The Role of Gold in Industry

A SURVEY OF TRENDS IN DEMAND AND SUPPLY

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The use of gold in industry has increased rapidly over the past few years and is now running at about the same level as the output of newly mined metal. A detailed analysis just published attempts to quantify the end uses for gold and to estimate their future trend.

Some four years ago the present writer and his colleagues at Consolidated Gold Fields began a study of such statistics and estimates as then existed to see how much gold was going into commercial hands and what the likely future trends might be. In those days some of our forecasts were right and some were wrong but one main conclusion that emerged clearly from the analysis was that for some little time—and certainly since about 1965—the demand for gold for industrial and private purposes had been the major factor in the market, with the international monetary authorities dealing in gold in relatively minor quantities. The prominent part ascribed to gold as a monetary standard had in fact caused many of us to overlook the growth of new applications in industry based upon its inherent chemical and physical characteristics.

We therefore embarked on a close study of the demand for gold and of its end uses. Very little published information was available on this subject, and uncharted areas appeared in the unpublished knowledge of those engaged in the fabrication and marketing

The bonding stage in the production of integrated circuits at Texas Instruments. Gold lead wires are being connected to the metallised area of the silica slices.

Increasing requirements of yield, reliability and long life have led to the widespread use of gold plating in the electronics industry. This installation of Sel-Rex Module X equipment is being used in France for the gold plating of printed circuits.

of gold. Studies of individual markets, countries and uses were therefore commissioned in an attempt to find overall answers to some of our questions. These studies enabled us to see much more clearly the pattern of demand for gold, and although by the autumn of 1969 they had not been fully completed we felt that sufficiently worth-while results had been obtained to justify the publication of our broad conclusions in the form of a booklet, *Gold 1969*. Since that time we have been able to continue the analysis in greater depth and to enlist the help of other authorities as well as making a great many more direct approaches to the ultimate users of gold. The results of this more extensive survey have now been published as *Gold 1971*.* This volume surveys and attempts to quantify the end uses for gold and to estimate their future trend in all parts of the world, but in the present article it is proposed only to outline certain of the conclusions we have reached that are of more particular interest to the industrial user and to the prospects for gold as a commodity.

To define our terms in this survey, we have naturally distinguished between the holding of gold in bar form, whether as financial backing or for personal hoarding, and the use of gold in fabricated form.

The quantities do not follow a steady growth

Table I
Gold Usage in the Electronics Industry
Metric Tons

Country	1968	1969	1970	Average of 3 years
United States	46·0	61·1	56·1	54·4
West Germany	15·0	17·3	19·4	17·2
Japan	14·0	13·4	20·5	16·0
United Kingdom	6·5	6·8	5·8	6·6
Brazil	4·0	3·5	2·5	3·3
Hong Kong	3·0	3·5	3·5	3·3
France	2·2	3·5	4·0	3·2
Benelux	2·3	2·2	2·2	2·2
Italy	1·2	1·3	1·5	1·3
Taiwan	0·5	1·0	1·5	1·0
Switzerland	0·7	0·8	0·9	0·8
Austria	0·5	0·7	1·0	0·7
Spain	0·5	0·9	0·8	0·7
Canada	0·5	0·5	0·5	0·5
Australia	0·2	0·3	0·4	0·3
Sweden	0·2	0·2	0·3	0·2
TOTAL	97·3	117·0	120·9	111·7

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Fine gold wire, precision drawn to close mechanical specifications, is required in increasing amounts in the electronics industry. This shows the final stages of production in the works of Johnson Matthey Metals.

pattern, but there is some evidence that inventories of gold held by consumers in a number of developed countries were built up in 1968 in anticipation of a rise in the gold price and that they were allowed to run down again over the following two years, partly because these expectations were unfounded and partly because of the slackening of industrial activity in the United States. We find therefore that an average of the three years provides the best guide to trends in demand.

Taking fabricated gold, including all its many end uses, we have arrived at an average absorption in the free world over the past three years of a little over 1300 metric tons a year, compared with an output of newly mined metal of about 1270 tons. Of the former amount, a large proportion, something like 73 per cent in fact, is alloyed and worked up into carat gold jewellery, thus accounting for around 960 tons a year. Our estimate of gold used in dentistry is about 7 per cent of the total quantity of gold fabricated during 1968–70, or some 91 tons. The production of coins and medals accounts for a further 6 per cent or around 82 tons, leaving 14 per cent, or a total of 180 tons a year, taken up in the industrial, technical and scientific applications that are discussed in this brief review.

Of these industrial uses the electronic and electrical engineering industries together account for the major proportion, and Table I shows our calculations of usage in this sphere in the countries of the free world. The geographical distribution of consumption does in fact correspond roughly to the relative sizes of the electronics industries as measured by outputs of computers and television sets, although West German usage is relatively higher on account of a considerable quantity of electronic components exported for assembly abroad, particularly in France and Italy.

A great deal of gold employed in the production of electronic components is in the form of the cyanides of the metal for the preparation of electroplating solutions. A high level of technical efficiency is a feature of the supply side of this industry, in which competitive proprietary electrolytes offer an abundant choice to the user while specialised automatic or semi-automatic plants are available for the gold plating of contacts and connectors. The use of gold plated base metal strip or of metallurgically bonded gold inlays in base metal strip, of precision drawn fine gold wire for leads and of screen printing preparations for the production of hybrid circuits, all provided by the major precious metal refiners and fabricators, accounts for most of the balance of the 110 to 120 tons of gold absorbed annually in the electronics industry.

While some advances in techniques in the United States have reduced gold consumption per unit in the field of electronic components, the forecast rate

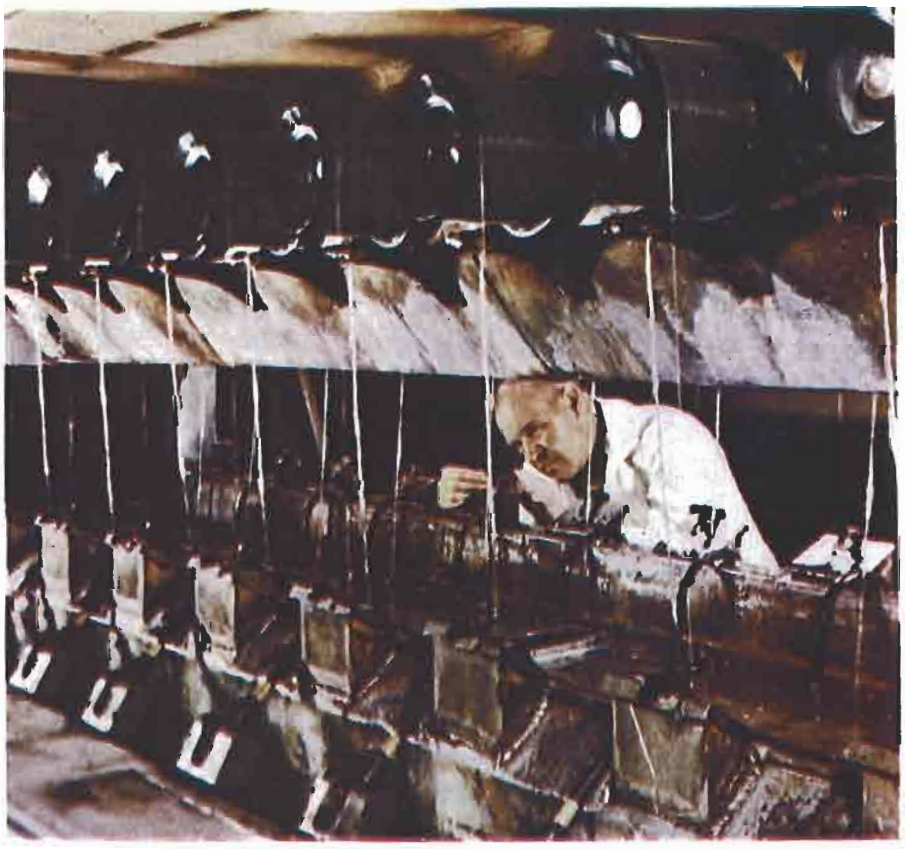
Table II
Gold Usage in Other Industrial and Decorative Applications
Metric Tons

Country	1968	1969	1970	Average of 3 years
United States	18·9	23·6	22·2	21·6
West Germany	10·0	10·0	9·0	9·7
France	7·3	10·1	9·6	9·0
Japan	6·5	11·0	12·2	9·9
Spain	4·3	5·9	5·3	5·2
Switzerland	4·0	3·5	3·5	3·7
United Kingdom	3·0	3·0	3·0	3·0
India	—	3·0	3·0	2·0
Italy	2·7	2·9	3·0	2·9
Benelux	1·8	1·7	1·7	1·7
Mexico	0·5	0·5	0·5	0·5
Australia	0·3	0·4	0·4	0·4
TOTAL	59·3	75·6	73·4	69·6

of expansion of the industry, particularly outside the United States, is such that gold usage is expected to rise at a rate of about 6 per cent per annum over the next ten years. A projection on this basis suggests that by 1980 the consumption of gold in electronics should reach some 200 tons a year.

Other than in electronics and light electrical engineering, the uses of gold in modern technology comprise a rather unusual mixture, some based upon its optical characteristics in the wider sense—including infra-red reflectivity—others on its capacity to provide, when alloyed with copper or nickel, a range of high temperature brazing alloys, and of course some based solely upon its appearance or decorative value combined with its absolute permanence in corrosive environments. This last factor, the immunity of gold from oxidation and from attack by almost all corrosive media, accounts for a number of further applications that are capable of extension in modern technology. The lining of specialised chemical plant, for example, and the use of gold in certain processes for the production of atomic fuels are likely to grow, while an old established process—the production of viscose rayon—calls for increasing amounts of gold in the form of platinum-gold alloys capable of withstanding the extremely corrosive conditions involved.

Table II gives our estimates of gold usage by



The spinnerets used in the production of viscose rayon are subjected to an alkaline solution on one side and to an acid coagulating solution on the other. To withstand these severe conditions the majority of spinnerets are made from an alloy of 30 per cent platinum, 70 per cent gold.

Solutions of complex gold compounds in organic solvents, generally known as "liquid golds", are produced with suitable viscosities for application to pottery and glassware by brushing, spraying, screen printing, or by specially designed machines. A firing operation then decomposes the organic materials, leaving a firmly adherent film of gold. Bands of liquid gold are shown being applied to bone china in the works of Minton Limited.

countries in these applications. The major use of brazing alloys and of gold coatings for infra-red reflection is in the aircraft and space exploration fields, so that the United States is of course much the largest consumer in this category, but the adoption of gold coated windows for buildings in hot climates seems likely to grow fairly rapidly in other parts of the world, while the use of electrically heated windscreens having a thin transparent and conductive layer of gold to provide good visibility with de-icing and de-misting properties is growing in a number of European countries for ships, hovercraft and locomotives.

A further small proportion of consumption is accounted for by the many uses of rolled gold—a hard wear-resisting alloyed gold coating bonded to a bronze backing—for pens, pencils, spectacle frames and other personal articles, while a further substantial amount goes into the decoration of pottery and glassware.

Our analysis leads us to conclude that the usage of gold in these minor industrial and decorative applications should grow by about 5 per cent per annum, leading to a total figure of over 110 tons by 1980, but it would need very little development in any one of a number of technological directions for this figures to be increased substantially.

Thus the most rapidly expanding sector of gold consumption is in the purely industrial field, and although the outlook naturally varies from country to country virtually all these applications show signs of growth, likely to accelerate with the development of more advanced technologies.

As has been made clear in this short review, gold consumption, excluding hoarding and speculation, is already approximately equal to gold output, and it cannot therefore be realistic to forecast a price that is too low to allow the industry to reproduce itself when existing mines are exhausted.

It seems more sensible to assume a price trend that shows a slow but steady increase in real terms from current levels. Of all the metals, gold has displayed by far the most stable price over the last thirty years—it is at present only some 15 per cent higher than in 1934—and it is likely that in the future gold will more and more be regarded as an industrial commodity, finding a price level based to a greater extent on real supply and demand. Such a modest rise in price would probably have little effect on demand for industrial purposes, although it might well have an effect upon the demand for jewellery. There is thus no prospect of famine and gold will continue to be available for industrial uses at prices which will probably encourage further development of its many roles.