

**ECONOMIC GEOLOGY
RESEARCH UNIT**

University of the Witwatersrand
Johannesburg

WORLD GOLD RESOURCES

**PRODUCTION RISES MARGINALLY WHILE CONSUMPTION
IS STILL IN EXCESS - STOCKS AT SURFACE
REMAIN THE BIG MARKET FACTOR**

J. HANDLEY

• **INFORMATION CIRCULAR No. 317**

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by

JOHN HANDLEY
(*Geological Consultant, P.O. Box 75741,
Gardenview 2047*)

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ABSTRACT

Gold remains a medium of currency, a store of wealth and a hedge against political or economic disaster. Its beauty and colour and other physical properties make it a valuable commodity. Since time immemorial an estimated 128 296 tonnes of gold have been produced but unrecorded production could raise this to as high as 134 710 tonnes.

Regional Data in Tonnes of Gold Per Region

	Cumulative Production to 31.12.1996	Resources as at 31.12.1995	Resources as at 31.12.1996	Change 1996 on 1995
Africa	56 002	41 463	44 524	3 063
Europe	23 336	10 839	12 628	1 789
Asia	6 236	6 662	8 474	1 812
N & S America	32 295	25 945	27 473	1 528
Australasia	10 427	8 791	9 643	852
World Total	128 296	93 700	102 742	9 044

New exploration discoveries led to an increase in resources but also the higher prices during parts of 1996 led to the writing back of some marginal resources. Land problems also led to increased exploration within mine leases and much new gold was discovered at low costs. The South African mines are under pressure due to falling grades and increasing depth but other countries, particularly Indonesia, Peru and Ghana are set to increase production. The other big three producers, Australia, Canada and the USA are all expected to post continued production increases.

Increased mining since the high prices of the early 1980s has seen Western mine production rise from 965 to 1959 tonnes per annum over the period 1980 to 1996. This compound increase of 4.25% is high for the metals industry but in the future it is expected that production will rise more slowly as many mines will close in the next few years and replacement will not maintain the current growth. During the period 1990 to 1996 growth in production has been at an annual rate of only 1.8%.

Production from the CIS has been lagging due to shortages of capital but interest in developing some world class ore bodies by Western miners could see production rising again before the turn of the century. In China gold production is rising steadily but the resource is not very large and cannot sustain more rapid growth. Here too, Western miners are showing some interest in carrying out mine development.

Taking an overall view it is expected that gold production will rise slowly and attain levels for the whole world of about 2500 tonnes per annum by 2002.

Supplies are insufficient to meet industrial demand and the shortfall has been made up by Central Bank sales and also by active forward selling. Industrial demand since 1990 has been growing at a rate of 3.3% per annum while the growth of demand for jewellery has increased at about 3.6% for the same period but is maintaining the very high demand levels in the 1980's when growth rates exceeded 10% per annum.

The first contraction in gold supply is already with us and is likely to become worse as South African mines are operating under labour and cost escalation stresses. There is scope for expansion in South Africa but at present the will in the industry is weak. Canada, Brazil and the US appear to be at or near peak production and no large increases are expected. New mine starts are expected in South America, West Africa, Russia and China but the time-lag to production will see little impact for a few years yet.

The gold industry has been making very good profits of late and this has created two distinctly opposite reactions. Where production is most advanced, as in Australia, Canada, the USA and Papua New Guinea, governments have introduced ways of applying taxes to mining. Also far more stringent land, environmental and rehabilitation laws have been or are to be applied. Elsewhere in the world many governments see mining as a development tool and have revised their mineral and fiscal laws to attract investment. Hence the rise in projects in countries like Chile and Ghana, to mention only two. The impact on production is hard to forecast at the present time.

Russia and other CIS countries remain wildcards. Reserves have exceeded those of the USA for the first time and provided fiscal and legal problems can be overcome the CIS could see greatly improved production in the medium-term.

Gold is held by many parties in the world but the trend for the past two decades has been disposal by Central Banks and some private hoarders and acquisitions by the man in the street. The position is now that Central Banks and other official stocks amount to 26.8% (27.5%) of total gold produced against John Citizen's 63.1% (62.3%) and the discrepancy is growing. The selling of gold by European Union Central Banks, the IMF and possibly the Swiss Central Bank has introduced fears of price falls and sentiment in the market is bearish.

Early in 1997 one of the greatest mining scams of all time broke when the firm Bre-X collapsed after checks on samples showed that they had been grossly overstated and a claimed 70 million ounce gold deposit possibly did not exist. The loss of public confidence from this has already impacted seriously on the market rating of junior companies and the raising of funds for exploration will become more difficult. The major companies are unlikely to be seriously affected as they fund most work from profits. Majors will have many prospects to choose from as juniors try to divest.

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WORLD GOLD RESOURCES

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INTRODUCTION

Since the gold price took off in the early 1970s the market has been in a constant state of adjustment as the various players position themselves. Certain features stand out and need to be remembered, namely:

- The higher gold prices brought vast tonnages of sub-marginal ore into the payable category.
- Exploration targeted old goldfields world wide with resounding success.
- New techniques of mining, notably, open cast operations and also extraction (CIP, CIL and Heap Leaching) lowered working costs and enabled low grade surface ores to be worked.
- The first, and easy targets, were the old mining countries notably Australia, Canada and the United States where many shallow deposits were rapidly outlined in fallow mining districts and brought to production in only a few years.
- The secondary targets lay in more remote and less developed countries. Here success trailed by a few years, but countries like Papua New Guinea, Indonesia, Chile, Brazil, Ghana and Peru received high exploration budgets.
- Meanwhile the political restructuring in the USSR opened up vast new areas for examination, but also created a plethora of legal and financial problems which are still being addressed.
- A third wave of exploration was fired by repressive laws relating to land, environment and taxation in the established mining areas which sent explorationists to more attractive fields in South America and Africa and later China and the CIS countries.
- Total Western Mine production has soared from 965 tonnes per annum in 1980 to 1959 tonnes in 1996 - an increase of 4.25% per annum. The source of new production has changed with Russia and South Africa loosing percentage production to a general increase in production in many other countries.
- Finally, governments started to take notice of the rapid growth in gold production and the profits which were being generated. This set in motion two contrary movements. The rich governments wanted a greater slice of the pie and reviewed various forms of taxation upwards. The poorer countries looked upon mining as a means of creating development and relaxed fiscal, land acquisition and other laws to encourage exploration.

PRODUCTION

Production has tended to flatten but the 1996 year saw an increase to a new all time high of 2345.5 tonnes of gold. Future production now becomes a matter of timing - will new production rise fast enough to more than replace closures in future years. South Africa, still the world's largest producer, suffered its third successive year of falling production and with only 494.5 tonnes produced recorded its lowest production since 1956. This was from a combination of additional holidays, general labour lethargy, greater mining depths and falling grades (as tonnage shortfalls continued to be met by substituting low grade surface materials). The average grade of 4.91 g/t for Chamber of Mines members is amongst the lowest on record. The other big producers, Australia, Canada and the USA all increased production while Peru, Chile, Indonesia, China and Uzbekistan posted significant increases. The net result was an increase from 2269.2 tonnes of gold in 1995 to 2345.5 tonnes of gold in 1996 (3.4% up). Figure 1 shows Western World Gold Production for the period 1850 to 1996. The level of production is guided by the installed capacity of mines as well as the ability to replace depleted ore reserves on the mines with new discoveries elsewhere. Discovery and installation both take time and

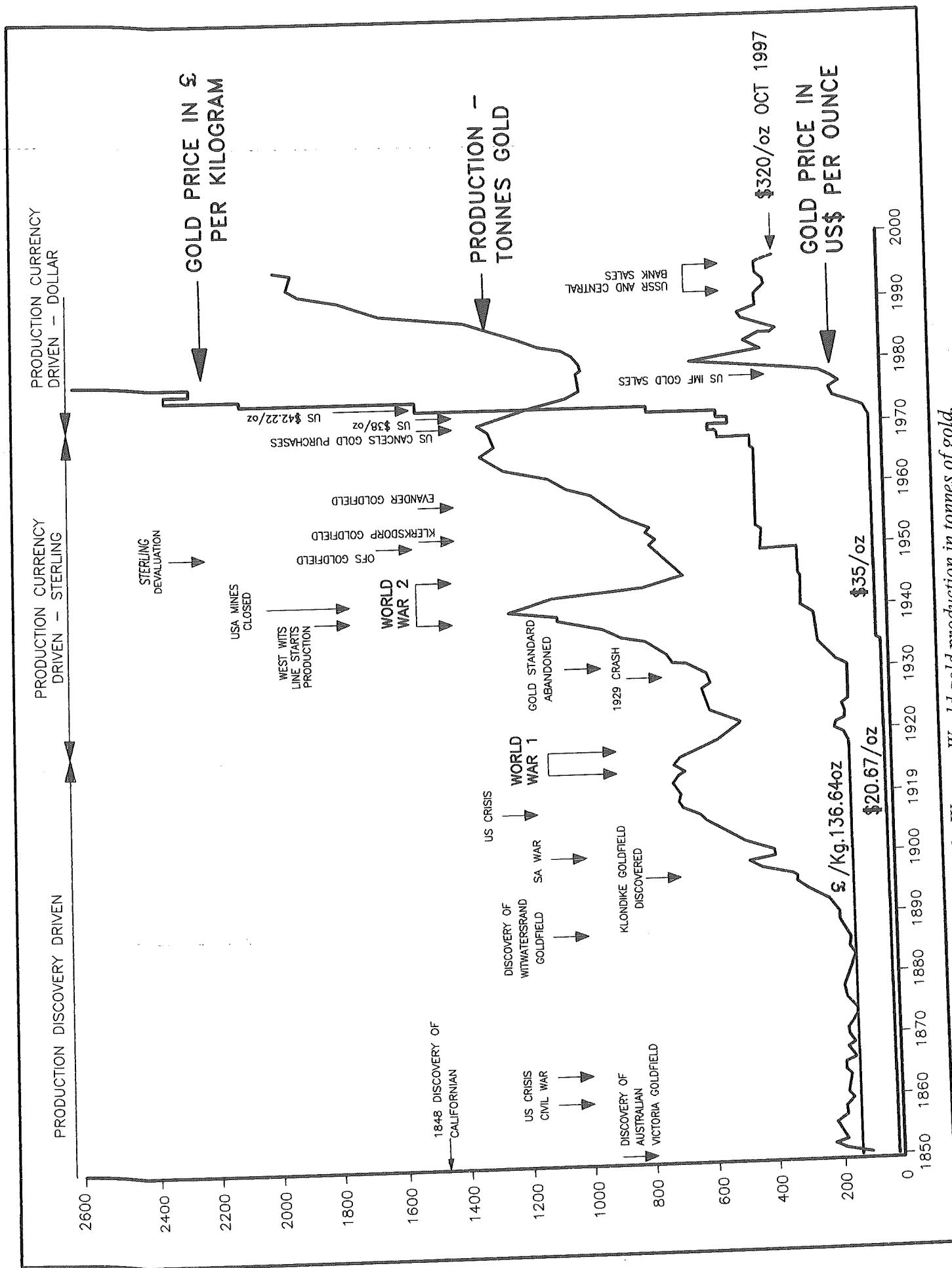


Figure 1. Western World gold production in tonnes of gold.

as one views present plans within the industry it seems likely that at best production can be increased slowly to meet increasing demand. Production is set to increase marginally in many countries with the greatest percentage increases expected in South American and West African countries. The big four all have some new or old mine expansion but the question is whether this expansion will offset closures. In the CIS the inflow of Western capital might cause a turnaround - Russia suffered a falling year in 1996, but Uzbekistan saw production rise following the commissioning of the Newmont joint venture at Murantau.

Mine production is still the main source of gold supply. The other sources of supply vary and are to a degree determined by the demand within the market. Table 1 sets out the main sources of supply of gold, which have shown a relatively steady increase over the past ten years. The average growth of 3.6% for the period gives some idea of the strength of the industry but at the same time is short of the growth in consumption of 5.5% for the same period. The shortfall has been made up by central bank sales, dishoarding and forward sales of gold.

Table 1: World Gold Supply - 1986 to 1996 in Tonnes of Gold

	Western Mine Production	Com Econ. Prod.	Scrap Supplies	Physical Deriv. Supply	Total Annual Supply	Percent Annual Change
1986	1296	341	524	45	2206	
1987	1384	350	470	149	2353	6.7
1988	1551	357	394	353	2655	12.8
1989	1683	380	393	193	2649	0.0
1990	1755	378	530	234	2897	9.4
1991	1790	370	480	111	2751	-5.0
1992	1872	360	487	259	2978	8.3
1993	1904	385	574	215	3078	3.4
1994	1898	379	615	370	3262	6.0
1995	1891	378	625	553	3447	5.7
1996	1959	386	644	262	3251	-5.7

Based on data in GFMS "Gold 1997"

Table 2 gives an indication of the source of recorded production throughout history, with the additional production credited to individual countries over the past five years. The table is a useful indication of changes in the production profile around the world and one can identify countries which are decreasing, static or increasing production.

ILLICIT GOLD

Illicit gold is from two main sources, namely gold stolen from legitimate operating mines and gold mined clandestinely by local populations. Both these sources have been operative throughout history and it is almost impossible to account for them in statistics.

Gold stolen from mines fails to report as production and is lost in the accounting procedures as its absence lowers the mine call factor, which is only an estimate of what should have been recovered had all mining operations progressed according to sampling and recovery estimates. Gold theft is frequently reported in the press and the amounts involved can range from a few kilograms to hundreds of kilograms. These reports cover only the discovered thefts while the undiscovered may be several times this amount. Estimates have placed this theft as between 5 and 10% of South African production and similar levels could be expected elsewhere particularly as in many operations the end product is concentrate, bullion or native gold.

Clandestine mining takes place in many countries and in Brazil it is a constitutional right of all citizens to mine minerals provided that they do so in a rudimentary fashion. In many other countries such as Ghana, Zimbabwe, China, Papua New Guinea, Venezuela, Tanzania large numbers of people extract gold from alluvial or eluvial deposits by panning or sluicing and the production makes up a

Table 2: Estimates of Total Historical Production in Tonnes of Gold to 31.12.96

Continent	Country	1992	1993	1994	1995	1996
Africa	Egypt	1753	1753	1753	1753	1753
	Nubia	1835	1837	1841	1845	1849
	Ethiopia	622	626	630	633	636
	West Africa	1824	1883	1944	2018	2092
	East Africa	178	186	193	200	207
	Zimbabwe	1822	1843	1865	1891	1918
	South Africa	44513	45133	45717	46239	46734
	Others	740	757	778	796	813
Regional Total		53287	54018	54721	55375	56002
Europe	Iberia	1922	1928	1935	1941	1946
	France	610	613	618	623	629
	Great Britain	96	97	98	99	99
	Italy	231	232	234	234	235
	Carpathians	948	958	963	970	977
	USSR (CIS)	16971	17219	17462	17689	17912
	Others	1511	1516	1520	1529	1538
Regional Total		22289	22563	22830	23085	23336
Asia	India	1525	1527	1529	1531	1533
	China	1323	1442	1563	1696	1841
	Japan	338	347	356	366	375
	Arabia	163	169	176	185	194
	Asia Minor	174	175	176	178	180
	Others	1701	1777	1834	1892	2113
Regional Total		5224	5531	5844	6184	6236
America	Bolivia	468	480	495	511	526
	Brazil	2569	2645	2718	2785	2849
	Canada	7874	8027	8173	8324	8488
	Chile	617	655	699	748	804
	Colombia	2115	2141	2167	2191	2214
	Dom. Rep.	126	127	129	133	136
	Ecuador	113	121	129	140	152
	Mexico	1838	1850	1863	1883	1908
	Nicaragua	39	40	42	44	46
	Peru	438	465	504	561	626
	USA	12064	12396	1272	13041	13370
Regional Total		29263	29977	30705	31477	32295
Australasia	Australia	7386	7633	7888	8142	8431
	New Zealand	979	990	1001	1013	1025
	P.N. Guinea	503	565	625	680	733
	Others	184	189	207	220	238
Regional Total		9051	9377	9721	10055	10427
World Total		119114	121403	123681	125950	128296

Based on long-term K&S research updated by recent production in GFMS "Gold 1997"

significant part of local production. Governments try to "capture" this gold for international finance purposes by setting up buying offices in districts where mining is active. Any such gold bought naturally enters the production statistics of the country concerned. However, the price offered for the gold is lower than world market prices as the concentrates are impure and require refining. The gold may be sold locally or exported illegally in which case it does not enter the production record.

In Table 2 the estimate of total world gold production to date of 128296 tonnes is certainly an understatement. Assuming that 5% of gold produced has not been recorded then the total may be 134710 tonnes. The 1997 GFMS survey estimated above ground gold stocks at 132300 tonnes, which is fairly neatly positioned between the above two estimates.

TOP TEN WORLD PRODUCERS

Since the new wave of gold production started in 1980 some new significant producers have emerged. Table 3 illustrates the top ten in 1980 and 1985 as well as the most recent grading. It is interesting to see the newcomers which have gained access to the top ten and also to note those that have fallen by the wayside. The significant increase in total production by the top ten shows the growth in the industry, but the old leaders, South Africa and the CIS (USSR), have been unable to maintain production while others have increased considerably. Countries falling out of the top ten are the Philippines and Colombia to be replaced by newcomers Indonesia and Peru which have shown incredible annual percentage growth from their original low bases. Australia and the USA have climbed the ladder most successfully.

Table 3: Top Ten World Gold Producers (Tonnes)

1980		1985		1996	
Country	Tonnes	Country	Tonnes	Country	Tonnes
South Africa	675	South Africa	672	South Africa	495
USSR	311	USSR	271	USA	329
Canada	52	Canada	90	Australia	289
China	50	USA	80	CIS (USSR)	223
Brazil	35	Brazil	72	Canada	164
USA	31	China	59	China	145
Philippines	22	Australia	59	Indonesia	92
Australia	17	Philippines	37	Peru	65
Colombia	17	P. New Guinea	31	Brazil	64
P. New Guinea	14	Colombia	26	P. New Guinea	53
Total for Top 10	1224	Total for Top 10	1397	Total for Top 10	1919

Based on data in Gold Fields reports for the relevant years

GOLD OWNERSHIP

There is little doubt that John Citizen, with his love of jewellery, continues to purchase gold and his holdings are rising relative to the gold held by Central Banks (Table 4). Currently all official stocks represent only 26.93% (27.48%) of recorded mined gold. This is a far cry from the 47.6% of mined gold held by Central Banks at their peak holding in 1965. In contrast man is personally holding 63.1% (62.3%) of all the gold mined in the form of bars, jewellery and coins. The balance of 9.97% (10.24%) is held in public corporations, manufactured goods, manufacturing pipelines, churches and medals. Central Banks appear to be taking a new interest in gold, despite the fact that their total holdings were again reduced slightly during 1996. Four wild cards remain:

- the Far East, where many governments hold very low percentages of gold in their foreign reserves. Conversion of dollar holdings by eastern nations into gold, as protection against a possible weakening of a strong dollar, seems a likely possibility in the medium-term. This could be the catalyst to set the gold market on fire.
- the I.M.F. is considering the sale of part of its gold holding to assist weak economies with their financial problems. This will place a still higher proportion of gold in private hands particularly if the sales are by regularly announced auctions as happened in the 1970's.
- The Swiss are considering reducing the 40% gold backing which their currency enjoys and also speak of raising the value of the gold in their stocks closer to market related prices. These announcements, coupled with the declared intention to establish a Holocaust Trust of about US\$8 billion has raised fears of possible Swiss Central Bank gold sales.
- The European Monetary Union is planning establishment of its currency in January 1999. The terms for member countries to enter the EMU are stringent and may see some members trying to sell gold to strengthen their balance sheets before the time, though such sales have been declared unacceptable by the EC. This has also raised fears of massive gold sales. However, it seems strange that members have not done mutual gold swaps (sales) such as, for example, France and Germany selling one another, say, 1000 tonnes of gold for identical packages of foreign exchange. Add in a contango of say, 4%, and both banks could considerably strengthen their bottom lines and bring sterilized gold into use at current market price levels. Maybe some of the proceeds could go towards public debt!

Table 4: Estimate of the Ownership of Gold at Surface at 31.12.1996

Held By	Tonnes Gold	Balance Tonnes	% of Total	Reliability of Estimate
Mined to 31.12.96	128296	128296	100.00	Fair
Central Banks	28135	100161	21.93	High
Other Official Stocks	6283	93878	4.90	High
Private Banks - Public	2500	91378	1.95	Low
Jewellery Manu.	2500	88878	1.95	High
Pipeline				
Bar Hoarding - Public	5557	83321	4.33	Fair
Coins - Public	20934	62387	16.32	Fair
Jewellery - Public	54465	7925	42.45	Fair
Decoration - Churches	2286	5639	1.78	Low
Medals - Public	1624	4015	1.27	Fair
Electronics - Public	2413	1602	1.88	Fair
Dentistry - Public	1382	220	1.08	Fair
Other / Lost	220	-	0.17	Low

WORLD RESOURCES

1996 is the eighth year that data has been compiled in an effort to estimate identified world gold resources. A pattern is starting to emerge, and as the total amount spent on exploration compounds, the resources are increasing year by year despite the depletion that has been taking place. However, there is a trend towards a lowering of average grades, an increase in the tonnage mined and a proliferation of small deposits. Coupled with the high degree of low-cost open-cast workings the environmental impacts are becoming more obvious and in the future there will be a higher allocation of funds towards rehabilitation of mined areas. Cash costs are increasing steadily and have risen from \$250/oz in 1990 to \$262/oz in 1996 while total costs have risen to \$312oz. This is indicative of increasing depths of open pit mines and the

necessity to treat sulphide ores as the pits get deeper. The profits at a gold price around \$345 are starting to be squeezed.

The compilation of total resources depends to a degree on the amount of disclosure of individual companies. It is also affected by the nature of the mine. Open pit mines tend to be fully explored and planned before mining starts. Underground mines identify sufficient ore to justify the costly underground development but tend to find more ore as development is extended into the property.

The Bre-X debacle introduced a new dimension which needed consideration when assessing resource declarations by junior companies. It is quite apparent that many junior companies, in order to justify their continued existence, declare a resource. This is not an entirely fictitious resource but it is unlikely to ever become a reserve because it is based on data which lacks continuity and is usually far too small to support a mine. However, it does enable the directors to report back to their shareholders and continue operations. If the resource can be suitably presented in a favourable geological setting, with a geophysical anomaly thrown in for good measure, it is possible to raise additional capital for further exploration - and, exploration being what it is, every now and again further work does lead to the discovery of a significant ore body (remember Voisey Bay). During the examination of resource declarations for the 1996 figures companies were scrutinized more severely. If they had declared only a token resource, say 100 000 oz, and if this resource had not been increased for two or three years, then it was concluded that the resource was fictitious and would never rise to being an ore body. It was then deleted from the data base.

Table 5 lists the estimates as determined at the end of 1996. The second column estimates the potential total resources which might ultimately be found in some of the countries based on their geological make-up and on past production. This is an indication of both past and future prospectivity and while it could trigger a rush to Timbuktu, the serious explorationist would do a desk study before dashing off to peg any claims.

THE BIG FOUR (AUSTRALIA, CANADA, SOUTH AFRICA AND THE UNITED STATES) - AND THE REST OF THE WORLD

The rest of the world is catching up slowly on the Big Four as exploration successes there are now being brought to account. In terms of production the Big Four produced 1276.6 tonnes of gold in 1996 (1245.2 t in 1995) which represented 54.4% (54.9%) of world production. This percentage has come down successively over the years having been 61.5% in 1990. South Africa showed a serious production fall, while Australia, Canada and the USA all increased production over their 1995 outputs.

The mining industries of the Big Four are generally in a consolidation phase where established mines are endeavoring to add to their resource base and thereby increase life. Except in South Africa, this has often been accompanied by production increases. Notwithstanding these increases, closures or falling production prior to closure has affected many smaller mines resulting in an overall fall in production. In terms of resources the Big Four currently have 57173 tonnes or 55.7% (64.4%) of world resources.

Table 6 and Figure 2 provide a summary of the progressive changes in total resources of the world from 1991 to 1996. In reading this table it is as well to keep in mind that many of the changes are related to additions to the data base as projects pass into stages where resource estimates are made. Contrariwise, falls indicate recession in the industry when projects were abandoned or lack of interest resulted in them not being recorded. Accepting these limitations, the tabulation does emphasize that continued exploration has added to the overall resources base. In the case of South Africa, the high

Table 5: Estimates of Total Identified Resources with Estimates of Hypothetical Resources as at 31.12.1996

		Hypothetical Resources	
		Identified Resources Tonnes	Hypothetical Resources
Africa	Egypt	55	1000
	Nubia	63	1000
	Ethiopia	32	500
	West Africa	3018	4000
	East Africa	324	500
	Zimbabwe	496	1000
	South Africa	40154	60000
	Others	382	500
Regional Total		44524	68500
Europe	Iberia	171	1000
	France	27	500
	Great Britain	38	150
	Carpathians	302	1000
	Greater Russia	11706	15000
	Others	357	1000
Regional Total		12628	18650
Asia	India & Pakistan	60	1500
	Greater China	810	1900
	Japan	503	1000
	Arabia	136	500
	Asia Minor	149	500
	Indonesia	4417	5000
	Philippines	1848	2500
	Thailand	145	1000
	Others	406	500
Regional Total		8474	14400
Americas	Argentina	1535	3000
	Bolivia	379	750
	Brazil	1808	3000
	Canada	7455	10000
	Chile	2066	3000
	Colombia	40	1500
	Dominican Rep.	129	500
	Ecuador	232	500
	Mexico	1584	2000
	Nicaragua	183	500
	Peru	805	2000
	United States	9564	12000
	Venezuela	473	1000
Regional Total		27473	41250
Australasia	Australia	6433	8000
	New Zealand	151	750
	P.N. Guinea	2815	6000
	Others	244	500
Regional Total		9643	15250
World Total		102742	158050

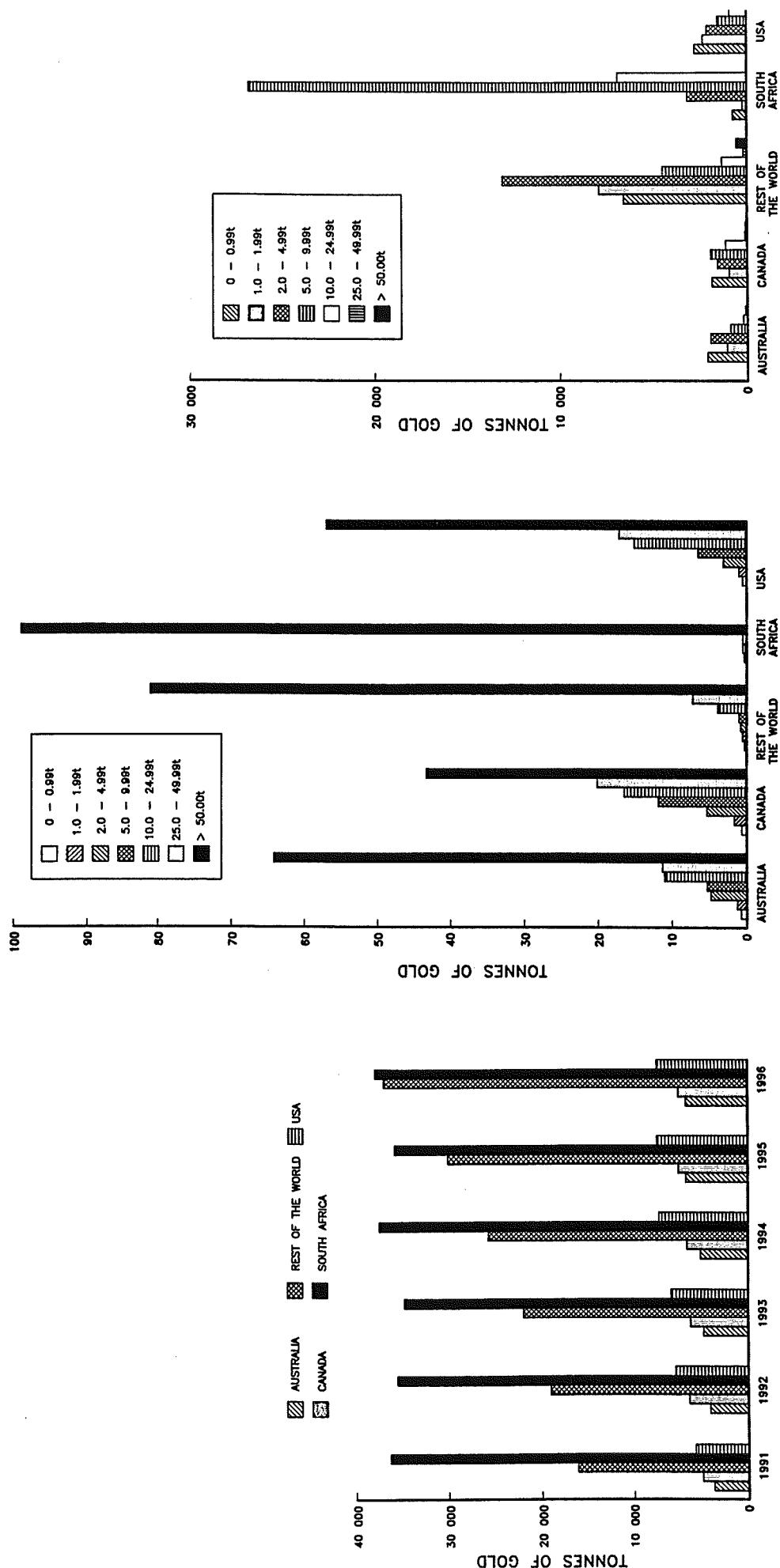


Figure 2: Growth in world resources in contained tonnes of gold.

Figure 3: Percent distribution of deposits by size in tonnes of contained gold as at 31.12.96.

Figure 4: Distribution of tonnes of gold in various grade categories.

sensitivity of the Witwatersrand ores at current pay limits has seen resources of gold being written off due to the lower gold price. In the early months of 1996 the weakening rand saw an 18% increase in the rand gold price - this has resulted in marginal resources being written back but as the gold price weakens they are likely to be written off again. Other increases in South African resources come from the decisions to examine the Target, Sun and Oribi projects and the Evander consolidation, both actions creating a larger resource base.

The growth in identified world resources in the regions summated since 1991 shows very steady growth of over 6.4% per annum which is outstripping the growth in production which averaged only 1.8% during this period. The world's gold production machine is in very good order and has created a resource base which should be sufficient to meet all demand calls for many years to come. The future growth in production will depend on the attractiveness of investing further funds in production capacity. With the gold price below \$350/oz it is probable that only projects already underway, or highly profitable projects in any gold price scenario, will be brought to fruition. The existing impetus in the production cycle will probably be maintained but increased growth is unlikely.

The growth in identified resources is influenced by the gold price in that with a falling gold price:

- Companies tend to put projects "on ice" and do not report results.
- Many smaller companies stop activity and may even go into liquidation.
- The lower profit margins result in lower pay limits and render large tonnages unpayable. The resource calculations have been adjusted accordingly

With a rising gold price the above reductions are reversed and exploration funds and activity rise. The need to maintain shareholder interest and attract funds causes most small companies to disclose maximum results (even to the point of exaggeration). On the contrary, the major companies tend to operate under a cloud of secrecy until projects are well advanced but they too are liable to have more confidence and disclose results in a rising gold market. Equally, mining operations inherit a bonus by the mere fact that marginal ores, previously not included, are deemed to be payable under the higher price regime.

The growth in resources has not been even across the regions for the period 1991 to 1996. Australia experienced incredible identified resource growth in the fifteen year period prior to 1988 but this tailed off to 1994 and then surged in 1995 and went flat again in 1996. Canada showed good growth of 7.2% over the period 1991 to 1995. The USA, following full scale evaluation of the Carlin trend, saw reported resources increasing at the very rapid rate of 8.9% per annum since 1991. However, the Rest of the World, where exploration has been on a steep increase and new disclosures from the CIS and China have been made, has seen the highest increase of 13.6% per annum. South Africa, which was depleting resources faster than replacing them, has shown an annual growth of only 0.7% for the same period.

The Witwatersrand ores are sensitive to gold price changes and as the grades which are mined drop this sensitivity increases. It is difficult to define this sensitivity industry wide, but for individual mines it ranges between a sensitivity index of between 0.2 and 4.0%. This index represents the percentage multiplier by which the tonnes of gold available in a resource will increase for every one percent increase in the gold price. Mines with a high percentage payability (Western Deep Levels) have a low index and marginal mines (Durban Deep) have a high index. With many SA mines operating close to their pay limits it is clear that the sensitivity will rise as the gold price falls.

Table 6: Estimates of Total Identified Resources for the Big Four and for the Rest of the World - 1991 to 1996

Country	Year	Tonnes Ore Million	Tonnes Average	
			Contained Gold	In Situ Grade G/T
Australia	1991	3091	3675	1.19
	1992	3288	4151	1.26
	1993	3649	4664	1.28
	1994	3884	5012	1.29
	1995	4692	6497	1.38
	1996	5119	6433	1.26
Canada	1991	4211	4913	1.17
	1992	6598	6265	0.95
	1993	6446	6007	0.93
	1994	6872	6508	0.95
	1995	7521	7340	0.98
	1996	6983	7455	1.06
Rest of the World	1991	n.a.	18165	n.a.
	1992	15849	21104	1.33
	1993	19360	24086	1.24
	1994	22117	27996	1.27
	1995	24406	32378	1.30
	1996	36130	39116	1.08
South Africa	1991	6425	38426	5.98
	1992	6333	37800	5.97
	1993	6070	37070	6.11
	1994	6200	39933	6.44
	1995	6160	37885	6.15
	1996	6338	40154	6.35
USA	1991	3593	5723	1.59
	1992	5331	7857	1.47
	1993	5379	8082	1.50
	1994	6562	8987	1.30
	1995	8004	9560	1.20
	1996	7766	9564	1.23

Despite the large increases in resources it must be remembered that significant percentages of the resources are in very small or very low grade deposits which can only be brought to account under favourable economic or locality situations. Thus, while the figures suggest that the world has sufficient identified resources to support mining for 44 years, allowing for normal mining losses and non-viable resources, the true figure is probably closer to 25 years.

GOLD DISTRIBUTION IN VARIOUS RESOURCE CATEGORIES

The tabulations below show how the quantity of gold resources are distributed by sorting the data in two respects. The initial sorting selects the size of the identified ore resource bodies (i.e. the contained tonnes of gold) and these have been expressed as a percentage of the total resource. Thus, Table 7 and Figure 3 show the percentage of the tonnes of gold in the various categories. It is quite apparent that the South African ore bodies are several orders larger than their counterparts elsewhere except that some large deposits are emerging in the Rest of the World, particularly, the CIS countries,

Indonesia, Papua New Guinea, Mexico and South America. It also indicates the percentage of very small deposits (say, below 5 tonnes of gold) which might never be brought to account as stand-alone operations. They will be worked only if they lie close to existing infrastructure. Their validity as a true resource could be questioned.

In Table 8 and Figure 4, the second sorting by grade of the resource, is interesting in that in terms of Australia and Canada it suggests that there are two very distinct populations, namely, open cast and underground, but the distribution also reflects the higher grade gold deposits as opposed to the lower gold content in base metal deposits. For South Africa the distribution is dominated by the very large underground mines with relatively high grades. Also, the absence of low percentages of very rich ore in South Africa is masked by the large area of the ore bodies (mining leases), which are of several square kilometre dimensions versus many small claim sized bodies in other countries. The small patches of very rich South African ores become diluted on a mine basis in the ore reserve (resource) disclosures by being mixed with high tonnages of lower grade ore. The U.S.A. shows an almost straight line decrease with the low grade open cast/heap leach operations dominating the scene. Here again, dilution of very rich ores by large tonnages of lower grade ores masks the categories over 25 g/t.

Resources in the Rest of the World have seen the greatest advance in their resource base over the past five years. Some spectacular finds have been made and continued exploration around known deposits, as at Grasberg-Ertsberg in Indonesia, has seen resources being built up to some of the largest in the world. Indonesia in particular has seen some major advances and it has now outstripped Papua New Guinea in terms of contained tonnes of gold to take up the sixth position in the world after the Big Four and the CIS.

Table 7: Distribution of Resources in Terms of Tonnes of Contained Gold Based on Data as at 31.12.1996

Category Tonnes of Gold	Percent of Total Resources				
	Australia	Canada	South Africa	USA	Rest of the World
0 - 0.99	1.1	0.9	NIL	0.4	0.1
1.0 - 1.99	1.6	1.9	NIL	0.8	0.2
2.0 - 4.99	4.9	5.0	NIL	3.3	0.9
5.0 - 9.99	5.4	12.2	0.1	6.7	2.0
10.0 - 24.99	11.2	16.5	0.3	15.0	6.5
25.0 - 49.99	12.0	20.0	0.3	17.0	9.8
Over 50.00t	63.9	43.4	99.3	56.9	80.5

Table 8: Tonnes of Gold in Resources in Various Grade Categories Based on Data as at 31.12.1996

Category Grade g/t	Tonnes Gold (%)				
	Australia	Canada	South Africa	USA	Rest of World
Undisclosed					5281 (13.5)
00.00 - 00.99	2063 (32.1)	1819 (24.4)	650 (1.7)	2760 (28.9)	6423 (16.4)
01.00 - 01.99	1335 (20.8)	970 (13.0)	150 (0.3)	2373 (24.8)	7857 (20.1)
02.00 - 04.99	1994 (31.0)	1443 (19.4)	3032 (8.0)	2085 (21.8)	13111 (33.5)
05.00 - 09.99	873 (13.6)	1948 (26.1)	27139 (71.7)	1468 (15.4)	4430 (11.3)
10.00 - 24.99	154 (2.4)	1105 (14.8)	6914 (18.3)	826 (8.6)	1326 (3.4)
25.00 - 49.99	14 (0.2)	97 (1.3)	Nil (Nil)	51 (0.5)	188 (0.4)
Over 50.00g/t	Nil (Nil)	72 (1.0)	Nil (Nil)	Nil (Nil)	500 (1.3)

During the year the greatest advance has been in Peru where figures for the Chimu (Altai Resources) and Cerro Corona (American Barrick) deposits have been recorded for the first time. These have pushed the total Peruvian resource from the 364 tonnes recorded in 1993 to 805 tonnes

over the last two years. Indicative of this advance is the fact that Peru is now the largest gold producer in South America (1996 - 64.8 tonnes of gold) against Brazil's 64.2 tonnes.

Numerous large bodies have also been disclosed from the CIS countries where the results of many years of exploration under the Communist regime are only now being disclosed. These are being disclosed almost monthly as Western companies enter into negotiations and start to disclose their intentions and the size of the target they are to examine. Financing, as well as infrastructure, can pose problems for these deposits and the different cultures are finding it difficult to come to terms. Despite some withdrawals many Western companies have successfully set up development plans on a host of CIS ore bodies.

The addition to resources in the other countries is to be expected as large sums of money have been expended over the past five years. This trend will continue and in future years further disclosures from South America, West Africa, East Africa and Indonesia will be entering the lists. The Bre-X debacle may reduce efforts by the junior companies as their funding will be restricted but the majors are expected to push ahead and in fact take over the more prospective projects of the juniors.

SUPPLY AND DEMAND - A BALANCING ACT

Table 9 is an attempt to balance the physical gold in the market, ignoring economic, speculative and political motives which might call for the sale of gold already on surface. The market is further obfuscated by producers selling forward, speculators buying and selling and gold movements in bar form between gold bulls and stale gold bulls. In between these gyrations the fabricators latch onto some gold and it reappears as jewellery, electronic goods, coins etc. Most of this latter gold becomes removed from the market as John Citizen continues to accumulate.

In recent years there has been a large gap between the physical supply of gold from the mines and the gold used in manufacturing. In each year this shortage has been satisfied in a different way - one year by central bank sales, another year by large producer forward selling etc. It is almost impossible to predict by whom the gap will be filled in the future, but filled it will have to be if the market is to remain balanced. No institution wishes to remain permanently long or short in gold. With this in mind the following figures have been extracted for the years 1991 to 1996 and a simplistic forecast has been made for the period 1997 to 2002. This looks only at the gold mined or to be mined and the gold used or to be used in industry. Scrap has been included in the equation because much of the scrap recorded is gold that is virtually circulating in high carat jewellery and bars and it responds to economic cycles, seasonal and business, and is included in annual manufacturing figures.

One major factor in gold supply in recent years has been producer forward selling. This is not a completely open-ended process as contracts entered into today must be delivered in the future. A contract puts gold into the market but its delivery takes gold out. Sooner or later this flow of gold must start to balance itself and its impact will be little felt. Thus the shortage in supply will start to fall on central banks and other surface stocks. Recently, a bevy of smaller central banks have adopted a policy of mobilizing their gold by providing the physical metal on loan in order to effect forward sales. The bulk of central bank gold appears not to have taken part in these transactions. It was estimated that banks holding about 6400 tonnes out of a total of 28 135 tonnes of central bank gold were active in lending gold to cover forward sales. None of them would lend all their gold (remember the Drexel Burnham debacle) so the amount to cover forward sales may be getting thin. This could force a general rise in forward sale interest rates making forward sales less attractive.

Table 9: Estimate of Gold Supply and Demand 1991 - 2000 in tonnes of gold

Year	Estimated World Production	Scrap Supply	Total Physical Supply	Total Industrial Use	Physical Shortfall
1991	2159	480	2639	2866	(226)
1992	2232	487	2719	3205	(486)
1993	2289	574	2863	3034	(171)
1994	2278	615	2893	3074	(181)
1995	2269	625	2894	3266	(372)
1996	2346	644	2990	3290	(300)
Total	13573	3425	16998	18735	(1736)
Forecasts					
1997	2355	625	2980	3350	(370)
1998	2400	650	3050	3400	(350)
1999	2400	675	3075	3500	(425)
2000	2400	700	3100	3500	(400)
2001	2450	725	3175	3600	(425)
2002	2500	750	3250	3650	(400)
Totals	14505	4125	18630	21000	(2370)

EXPLORATION - A NEW POST-Bre-X ERA DAWNS

The Bre-X debacle has introduced a completely new set of thoughts into the veracity of company disclosures. Scams in exploration have been in existence since time immemorial and a spate of them during the “Forty Niners” caused Mark Twain to comment that “A mine is a hole in the ground with a liar standing next to it.” In the 20th Century there have been many scams, one of the most famous being the Erfdeel salting, where careless filing of a gold ring into a sample produced a value of such magnitude that it was immediately queried and the perpetrators were brought to book. During 1996 another such scam emerged when a borehole result from the Sitakili lease in Mali was published by Timbuktu Gold Corporation. At 84 g/t over 62.5 metres this was sufficiently suspicious to generate an immediate investigation by the Alberta Stock Exchange leading to the suspension of the share. However, the share price had already soared and fallen!

Not so the Bre-X debacle - this was cleverly engineered over a period of more than two years. The levels of gold content disclosed were within reason and the ranges were what would statistically be expected from the drilling of a large surface gold deposit.

The saga was meteoric and reads like this:

- 1995 - 1 million ounces of gold resources in the best prospect at Busang in Indonesia.
- 1996 - 69 million tonnes at 2.69 g/t equal to 5.97 million ounces at Busang plus an inferred resource averaging 2.66 g/t of 15.68 million ounces.
- 1996 - July - Possibly as much as 47 million ounces (but it could be three times this figure)
- 1997 - February - A resource of 71 million ounces but it could be 200 million ounces!

By this stage the clamour to get a part of this fabulously large deposit (6220 tons of gold - almost as much as the total resource of Australia) saw many suitors trying to get in on the act. Barrick looked as though they had clinched the deal and they had apparently accepted the results. However, through the intervention of the Indonesian government, Freeport Copper and Gold won the day. Freeport immediately set about a due diligence study and within weeks it became apparent that something was amiss. Test boreholes and sampling by Freeport suggested that the values declared by Bre-X were between 100 to 500 times overstated. The gold resource and the Bre-X market capitalisation disappeared over night and the company has been liquidated. There will no doubt be several law suits arising from this scam. The question remains, how was it possible to tamper with thousands of samples to effect the scam in such a way that suspicion was not aroused? Who were involved - one or two people in the field staff and the laboratory or the entire management? There is no question that the share traded with extreme upward volatility and billions of Canadian dollars changed hands - was there insider trading? Maybe next year some of the answers will be available but the damage to the exploration sector has been done and it will take a long time for confidence to return.

The impact of the Bre-X debacle is likely to be:

- Loss of confidence in junior companies.
- Difficulty of raising funds by junior companies to continue exploration and the threat of many liquidations and the abandonment of properties.
- A need to substantiate disclosures, possibly by an audit by an outside consultant.
- Large companies will have sufficient funds to continue exploring but will be very selective in taking over an increased flow of projects from juniors.
- Resources will be reassessed and some will doubtless be written off.
- More capital for exploration will have to come out of profits as public subscription will not be as readily available as in the past.

Following the dip in the gold price in the early 1990s, which was accompanied by a fall in gold exploration, the years 1994 to 1996 have seen an increase in spending but the levels have still to reach those of the heady days of 1988-89. Also, while gold still provides a lucrative steady market into which new better class deposits can be launched there has been a strong swing towards diamonds and base metals. The successful identification of diamondiferous kimberlites in Canada and the finds of rich nickel deposits at Voisey Bay has diverted some exploration funds. The amount spent on gold in 1996 was probably less than 65% of exploration budgets which totalled about \$US 3.5 billion world wide.

Features arising from the exploration policies of the last few years are still in place. These may be summarised as follows:

- A concentration of exploration around existing mines where the land situation is already secure and the chances of extending the life of the mine are good. This was done with considerable success in Australia, Canada and the USA.
- Selecting those countries where changes in the mining/fiscal laws created a favourable climate for investment and reduced risk. Here one may mention Chile, Peru, Argentina, Ghana, Tanzania, Brazil and many others.
- Examination of identified resources which had not come on stream, largely because of lack of capital - the CIS and China are good examples but there are many others such as the Peruvian and Argentinean release of mine projects.
- Using remote sensing techniques to identify prospective areas and to return to grass-roots exploration in countries offering reasonable terms and areas for such work.

The growth of resources, almost world wide, illustrates the success achieved. Much of the growth has arisen from work done over the last six years when a total of about \$11 billion might have been spent. The growth of resources in the Western world is estimated to have been about 23 000 tonnes (740 million ounces) which implies a cost of about US\$15 per newly discovered ounce. This is considerably below the US\$35 which was calculated for the 1970-1980 period but some of the new discoveries came from a "running start" where additions were made to mine resources and where earlier unpublished projects were revived and brought to account. However, the discovery and evaluation of a large number of big deposits in the rest of the world may have set a new pattern. At looks as though exploration remains high profitable!

A slightly disturbing tendency is entering some company reports. Resources are being declared in thousands or millions of ounces but no tonnage or grade figures are given. Viability depends on these three parameters and ounces alone are quite meaningless. This tendency was noted in some of the local press releases on Bre-X, but this may have been the fault of the media. Whoever is at fault, vague reporting is undesirable.

CAPITAL COSTS OF GOLD DEVELOPMENT

Capital costs comprise those costs incurred in bringing a mine into production. The term is also applied to the costs of expansion of an existing producer. Once in production further capital is invested at an on going rate sufficient to maintain equipment in working order or to replace, by development, ore which has been depleted. This latter capital is normally obtained from working profits.

The feasibility study for a mine examines in detail the ore body in terms of tonnes and grade, the mining techniques to be used, extraction methods and efficiencies and, finally, the infrastructure needed to attain production and its cost. In certain circumstances an ore deposit may be favourably placed, relative to another mine and its infrastructure or to population and communication centres. In other cases the mine may be so remote that all aspects of mining as well as living for the employees must be constructed. Thus initial capital calls can vary between wide limits, but it is immediately apparent that the smaller the capital calls the smaller will be the risk undertaken. Also, the richer the ore the greater will be the revenue hence the probability of profit is greater.

The gold mining industry has been in a period of intensive capital investment for some 18 years but the lower gold prices of the 1989 - 1992 period resulted in a slowing down of new capital investment. Since that time the price of gold and most base metals has turned upward and many new projects are underway for gold or base metal-gold projects. The money to fund the new capital has been drawn from mining profits, public subscription or by gold loans.

The projects listed in Table 10 are all new projects which were funded during 1996 and are all small- to medium-sized mines. The Cononish mine is in Scotland and is a small vein type deposit which is accessible by adits. The capital cost is thus a competitive US\$440 per annual ounce of proposed production. The life is short, but as development proceeds it is very likely that additional ore will be exposed. Freddies No. 4 Shaft is the only deep level gold mine listed. The cost per annual ounce of only US\$704 is low for this type of development but this shaft is a part of the Freegold Mine (OFS Goldfield) and hence all other mining infrastructure is in place. Henty is a relatively shallow underground mine in Tasmania, but it has rich ores. Mount Polley is a large open pit mine in Canada and Musselwhite is a large combined open pit and underground mine also in Canada. The capital cost per annual ounce is an indication of the cost of setting up a completely new mining venture but this is relatively low as first production will be from an open pit. The Mastira Mine is in Turkey. Both the

Sunrise Dam and Vera/Nancy operations are in Australia and both are benefitting from some pre-existing infrastructure hence the low cost per annual ounce produced.

It is evident from the above that the capital cost of producing an annual ounce varies considerably. Part of the cost is in the lead time to production and also the depth of the ore body. Open cast or alluvial deposits have much lower capital costs and as a result proportionately less risk. Construction of a dredge or a surface plant might take a few months to a year, but once it is in place revenue starts to flow almost immediately.

Table 10: Capital Costs and Capital per Annual Ounce of Proposed Production

Project Name	Owner	Proposed Production oz / annum	Capex Millions \$US	Capex Cost \$US per Annual oz	Life: Years	Type *
Cononish	Fynegold	25000	11	440	6	UG
Freddies No. 4	Freegold	179000	126	704	19	UG
Henty	Renison	90000	45	500	5	UG
Mastira	Inmet	45000	17	378	9	UG
Mt Polley	Imperial	100000	91.5	915	11	OP
Mussel White	Placer	200000	190	950	9	OPUG
San Gregorio	Amer Res	70000	35.3	504	6	OP
Sunrise Dam	Acacia	100000	37	370	4.3	OP
Vera / Nancy	Normand	100000	40	400	11	OPUG

* OP = Open Pit UG = Underground

In Australia and Canada plants (which are already depreciated) have been moved from a depleted pit to a new location in a matter of weeks or the mill is used to toll treat ore transported to it. Such agility reduces capital costs appreciably and enables many ores to be worked on a cash cost rather than total cost basis.

THE MAIN GOLD PRODUCERS IN THE WORLD

This section is devoted to several countries or areas which are the main producers. A brief review of their recent production histories, if this has not been given already, and their future potential is made.

AUSTRALIA

Australian production increased to an all time high of 289 tonnes of gold in 1996. This was largely the result of the intensive exploration around mines in the last few years which saw resources increased. As a result production facilities were enlarged and more gold was produced. There were several small closures but in most instances the mill was either moved to another site or ore was trucked in for toll milling. A total of 13 mines, producing 39 tonnes of gold per annum, have lives of less than three years. This loss of production will be made up by new starts or by extending the lives of some of these mines. The latest resource estimates are given in Tables 11 and 12.

The Australian resource total is adequate to maintain the industry for many years but the low average grade and the low proportion of the ore reporting in the higher grades suggests that the Australian industry will always be dominantly open-pit with only a small contribution from underground mines. There is also a large element of very small projects in that 295 of the 452 identified projects have less than 5 tonnes of gold content and are probably too small to be stand alone mines.

The land problems in Australia have not gone away and the MABO legislation is still in place. The Century zinc mine, a world class deposit, remains blocked while the question of pastoral leases is exercising legislators minds. The Lake Cowal development was stopped in its tracks by rejection of its environmental plan. All these bureaucratic problems will continue to plague the industry for many years and the land problem might be insoluble. Australian legislators face the problem of reconciling

Table 11: Distribution of Australian Deposit Sizes in Terms of Tonnes of Contained Gold at 31.12.96

Category Tonnes of Gold	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	30	2.12	64	1.0	151
1.0 - 1.99	46	1.95	90	1.4	62
2.0 - 4.99	131	1.99	260	4.0	82
5.0 - 9.99	192	2.07	398	6.2	53
10.0 - 24.99	407	2.08	849	13.2	53
25.0 - 49.99	491	1.50	1003	15.6	29
Over 50t	3821	0.99	3769	58.6	22
Total / Average	5119	1.26	6433	100.0	452

Table 12: Distribution of Australian Deposit Sizes in Terms of Average Grade at 31.12.96

Category Grade g/t	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	3265	0.63	2063	32.1	33
1.0 - 1.99	981	1.36	1335	20.8	110
2.0 - 4.99	721	2.76	1994	31.0	231
5.0 - 9.99	141	6.20	873	13.6	58
10.0 - 24.99	10	14.68	154	2.4	19
25.0 - 49.999	0.5	27.04	14	0.2	1
Over 50 g/t	0	0	0	Nil	0
Total / Average	5119	1.26	6433	100	452

the needs of what was a migratory, food gathering minority who have no written records with the need to legislate fairly for a modern economy in a world tuned to human rights. Could royalties be the answer?

The mention of royalties above brings to mind the fact that the West Australian government has introduced a 2.5% royalty on revenue. This will knock out a few marginal mines if the gold price does not move up. On the bright side, moves are afoot to streamline the environmental laws, which might reduce the time taken for the approval of environment impact reports.

Australian companies are very active in world exploration being operative in the Pacific Islands, Papua New Guinea, Indonesia, the CIS, China and the Far East, India, Zimbabwe, South Africa, East and West Africa, Canada, the USA and South America. The expertise that has been developed for the identification and exploitation of shallow open cast deposits has found wide application and a fair measure of success.

Production in Australia reached 255 tonnes of gold in 1994, falling back marginally to 254 tonnes in 1995 but rising again to 289 tonnes in 1996. Expansions at several of the larger mines are likely to see this peak exceeded in future years. However, the long-term future of Australia depends on discovering sufficient ore to replace depletion. While total resources stand at nearly 6433 tonnes of

gold, sufficient for over 22 years at present production rates, much of this is in small deposits or in base metal mines which will only be worked under the right conditions or in the long-term. Only 15.7% of Australia's resources are above 5 g/t, which implies that the chances of establishing a large underground mining industry are slight on present knowledge. Despite this, Australia will remain an important source of gold well into the next century.

BRAZIL

Brazilian gold production peaked in 1988 when "garimpeiro" production from surface deposits was at its height. From this peak of 102.2 tonnes production has fallen fairly steadily to the 64.2 tonnes reported in 1996. Replacement of fields for artisanal exploitation has not happened and Brazilian production is moving from the informal to the formal sector. Recent changes in legislation have seen much more interest being shown by international companies, but a fairly long period of exploration and development may be necessary before Brazil again attains annual gold production of over 100 tonnes. The privatisation of some of the CVRD-held mineral projects could go a long way to encouraging exploration and development spending.

Identified resources in Brazil are presently about 1808 tonnes of in situ gold but the news of the recent closure of Morro Velho could be a set back. The Salobo project in the Amazon (Minorco and CVRD) could take several years to reach full capacity. Many overseas companies have again entered Brazil and a multitude of exploration permits have been issued. The country is certainly prospective with a wide range of gold deposits in a variety of geological settings.

CANADA

Canada has seen a resurgence of interest in exploration, possibly arising from a boost following successful diamond tests while exploration got a boost in general from the very rich serendipitous finds of nickel at Voisey Bay. The active gold market saw many junior companies returning to the market and new funds were raised. A very large number of projects have been dusted off and re-examined. Some needed additional drilling, others needed detailed feasibility while even a few grass roots projects were started. Like other countries the Canadian producers looked in their own back yards and many mines carried out exploration projects to add to resources within their mining leases. A large number of these were successful and Canadian mines have added to their resource base and many are planning to expand production.

Ten new mines starting in 1996 are expected to add about 16 tonnes of gold when they reach full production while a further 10 mines could start during 1997 to add an additional 23 tonnes of gold. Closures are expected to see the loss of about 5 tonnes of gold and some other mines could be winding down, but Canada looks certain to add over 30 tonnes of gold to its annual production by the year 2000. This would lift the 1996 record production of 164 tonnes to close to 200 tonnes per annum. The only cloud is the Bre-X debacle which is likely to have a major impact making future exploration much more difficult for the junior companies. The 2000 odd Canadian exploration companies, with possibly over 5000 projects, were a major force both at home and abroad in locating deposits. More stringent rules will probably apply for stock exchange listings and a land play with a programme will be insufficient to raise funds. Many of the smaller Canadian resources may disappear with the companies that owned them and lie fallow for many years.

As at 31.12.96 the summated Canadian resources are as listed in Tables XIII and XIV.

Table 13: Distribution of Canadian Deposit Sizes in Terms of Tonnes of Contained Gold at 31.12.96

Category Tonnes of Gold	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	62	1.04	64	0.9	142
1.0 - 1.99	95	1.53	144	1.9	97
2.0 - 4.99	2020	2.55	515	6.9	168
5.0 - 9.99	459	1.72	791	10.6	113
10.0 - 24.99	645	1.86	1201	16.1	77
25.0 - 49.99	2301	0.67	1536	20.6	43
Over 50t	3220	0.99	3202	43.0	38
Total / Average	6983	1.06	7455	100.0	678

Table 14: Distribution of Canadian Deposit Sizes in Terms of Average Grade at 31.12.96

Category Grade g/t	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	5470	0.33	1819	24.4	109
1.0 - 1.99	647	1.50	970	13.0	68
2.0 - 4.99	486	2.97	1443	19.4	145
5.0 - 9.99	291	6.69	1948	26.1	235
10.0 - 24.99	86	12.85	1105	14.8	109
25.0 - 49.99	2.7	36.08/	97	1.3	9
Over 50g/t	1.1	63.32	72	1.0	3
Total / Average	6983	1.06	7455	100.0	678

What is most impressive of the Canadian industry is the number of projects which have now attained feasibility and for which development go-aheads have been announced. Equally impressive is the use being made of existing infrastructure with ore often being trucked to existing mills some tens of kilometres away. This tendency, with many company consolidations into larger units, is adding strength to the industry.

The four largest new mines are Holloway, Brewery Creek, Mount Nansen and Komis all planned to start in 1996. The largest 1997 starts are Musselwhite, Troilus, Mount Polley and Bissett. In British Columbia the giant Kemess gold-copper open cast is getting underway and should commence production in 1998.

Canadian production fell off from a peak of 176 tonnes in 1991 to 146 tonnes in 1994 but staged a recovery to 150.3 tonnes in 1995 and repeated this in 1996 to return 163.9 tonnes. Disclosed resources which have risen to 7455 tonnes, are sufficient to maintain production at current levels for over 45 years. However, 56% of this gold is in low grade surface or base metal deposits which will depend on the general level of metal prices for their exploitation. Also, the shake out following Bre-X is still to be felt and this could seem some contraction in the low tonnage or low grade resources. The high grade gold deposits are being depleted faster than equivalent new ore is being discovered. Despite some adverse features it is believed that Canadian production will increase steadily to approach 200 tonnes/annum by the year 2000.

Canadian companies have very high levels of exploration and development expertise and are currently active in South America, Mexico, West Africa, Russia and China. Interest in diamonds has also seen funds being devoted to this precious stone in South America and Africa. Some subsidies and funding arrangements may indicate a change of heart in the Canadian government in an effort to attract the spending of more exploration dollars at home. The outcome will be known when the Bre-X dust settles.

CHILE

Chile has become a star attraction for development and exploration capital. The mining and fiscal codes attract overseas capital and the geological setting provides a range of medium to very large deposits. Most of Chile's gold occurs as a by-product of the massive copper porphyries with which Chile is blessed. However, the El Indio (155 tonnes of gold) Pascua (519 tonnes), Marte-Lobo (135 tonnes) and Refugio (213 tonnes) deposits all have large resources of gold and will be contributing for many years as exploration more than replaces annual depletion of ore.

Gold production has risen steadily from 22.8 tonnes in 1985 to 56.4 tonnes in 1996 and is likely to maintain this momentum for a few more years. While not quite as rapid as Australian expansion in the 1980s the growth is nevertheless impressive as a large proportion of it comes from secondary gold produced by the copper industry. The deposits listed above are primary gold deposits and as they are brought to account Chile's gold production will increase rapidly.

Total identified resources stood at 2066 tonnes gold at the end of 1996 a major step up from the 1305 tonnes at the end of 1995. With many exploration projects showing indications of contributing additions in the short-term Chile's resources and production will continue to grow.

CHINA

Interest in China as a supplier and consumer of gold remains high. On balance though, it would seem that Chinese consumption is liable to be much higher than production, being respectively 198 and 144.6 tonnes of gold in 1996 with large imports of jewellery from Singapore and Hong Kong adding still more to the consumption side. There is also a large informal mining sector in China, said to number several hundred thousand people, for which no production statistics are available. Most of this informal gold is thought to be absorbed in locally manufactured jewellery.

During the year the Chinese government announced that tenders were to be called for the development of ten low grade deposits with difficult metallurgy. Unless the deposits are very large and profit margins are attractive there is little likelihood of a major rush by western companies. Meanwhile the first tentative steps have been taken and eighteen Canadian and USA companies are listed as having interests in China though expenditures are thought to be only a few million dollars at this stage. Some Australian companies also have a presence and visits by several South African mining houses have been made.

The disclosed information on Chinese ore bodies is very spare and almost all visitors are shown the same mines. The claims that there are over 600 mines and that gold occurs in nearly all the provinces still does not add up to vast resources. To date only 29 mines have been included in the data base and some of these are from reports ten or fifteen years old so a detailed update on the gold mines of China is overdue. The individual production from these sources must be very low if the total is only 145 tonnes per annum. Total disclosed resources have been estimated to be only 810 tonnes of gold.

A final point for consideration is the low level of solid gold artefacts in Chinese archaeological finds. The high level of metal working expertise attained by the Chinese, particularly in bronze, would have allowed equal industry in gold. The absence of gold artefacts suggests, that unlike in Africa and Europe, there were few high-grade gold deposits at surface.

COMMONWEALTH OF INDEPENDENT STATES - COMECON - RUSSIA

A large number of Western Companies are entering into joint ventures with government agencies to develop or re-equip mining ventures. In previous years it was thought that the massive exploration forays of the USSR government had found very little as the falling CIS gold production seemed to indicate that resources were being depleted faster than discovered. As more information has been released it has now become apparent that several world class deposits were located by USSR explorationists but that a shortage of internal capital, infrastructure and foreign exchange to develop these fields was the prime cause of stagnation.

Tables 15 and 16 show the distribution of the 74 known deposits in terms of deposit size in tonnes of gold and the distribution in terms of grade. The pattern in the CIS has similarities with that of Canada but also with South Africa, in that large deposits with over 50 tonnes of gold in them make up 83.6% of the Russian resource.

Table 15: Distribution of CIS Deposit Sizes in Terms of Tonnes of Contained Gold at 31.12.96

Category Tonnes of Gold	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	Nil	Nil	Nil	Nil	Nil
1.0 - 1.99	Nil	Nil	Nil	Nil	Nil
2.0 - 4.99	6.4	0.65	4	0	1
5.0 - 9.99	20	2.09	42	0.4	6
10.0 - 24.99	407	3.28	1334	11.4	19
25.0 - 49.99	153	3.53	540	4.6	15
Over 50t	5095	1.92	9786	83.6	33
Total / Average	5681	1.06	11706	100.0	74

Table 16: Distribution of CIS Deposit Sizes in Terms of Average Grade at 31.12.96

Category Grade g/t	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
Unclassified	Nil	Nil	1925	16.4	22
0 - 0.99	3115	0.40	1249	10.7	8
1.0 - 1.99	556	1.35	750	6.4	10
2.0 - 4.99	1734	3.36	5775	49.3	10
5.0 - 9.99	256	6.14	1571	13.4	14
10.0 - 24.99	28.6	13.80	395	3.4	9
25.0 - 49.999	1.6	25.30	41	0.4	1
Over 50 g/t	Nil	Nil	Nil	Nil	0
Total / Average	5681	1.06	11706	100	74

The Muruntau open pit (15 tonnes gold p.a.) remains the largest operation in the CIS and this is due for an increase in production as the Newmont tailings/low grade dump treatment gets underway (10 tonnes in 1996).

In addition, Homestake is examining the Pokrovskoye deposit in Russia, Placer Dome the Vasilkovskoye deposit in Kazakhstan, and Cogema the Yubileinoye deposit in Kazakhstan. Nelson

appears to have some projects in the Dzeruy area as well. A total of about 40 US and Canadian companies have made contacts in Russia and British, Australian and South African companies are also active but in fewer numbers. JCI has, through Star, obtained access to the Sukoi Log deposit, though details are still awaited.

The capital requirements for developments in the CIS states will be vast as some of the projects are big and will require additions to infrastructure. It will be interesting to watch the developments here and the possible growth in production. Lead times are expected to be a few years so no great increases are expected before the turn of the century. According to the latest GFMS survey production for 1996 totalled 223 tonnes for the combined CIS states, slightly down from the 226.9 tonnes recorded for 1995.

Total resources are now placed at 11 706 tonnes of gold, a substantial rise from the 9920 tonnes recorded last year, but much of this is from deposits tested many years ago and only now disclosed. It is worth noting that the resources in Russia are now second only to those in South Africa.

GHANA

This West African state is probably the source of the greatest amount of gold from West Africa. A liberal mining code and attractive taxation regimes have seen many companies focus on Ghana. The success of Ashanti in raising its production almost three fold in less than a decade brought a new appreciation of the potential of this area. Ashanti is the giant mine but recent work has identified significant tonnages of gold at such places as Iduapriem (131 tonnes), Kwabeng (190 tonnes), Sansu (290 tonnes), Tarkwa (404 tonnes) and Teberebie (143 tonnes). Ghana's total resource of 2225 tonnes of gold identified at the end of 1996 is becoming significant in world terms and exceeding countries like Mexico and Brazil.

Africa was avoided during the massive exploration boom of the 80's but it was one of the first to receive attention as the boom spread world wide. Ghana continues to be chosen by many overseas companies as a target and 35 (12) Canadian and 18 (7) USA companies have interests in prospects there. The year on year increase is phenomenal. Almost every major explorationist from South Africa has some level of operation in Ghana. The Australians, too, have already bagged some operations and are working open cast deposits. In addition some old British companies, which had ties in the Colonial era, are still working.

Ghana is geologically unique in that it hosts ancient conglomerates, somewhat similar to those of the Witwatersrand, as well as shear-zone, quartz-vein and sediment-hosted deposits of the Archaean type. The geological models are well known and explorationists are having a field day. The summation of Ghanaian resources is probably also incomplete, largely because of the pace with which exploration is progressing. Nevertheless, it gives the situation as determined at the end of 1996.

Production from Ghana is on the increase as existing mines are expanded and several new mines are being developed. In the early 1980s Ghana was a steady producer of about 10 to 12 tonnes of gold per annum, but from 1989 this started to climb and in 1995 production of 52.2 tonnes of gold was recorded. This came back slightly to 50.7 tonnes in 1996 following depletion of some of the Ashanti open pits and poorer results from Teberebie. This rapid growth per annum is second only to that of Indonesia for a similar period. However, with many new open cast mines in the pipeline and more favourable geography, Ghana is likely to be amongst the leaders for growth during the 1990 decade and production of as much as 100 tonnes is possible by the year 2000.

INDONESIA

These East Indian islands are at the end of the massive Alpine fold belt that extends from Europe to the eastern extremity of Asia. The Neogene arcs with their associated volcanism and attendant epithermal deposits and copper porphyry intrusives have created a wealth of mineral deposits over a 7 000km strike. The country has a long history of small gold production from a few alluvial deposits and high grade veins deposit which were worked before and during the colonial era. Hidden in the mountains in dense tropical forests was one of the world's greatest ore bodies - the Grasberg-Ertsberg complex now belonging to Freeport Copper and Gold (RTZ). This copper porphyry contains a viable copper content but in addition has about 1.5 g/t of gold. The vast tonnage of the porphyry makes this one of the largest remaining gold resources in the world - more than 2280 tonnes of gold still to be mined with a 50 year life at present rates of extraction. Production was increased in 1995 and the impact raised Indonesian production. As it is Indonesia has had the highest growth of gold production in the world over the last seven years - 35.8% per annum. Current production of 92.1 tonnes per annum is certain to continue rising.

It is little wonder that Indonesia has become a target for scores of overseas companies from countries including Australia, Canada, South Africa, USA and Europe. The presently identified resources is up from 2916 tonnes in 1995 to 4417 tonnes of gold in 1996 placing Indonesia sixth in the world behind the Big Four and the CIS. (This does not include any Bre-X gold which has been excluded.) This means that current production can be maintained for the foreseeable future.

Work in Indonesia is not easy - the mountains are rugged, forest covered and very difficult of access. Discovery of a mine can mean creation not only of the operation, but also all the required infrastructure down to power, roads, ports, towns (with schools and hospitals) etc. But, the rewards are large for those who succeed.

Newmont is well placed having large participations in the Batu Hijau and Minahasa developments which together contain about 800 tonnes of resource gold. Production could start in 1996. B H P, R T Z, Placer Pacific, Gencor, Ashton, Lone Star, Carrie Pacific, Laverton and Mekkathara are some of the names with exploration exposure - watch this space for growth except note that Bre-X is no longer in the list - it has been discussed elsewhere in this report.

MEXICO

Mexico is one of the world's greatest silver producers but has not rated very highly as a gold producer. Estimated historical production to date is 1908 tonnes and production in 1996 was only 24.5 tonnes up from 20.3 tonnes the previous year. This 20.7% increase is indicative of the weight of exploration funds being spent and the modern ability to bring low-grade near surface deposits into production rapidly. Almost 100 US and Canadian companies are presently active in Mexico and the list of declared resources is testimony to some success. Also, many of the Mexican deposits are polymetallic with silver, copper, lead or zinc as common associated minerals. A number of projects are passing through the feasibility stage and production will increase sharply in the next few years.

In future years Mexico will be climbing the world production ladder and will certainly feature in the top fifteen producers. The disclosed resources grew from 735 tonnes in 1994 to 1018 tonnes in 1995 and reached 1584 tonnes in 1996. This rate could well be maintained given the large number of projects underway. A significant find is the Metates project of Cambior which has recorded resources of 434 tonnes of gold. As an open cast operation this could be a large producer.

PAPUA NEW GUINEA

Papua New Guinea became a significant gold producer from 1972 onwards with production rising to a peak of 71 tonnes of gold in 1992, but following mine closures and interruptions by indigenous tribes and some mine mishaps production has fallen in subsequent years to the 1996 total of only 53 tonnes. In many respects the country is like Indonesia with significant epithermal, volcanogenic and porphyry type deposits, though PNG seems to be more gold than copper-gold orientated.

In the period 1970 -1990 PNG was one of the great venues for exploration but matters have cooled following the warlike activities of some of the inhabitants, which have seen Bougainville closed for several years and threatened closures at OK Tedi and Mt Kare. Attacks on exploration camps have also taken place in the past.

A further negative factor was the attitude of Government which felt that company profits were too high and demanded a greater share in operating mines. The outside partners granted government an increased stake in Porgera from 10% to 25%. In the case of Lihir the government negotiated a 30% stake, half of which will go to the local people in time.

The Lihir development has finally got the go-ahead and the US\$ 770 million project is expected to commence production in 1997. The proposed output of 620000 oz per annum (almost 20 tonnes) represents a capital cost of US\$1242 per annual ounce. The negotiation of this contract saw R.T.Z. dilute its exposure to 30% of the project, Niguini Mining and the PNG government also took 30% while Vengold had the remaining 10%.

The successful conclusion of this difficult negotiation might lead eventually to a renegotiation of the Bouganville problem. A more peaceful PNG could see production increasing once more to new record levels as the resource base of 2815 tonnes of gold in 1959 million tonnes of ore at 1.44 g/t is very healthy as most of this is in open cast deposits.

PERU

Peru has emerged as the leading gold producer in South America, surpassing the falling Brazilian production by a few hundred kilograms. With recorded production at 64.8 tonnes and several developments in the pipeline Peru is likely to continue expansion. The large step up in production in recent years is largely attributable to the Yanacocha Mine (Newmont and Buenaventura) which recorded 25.2 tonnes of gold production in 1996. The total resource recorded is only 805 tonnes of gold but with many active projects like Chimu and Michiquillay, both of which claim in excess of 100 tonnes of gold resource, the country is being favoured by international exploration companies.

PHILIPPINES

Philippine production fell from a high of 39.5 tonnes in 1987 to a temporary low of 27.2 tonnes in 1992 and has since risen steadily to 31.1 tonnes in 1996. This is partly explained by adverse political conditions which have since improved under the Ramos administration.. A revised mining law has already seen an upturn in exploration and development which is likely to continue for some years. Canadian, US and Australian companies are active with a fair number of local companies and a large informal sector which accounts for about half of production, and occasionally clashes with the formal sector. Several feasibility studies are underway and some mine expansions are planned.

The resource base rose from 1627 tonnes in 1995 to 1848 tonnes in 1996 and is composed of alluvial, disseminated epigenetic, skarn and volcanogenic deposits many of which have associated

copper. Some very large tonnage opencast propositions are being tested for feasibility and should they go ahead production would rise substantially.

SOUTH AFRICA

South Africa is still retaining its position as the world's largest producer but the gap is narrowing and while it was 311 tonnes ahead of its nearest rival, the USA, in 1990 by 1996 this lead has fallen to only 165 tonnes. Some forecasters are already saying that the USA may overhaul South Africa as the premier producer by the turn of the century while elsewhere forecasters are suggesting that Australia will be overhauling the USA. There is no question that the battle is on for the top slot but South Africa is going through a period of change and during the current year there were indications that the giant is getting onto his feet again after a few body blows had sent him into a groggy spell.

There are many reasons for the fall in South African production, namely;

- Average yields falling from 13 g/t to under 5 g/t over the last 25 years i.e. the very rich ores have been depleted.
- Average mining depths increasing from about 1 000 to 2 000 metres below surface over a similar period with new starts looking at ores between 2 000 and 4 000 metres below surface.
- Labour costs continuing to rise to over 50% of cash costs as efficiencies, travelling times, heat (refrigeration), service conditions and public holidays each claim their pound of flesh.
- The inability of the mines to mechanise completely as they are tied into a narrow tabular ore body of large areal extent and much of the movement of rock in the stopes is still manual.
- The financial and working risks associated with ultra deep mining which have equals nowhere else in the world and lead times of 5 to 8 years from initiation to production.

Despite these adversities the gold mining industry is accepting the challenge and industry-wide cost-cutting measures are being undertaken:

- Consolidation of mining areas to reduce overhead costs, taxation, free up boundary pillar ore reserves and reacquire economies of scale.
- Increasing productivity by reducing lines of communication, incentive bonuses and improved planning to eliminate the impact of public holidays.
- Negotiating full calendar operations (FULCO) contracts (i.e. maintaining production 7 days a week).
- Designing improved transportation systems for men and materials thereby improving the productive time at the face.

The results of these new initiatives have still to filter through the system but given the determination with which they are being implemented there is a degree of confidence that the downturn in the industry will be stopped and reversed. One must add to this the incredible strength of the Witwatersrand ores which have a perfect log-normal gold distribution allowing mining plan adjustments to be made as the gold price varies. Mines which should have closed in 1970 are still operating as they have taken advantage of gold price rises and then currency depreciation as the gold price fell. Even a number of gold mines which closed in the 1960-1970 period have been reopened, as small operations, and are producing profitably under present conditions. The Witwatersrand ores are a very powerful tool!

One must add in a new entrepreneurial philosophy which is emerging as a replacement of the death and doom scenario which was being forecast. These approaches are guided by several premises, namely:

- A need to consolidate, eliminate management fees, jump over the taxation ring-fence and create economies of scale as practised in the Randgold stable. This has brought some success to some marginal mines but ultimate success is still awaited. Other recent consolidations involve the Evander mines (Winkelhaak, Kinross, Leslie and Bracken) and the Avgold group of mines (Hartebeestfontein, Loraine, E T Cons and the Target/Sun/Oribi projects), while the Elandsrand/Deelkraal merger is underway.
- The need to bring in new developments and mining methods to exploit the very large identified resources. Mining below 4000 metres at Western Ultra Deep could access 150 million tonnes of ore at an in situ grade of 12 g/t = 1 800 tonnes (57.9 million ounces) of gold. Mining the thick delta reefs of the Target area by mechanised means could bring in another 600 tonnes (18.6 million ounces) of gold and this would lead to further developments in the Sun area to the north. Massive mining methods would enable lowered stoping costs to compensate for the depth and complexity of these operations. Anglo American and Avgold need to be congratulated for their innovative planning and development of these two projects.
- The consolidation of mineral rights to enable mega-mines to be developed in place of several independent mines. This is already happening in the Harmony-Unisel-Lydex deal, the Anglo American-Gencor swaps of mineral rights in the Evander, Klerksdorp and Free State goldfields and other deals are on the drawing boards.
- South Africa has a wealth of mining expertise, infrastructure and resources. Barriers to the optimum exploitation must be eliminated.
- The Mining Houses are a blessing and a threat - they are large and strong and can carry out major developments - on the other hand, they are greedy and selfish and charge management fees which sometimes are not justified. An altruistic approach to exploration and mining development is called for and in several cases has already been heeded. Also, as a major job creator the government need to be more altruistic towards the industry and enable a portion of profits to be reinvested to fully develop known resources i.e. lift the ring fencing taxation laws and engineer tax breaks outside the formula taxation system..

The trend of the industry is summarised in Table 17:

Table 17: South African Production from only Gold Mine Members of the Chamber of Mines

	Ore Milled Tonnes	Gold Prod. '000 kgs	Grade g/t	Working Revenue	Working Cost	W/Cost as % of W/Revenue
1990	111175	565653.7	5.05	18109	14413	79.6
1991	107352	562023.0	5.20	18406	14613	79.4
1992	106400	574318.7	5.37	18677	15077	80.7
1993	103297	578010.8	5.56	21349	15838	74.2
1994	98852	537147.0	5.43	20408	15150	74.2
1995	98815	483010.7	4.87	21703	18302	84.3
1996	93724	460765.7	4.91	24425	19388	79.4

Note: Non-members of the CIM produce roughly an additional 5% of gold

The working cost as a percentage of working revenue tells the whole sorry tale. Margins across the industry are too tight. An average 21.1% working profit over the last 7 years is too little to allow for the payment of essential capital expenditure, taxes, dividends and investment for survival. At these levels the industry will die and the resources still in the ground will remain there. It is, therefore, essential that the scenarios suggested in the paragraphs above must be implemented. Without innovative new developments the industry will be doomed.

It must be admitted that at the present time the gold price is at a low in rand terms and the mines are suffering as they did in the period 1990 to 1992 when a strong rand and a low dollar gold price coincided to keep revenues flat in an inflationary environment. The same scenario is repeating itself in 1997 following the stability of the rand in the last six months. The mines are price takers and not price makers and they must adjust themselves to this fact.

Several of the South African mines however, remain in the world class category and have costs comparable with world levels. Beatrix with costs of \$213 per ounce will survive in any climate and it does this on the remarkably low average yield of 6.3 g/t for a medium-depth underground mine. Its annual production of 15 tonnes of gold places it in the upper quartile of world producers. Elandsrand is also performing well and the planned merger with Deelkraal will have a beneficial effect. Elandsrand operated at a cash cost of \$259 in producing 16.5 tonnes of gold from ore giving a yield of 7.64 g/t. Driefontein had a bad year, with fires and labour disruptions but still managed to produce 46.6 tonnes of gold at an average cash cost of \$246 and from ores with a yield of 6.51g/t. The balance of the industry is in survival mode and while some mines are showing losses after capital expenditure they can be kept operative by corrective action.

THE FUTURE OF THE SOUTH AFRICAN MINING INDUSTRY

At 31.12.96 South Africa had an estimated total resource of 40 154 tonnes of gold at an average in situ grade of 6.3 g/t. Of this total some 17 237 tonnes of gold was available within the leases of operating gold producers in 2.796 billion tonnes of ore averaging 6.17 g/t in situ. This remains a very sizeable percentage of total world resources and with a strong industry in place there is little doubt that much of this gold will be recovered. At present gold prices it is hard to justify many major new developments, although the industry is positioning itself for the spending of several billions of dollars, but looking five to ten years ahead it is likely that much of the open cast world resource will have been depleted. It is at this point that some of the longer-term deeper South African resources will be brought to account. In the meantime production is likely to be maintained, or might even increase slightly, as mines such as Joel, Oryx, Western Areas, Eastvaal, Leeudoorn (Kloof), Kalahari Gold and Amalia are all to increase production while the newcomer Target will make a contribution before the turn of the century. Evander is also looking to improve production off a low base and is examining the feasibility of bringing the Poplar project into production, which would be additional tonnage. The bulk of the industry is introducing measures to improve efficiencies and streamline production. This should avoid any mine closures in the short-term. On this basis it is predicted that South African production will bounce around the 500 tonnes per annum of gold with a high of about 520 tonnes into the next century. From then on some major new mines will be needed to stem further falls in production. This could happen with a buoyant gold price as the deep level resources are already drill-indicated.

UNITED STATES

The USA remains firmly entrenched as the world's second largest producer of gold with production peaking in 1993 at 332.1 tonnes. The last four years have seen total production running at 332.1, 326.0, 319.0 and 329.3 tonnes which gives a very clear indication that a plateau has been

of several large long-term operations. The closure of mines is often long drawn out as small pockets of remaining ore are worked, marginal dumps can be brought to account and clean-up operations can be protracted. Accordingly, future production in the USA is likely to remain on a slightly rising trend before any contraction takes place. If additional capital is invested to increase throughput, there could be a sustained increase in production driven by the larger producers. Reports that the USA could overhaul South African production by the year 2000 are a little optimistic as production would have to be increased by 50% over a four year period - rather a tall order. The sole cloud on the horizon is that of new, more stringent and expensive, mining legislation.

Tables 18 and 19 illustrate how the US deposits are skewed towards large deposits and towards low-grade deposits. This reflects their open cast/heap leach nature. Ample resources have been identified to replace existing mines with new mines of similar size and grade.

Barrick and Newmont have surface and underground plans afoot which should see their production maintained or increasing up to the year 2000. In particular the new underground Meikle mine (Barrick) is liable to add about 12.5 tonnes of gold per annum over its expected 17 year life. Other large projects in the final stages of planning are Amax Gold's Fort Knox (10.25 annual tonnes gold), Phelps Dodge's Mc Donald-Seven Up Pete (9.33 annual tonnes of gold) and Placer Dome-RTZ's Pipeline openpit (10.25 annual tonnes of gold). All of these are expected to start production during the 1996 - 1997 period and with foreseeable lives in excess of 15 years will soften the blow of the expected mine closures.

Congress is still in a mood of change and during 1995 quite inexplicably the US Bureau of Mines came under fire and was all but closed. Budget cuts which were proposed would render the Bureau ineffective or signal its death while organs like the US Geological Survey would almost cease to function. For a country like the US, where metals and minerals play an increasingly important role in the economy, it is difficult to justify such moves.

Table 18: Distribution of Deposit Sizes in the United States in Terms of Tonnes of Contained Gold at 31.12.96

Category Tonnes of Gold	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	31	1.20	37	0.4	92
1.0 - 1.99	40	1.64	66	0.7	44
2.0 - 4.99	157	20.8	322	3.4	94
5.0 - 9.99	504	1.37	693	7.2	97
10.0 - 24.99	838	1.53	1278	13.4	80
25.0 - 49.99	2020	0.84	1707	17.8	48
Over 50t	4178	1.31	5461	57.1	37
Total / Average	7766	1.23	9564	100.0	492

Table 19: Distribution of Deposit Sizes in the United States in Terms of Average Grade at 31.12.96

Category Grade g/t	Tonnes of Ore in Situ (millions)	Average Grade (g/t)	Tonnes Gold Contained	Percent of Gold in Total	No. of Projects
0 - 0.99	5073	0.54	2760	28.9	113
1.0 - 1.99	1622	1.46	2373	24.8	157
2.0 - 4.99	801	2.60	2085	21.8	104
5.0 - 9.99	215	6.82	1468	15.4	68
10.0 - 24.99	53	15.64	862	8.6	44
25.0 - 49.999	1.6	32.56	51	0.5	6
Over 50 g/t	Nil	Nil	Nil	Nil	Nil
Total / Average	7766	1.23	9563	100.0	492

Changes to mining legislation are certain to be made but the matter is still under discussion. Much of what follows was said last year but in view of the impact it is having on exploration and development funds within the USA it is repeated here as it sets the scene for the future.

The General Mining Law (1872) still provides the basis under which federal lands may be prospected and mined. This act aimed at providing security of tenure to mines in order to stimulate mining development at the time. It did not address any environmental or reclamation matters. However, many state and local regulations have since addressed environmental and rehabilitation matters some of which pose substantial hurdles to starting new projects. The real question is how far will the new mining legislation go. Some members of the Administration wish to include the new proposals in trade agreements, like NAFTA, whereby member countries entering into trade agreements will demand similar environmental controls to those enforced in the US before buying the product. Extension of this to contracts for the purchase of iron ores or precious metals could see the playing fields being levelled world wide.

At present the Administration, the Senate and the House of Representatives are all examining possible changes to the General Mining Law but there has been little sign of progress in the press and in journals. The House Mining Reform Bill, proposed by Rahall and Bumpers, is the most drastic and aims at:

- Establishing federal standards for the reclamation of mining operations.
- Regulate both mining and exploration by federal legislation.
- Adjust the cost of claims to be more realistic in today's economy and considerably above the current fee of \$2.50 to \$5.00 per acre.
- Impose an 8% royalty on the processed value of gold, silver and metals mined.
- Impose an additional royalty of 1% to rehabilitate abandoned mine workings.
- Eliminate the patenting process which transfers federal land to private title.
- Establish a review process on the use of federal land.

The Senate bill is less severe, for example, only recommending a 2% royalty on the value of the mined metals before processing and allowing a modified patenting process to be continued. During 1995 a third mining reform proposal from Senator Larry Craig suggested a royalty of 3% on net proceeds as well as more realistic fees for the patented land (claims). Part of these funds would be used for clean up of past operations. These bills will have to be reconciled and as presented at the moment probably set the extremes between which agreement will be reached. Whatever happens, US mines will carry a higher tax burden in the future.

Royalties add considerably to the cost of mining as they are generally calculated on total revenue before other taxes, federal or state. An 8% royalty is very onerous as it is as large as the after tax hurdle rate (profit) considered necessary for a viable operation. It will, very simply, render all low-grade deposits non-viable. Little wonder that American companies have turned their attention to Mexico - one hopes they do not get caught in a NAFTA trap. It is also well known that operations offshore are not always easy and carry legal, fiscal and political risks that are hard to predict. Adding these to the normal prospecting and mining risks create some formidable hurdles.

An example of more stringent (realistic) environmental laws in the withholding of the right to mine the New World Project in the Yellowstone National Park. About 56 tonnes of gold resource is involved. The state will pay compensation and no mining will be allowed.

Despite the uncertainties, mining and exploration in the US in the short-term remain very healthy with many mines expanding, average total costs competitive with other main producers (\$US300/oz total costs) and substantial profits at the richer mines. The resource base has grown from 5723 to 9564 tonnes of gold in the period 1991 to 1996 - a growth rate of 10.8% per annum which exceeds depletion by an order of nearly four. The total gold produced over this period is 1932 tonnes, or translated into dollars at \$350/oz, worth nearly \$US 22 billion of potential or saved foreign exchange. The US gold industry is a significant production source.

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AUTHOR'S NOTE

The data compiled in this report is from many sources ranging from books, company annual reports, scientific papers, journals, press releases and reports and studies by other analysts. In view of the vastness of the subject and because of the constant change due to mining, new discoveries, economic restraints (particularly changes in the gold price), markets and politics, there is no stage at which the total gold resource for any country is static. The results presented are, therefore, a "best estimate".

Reference to the many sources consulted are not individually made as their inclusion in the text would spoil the flow of reading. The selected bibliography has been updated for this year. A more extended bibliography appears in previous issues of this report. There is no single reference to a country's gold resource as this has been derived, in all cases, by a summation of data from many sources by the author.

In many tables yields or grades are given to two decimal points. Such accuracy is not really possible in practice, but has been used so that a reasonable arithmetic balance is achieved between the various figures quoted.

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