VALUING TIN MINES

The following notes refer particularly to alluvial tin bearing properties, although the broad principles of mineral valuation apply to all types of deposits.

The value of a mining property is based on the profit that can be expected from the sale of minerals won after deducting all operating and other expenses. The first stage in valuation, therefore, is to prospect the land to find out the grade and extent of the mineral reserves.

The results of prospecting must enable estimates to be made, including:

(a) The average recoverable value of tin concentrates per cubic yard so that the monetary value of the mineral from each cubic yard worked can be determined at any tin price, i.e., how much the tin from each cubic yard will be worth.

(b) Operating costs so that the profit from working each cubic yard can be assessed.

(c) The total yardage available to give a total profit.

(d) The type and size of equipment to be used to work the property so that the time it will take to obtain the total estimated profit can be determined, i.e., the life of the property. The rate of working also affects the profit per year.

(e) From (d) above, the capital cost of equipping the property.

It is always assumed that the land is worked by the best possible methods applicable to the particular property under consideration.

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As an example, take the following reserves as having been proved:

Yardage ..... 3,000,000 cu. yds.

Av. recoverable value k.p.c.y. 0.30

At $400 per picul for tin concentrates the mineral in each cubic yard is worth $1.20 when it is recovered and presented for sale. If the land is worked by gravel pump methods at the rate of 25,000 cu. yds. per month (300,000 cu. yds. per year) at a cost of, say, 80 cents per cu. yd., the life of the mine will be 10 years, and the profit per cubic yard 40 cents.

Profit per year (Annual Value) .. $ 120,000

Total profit obtained over 10 years $1,200,000

An income of $1,200,000 spread over a period of 10 years has a value now (a Present Value) and it is the amount that a purchaser would be prepared to spend now to enjoy future benefits which constitutes the Present Value. The Present Value is clearly much less than $1,200,000. The Present Value of a mining property is calculated by assuming that an investor will want an annual return on money invested and the investment recovered intact when the property is exhausted. Allowing an annual interest rate of, say, 15% (sometimes called Remunerative rate or Risk rate) on a mining investment, and assuming that each year a sum of money is set aside in a sinking fund at a safe rate of interest to provide for the return of the invested capital when mining ceases (after 10 years), the Present Value of $1,200,000 recoverable over 10 years can be calculated from the formula:

$$\text{P.V. (Present Value)} = \frac{\text{Annual Value}}{\dfrac{r}{(1+r)^n - 1} + r^1}$$

where r^1 = Risk rate, say, 15%
r = Safe rate, say, 3% (see note below)
n = Working life of property or period of deferment of return from mining, in this case 10 years.

This is called the Hoskold formula, which is a two-rate formula.

Note: Money set aside in the Sinking Fund is assumed to be invested at a safe rate of interest, compounded annually.

This looks complicated, but, in practice, valuation tables giving a factor (the Hoskold factor) by which the annual value is multiplied to get the Present Value are used.

The factor for 10 years at 15% risk rate and 3% safe rate on the sinking fund is 4.215. The Present Value of $120,000 per year for 10 years is therefore $120,000 × 4.215 = $505,800.

This means that if $505,800 is invested in developing the property, i.e., purchase of land and the capital expenditure required for machinery, working capital and other items to get the mine to a productive stage, the return on investment will be 15% per year for 10 years and the original investment will be recovered when the property is exhausted.

Actual figures may make this clearer:

Investment	$505,800
15% per year (simple interest)	$ 75,870 per year
For 10 years	$758,700
Annual Sinking Fund (from tables)	$ 44,121
For 10 years	$441,210

The total of the interest for 10

years and the sinking fund for 10 years is $758,700 + $441,200 = $1,199,900, which is near enough, allowing for decimal points, to $1,200,000, the total profit the property is estimated as being capable of yielding.

The annual sinking fund of $44,121 invested at 3% interest compounded annually would, in 10 years, amount to $44,121 × 11.464 = $505,800, which is the amount worth investing, i.e., the Present Value. (The factor 11.464 is also obtained from tables.)

The estimated Present Value of future operating returns, or the Discounted Value of future operating returns, as it is often called, has to cover all capital investment in the mining enterprise. In the example taken, the Present Value of $505,800 could be apportioned as follows:

Present Value of future operating profit discounted at 15% and 3%	$505,800
Capital cost of palong, machinery, monitors, pipes, kongsi, tailings areas, working capital, etc., say	200,000
Net Present Value of land	$305,800

The land has, of course, no further value as a mining property when reserves are exhausted. Some of the machinery may have a residual value, but, after 10 years' use, this will be low and it is common practice for valuation purposes to write off the cost of all machinery and other equipment over the life of the mine.

Main Factors Affecting the Value of Proved Mining Reserves

Changes in the tin price and operating costs directly affect operating profit and consequently annual value. Incorrect forecasts of these two variables can have more effect on estimates than any other factor. For example, estimates may have been prepared as follows:

Total Return per cu. yd.	Operating Cost per cu. yd.	Operating Profit per cu. yd.
$1.00	$0.60	$0.40

A drop in metal price of, say, 20% would produce the following results:

Total Return per cu. yd.	Operating Cost per cu. yd.	Operating Profit per cu. yd.
$0.80	$0.60	$0.20

Operating profit has, therefore, been reduced by 50% by a drop of 20% in the tin metal price. A similar rise in the tin metal price would improve operating profit by 50%. Changes in operating costs can have the same effect. Where the margin of profit is small, estimates are most seriously affected by changes in working costs and tin metal price. The important point is that it is the future average tin price and working cost which affects the value of a mining property. Past and present levels can give no more than a certain amount of guidance as to future prices and costs. In the example taken it is assumed that the tin concentrates price will average $400 per picul and operating costs 80 cents per cubic yard for the next 10 years. How accurate this or any other forecast will prove to be is questionable. For safety, estimates can be based on very conservative levels of price and costs but this does not solve the problem. Such a course may result in abandoning what may turn out to be a valuable mining property.

Other factors being equal, the present value increases as the life of a property is extended. The increase in present value is not, however, proportionate to the increase in life but something considerably less. Example 1 sets out the present value of $120,000 per year at increments of five years, assuming a remunerative rate of interest of 15% and a sinking fund rate of interest of 3% as before.

As the example shows, the first five years of operating profit are worth $354,600, whereas the last five years add only $35,400, i.e., about one-tenth. The present value of reserves which cannot be developed within the next 10 to 15 years is relatively low. Operating results achieved early in the life of a mine affect present value more than those towards the end and inaccuracies in estimating yardage in a long life property need not have a serious effect on present value. The valuation will, of course, be affected by errors in estimating average ground values as soon as mining begins.

Conversely a rapid rate of development of a mining property gives it a greater present value be-

EXAMPLE I

$120,000 per year

Life	Hoskold Factor	Present Value	Increase in Present Value
5 years	2.955	$354,600	$354,600
10 years	4.215	$505,800	$151,200
15 years	4.908	$588,960	$ 83,160
20 years	5.341	$640,920	$ 51,960
25 years	5.636	$676,320	$ 35,400
			$676,320

cause the return per annum is increased.

For example, a dredging property averaging 0.30 k.p.c.y. with a life of 20 years would have a present value as below, assuming that the value of concentrates will average $400 per picul and working costs average 30 cents per cubic yard for the next 20 years.

The difference in the present values of the same property worked by two dredges instead of one is about $3,000,000. The capital commitment is, however, much higher when two dredges are used.

Value of concentrates per cu. yd.		$1.20
Operating cost per cu. yd.		$0.30
Estimated profit per cu. yd.		$0.90
Yardage per year, say		5,000,000
Estimated profit per year		$4,500,000
Present value of $4,500,000 per year for 20 years allowing 15% remunerative rate and 3% on sinking fund = $4,500,000 × 5.341	=	$24,034,500
Estimated cost of equipping property, say		$12,000,000
Net present value		$12,034,500

If the property is equipped with a second dredge of similar capacity requiring the investment of a further, say, $11,000,000, the annual return will be $9,000,000 for 10 years as against $4,500,000 for 20 years and the present value as given below:

Present value of $9,000,000 per year for 10 years allowing 15% remunerative rate and 3% sinking fund = $9,000,000 × 4.215	=	$37,935,000
Estimated cost of equipping property with 2 dredges, say		$23,000,000
Net present value		$14,935,000

Whatever the scale of mining, an increase in the rate of production will improve the present value of a property provided that the capital required to raise production is properly applied, and provided that reserves are sufficiently large to warrant the additional investment on equipment. Security of tenure of the mining land and freedom of concern over political and other disturbances must, however, be taken into consideration, most particularly when a heavy capital commitment is contemplated.

It must be appreciated that the total profit a mining property, suitably equipped, can yield is, for valuation purposes, considered as being fixed. If a 20% return per annum is expected on invested capital, the amount invested cannot be as great as it could be if, say, 10% return per annum is acceptable.

In the example of a gravel pump property previously given, the total profit obtainable over 10 years was estimated as $1,200,000 and the profit per year as $120,000.

The present value of $120,000 for 10 years at different remunerative rates of interest is shown below:

Remunerative Interest	Present Value of $120,000 for 10 years, i.e., total of $1,200,000
5% and 3%	$874,440
10% „ 3%	$640,920
15% „ 3%	$505,800
20% „ 3%	$417,840

The figures illustrate that 5% remunerative interest per year for 10 years can be obtained on an investment of $874,440, and the original investment recovered, out of the total of $1,200,000 the property can yield. If 20% remunerative interest is required for 10 years, only $417,840 can be invested to get such interest payments and recover the original investment out of the fixed sum of $1,200,000.

A high risk (or remunerative) rate decreases the present value and conversely a low risk rate increases the present value of a property.

The risk rate required is a matter of opinion. All investment carries risk. Investment in mining is considered to be associated with greater hazards than investment in most other industrial undertakings, consequently a higher return is usually expected. In a new mining venture a return of about 15% would probably be considered reasonable where there is secure tenure of land. A lower return might be accepted from a proved mine.

Present Value Without Hoskold

The Hoskold formula is often used to discount future profits because the method has wide acceptance, although it does allow a risk rate on the whole of the invested capital for the entire life of the mine, even though some capital is withdrawn and placed in a sinking fund at a safe rate of interest.

A simpler method is to discount future profits, allowing a risk rate of interest only and neglecting the interest which would accumulate on the sinking fund. The present value of $1,200,000 discounted at 15% simple interest per year for 10 years is $480,000, as against $505,800 calculated by way of Hoskold. The difference is relatively small compared with the changes which might occur in the tin price and operating costs, on which the valuation is based, over a 10-year period, and compared with errors in assessing the average recoverable value of the ground, however carefully prospecting has been conducted. The method of discounting future profits is much less likely to give an unrealistic present value than an incorrect assessment of average tin

price, average operating costs and recoverable average ground values during the life of the mine.

The calculation of present value provides management with a basis on which to assess the worth of an investment, and is of use when it is necessary to make decisions on mining policy and development. It is also determined for many other reasons, such as the transfer of land from one mining company to another, the sale of tin-bearing agricultural land to a mining company, and for assessment of death duties. Apart from these reasons, it is sometimes difficult for a miner or a mining company to assess the value of mining land unless the present value is calculated. For example, it is not immediately obvious which of the following propositions is the best investment:

(a) Land yielding $100,000 per year for 20 years, total yield $2,000,000.
(b) Land yielding $150,000 per year for 10 years, total yield $1,500,000.

The present values, allowing 15% risk rate and 3% on the sinking fund, are:

(a) $534,100.
(b) $632,250.

Approximately the same difference in favour of (b) results if simple interest of 15% per year only is allowed and the sinking fund is neglected.

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company's published accounts. Some volume of unpresented cheques is only to be expected, but concern could be expressed at a situation where the volume is abnormally increased at the time of preparing a balance sheet and particularly where some are not even despatched to creditors at that time. Whilst the total of current liabilities is not affected, the apparent bank overdraft facilities of the company are increased beyond the true position and perhaps far beyond the actual overdraft limit of the company. A large amount of overdraft accommodation in use may appear to show a confidence in the company on the part of its bankers, and along with an understatement of amounts owing to creditors could create a wrong impression of the situation of the company.

20. There is no untoward effect so far as a debenture trust deed is concerned. Provision is normally made for the figures disclosed in the audited published balance sheet to be used as a basis for calculating borrowing limitations, and the effect may be to overstate secured borrowings and reduce the margin available under an open-ended deed for the issue of further debentures. However, a purchaser of debentures could be misled as to the strength of the industrial company concerned, and a case can be made for the publication in annual accounts of (i) the arranged bank overdraft limit or (ii) a reconciliation between book and actual bank overdraft. It is believed that a statutory provision along these lines would be supported by many bankers who have been embarrassed through the linking of their names with company overdraft facilities of a degree that they would not entertain.

(To be continued.)

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between the first period, 1954 to 1959, and the second period, 1959 to 1963, might have led to abnormal results, and that if the economic circumstances had remained unaltered the survey would have shown that growth does breed growth. It is my impression that those who believe that "growth breeds growth" believe that their selected growth stocks will perform better than average, no matter what the average does. If so, they cannot claim that the change in economic circumstances invalidates the results set out above. On the other hand, if it is claimed that past growth is a guide to future growth only so long as economic conditions remain static, then this guide is of little practical value whether it is correct or not.

These results support Mr. Little's belief that past growth of earnings is not a useful guide to likely future growth of earnings.

TABLE III

Annual Percentage Growth Rates of Earnings per Share Averaged for the Companies in each Group

	From 1954 To 1959	From 1959 To 1960	From 1959 To 1963
Group 1	-6.6*	7.1	4.7
2	1.7	12.4	5.5
3	6.0	8.3	3.0
4	10.5	6.1	3.3
5	23.4	9.3	1.3

(* From 1954 to 1959 the earnings per share of all the companies in Group 1 *declined*. The average rate of decline was 6.6% p.a.)

At first glance it may seem strange that 23.4% p.a. is equivalent to a growth of 186.8% in five years (these are the figures for Group 5 from 1954 to 1959). These figures are reconciled in the table below.

TABLE IV

Earnings	1954	100.0	23.4%	Growth of earnings	54/55	23.4
	1955	123.4	23.4%	„ „ „	55/56	28.9
	1956	152.3	23.4%	„ „ „	56/57	35.7
	1957	188.1	23.4%	„ „ „	57/58	44.2
	1958	232.3	23.4%	„ „ „	58/59	54.5
	1959	286.8				

Thus at a growth rate of 23.4% p.a. over five years, a growth from 100 to 286.8 results, an increase of 186.8% in five years.