreover, entrepreneurs earn profits and avoid losses by anticipating these changes. If they anticipate falling prices of their outputs, they will reduce their demands for inputs today pushing their prices down. When output and input prices fall together, profit and production are maintained. The symmetric process occurs during price inflation. If entrepreneurs anticipate higher output prices, they will increase their demands for inputs today pushing their prices up. As a result, output and input prices move up together and profit and production are maintained.

Even if the prices of inputs entrepreneurs buy remain sticky downward, the effect on their profit and production is cushioned by the decline in the value of the assets they own. The market value of their assets adjusts downward with the decline in the prices of their outputs as investors reduce their demands to hold claims to these assets in financial markets. A decline in the value of their assets restores the profitability of production. Entrepreneurs with superior foresight in anticipating declines in the prices of their output will invest sufficient equity in their enterprises to cushion the blow and provide time for adjustments in the prices of their inputs.

UCLA economist Andrew Atkinson and Minneapolis Federal Reserve Bank economist Patrick Kehoe in a 2004 *American Economic Review* article, have shown that there is no correlation between deflation and depression.[10] Looking at the evidence across 17 countries over more than 100 years, they concluded, "A broad historical look finds more periods of deflation with reasonable growth than with depression, and many more periods of depression with inflation than with deflation. Overall, the data show virtually no link between deflation and depression."[11] Even for the Great Depression, they find that while all 16 countries for which there were data experienced deflation only 8 of them had a depression. And the relationship between deflation and depression was not statistically significant. For all other periods, beginning in 1820 for some countries, 65 of 73 deflation episodes had no depression and 21 of 29 depressions had no deflation. They wrote, "In a broader historical context, beyond the Great Depression, the notion that deflation and depression are linked virtually disappears."[12] When all periods are put together, they found that "a 1-percentage-point drop in inflation

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Production of Money on the Market

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is associated with a drop in the average real growth rate of just 0.08 of a percentage point, say, from 3.08 to 3.00."[13] Finally, when they break the data into Pre-WW II and Post-WW II, they find a stronger correlation between deflation and depression for the early period, but a correlation between inflation and depression in the later period.

Stimulating Economic Growth

There is no social benefit from attempting to accelerate economic growth. The alleged benefit is that monetary inflation through credit expansion builds-up the capital structure of the economy more fully than otherwise. Monetary inflation and credit expansion generate the boom-bust cycle, however, not economic growth.[14] The capital structure of the economy is the stages of production from extraction of raw materials to the production of intermediate capital goods to the production of consumer goods. Iron is mined out of the ground, then steel is made, then fenders for an automobile, then the automobile is assembled. In a market economy, not only is each production process justified by passing the profit and loss test, but the entire capital structure satisfies people's inter-temporal, or time, preferences. The degree to which they desire to postpone their current consumption by saving and investing to build up capital capacity across the capital structure in order to enjoy more and better consumer goods in the future is satisfied in the market. If people intensely desire present consumption over future consumption, then the premium they place on the present, that is, the interest rate, will be high and the amount of their saving and investing will be small and their consumption will be large. Only a small number of investment projects will be profitable; therefore, the capital structure will not be built up extensively. If people lower their time preferences, then the interest rate will fall and they will save and invest more and consume less in the present. With more resources at their command, entrepreneurs will build up the capital structure more extensively. The greater productivity of the expanded capital structure results in the production of more and better consumer goods. This is the process of economic growth. And, as with other aspects of production in a market economy, people get the amount of economic growth that they prefer.

Credit expansion suppresses interest rates below the levels determined by people's time preferences and increases funds for investment beyond the amount determined by people's preferences for saving. When the borrowers spend the additional money, they bid up the prices of the goods they are buying. Prices of houses and cars, for example, are pushed up by the addition demand of consumers made possible by credit creation. Prices of producer goods are also bid up by the additional demand of entrepreneurs made possible by credit creation. Prices for auto factories, lumber mills, are pushed up and the capital goods across the capital structure used to produce goods in the expanding areas, iron mines, timber lands, and so on. Monetary inflation through credit expansion makes it possible for borrowers to demand more assets without lenders reducing demands for other goods. Therefore, rising asset prices increase the profitability of their production while the profitability of other goods need not decline.

Not enough resources are released from the production of other goods to complete all of the projects made profitable by the credit expansion. With a market monetary system, the proper amount of resources are made available because an increase in the supply of credit can only be brought about by people saving more and consuming less. The additional investment projects made profitable by the increase in saving are balanced by the projects no longer profitable because of the reduced consumption. But with an elastic currency system, the build-up of capital capacity and other investment projects financed with created credit do not wind up satisfying people's time preferences. The build-up of the capital structure during the boom is unsustainable. It ends in the liquidation of the build-up in the bust.

What brings the boom to an end is the re-establishment of people's time preferences and preferences for saving. People do this through the disbursement of their incomes. The credit created during the boom is spent by the borrowers to buy goods, houses, factories, etc. The entrepreneurs who produce these goods then receive the new money as revenues for selling the goods. They pay producers to buy the resources used to produce the goods. The new money is then income for the producers. People disburse their income to satisfy their preferences, including their time preferences. They prefer to save only a fraction of their incomes. Although the entire amount of the new money issued starts out increasing the supply of credit, only a fraction of it winds up as supply of credit. Monetary inflation and credit expansion runs counter to people's time preferences and market economies operate to satisfy people's preferences.

Another factor working against the sustainability of the boom is that the further credit expansion extends the riskier the projects and the less creditworthy the borrowers become. As financial intermediaries, banks economize credit, lending to the highest return, most secure projects and the highest interest rate, most credit-worthy borrowers. Additional credit must be extended to lower return, less secure projects and lower interest rate, less credit-worthy borrowers. If monetary inflation and credit expansion go on far enough, investors refuse to accept the additional risk and sell out of the lines of production expanded during the boom. Since the prices of assets in the more sound projects have been bid up along with the prices of projects in the less sound projects, investors in the more sound projects will also lose wealth if they continue to hold their investments.

Once people restore interest rates and asset prices to the levels that reflect their preferences, the particular lines of production in which malinvestments have been made in building up the capital structure during the boom are revealed. The bust consists of reconfiguring the malformed capital structure to best satisfy people's preferences. Mal-invested assets must be sold to entrepreneurs in lines of production that will prove to be profitable. Labor must be re-allocated away from boom lines into production supported by people's preferences. As with all production decisions, these can be made in the most economizing fashion by entrepreneurs earning profits from their superior foresight in satisfying preferences and suffering losses for their inferior foresight.

An elastic currency is the cause of financial crises and economic downturns. Supplant it with a market system of commodity money and money certificates and there would be no crises and downturns. The residual business fluctuations would not justify government intervention to solve the social problems associated with crises and downturns.

As the monetary system has become more elastic in American history, booms and busts have worsened. George Selgin, William Lastrapes, and Lawrence White conclude, in their 2010 *Cato Working Paper*, that recent research demonstrates that the Fed has not lived up to its original promise.

Selgin, Lastrapes, and White summarize their findings on the performance of the Fed in these words: "Drawing on a wide range of recent empirical research, we find the following: (1) The Fed's full history (1914 to present) has been characterized by more rather than fewer symptoms of monetary and macroeconomic instability than the decades leading to the Fed's establishment. (2) While the Fed's performance has undoubtedly improved since World War II, even its postwar performance has not clearly surpassed that of its undoubtedly flawed predecessor, the National Banking system, before World War I. (3) Some proposed alternative arrangements might plausibly do better than the Fed as presently constituted. We conclude that the need for a systematic exploration of alternatives to the established monetary system is as pressing today as it was a century ago."[15]

I concur with their conclusion. Economic theory and historical evidence demonstrate that a central bank confers no benefit on society at large. The Fed should be abolished and a market monetary system of commodity money and money certificates should be established.

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Production of Money on the Market

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Monetary Reform

The goal of monetary reform is to make money production subject to the profit and loss test of socially beneficial production. Money production must become an integral part of the market economy. There may be several viable paths of transition to a system of market production of money, but any such path must take account of Carl Menger's famous demonstration that an item can only arise as money consistently with what people are actually using as the most widely traded good.[16] After the transition, a monetary system integrated into the market economy could begin.[17]

Federal Reserve Notes are money in the American economy. Thus, the most direct way to establish a market monetary system is to reestablish FRN as redemption claims for commodity money. The most widely-recognized commodity money today is gold coins. The primary step in monetary reform, then, is to turn FRNs into 100-percent-reserve redemption claims for gold coins.

The other step along this path to a market monetary system is to establish a 100 percent reserve of money against bank issued fiduciary media. The Fed's tripling of its balance sheet in response to the crisis of 2008 makes this part of the transition easier. Banks now hold reserves against their checkable deposits in excess of 100 percent. In early April, banks held $1,587 billion in total reserves against $1,204 billion in total checkable deposits. Fifty billion dollars of their total reserves consisted of vault cash and $1,537 billion reserve balances in accounts with the Fed. Therefore, banks would need to build their cash reserves up to 100 percent of their checkable deposits of $1,204 by redeeming $1,154 billion of their reserve balances at the Fed for cash. The Fed could acquire the cash needed by selling some of the more than $2 trillion in assets it built up on its balance sheet during the crisis or by printing more FRNs or some combination of the two. Whatever the total value of FRNs was at the point where checkable deposits are 100 percent backed by a reserve of cash, the redemption value of all FRNs could be set by calculating the ratio of FRN to the gold holdings of the Fed. If no change in the stock of FRNs outstanding was necessary to accomplish the transition, then the calculation would be as follows. The Fed is showing on its balance sheet of April 18, $11.041 billion in gold holding. Valued at $42.22 per ounce, this is 261.5 million ounces of gold. On the same balance sheet, the Fed shows $1,100,160 million in currency in circulation. Thus, the redemption ratio would be $4,207 per ounce of gold. The actual calculation, however, could only be done after an audit of the Fed and the process of establishing a 100 percent cash reserve, described above, were completed.[18]

Once this transition was accomplished, the government should permit private production of money and money certificates according to the general laws of commerce. Mining and minting companies would produce commodity money that people made profitable by their demands. To earn profit, entrepreneurs would produce coins from the metals, in the weights, and with the designs people preferred. They would keep their costs down and invest and innovate

when people's demands made it profitable. Scholars have chronicled many historical episodes of private production of coins. Recently, George Selgin, in his book Good Money, has recounted the production of private coinage in England in the late 18th and early 19th centuries. As he shows, private coinage thrived until the British government outlawed it in 1821.[19]

Banks, too, should be put under the general laws of commerce including those relating to warehousing money by holding a 100 percent reserve of money against their money substitutes. Banks would earn profit by producing the amounts and types of money substitutes that satisfied people's demands. To earn profit, they would keep their costs down and invest and innovate when people's demands made it profitable. The operation of 100 percent reserve banking is described in Jesús Huerta de Soto's book Money, Banking, and Economic Cycles. As he documents, money warehouse banks thrived in Amsterdam for over a hundred years in the 17th and 18th centuries.[20]

Conclusion

No one can describe today the configuration of commodity money and money certificates that entrepreneurs would bring about if permitted to operate private enterprises in their production any more than one could have predicted in 1900 the development of the 21st century automobile industry or predicted in 1950 the 21st-century consumer electronics industry. What we do know is that their production would be regulated by profit and loss and therefore, would result in the satisfaction of people's preferences. The monetary inflation and credit expansion of our elastic currency system would be eliminated and with it the booms and busts that have plagued our history. ▲▲

Notes

1. This is an implication of Mises's famous argument that central planners cannot economize the use of resources in society. See Ludwig von Mises, Economic Calculation in the Socialist Commonwealth (Auburn, Ala.: Mises Institute, 1990 [1920]) and Mises, Human Action, scholar's edition (Auburn, Ala.: Mises Institute, 1998 [1949]), pp. 685-711.
2. Mises wrote that making money production conform to profitability and not politics, "is not a defect of the gold standard; it is its main excellence," Human Action, p. 471.
3. On bank production of money certificates and credit intermediation, see Jesús Huerta de Soto, Money, Bank Credit, and Economic Cycles, trans. Melinda Stroup (Auburn, Ala.: Mises Institute, 2006 [1998]), pp. 1-36.
4. On elastic currency, see Murray Rothbard, The Case against the Fed (Auburn, Ala.: Mises Institute, 1994).
5. Bureau of Engraving and Printing. (moneyfactory.gov/uscurrency/annualproductionfigures.html). April 27, 2012.
6. On fiduciary issue and credit creation, see Murray Rothbard, The Mystery of Banking (Auburn, Ala.: Mises Institute, 2008 [1983]).
7. F.A. Hayek, Denationalization of Money, 2nd edition (London: Institute of Economic Affairs, 1978 [1974]), p. 7.
8. The annualized rate of increase in the purchasing power of the dollar from 1815-1850 was 2.24 percent and from 1865-1900 was 1.75 percent.
9. Murray Rothbard, A History of Money and Banking in the United States (Auburn, Ala.: Mises Institute, 2002), pp. 42-179.
10. Andrew Atkinson and Patrick Kehoe, "Deflation and Depression: Is There an Empirical Link," American Economic Review Papers and Proceedings 94 (May 2004): 99-103. They define deflation "as a negative average inflation rate" and depression "as a negative average real output growth rate." Ibid., p. 99.
11. Ibid., p. 102.
12. Ibid., p. 101.
13. Ibid., p. 102.
14. On the boom-bust cycle, see Mises, Human Action, pp. 535-583; de Soto, Money, Bank Credit, and Economic Cycles, pp. 265-395; F.A. Hayek, Prices and Production and Other Works (Auburn, Ala.: Mises Institute, 2008 [1931]); and Murray Rothbard, America's Great Depression (Auburn, Ala.: Mises Institute, 2000 [1963]).
15. George Selgin, William Lastrapes, Lawrence White, "Has the Fed Been a Failure?," Cato Working Paper Dec. 2010, p. 1.
16. Carl Menger, "On the Origin of Money," Economic Journal 2 (1892): 239–55; Peter G. Klein and George A. Selgin, "Menger's Theory of Money: Some Experimental Evidence," in John Smithin, ed., What Is Money? (London: Routledge, 2000), pp. 217–34.
17. On such monetary reform, see Rothbard, Mystery of Banking, pp. 247-268; Salerno, Money, Sound and Unsound, pp. 333-363; and de Soto, Money, Bank Credit, and Economic Cycles, pp. 736-745.
18. Data from Federal Reserve Statistic Releases: H.3 Aggregate Reserves of Depository Institutions; H.6 Money Stock Measures; and H.4.1 Factors Affecting Reserve Balances. April 19, 2012.
19. George Selgin, Good Money: Birmingham Button Makers, the Royal Mint, and the Beginnings of Modern Coinage, 1775-1821 (Ann Arbor: University of Michigan Press, 2008).
20. De Soto, Money, Bank Credit, and Economic Cycles, pp. 37-114.

The Strange Case of Solar Flares and Radioactive Elements

From the Stanford Report, Aug 23, 2010
BY DAN STOBER

When researchers found an unusual linkage between solar flares and the inner life of radioactive elements on Earth, it touched off a scientific detective investigation that could end up protecting the lives of space-walking astronauts and maybe rewriting some of the assumptions of physics.

It's a mystery that presented itself unexpectedly: The radioactive decay of some elements sitting quietly in laboratories on Earth seemed to be influenced by activities inside the sun, 93 million miles away.

Is this possible?

Researchers from Stanford and Purdue University believe it is. But their explanation of how it happens opens the door to yet another mystery.

There is even an outside chance that this unexpected effect is brought about by a previously unknown particle emitted by the sun. "That would be truly remarkable," said Peter Sturrock, Stanford professor emeritus of applied physics and an expert on the inner workings of the sun.

The story begins, in a sense, in classrooms around the world, where students are taught that the rate of decay of a specific radioactive material is a constant. This concept is relied upon, for example, when anthropologists use carbon-14 to date ancient artifacts and when doctors determine the proper dose of radioactivity to treat a cancer patient.

Random numbers

But that assumption was challenged in an unexpected way by a group of researchers from Purdue University who at the time were more interested in random numbers than nuclear decay. (Scientists use long strings of random numbers for a variety of calculations, but they are difficult to produce, since the process used to produce the numbers has an influence on the outcome.)

Ephraim Fischbach, a physics professor at Purdue, was looking into the rate of radioactive decay of several isotopes as a possible source of random numbers generated without any human input. (A lump of radioactive cesium-137, for example, may decay at a steady rate overall, but individual atoms within the lump will decay in an unpredictable, random pattern. Thus the timing of the random ticks of a Geiger counter placed near the cesium might be used to generate random numbers.)

As the researchers pored through published data on specific isotopes, they found disagreement in the measured decay rates – odd for supposed physical constants.

Checking data collected at Brookhaven National Laboratory on Long Island and the Federal Physical and Technical Institute in Germany, they came across something even more surprising: long-term

observation of the decay rate of silicon-32 and radium-226 seemed to show a small seasonal variation. The decay rate was ever so slightly faster in winter than in summer.

Was this fluctuation real, or was it merely a glitch in the equipment used to measure the decay, induced by the change of seasons, with the accompanying changes in temperature and humidity?

"Everyone thought it must be due to experimental mistakes, because we're all brought up to believe that decay rates are constant," Sturrock said.

The sun speaks

On Dec 13, 2006, the sun itself provided a crucial clue, when a solar flare sent a stream of particles and radiation toward Earth. Purdue nuclear engineer Jere Jenkins, while measuring the decay rate of manganese-54, a short-lived isotope used in medical diagnostics, noticed that the rate dropped slightly during the flare, a decrease that started about a day and a half before the flare.

If this apparent relationship between flares and decay rates proves true, it could lead to a method of predicting solar flares prior to their occurrence, which could help prevent damage to satellites and electric grids, as well as save the lives of astronauts in space.

The decay-rate aberrations that Jenkins noticed occurred during the middle of the night in Indiana – meaning that something produced by the sun had traveled all the way through the Earth to reach Jenkins' detectors. What could the flare send forth that could have such an effect? Jenkins and Fischbach guessed that the culprits in this bit of decay-rate mischief were probably solar neutrinos, the almost weightless particles famous for flying at almost the speed of light through the physical world – humans, rocks, oceans or planets – with virtually no interaction with anything.

Then, in a series of papers published in Astroparticle Physics, Nuclear Instruments and Methods in Physics Research and Space Science Reviews, Jenkins, Fischbach and their colleagues showed that the observed variations in decay rates were highly unlikely to have come from environmental influences on the detection systems.

Reason for suspicion

Their findings strengthened the argument that the strange swings in decay rates were caused by neutrinos from the sun. The swings seemed to be in synch with the Earth's elliptical orbit, with the decay rates oscillating as the Earth came closer to the sun (where it would be exposed to more neutrinos) and then moving away.

So there was good reason to suspect the sun, but could it be proved?

Enter Peter Sturrock, Stanford professor emeritus of applied physics and an expert on the inner workings of the sun. While on a visit to the National Solar Observatory in Arizona, Sturrock was handed copies of the scientific journal articles written by the Purdue researchers.

Sturrock knew from long experience that the intensity of the barrage of neutrinos the sun continuously sends racing toward Earth varies on a regular basis as the sun itself revolves and shows a different face, like a slower version of the revolving light on a police car. His advice to Purdue: Look for evidence that the changes in radioactive decay on Earth vary with the rotation of the sun. "That's what I suggested. And that's what we have done."

A surprise

Going back to take another look at the decay data from the Brookhaven lab, the researchers found a recurring pattern of 33 days. It was a bit of a surprise, given that most solar observations show a pattern of about 28 days – the rotation rate of the surface of the sun.

The explanation? The core of the sun – where nuclear reactions produce neutrinos – apparently spins more slowly than the surface we see. "It may seem counter-intuitive, but it looks as if the core rotates more slowly than the rest of the sun," Sturrock said.

All of the evidence points toward a conclusion that the sun is "communicating" with radioactive isotopes on Earth, said Fischbach.

But there's one rather large question left unanswered. No one knows how neutrinos could interact with radioactive materials to change their rate of decay.

"It doesn't make sense according to conventional ideas," Fischbach said. Jenkins whimsically added, *"What we're suggesting is that something that doesn't really interact with anything is changing something that can't be changed."*

"It's an effect that no one yet understands," agreed Sturrock. *"Theorists are starting to say, 'What's going on?' But that's what the evidence points to. It's a challenge for the physicists and a challenge for the solar people too."*

If the mystery particle is not a neutrino, *"It would have to be something we don't know about, an unknown particle that is also emitted by the sun and has this effect, and that would be even more remarkable,"* Sturrock said. ▲▲

Chantal Jolagh, a science-writing intern at the Stanford News Service, contributed to this story.

34th International Geological Congress (IGC)

Unearthing Our Past And Future – Resourcing Tomorrow

Brisbane Convention and Exhibition Centre

Queensland, Australia 5 - 10 August, 2012

The IGC is the pre-eminent global geoscience congress. Held every 4 years, it has only been held in Australia on one previous occasion - in Sydney in 1976 - when it attracted over 3,500 delegates and provided a major boost for the geosciences in this region. The 34th IGC is being hosted by the Australian Geoscience Council, the peak body for the learned and professional societies. See the wide-ranging and interesting scientific program and field trips, and register for this large and prestigious congress at:

www.34igc.org

AGC

The 34th IGC is supported by the member societies of the Australian Geoscience Council

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34th International Geological Congress (IGC)

Brisbane, Australia, August 2012

www.34igc.org

The 34IGC is rapidly approaching and by the time readers see this article the congress will be less than three months away. There is no doubt the IGC will be the premier geological event in Australia in 2012 and AIG is involved and actively contributing to a number of the scientific programs, field trips, workshops and general 34IGC organisation and planning.

For geoscientists with an industry focus, the IGC promises to have a substantial and diverse range of topics and presentations covering all disciplines of interest will run across every day of the IGC.

A snapshot of the status is as follows:

- Early bird registration closed on 30 April and at that point well over 3,000 registrations had been received
- Over 5,000 abstracts for oral and poster presentations have been received. The scientific program is being finalised
- Each day a plenary program will be featured encompassing:
  - The earth and man: Living with a restless earth
  - What does the geological record tell us about the earth's past climates in relation to projected climate change
  - Energy in a carbon constrained world
  - Resourcing tomorrow: meeting the needs of a growing population
  - Digital earth: The information explosion
- The second world YES Congress (young earth scientists) will be held concurrently at IGC
- Bookings for many of the proposed field trips have received strong support and are now confirmed to operate. Many others are close to the minimum level to operate
- Three GEOHOST training workshops and the funded delegate program have received strong support to provide financial support for young earth scientists and those from lower income countries to attend the IGC
- Nearly thirty pre, during and post conference professional development workshops are being offered and many have received strong support
- Sponsorship of the IGC has now exceeded the budget amount of $0.5M and continues to grow
- The exhibition at the congress is fully booked
- An accompanying program is in development for partners

Previously AIG called on interested members to volunteer assistance and quite a few people contacted me to offer their support. If anyone is interested in volunteering please register on the IGC website using this link http://www.34igc.org/volunteers.php

If you have any queries on any aspect of IGC, visit the website (www.34igc.org) or contact me. ▲▲

Mark Berry
(AIG representative on the 34IGC Organising Committee)
mberry@amcconsultants.com.au

30th Anniversary Member

Bill Peters

AIG Member No 2249

Bill Peters joined the AIG thirty years ago but spent the last thirty eight years as an exploration geophysicist both as a company employee and as a consultant and business manager. He's highly experienced in the application of geophysical techniques in mineral exploration for gold, base metals, iron ore, uranium, nickel, diamonds, coal, beach sand heavy minerals, platinum, and rare earths, and is experienced in the application of potential fields methods for hydrocarbon exploration and was directly responsible for the geophysical discoveries of several mines.

His professional career, after emigrating from England started with McPhar Geophysics, Anglo American in Southern Africa, BHP back in Australia, a stint as a lonely consultant, to finally culminate as MD of Southern Geoscience Consultants in Perth, WA.

Bill's company, Southern Geoscience Consultants sponsors the annual AIG WA-GSA Christmas boat cruise in Perth.

Resource Evaluation and Mining 30th March 2012

Jacqui Coombs

Louis Voortmann

John Henstridge

Ian Plimer Dinner 30th March - "How to get expelled from school"

Ian Plimer, Sebastian Vearncombe, Ronan Dixon, Richard Chen (all age 10) and Conrad Dixon (age 14)

Wayne Spilsbury introduces speaker Ian Pilmer

Ian Plimer, Jocelyn Thomson and John Vann (one of Ian's former students)

L to R: Richard Chen, Sebastian Vearncombe, Ronan Dixon and Prof Barry Marshall (Nobel Prize winner)

The Sun Rules Our Climate – Obviously

Ian Levy

CSIRO's STATE OF THE CLIMATE 2012 report and press releases by the Bureau of Meteorology suggest we should disregard the recent falls in global temperatures, blaming it on La Nina – making excuses as if La Nina was not part of our climate. And proponents of the unproven hypothesis that human induced atmospheric CO_2 controls our global climate seem undaunted by the fact that CO_2 emissions have increased over the past 15 years of industrialisation by China and India and yet there was no resulting global warming.

This myth is busted but persists because it is a pillar of the "climate change" creed that forewarns of terrible apocalypse if mankind does not mend its way. Fortunately, mankind is always improving.

The Global Temperature statistics reveal patterns which show that world's climate probably entered a 33-year cooling period at the end of 2010. Australia should delay the introduction of the Carbon Tax until 2014 so that we have had time to assess the Global Temperature data for years 2012 and 2013 at least.

1. Data Presentation – a trap for beginners

Global temperatures are expressed as degrees difference from the "average" of the 1961-1990 temperatures. This statistical manipulation disguises the cycles in the data, so temperatures herein are restored back to their original Celcius values.

2. Look at the Data:

Plotting temperatures over time in Figure 1, we see some cyclical patterns:

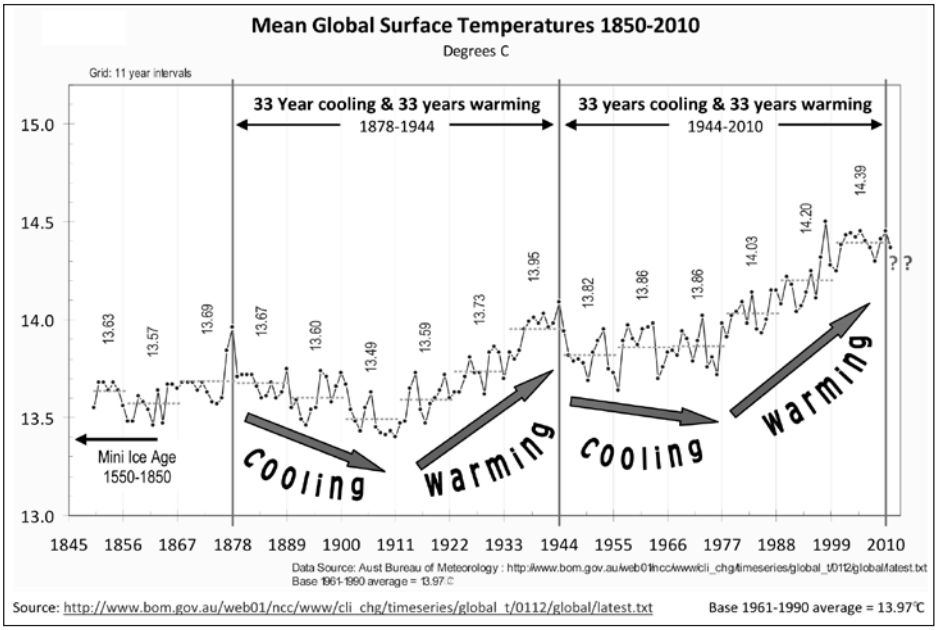


Figure 1.

Observations

- Two distinct peaks in temperatures at 1878 and 1944 (66 years apart);
- A distinct minimum temperature in 1911 (33 years after 1878 & 33 years before 1944);
- Two warming periods: 1911 to 1944 (33 years) and 1977 to 2010 (also 33 years); and,
- A possible longer warming period from 1955 (or 1956) to 2010 (55 years).

Conclusions:

The patterns seem to occur at 33, 55 and 66 year intervals – all multiples of 11 years.

3. What has an 11-year cycle?

The sun rotates its magnetic field every 22 years – a phenomenon called the "solar cycle". Earth absorbs energy and nuclear debris from the sun, especially from solar nuclear firestorms that create "sunspots" which occur in 11-year cycles. This solar half-cycle appears to be most likely cause of 11-year patterns.

So, Figure 1 has 11-year intervals marked and for each interval, the average temperature is shown as dashed horizontal lines with the average temperature value shown above the line. These 11-year statistical means reduce the impact of the short-term noise in the data.

4. 33 Years Cooling Follow Each Peak Temperature Year

The peak temperatures in 1878 and 1944 are 66 years apart. The next 66-year interval ends in 2010. It appears highly plausible that 2010 was a peak temperature year just like 1878 and 1944.

The 11-year average temperature for 1867-1878 was hotter than the two preceding 11-year periods and was followed by 3 distinctly colder 11-year periods. The 11-year average temperature for 1933-1944 was hotter than the three preceding 11-year periods and was followed by 3 distinctly colder 11-year periods.

Continuing this pattern in Figure 1, the 11-year average temperature for 1999-2010 was the hottest since 1850, and if so, it may well be followed by 33 cooler years and the next warming cycle may start in 2043. If this happens, it will debunk the unproven hypothesis that human-induced atmospheric CO_2 controls our global climate because-human-induced CO_2 emissions will rise substantially during that 33 year cooling period. The most likely truth is that the CO_2 hypothesis is valid but insignificant compared to the Sun.

5. When Will We Know If It Is Cooling? By 2014 (Perhaps)

The drop in temperature in 2011 is not statistically sufficient to confirm cooling. Similar one-year temperature falls have occurred many times, even during the strongest warming periods.

However, rarely has the temperature fallen significantly for 3 consecutive years, other than at the transition from the 33-year warming period to the following 33 years of cooler temperatures.

Therefore, it may be late March 2014 when the global temperatures for 2011, 2012 and 2013 are known before we have any inkling that the

Cont. Overleaf

The Sun Rules Our Climate - Obviously

Cont. from Page 21

global temperatures have in fact entered a 33-year period of cooler temperatures or not. A justifiable argument exists to wait until 2014 before taking substantive and disruptive action to combat a perceived threat from global warming.

Chinese scientists are aware of this and China has sensibly delayed the introduction of a carbon tax until after 2016, even though China's proposed carbon tax regime is far less severe than Australia's carbon tax. Canada and America have completely abandoned plans to impose a carbon tax – they are not stupid.

Science is meant to be fact-based but some scientists and economists have exaggerated the importance of their hypotheses by exaggerating the consequences. Regrettably, our economy may become distorted by a massive Carbon Tax intervention as a result of a premature acceptance of the unproven human-induced CO_2 hypothesis and a naïve belief that if we don't act now, the costs of combating some vague notion of "climate change" will become punitive later on.

This has been an unproven hypothesis, multiplied by a belief, and raised to the power of a vague notion.

** Ian Levy, BSc(Hons), MSc(Dist) is a geologist with majors in Economics, Science & Statistics at ANU in 1975 & London University in 1980. He first began researching the CO_2 greenhouse effect professionally in 1980. Since 1992, he has conducted further studies, including coral studies and geostatistical analyses on temperature data and concluded that whilst the reasons for the long-term warming trend are still unresolved, the solar cycles are probably a significant causal factor that could dwarf all other influences on global temperatures.*

APPENDIX:
Are the 33 Year Cycles Statistically Valid?

The experimental semivariogram is an unbiased graphical test for cycles by studying how stable the differences between annual temperatures are at various time-lags. The logic is that the temperature differences will be stable within the time-span of a genuine cycle and then become increasingly erratic when the time-lag extends beyond the cycle's time length, a time length called the "range". Once the time lag exceeds the range, the variability in differences should plateau at a value reflecting the variability at random time intervals. This creates a pattern called the "sill" (see Figure 2 below).

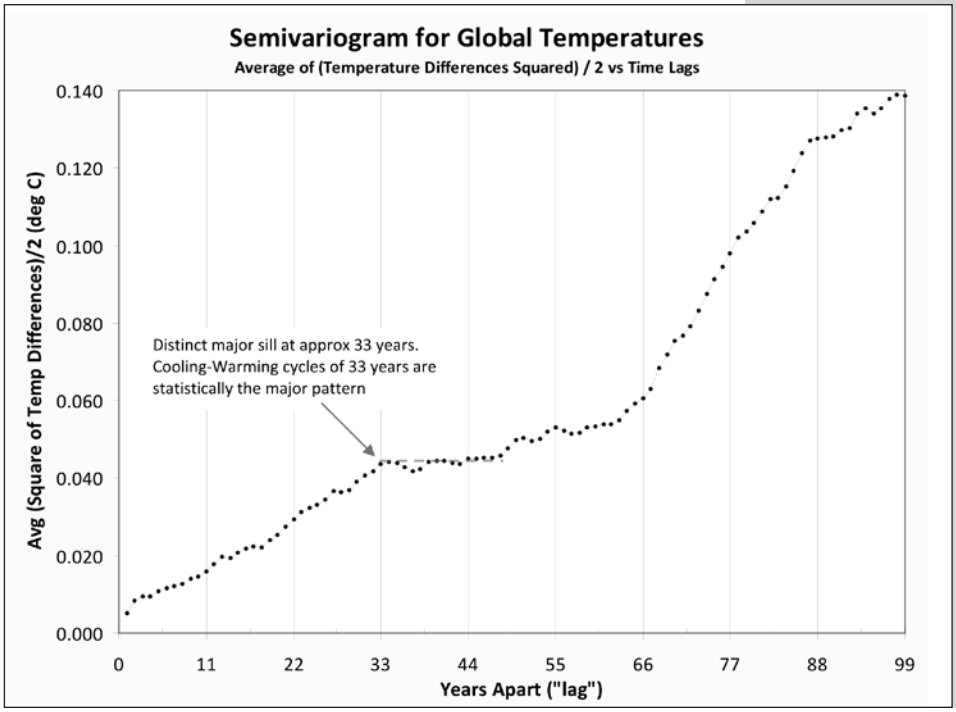
The method selects all pairs of data at a certain time-lags (eg. pairs of temperature data 4 years apart). It then averages the squares of the differences between each of the paired readings and then divides by two. This is done for each time-lag until the number of pairs being tested reaches about half the number of data points (ie. 81 pairs from the 162 year data set).

There is a distinct "sill" structure at 33 years range which marks the limit of correlation between data.

This is many times stronger than the weak secondary sill at 55 years time lag and an even weaker tertiary sill at 88 years which may relate to some longer-term solar seasons that we are yet to understand due to a shortage of data. We also are aware of major longterm solar variations that cause ice ages and hot epochs, well before mankind existed. Our knowledge base is too small to assess these long cycles.

The semivariogram in Figure 2 clearly shows that the 33-year cycle dominates the temperature data set, exceeding all other features by orders of magnitude. The 33-year cycle is almost certainly related to the solar cycles and has no relationship with the CO2 hypothesis which is probably relatively insignificant. ▲▲

Figure 2.



CSIRO Reply:

Subject: Our Ref TP283173 - RE: Sophistry by CSIRO about Climate will not help Australia or CSIRO succeed

Dear Ian,

Thank you for your enquiry regarding State of the Climate 2012.

CSIRO and the Bureau of Meteorology have received a large number of emails concerning this new publication. We are unable to individually address every enquiry at this time. We hope the following information will help direct your questions to relevant answers online.

The information contained in State of the Climate 2012 draws from peer reviewed scientific publications. A full list of references can be located on the CSIRO website at http://www.csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012/References.aspx

State of the Climate 2012 also underwent independent external review. CSIRO is satisfied that State of the Climate 2012 is scientifically sound.

Data sources for Australia's climate conditions include:

- Bureau of Meteorology – Australian climate change: http://www.bom.gov.au/climate/change/
- Historic climate data (temperature, rainfall, etc): http://www.bom.gov.au/climate/data/
- Greenhouse Gas Data: http://www.csiro.au/greenhouse-gases/
- Sea Level Rise: http://www.cmar.csiro.au/sealevel/
- CSIRO climate scenarios: http://www.csiro.au/ozclim

Our climate scientists have also contributed to a number of fact sheets addressing the common enquiries about CSIRO's climate change science, which are readily available on our website at:

- "Climate questions, Science Facts": http://www.csiro.au/resources/Climate-questions-science-facts.html

CSIRO welcomes open and serious scientific debate, discussion and questioning of their science through the peer-review process.

We trust this assists with your enquiry.

Kind regards,

CSIRO Enquiries

Phone: 1300 363 400 |

Fax: +61 3 9545 2175

enquiries@csiro.au | www.csiro.au

Address: Locked Bag 10, Clayton South VIC 3169

Education Report

Kaylene Camuti
(Chair, AIG Education Committee)

This year's student bursary program is underway and the bursary application form has been sent to AIG student members, to universities, and is available from the AIG web site. The closing dates for applications are the 30th June for honours and postgraduate students and the 2nd August for third year students.

Last year we awarded bursaries to 17 third year, honours and postgraduate students. In this issue of AIG News we include abstracts from three of the honours students who were awarded bursaries in 2011. The students are:

Michael Gill from the University of Tasmania, who was awarded a Digirock – AIG Honours Bursary for his project *"The Petrogenesis and FeTiO Accumulation of the Youanmi Igneous Complex (Yilgarn Craton), Western Australia"*. Michael is based in Perth working for Rio Tinto this year.

Kathleen Lane from the University of Adelaide, who was awarded a PIRSA – AIG Honours Bursary for her project *"Metamorphic and Geochronological Constraints on the Evolution of the Kalinjala Shear Zone, Eyre Peninsula"*. This year Kathleen starts a PhD at the University of Adelaide working on the Archean-Paleoproterozoic tectonic evolution of the Gawler Craton.

Luke Mahoney from the University of Melbourne, who was awarded a Gnomic – AIG Honours Bursary for his project *"Thermal Structure of the Otway Basin, southeastern Australia"*. Luke is based in Victoria working on gold exploration projects.

Amberley Murray from the Australian National University, who was awarded a Symposium – AIG Honours Bursary for her project *"Hydrothermal Alteration, Ore Fluid Characteristics and Mechanisms for Gold Deposition at the Wallaby Gold Deposit, Laverton, Western Australia"*. Amberley is now working with Barrick Gold in Western Australia.

Kristen Parmeter from the University of NSW, who was awarded an AIG Honours Bursary for her project *"A Comparative Study of Fossil Site AL90 and Two Nearby Sites, Riversleigh World Heritage Area, Northwestern Queensland"*.

Bursary Sponsors

The AIG would like to welcome our new bursary sponsor:

Alexander Research: Alexander Research is a Perth-based company that offers services to professional valuers in the extractive minerals industry, through the provision of data, programmes, and innovative valuation techniques. Jonathan Bell, the MD, is a geologist who specialises in mineral asset valuations and has been involved in independent technical reviews, audits and valuations of Australian and international mineral assets.

We thank our new sponsor for contributing to the AIG bursary program and acknowledge the support of our continuing sponsors:

Chris Bonwick: Chris Bonwick, MD of the Independence Group, has provided substantial support for the bursary program. Eleven Bonwick – AIG bursaries have been awarded since 2003.

Geoff Davis: Geoff is the chairman of Medusa Mining Limited and a graduate of both UWA and JCU. The Davis – AIG bursaries are offered to students at UWA and JCU to help cover the costs associated with field projects.

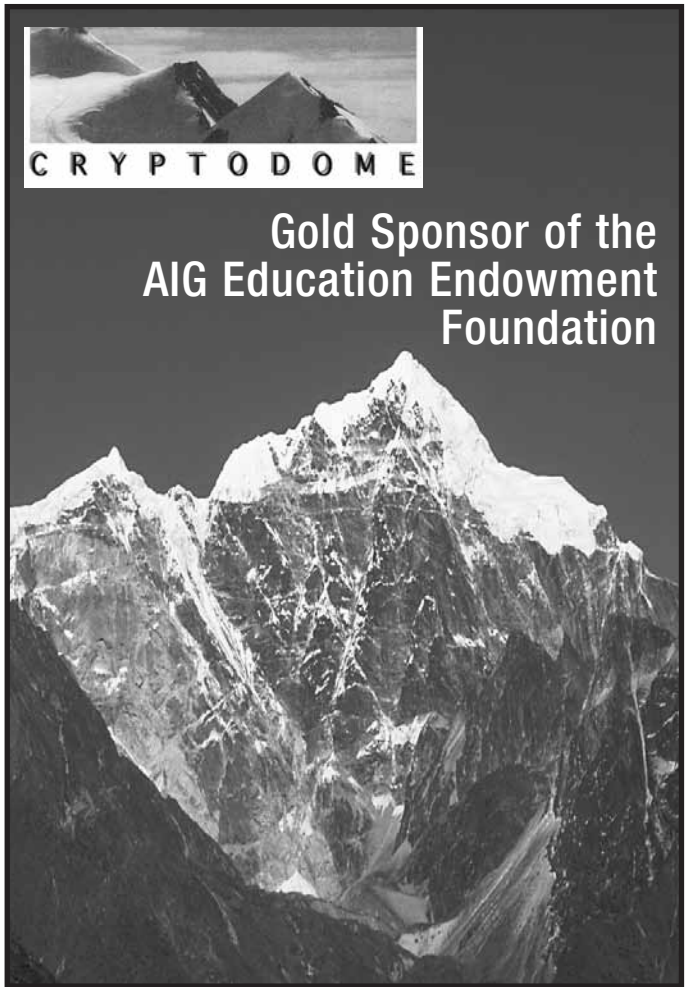
Digirock Pty Ltd: Digirock is a Perth-based geological contracting and consulting company that provides high quality exploration geologists to the minerals industry and offers specialised training courses in geological practices and procedures. Five Digirock – AIG bursaries have been awarded to geoscience students since 2008.

Geoconferences (WA) Inc: Geoconferences is a non-profit organisation, run by volunteers from the Western Australian geoscientific community, dedicated to the promotion of geoscience by arranging conferences, symposia and other meetings.

The Macquarie Arc Conference: This is a collaboration of government and industry organisations, headed by the Geological Survey of NSW, involved in organising the Macquarie Arc Conference.

SA Department for Manufacturing, Trade, Resources and Energy – Minerals Group (DMITRE): DMITRE (formerly PIRSA) has been a long-term ongoing supporter of the AIG bursary program. Seven DMITRE / PIRSA–AIG bursaries have been awarded to South Australian students since 2003.

Symposium: Symposium is a Sydney-based organisation that organises events, ranging from monthly road shows to annual conferences, that provide opportunities for mining, coal, oil, gas and other energy-related businesses to present to and engage with investors.



Cryptodome Pty Ltd: Cryptodome is a Perth-based company run by Marcus Harris, former Managing Director of Dalrymple Resources. Marcus is a member of the AIG WA Branch committee and a former AIG Councillor. Five Cryptodome – AIG bursaries have been awarded to third year, honours and PhD students since 2004.

Gnomic Exploration Services Pty Ltd: Gnomic Exploration is a Townsville based provider of contract personnel to the resources industry. Gnomic has been a supporter of the bursary program for many years.

AIG State Branches: The support of the AIG state branches was vital to the initial development of the AIG bursary program. Over the years the state branches have continued to provide critical support in the form of funding and organising student functions and bursary presentations.

Learning and Teaching Academic Standards Project for Earth Science

A national Learning and Teaching Academic Standards Project was undertaken in 2010-2011 to develop a set of standard pass-level capabilities for three year science degree graduates – referred to as Threshold Learning Outcomes. Submissions were invited from interested parties and, in early 2011, the AIG made a submission to the Science Discipline group. In September 2011 the Science Discipline group released the Academic Standards Statement for Science. The statement consisted of five Threshold Learning Outcomes that define minimum standards for science graduates; it can be found at
http://www.olt.gov.au/resources?text=learning+and+teaching+academic+standards+science

The Australian Council of Deans of Science endorsed the Science Standards statement in September 2011 and encouraged the adaption of these generic standards for each sub-discipline area within science. The Earth Science standards project is now underway, led and coordinated by Professor Ian Fitzsimons from Curtin University. Representatives from the various geoscience professional bodies and societies have been invited to contribute to the development of the earth science standards, with the aim of having a provisional document prepared by early 2013.

Teacher Earth Science Education Program (TESEP)

In April, Jill Stevens, the founder and chairperson of TESEP, was awarded the prestigious Harrison Schmitt Award by the American Association of Petroleum Geologists (AAPG), in recognition of her outstanding accomplishment in Teacher Education outreach work. Jill was presented with her award at the AAPG Awards Ceremony in Los Angeles, and her achievements were acknowledged in an article in the April edition of the AAPG Explorer magazine, which can be found here:
http://www.aapg.org/explorer/2012/04apr/difference0412.cfm

In other good news from TESEP, Jill reported from her trip that there was interest shown in trialing TESEP in other areas of the world, including Thailand, the African region, and the Middle East. ▲▲

HONOURS ABSTRACT:
2011 Gnomic — AIG Honours Bursary Winner

Thermal structure of the Otway Basin, southeastern Australia

Heat loss from the Earth is a primary control on the geodynamic evolution of the continents and the ocean basins. The Earth's heat loss is non-uniform and understanding the thermal structure of the lithosphere, in particular, has been a topic of much research effort.

This study aims to explore the variation in subsurface temperature and heat flow in sedimentary basins, using the Otway Basin, Victoria, as a case example. Given the recent drive for low-carbon energy resources and the recognition of the potential for geothermal energy, this thesis has also assessed the potential for economically viable thermal resources in the Otway example (> 150°C within 5 km of the surface).

In this case example, unlike in most previous studies, both structural architecture and well-constrained thermal data have been the primary 'inputs' into a series of thermal models. Surface heat flow estimates from downhole temperature logs compiled and collected from the study site were used to adjust the goodness of model fit, to produce a model deemed to best reproduce true thermal structure.

Modelling results indicate that surface heat flow and temperature distribution within this area are largely influenced by lateral heat flow at thermal conductivity contrasts between stratigraphic units, especially at the basement/sediment interface. The primary influence on temperatures at 5 km depth is the thermal conductivity of overlying crust. Economic temperatures > 150°C were identified beneath thick and insulating Port Campbell Embayment sediments at the coastline and extend to 40 km inland. This region, along with similar regions of thick sediment insulation within the Otway Basin, may prove to be highly prospective for geothermal energy resources. ▲▲

Luke Mahoney
University of Melbourne

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To encourage new membership and in recognition of the services offered by the associations and societies that uphold the professionalism within our global mining industry - Snowden will be offering the individual members of these associations a 10% discount off our public training course registration fees during 2012.

HONOURS ABSTRACT: 2011 PIRSA — AIG Honours Bursary Winner

Metamorphic and geochronological constraints on the evolution of the Kalinjala Shear Zone, Eyre Peninsula

In situ monazite U-Pb dating from metasedimentary rocks in the core of the crustal scale Kalinjala Shear Zone in the eastern Gawler Craton indicate that peak condition of > 9 kbar at temperatures of around 810ºC occurred at *c.* 1700 Ma during the craton-wide Kimban Orogeny. Metapelite contains an early assemblage preserved in garnet cores characterised by a kyanite-rutile association. The enclosing matrix contains a cordierite-bearing assemblage that formed during the development of the principle gneissic fabric within the shear zone and documents ~4 kbar of decompression of the shear zone core during deformation. Garnet-biotite diffusional modelling suggests that the shear zone core cooled > 50ºCMyr-1 implying rapid exhumation of the core. Fe-Mg garnet diffusional modelling suggests that on the flanks of the shear zone, exhumation and cooling rates were slower, and the maximum metamorphic pressures were less than in the core, suggesting that the central region of the Kalinjala Shear Zone was rapidly exhumed compared to the flanks of the shear zone. Where the shear zone reworks rocks belonging to the early Paleoproterozoic Carnot Gneiss, early formed high pressure, high temperature assemblages are overprinted by lower pressure granulite assemblages leading to the formation of secondary cordierite-spinel at the expense of garnet-sillimanite. In Mg-Al rich rocks these early assemblages include rare garnet-sillimanite-orthopyroxene assemblages which formed at the expense of early sapphirine-rutile bearing associations. The garnet-sillimanite-orthopyroxene assemblage has been overprinted by cordierite-spinel-sapphirine-biotite at *c.* 1745 Ma. This age is slightly older than typically assigned to the Kimban Orogeny, and suggests that the event may be longer lived than previously thought. The timing of the earlier high pressure assemblage is equivocal, and could conceivably be related to the previously recognised *c.* 2450 Ma high-grade metamorphism in the Carnot Gneiss, and therefore not part of the Kimban-aged metamorphic architecture. The metamorphic constraints and age data from the core of the Kalinjala Shear Zone, combined with existing data, support a transpressional setting associated with the Kimban Orogeny. ▲▲

Kathleen Lane
University of Adelaide

HONOURS ABSTRACT: 2011 Digirock — AIG Honours Bursary Winner

The petrogenesis and FeTiO accumulation of the Youanmi Igneous Complex (Yilgarn Craton), Western Australia

The Youanmi intrusion is a 39 by 14km layered mafic intrusion that crystallised at 2818.8±9.9 Ma as part of the Meeline Suite, one of the five suites of ~2.8 Ga mafic-ultramafic layered intrusions in the northeastern Murchison Domain (Yilgarn Craton), Western Australia. The Youanmi intrusion consists of a series of broadly synformal, 10-20m thick gabbro layers with an apparent thickness of at least 20km, although this is likely to have been substantially thickened by structural repetitions. The outcropping northeastern section of the intrusion, the focus of this study, consists of leucogabbro, leucogabbronorite, pyroxene-rich gabbro, anorthosite, oxide-rich gabbro and layers of massive FeTi-oxides. Importantly, this research documented rare cumulus olivine, which was not known to be present in the intrusion. FeTi-oxide accumulation to form massive almost monomineralic bands occurs in a distinct stratigraphic package. Individual FeTi-oxide layers have a variable morphology in terms of thickness, grading and contact relationships. Cycles in the FeTi-oxide accumulation zone have sharp basal contacts, massive FeTi-oxide layers at the base, variable FeTi-oxide content through the cycle, and grade up to leucogabbro or anorthosite. The mechanisms for FeTi-oxide accumulation are not definitive, with evidence for both FeTi-oxide crystallisation by gravity settling, and crystallisation from an immiscible Fe + Ti-rich melt. The main cumulus sequence is crosscut by a series of 2800±11 Ma aplite dykes which may represent crustal melts unrelated to the Youanmi main magmatic system.

The Youanmi intrusion is derived from an evolved (i.e. Fe-rich, low Mg), low H_2O, tholeiitic parental magma, which experienced further Fe-enrichment during crystal fractionation, and underwent between 6–30% upper crustal contamination. For the layered sequence examined, at least four new magma pulses of parental magma entered the intrusion. This parental magma crystallised at ~1050-1100°C, <9kb with low P_{H2O} and $\log_{10}$fO2 values close to QFM. This study confirms previous assumptions that the Youanmi intrusion is comagmatic with the larger Windimurra intrusion, also part of the Meeline Suite and located ~20km to the northeast. Specifically, the mineralogy and mineral chemistry observed in the northeastern Youanmi intrusion (Pl (An_{61-68}), Cpx (Mg_{74-78}) ± Opx (Mg_{70}) ± Ol (Fo_{65}) ± Mt/Ilm) matches very closely to that in the Lower Zone of the Windimurra intrusion. Both intrusions may have formed in the early stages of a continental rift, with the pooling and fractionating of the ascending magma in staging chambers producing the evolved parental melt that filled the magma chamber now represented by the layered intrusion itself. ▲▲

Michael Gill
University of Tasmania

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Perth	26-27 July

AIG MEMBERSHIP BENEFITS

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In recognition of the services offered by the associations and societies that uphold the professionalism within our global mining industry, we have decided to offer the individual members of the following professional associations a 10% discount off our public training course fees.

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HONOURS ABSTRACT:

2011 AIG Honours Bursary Winner

A comparative study of fossil site AL90 and two nearby sites, Riversleigh World Heritage Area, northwestern Queensland

A comparative study of the local geology and lithologies of three nearby Middle Miocene palaeocave fossil deposits within the Riversleigh World Heritage Area of far NW Queensland called AL90, Dome Site and Jim's Carousel was performed, in order to investigate fossil site and study area development and palaeoenvironmental conditions.

AL90 and the area surrounding the three fossil deposits was mapped at a scale of 1:300; and subsequent petrographic, mineralogical and geochemical analyses were carried-out on samples from the study area to determine if the fossils sites represent three discrete deposits, or collectively form a once continuous palaeocave system. An important auxiliary aim was the identification of palaeoenvironmental indicators, to gather information on the area's palaeoclimatic conditions at the time of fossil deposition.

Field mapping of the study area determined that massive micritic limestone hosts the fossil deposits, consisting of three subtypes; indicating that a change in depositional environment conditions occurred over time. Four younger cave infill lithologies were also indentified including both speleothem and later freshwater micritic and terra rosa sedimentary carbonates. Through the course of mapping, continuity in outcropping lithologies at the fossil deposits and within the study area was determined, therefore establishing connectivity between the sites.

Detailed wall mapping of AL90 showed that the deposit developed in seven major phases and that Dome Site and Jim's Carousel developed in four major phases. Initial speleothem precipitation occurred, followed by abundant fossiliferous micrite deposition, then final stages of desiccated terra rosa infill and capping, rich in iron oxides; indicating that palaeoenvironmental conditions underwent a transition from a wetter environment, to prevailing drier conditions as the deposits developed.

Petrographic, mineralogical and geochemical analysis of samples from the study area determined that common characteristics and features were present at all sites and from multiple localities. This provides further evidence that the three sites were, at one time, connected in a former cave network, and that the depositional environment shifted from initially wet conditions to a drier environment.

Key outcomes from this study include identification that certain geochemical signatures in samples including high phosphate, uranium and zinc levels were strongly associated with both the palaeocave depositional environment and the fossil-rich limestone and, as such; serve as indicators of this type of fossil deposit. Additionally, fossilised bone from the deposits was found to be uranium-rich, indicating that fossils from the site are potentially suitable for direct U-Pb radiometric dating. Furthermore, along with abiotic precipitation, biogenic agents are largely responsible for the precipitation and destruction of calcite in this freshwater carbonate system.

The study provides detailed new information on the geological development of the three fossils sites, indicating that a transition in palaeoenvironmental conditions occurred throughout site development. Moreover, a significant contribution was made towards the existing body of work undertaken in the area, in an effort to understand the palaeoenvironment in this region of the Riversleigh World Heritage Area.

Overall, the study served to enhance our knowledge of freshwater carbonate systems, and the role and importance of biological-induced carbonate precipitation. ▲▲

Kristen Parmeter
University of New South Wales

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The AIG wishes to thank the following individuals and organisations for their support of the

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HONOURS ABSTRACT:
2011 Symposium — AIG Honours Bursary Winner

Hydrothermal alteration, ore fluid characteristics and mechanisms for gold deposition at the Wallaby Gold Deposit, Laverton, Western Australia

The Wallaby Au deposit in the Laverton Greenstone Belt of the Yilgarn Craton is a magmatic – hydrothermal system with extensive pyrite-bearing mafic conglomerates that host a series of vertically stacked shear zone gold lodes, with 2010 year end published reserves of 3.62Mt at 5.20g/t for 0.61Moz, plus measured, indicated, and inferred resources (exclusive of reserves) of 6.8Mt at 7.7g/t for 1.69Moz. Categorising the deposit as an orogenic system or an intrusion-related system has been a topic of debate.

Fluid inclusions and pyrite studies have indicated four separate fluid stages responsible for the genesis of the deposit, with sulfidation (and redox) the main driver for gold deposition. They were (1) an oxidised pervasive hematite alteration event; (2) a widespread magnetite - actinolite alteration of the conglomerate; (3) emplacement of an igneous alkaline suite comprised mostly of syenite followed by (4) the high grade gold event associated with an As-rich reduced fluid.

Several pyrite varieties are present within the different alteration types in mafic conglomerate and form in equilibrium with hematite and magnetite at different stages of its genesis. Pyrite in the conglomerate and syenite show epitaxial overgrowths indicating pyrite generations young outwards. In situ $\delta^{34}S$ analyses across pyrite grains indicate a range of 20‰, with progression from an oxidised fluid (-10.5‰) associated with pervasive hematite alteration in event one to a reduced fluid (+11‰) associated with high grade gold pyrite + sericite + dolomite + albite + quartz in event four.

Detailed in situ laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS) of pyrite revealed that the gold is intimately associated with the last hydrothermal event, as invisible gold in the pyrite, and crosscuts the earlier alteration events.

A decrease in granophile elements; W, Pb, Zn, and Ni and an increase in Sb and As from event one to four reveals an evolving suite of fluids. Fluid inclusion microthermometry reveals two fluid compositions — one saline and the other H_20 - CO_2 rich, typical of other orogenic gold deposits in the Eastern Goldfields Province. The saline fluid is interpreted as magmatic-hydrothermal while the CO_2 - H_20 fluid is seen as typical shear zone Au fluid.

Detailed pyrite analysis and fluid inclusions indicate that the Wallaby deposit was characterised by the evolution of one fluid with time, from oxidised (high SO_4^{2-}) to reduced fluids (high H_2S). The entire fluid history of Wallaby can be seen through pyrite zoning of $\delta^{34}S$ and trace elements. The final event was gold-bearing and is responsible for the widespread bleaching of the mafic conglomerate. The deposition mechanisms for gold are sulfidation, with redox reactions amongst fluid wall rock interactions. ▲▲

Amberley Murray
Australian National University

Membership Update

New Members and Upgrades at the May Council Meeting 2012

FELLOWS

HUGHES	GUILLERMO
JONES	DAVID

MEMBERS

AVDEENKO	Vadim
CARLUCCI	Lorelei
CARSON	Malcolm
CHULUUNBAATAR	Ganzurkh
COUDERC	Pierrick
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DAY	Damian
DE MARIO	André
DENBY	Philip
DOWLING	Sarah
FIELD	Tony
FURNISS	Rafael
GEORGE	Mark
GRAAF	Joanna
GROBBELAAR	Gottfried
GUARNIERI	Lúcia
HEAD	Darren
HENDRICKX	Marc
KALLA	Jani
KNEER	Sebastian
KOOMBERI	Hazli
KOSE	Celal
LARKIN	Paul
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LIVESEY	Jaime
MAJOR	Timothy
MAPETO	Oliver
MARDOHIRAWAN	Irwan
MOORE	Ian
NGUYEN	Ta
NICOLSON	Ben

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PHILLIPS	Glen
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SHAHNAZ	Shaheen
SHEPHERD	Antony
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SUSANTO	Tody
TARUNO	Dwiyoko
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THOMAS	Malcolm
WEBERUSS	Bernd
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DITTY	Laura
GENDALL	Joseph
GUILLIAMSE	Joshua
HUTHMANN	Florian
KASINATHAN	Esther
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LEBEDEVA	Evgenia
MARRIOTT	Susan
MOLE	David
PENGELLY	Matthew
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COMBARDO	Michael
DINNISON	Cecil
DUFFY	Caroline
FLANNERY	Emma
GIRARDI	Owen
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KINSELA	Michael
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SAGE	Joshua
SAW	Kelly
VAN DEY LEY	Mira
VAN KRIEKEN	Ashley
WIGGERS DE VRIES	Paul
YAN	Jie

We welcome all new members to the AIG.

Registered Professional Geoscientist Approvals & Applications

CANDIDATES APPROVED BY AIG COUNCIL IN MARCH 2012 2011

Ms. Sharron Sylvester of Adelaide, SA, in the field of Mining

Ms. Kaylene Camuti of Townsville, Queensland, in the fields of Other Specialist Geoscience (Mineralogy) and Mineral Exploration

NEW CANDIDATES PUBLISHED FOR PEER REVIEW BY THE MEMBERS OF THE AIG

Mr. David MacDonald of Bayswater, WA, is seeking registration in Mineral Exploration

Mr. Hazli Koomberi of Kallaroo, WA, is seeking registration in Hydrogeology

Mr. Roald Strand of South Brisbane, Qld, is seeking registration in Geochemistry

Mr. Alan Hansen of Brisbane, Qld, is seeking registration in Coal and Regional Geology

It never rains....

AIG FEDERAL COUNCIL FOR 2012-13

AIG NEWS

CONTRIBUTION DEADLINES

AIG News is published quarterly as per the following table. Avoid disappointment by contacting the Editor at least several days beforehand to advise submission of items for the newsletter.

ISSUE DATE	CONTRIBUTION DEADLINE
February	January 31st
May	April 30th
August	July 31st
November	October 31st

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