THE ASSOCIATION FOR THE STUDY OF PEAK OIL
&
THE OIL DEPLETION ANALYSIS CENTRE
ASPO-ODAC

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Since the Newsletter is now read widely, it has been decided not to provide details of the membership and distribution to avoid the danger of the possible misuse of the information by unscrupulous commercial interests. Hopefully the recipients will therefore be spared the attentions of the purveyors of Viagra and worse, who already molest your Editor's e-mail with unsolicited, unwelcome and un-needed offers.

Any genuine enquiries will naturally be dealt with in a normal way.

ASPO is a network of European institutions and universities with an interest in determining the date and impact of the peak and decline of world oil production, due to resource constraints.
ODAC is a charitable organisation in London that is dedicated to researching the subject and raising awareness of the serious consequences.

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Editorial policy

This newsletter started as an informal communication for a group of institutions sharing a common concern about peak oil and its consequences. It has evolved in a pragmatic fashion, touching on items of interest, bearing on the issue. There are three very different matters to cover. The first is the strictly technical issue of how much oil is left to produce, how to define the different categories, where it is, when it was found, and how to model its depletion. The second relates the extraordinarily unreliable nature of public data, and the reasons why this important subject is not better understood. And the third relates to a wide spectrum of legitimate concerns about the consequences of the imminent decline in the world's premier energy source, which has wide political, economic and social consequences.

While it seems important to try to cover all these matters, it is not at all easy to know how to do so. A scientist seeks objective evidence and sound data with which to work, and he will be rightly suspicious of unsubstantiated expressions of opinion. Unfortunately, in this business he is denied the data he needs, although it exists and can be readily determined.

Political commentary is by its nature subjective, polemic or contentious. To ask if the oil companies are bent on deliberate denial and deception, as seems to be the case, is to head rapidly into difficult and threatening territory, yet since the questions are asked, answers, however unsure, have to be formulated. Then, there is the apparent failure of many governments and institutions to properly evaluate the evidence and adopt appropriate policies. That in turn challenges the foundations of economics, which developed in response to the Industrial Revolution driven by cheap energy from fossil fuels, which will soon be in short supply. At the end of the day, we are forced even to address the carrying capacity of the planet, its population, and the very survival of Mankind, given the current dominance of *Hydrocarbon Man,* who will be certainly be extinct by the end of the Century.

If all of this was n't difficult enough, we have had the Afghan War, as a highly emotive issue, indirectly affecting the stability of the Middle East and its oil supply.

It is easy to ruffle feathers when commenting on such matters, but perhaps that is not a bad thing to do in the circumstances. Dr Ziegler has his doubts.

Reflections on the political implications of oil depletion
by Dr. W.H.Ziegler (ODAC Advisor)

The Oil &Gas Journal of 7th January carried a chilling article by S.Bakhtiari about the new Oil Age and the Third World War which, according to him, had started after the events of the 11th September. Also, the last Newsletter "directionally" came to similar conclusions. Be that as it may. We shall live, if our aging bones permit, and see how things will evolve.

I think that this "war" talk is somewhat over-the-top, as war is always one of the least desirable means of arriving at a solution in any given conflict. War is now so dangerous that it is more than a powerful threat. It might lead to the ultimate catastrophe.

Clearly, the message has now sunk in among the strategic thinkers that the oil and gas bonanza will not last forever, and that we are now near the zenith of global production. But short-term considerations dominate. Markets fluctuate in a speculative frenzy, moving up and down at the slightest whiff of politics, blackmail, danger, coercion, collusion, scandal, weather or indeed almost any perceived influence. The markets do not really work in a predictable or even sensible way, because volatility is a paradise for the speculator and trader, who make money from it. This will go on for a while longer.

But over the medium run, real oil scarcity will become evident as one after another big field, producing area or nation reveals its limits. Production will not be sustainable, and new fields will not turn up in the desired frequency. New discovery will still be made, but many such finds will be in such hostile environments of deep water, remote location, or high sulfur content, that they will suffer severe economic penalties.

The eventual military dominance of the production capabilities in the Middle East and Caspian area by powerful consumer nations, perhaps with the support of the local elite, is a possibility that underlies Bakhtiari's contention. As we can observe, an almighty struggle is now underway with the hidden agenda of placing these oil resources into "safe hands", which may be the United States, Russia, Europe, private companies, and "friendly" governments in new coalitions. The aim is to control reserves so as to secure production, albeit in ever diminishing rations, while readying the consumer economies for inevitable oil- and gas-based energy shortages.

My guess is that we will not see this changeover in our life times, but that it will take place in a long time-frame. The events of September 11th provided the justification for an anti-terrorist coalition to mount a concerted effort to suppress the trouble-makers, who disrupt the established order and threaten the present power blocs. The role of Israel in this matter cannot be overlooked.

I do not think that war-mongering, if I may call it that, should be a preoccupation of the Newsletter nor of Dr. Bakhtiari because it may be inflammatory. It does not advance our scientific cause of evaluating the World's oil endowment and its depletion. We all support the conclusions, based on detailed data analysis, that the World will have to change its ways over the medium term. It has to do so, simply because of an evident and growing resource constraint. It is also a fact that a responsible "set" of powers will have to safeguard the global resource endowment for the common good of all. This begs the question "does this common good include the Chinese, the Indians, the Africans, and the denizens of the Third World?" .... or is only the "developed world" to be the beneficiary of sensible depletion management.

ASPO Workshop – Uppsala, Sweden, 22-25th May

Prof. Aleklett reports good progress in organising the Workshop and plans to formally announce the programme shortly.

Some Comments on Reserve Definition

The Norwegians have a love of honesty and openness, and so it is not surprising that the Norwegian Petroleum Directorate has one of the world's best reserve reporting procedures, which is open to the public on its website. It recognises as many as eight classes of reserves, based on different stages of development, giving detailed data by field. It rightly accepts a degree of uncertainty, providing Low, High and Best estimates over a comparatively narrow range.

The Practice and Consequences of Reserve Reporting

Explorers map the size of a prospect with the help of sophisticated seismic surveys but they have to estimate the reservoir characteristics, including the net thickness, porosity, saturation, fill and recovery, based on data from neighbouring wells and regional knowledge. They normally make a range of estimates for each parameter and then compute the alternative combinations with a technique known as Monte-Carlo simulation. The result is a plot showing estimated reserves against subjective probability rankings, normally recognizing a Low Case, having 95% chance of being greater than the indicated value, known as P_{95} ; a High Case, termed P_5 ; with *Mode*, *Mean* and *Median* values in between. The explorers aim to make a "best estimate", which equates in probability terms with a *Mean* estimate, although in the real world they are often under pressure to exaggerate. The trick of the trade is to raise the extremely uncertain P_5 value, which then lifts the *Mean* value.

If drilling on the prospect is successful, attention turns to designing an optimal initial development plan to drain the main part of the field with a given number of wells. The expected production from such wells is reported as *Proved Reserves*, it being normal to quote conservative estimates. As production experience is gained, the reserves can be reported with more confidence, leading normally to an upward revision. Later, when draining the prime part of the field is far advanced, attention turns to tapping subsidiary reservoirs and additional compartments that were not originally produced, leading to further upward revisions. These

late-stage secondary operations are much influenced by economic considerations, more being done in more profitable situations.

Proved Reserves are commonly defined as " those quantities which geological and engineering information indicates with reasonable certainty can be recovered from known reservoirs under existing economic and operating conditions". The key words are *operating conditions* : meaning in practice the currently producing (or planned) wells at any given time, not the field as a whole. They are commonly equated with a certain Probability ranking, (P_{90-95}), but it does not seem to be a sound practice because the term *Proved Reserves* refers to a particular stage of development whereas the probability ranking refers to the field as a whole. The probability ranking of any particular phase is not the same as that for the field as a whole. A large field will have several phases of development, with the consequential growth of *Proved Reserves*, whereas a small field with a short life may have only one. A cardinal mistake is to apply the reserve growth of the large fields of the past to the smaller more recent ones.

Proved Reserves are reported for financial purposes and enter the public domain, whereas *Proved & Probable*, which do relate to the field as a whole, are commonly not reported. This simple matter is at the heart of much of the confusion surrounding the subject.

The Treatment of Condensate

There is no standard agreement on the definition of *Conventional Oil*, meaning that each study must state how it applies the term. The writer has so far excluded *Condensate* on the grounds that its depletion is driven primarily by gas production and not oil production, but this may have been a mistake. Thinking further about the issue, we may note that an oilfield commonly contains hydrocarbons in both gaseous and liquid phases in proportions partly depending on ambient pressure and temperature, which can change over its life. The liquid, known as *Condensate*, condenses from the gas on being brought to the surface, where it is separated in order to meet the sales specifications of the gas, being commonly then fed into the oil stream, with which it is often metered.

During the early phases of development, efforts are made to maximize the production of oil, in part using the expanding gas cap as a drive mechanism to expel the oil. The production of *Condensate* is accordingly low. But later, when most of the oil has been extracted, more and more gas is produced as the pressure falls, eventually converting the field effectively into a gasfield, with an increasing yield of *Condensate*. In some cases, *Condensate* may even have developed in the reservoir itself in cases where it has been uplifted by earth movements into a lower pressure environment. The *Condensate* yield of gas also ranges widely, depending on geological circumstances related to source-rock and the maturity of generation. Norwegian practice is to meter *Condensate* with oil where it is fed into the oil pipeline system, which seems a sensible procedure. It is distinguished from Natural Gas Liquid (NGL) which is extracted by processing and metered separately. In future, we will follow the Norwegian practice in principle, although in global studies the available data are normally far too unreliable to attempt such fine distinctions. In short, Condensate from oilfields will, in principle, be included with oil; whereas NGL from gasfields will not.

New Study of Giant Fields

Matt. Simmons (an ODAC Advisor) has made an excellent new study of the world's giant fields. Whereas internationally, it is normal to define a giant field as one having more than 500 Mb of ultimate recovery, Simmons prefers to use production alone, defining a giant field as one producing more than 100 000 b/d. He was shocked to find how difficult it was to obtain accurate information on such fields, especially in view of their critical importance to

world supply. He identified 120 such fields, which provide 47% of the world's production, with the largest fourteen contributing as much as 20%. He further notes that 36 of these fields, which were found more than forty years ago, contribute as much as 21% whereas the 12 found over the past decade provide only 2%.

The world's dependence on these ageing giants at an advanced state of depletion is self-evident, and should be a cause of great concern.

Good Scenario of Supply by Totalfinaelf

P.R.Bauquis of this French oil group has published an excellent pragmatic review entitled "A Reappraisal of Supply and Demand in 2050" (Oil & Gas Science & Technology, Rev. IFP 56-4 389-402). It takes note of falling fertility rates, suggesting that the world population may not exceed 8 G by 2050, which will have an impact on energy demand. It pragmatically assumes that the good intent of Kyoto will in practice have little impact on climate change, so that we will have to live with the consequences whatever they may turn out to be. It notes that estimates of ultimate oil recovery have not changed much over thirty years being in the range of 2 to 3 trillion barrels, depending partly on whether Non-conventional liquid hydrocarbons, variously defined, are included. It suggests that oil production is likely to fall from around 2010 due to depletion, with a plateau of gas production following not long afterwards. It draws the obvious conclusion that there will have to be a radical change in the world's energy mix, speculating in an increase in nuclear power, possibly as a source of hydrogen fuel.

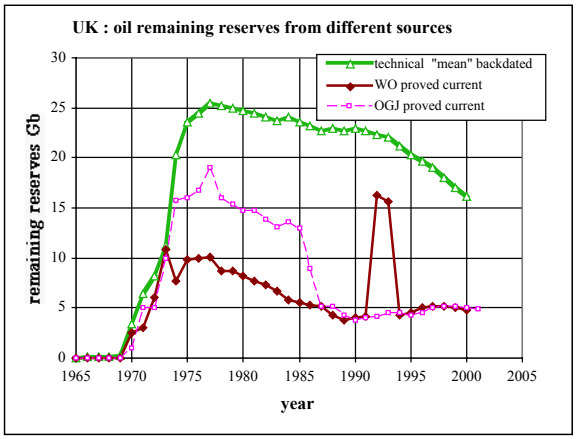
It is remarkable to find an oil company providing such a sound analysis, when so many are bent on denial and obfuscation, either claiming not to forecast the future or obscuring the situation with elegant multiple scenarios of minimal real meaning.

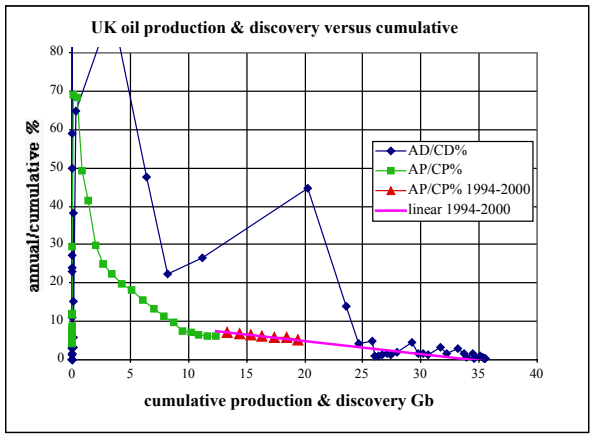
Certainly, it is in stark contrast with a recent paper by ExxonMobil, which is the latest to lumber in with the full spectrum of public relations platitude about market economics, technological impacts, and the need for government to let the industry run its own affairs. Any idea of government to government supply arrangements is roundly condemned. One searches in vain for valid data about the past trend of discovery, which could give an indication of future discovery, although careful reading does reveal that UK imports are set to rise. Could that possibly be an admission that indigenous production has peaked, as a very oblique reference to depletion? It is a sad commentary on the calibre of advice being given to the UK government by the oil industry. A similar document has been provided to the EU.

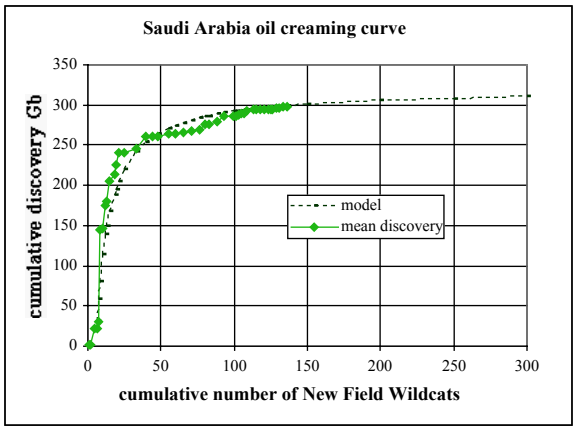
http://www.cabinet-office.gov.uk/innovation/2001/energy/submissions/ExxonMobil.pdf

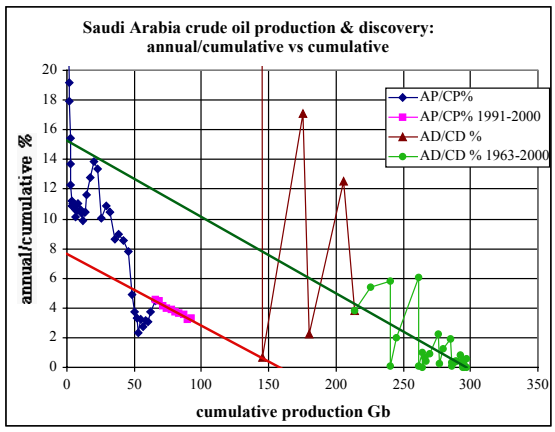
Review by Jean Laherrère of K.S.Deffeyes's book Hubbert's Peak

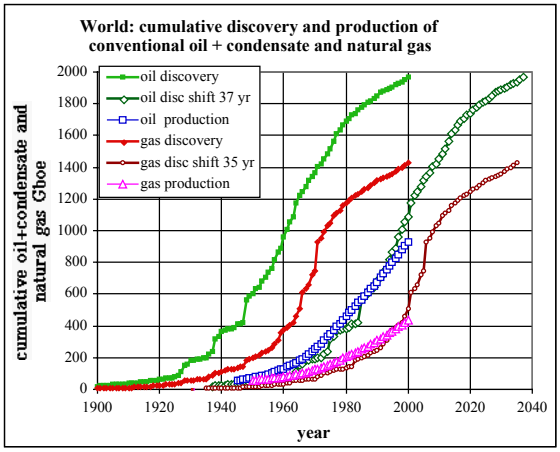
Jean Laherrère has produced an excellent review of this important book, with a full suite of very telling graphs and a discussion amplifying the analysis. A few examples are reproduced below to illustrate his work

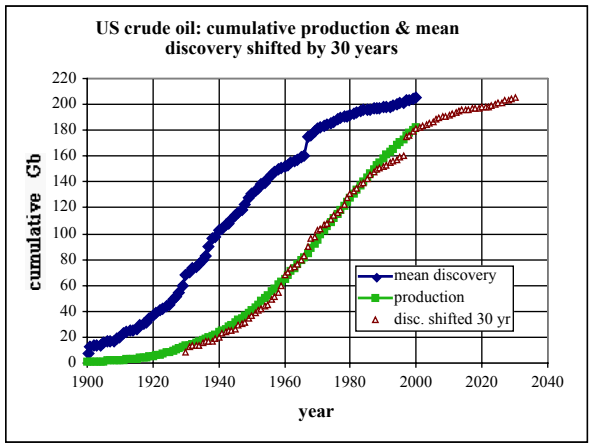












Depletion Statement by the BGR

The Biennial Report of the German Federal Institute for Geosciences and Natural Resources for 1999-2000 carries a telling statement on the risks of oil depletion

The End of the Petroleum Age and the Search for New Energy Sources

Energy drives our lives and societies. On the way to work, sitting in front of the TV, in the shower, we are consuming energy. Energy is such a natural part of our lives that we usually take it for granted. We seldom think about what it takes for us to have 10 litres of petrol to drive 100 km. That is 10 L. of a valuable mixture of hydrocarbons formed at several kilometers depth from the remains of living organisms deposited together with inorganic material millions of years ago. The formation of crude oil, from which gasoline is made, was an exceptional occurrence, and the accumulations of oil and gas in the Earth's crust are limited.

The rapid developments of the 20th Century were made possible by the apparently limitless availability of energy, mainly in the form of crude oil. Crude oil guaranteed economic growth, mobility and prosperity. Oil has also led to political conflicts. About 40% of the global energy demand is supplied by crude oil. The

remaining oil reserves are not evenly distributed among the countries of the world. Whereas most industrial countries, including Germany and the USA, have passed the apex of their crude oil production, the OPEC countries can increase production. OPEC has more than two-thirds of the known global oil reserves.

Viewed globally we are approaching the time when half of the conventional – i.e the easily obtainable oil reserves – have been used up. The estimates for this time range from a few years to 30 years[1]. From this time on, oil production will decline and the price of oil will increase. The decline will coincide with a continually increasing global demand resulting form a two-fold cause: global population growth and increased demand from the developing countries. Thus, it can be foreseen that there will be insufficient supplies in the near and medium term future that could shake the foundations of our global economy.

If a situation in which supplies cannot meet demand is to be prevented, unconventional oil occurrences must be developed and other energy sources must be found and developed. Unconventional oil occurrences include occurrences that would be difficult to develop with to-day's technologies. Advancing technological developments may be expected to make it possible to produce from such deposits. For example it is becoming technologically possible to produce from continually increased water depths in the oceans. Whereas oil production was previously concentrated on the continents and shallow marine water depths, new target areas are being developed on the continental margins. With this in mind, BGR has been conducting studies of the hydrocarbon potential in deep water areas – eg, in the South Atlantic off Argentina, Namibea and South Africa. Such studies are conducted in the long term "fore-field" of industrial development. A major aspect of efforts to find a way to avoid the predicted scarcity of oil must always be environmental compatibility.

Update of Database and Depletion Model

A first pass at updating the Resource Base and Depletion Model for 2001data has been completed, and a summary is attached in the tables below. More work is needed to check both the assumptions and the computations. Note briefly that Conventional Oil is here defined to exclude heavy oils and bitumen, deepwater and polar oils, and NGL from gasfields. Reserves, as reported by the Oil & Gas Journal and World Oil, are taken to refer to the reserves of the current status of development rather than to the field size as a whole, and are subject to over- and under-statement. They have been adjusted to remove the production of any period of implausibly unchanged reports and any identified Non-conventional oil, and then multiplied by a factor to give a realistic "best estimate" of full field reserves. The increase in the Ultimate from the previous 1850 Gb to 1950 Gb largely reflects a more generous treatment of Condensate, as discussed above. The spreadsheets of individual countries and regions are available separately on request.

The present Base Case Scenario assumes flat world oil demand until Middle East Swing share reaches about 24 Mb/d around 2010, which is assessed to be its capacity limit by that date. It will then be producing about 40% of the World's needs, and long-term decline sets in from a combination of high prices and growing shortage, at, it is assumed, the then depletion rate. Flat demand is perceived to be due to recession, indirectly caused by recurring price surges, due to limited spare oil capacity from depletion. Alternative scenarios with higher demand and production would introduce a new peak around 2005, close to the depletion midpoint of conventional oil, with the peak of all liquid hydrocarbons coming about five years later.

[1]Note: an accompanying plot shows that the 30 year forecast comes from Odell, whose unsubstantiated claims have been covered elsewhere in the Newsletters.

PRODUCTION FORECAST				
Base Case Scenario				
Mb/d	**2000**	**2005**	**2010**	**2020**
MEGulf	18.5	17.0	24.4	22.3
Eurasia	11.1	13.6	11.8	9.1
N.America	5.5	4.7	3.5	1.9
L.America	8.0	7.2	6.1	4.4
Africa	6.7	6.2	5.6	4.0
Europe	6.3	5.0	3.6	1.9
Far East	4.0	3.4	2.8	1.8
ME Other	3.0	2.4	1.8	1.1
Other	0.6	0.7	0.6	0.4
Unforeseen	0.0	0.0	0.1	0.2
Non-Swing	45	43	36	25
Swing %	29%	28%	41%	47%
WORLD	**64**	**60**	**60**	**47**

Note: *ME Gulf* is Abu Dhabi, Iraq, Iran, Kuwait, Saudi Arabia; *Eurasia* is the former Communist bloc plus China; *N.America* is USA and Canada; *Europe* is Norway to Italy; *Other* are countries with <500Mb Ultimate or not yet in production; *Unforeseen* is a balancing item to give a rounded world ultimate. *Conventional Oil* is here defined to exclude heavy oils and bitumen; deepwater and polar oil; and NGL from gasfields.

WORLD				**CONVENTIONAL OIL ENDOWMENT**												**2001**
Unit: Gb (billion barrels)				(Excluding Heavy, Deepwater & Polar Oil) Revised 31-01-02												
	PRODUCTION			**RESERVES**					**DISCOVERED**				%	Dep.	MP	Peak
		Cum.		Reported				**Assessed**		**YET-TO-FIND**			Disc.	Rate	Dep	Prod
	kb/d	**Prod.**	5yr	World	O&GJ	Adjust	Factor	**Reserves**			**YET-TO-PRODUCE**					
Country	2001	Gb	Trend	Oil		+/-						**ULTIMATE**				
MEGulf	15095	**225**	-2%	637	653	-22	0.79	**496**	721	**50**	546	**771**	94%	1.0%	2019	2014
Eurasia	11811	**176**	2%	95	82	-19	2.03	**127**	304	**35**	162	**338**	90%	2.6%	1999	1987
N.America	5485	**187**	-2%	27	27	-9	1.58	**28**	216	**7**	36	**223**	97%	5.3%	1973	1972
L.America	7893	**102**	-1%	94	122	-41	1.04	**84**	185	**18**	101	**203**	91%	2.8%	2001	1998
Africa	6621	**75**	-1%	84	76	-22	1.50	**81**	157	**11**	162	**168**	93%	2.5%	2005	1997
Europe	5942	**40**	-1%	17	17	-2.4	2.10	**30**	70	**6.0**	36	**76**	92%	5.7%	2000	2000
Far East	3916	**40**	0%	25	19	-1.0	1.55	**28**	68	**5.2**	33	**74**	93%	4.1%	1999	2000
ME Other	2833	**24**	-1%	17	33	-15.7	0.99	**17**	42	**4.2**	22	**46**	91%	4.6%	1999	1998
Other	660	**3**	16%		2	0	3.00	**5**	9	**1.3**	7	**10**	87%	3.5%	2008	2008
Unforeseen								**30**		**12**	42	**42**			2035	2035
Non-Swing	45160	**648**	-0%	359	378	-110	1.61	**432**	1080	**99**	531	**1179**	92%	3.0%	1997	2002
WORLD	60255	**873**	-1%	996	1031	-133	1.03	**928**	1801	**149**	1077	**1950**	92%	2.0%	2006	2000

The editor of the Newsletter very much welcomes contributions from members and other readers, who may wish to draw attention to items of interest or comment on the progress of their own research.

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