SOVIET GOLD PRODUCTION

By David Potts

The recovery of gold is widespread in the Soviet Union and Figure 1 shows the important gold producing locations for various sources of gold. Placer, lode and by-product gold all contribute a significant proportion of the total output.

The principal gold producing areas were originally in the Urals but the emphasis moved gradually to the East as old deposits became depleted and new deposits were discovered. This eastward trend was later reversed with the discovery of several major deposits in the South West and, in 1958, a major development began at Muruntau in Uzbekistan.

In 1926 the Soviet Government prohibited the publication of statistics of gold output and since that date there have been several attempts to estimate the level of production. The problem was further complicated in 1934 when Glavzoloto, the Chief Administration of Gold Mining, stopped giving data about geological deposits. In addition the State Bank has maintained secrecy over its gold reserves since 1935.

Initial Western estimates of Russian production were influenced by an announcement in one of the early Five Year Plans that intensive geological prospecting had raised known deposits to 3,500 metric tons in 1934 from 2,500 metric tons in 1926. The Director of Glavzoloto also declared that Russia would surpass the output of the Rand Mines and become the leader in world gold production from its reserves which were 60% alluvial and 40% in lode. Although these optimistic forecasts have not been realized one of the effects was to encourage estimates of up to 600 metric tons per annum of production and monetary reserves of between 3,500 metric tons and 8,500 metric tons.

In 1964 the United States Central Intelligence Agency (CIA) published a revision of its estimates and put Russian production in the range 135 to 155 metric tons per annum with monetary reserves of 1,750 metric tons. The published evidence for the much lower figures mentioned the abandonment of workings operated by forced labour in Stalin's day and assumed that the depletion of reserves resulted from gold sales

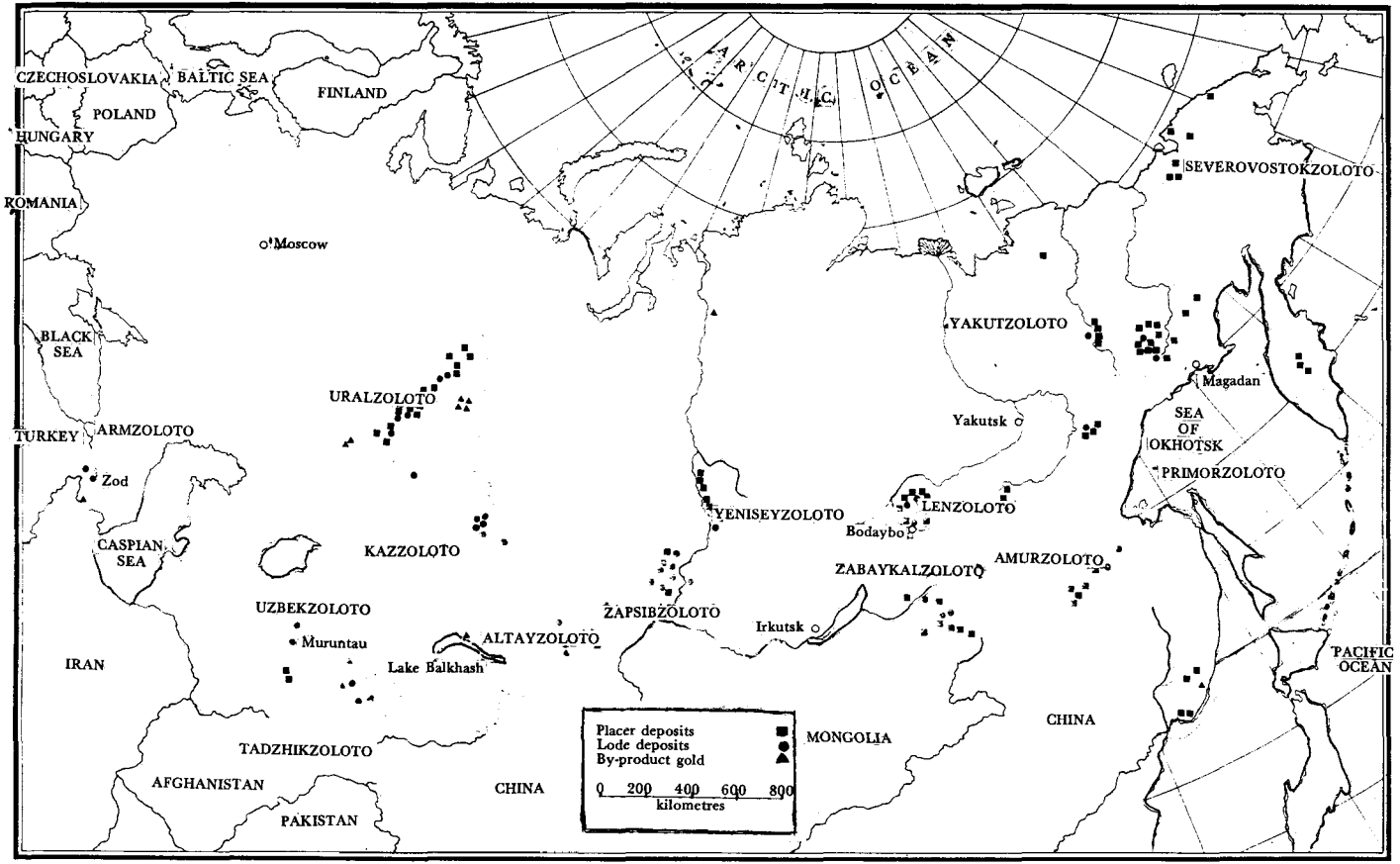

Fig. 1 — Important Gold Producing Areas and Administrative Units in the Soviet Union

to the West. It has been suggested, however, that the main evidence was a Party Central Committee document which had been photographed and transmitted by Colonel Penkovsky. Most of the Western observers began to use the CIA figures.

Consolidated Gold Fields Ltd., began to make a contribution to this debate at the beginning of the 1970s and the method adopted was to translate and collate the press reports and technical papers which were available in the West. The information was from public Soviet sources which concentrated on individual gold producing areas and made reference in percentage terms to the extent to which targets had been met, the rate of growth of output and additions to ore reserves. The targets and production figures were not given and had to be estimated.

In 1974 Consolidated Gold Fields Ltd., began to use an additional method for estimating Russian gold production. The principal effort was concentrated on information about the type and size of equipment and processes which were being used for mining and extracting the gold. The quantity of material treated was estimated from the nature of each operation and the related numbers, types and sizes of the machines being used. There was also an assumption, which now seems unlikely, of a reasonably full and efficient usage of that equipment. The gold content of the materials treated was derived partly from Soviet references and by comparisons with Soviet workings elsewhere.

A further refinement was introduced in 1978 when satellite photographs began to be used to supplement the techniques which have been outlined above. The results which have been obtained during the last two years are given in the remainder of this report and consist of descriptions and estimates of annual outputs from the Muruntau deposit, the Zod deposit and from By-product operations. Finally, we give details of the administrative organization of the Soviet gold industry.

Consolidated Gold Fields Ltd., are continuing to study and analyze available information on the remaining sections of the Russian gold mining industry but some tentative conclusions are now beginning to be drawn about total production.

At this stage, it is estimated that the annual output is in the range of 280 to 350 metric tons and this leads us to the conclusion that some of the Communist bloc sales of over 400 metric tons per annum in 1976, 1977 and 1978 were drawn from stocks.

The Muruntau Complex

The Muruntau gold fields lie in the centre of the Kyzylkum (Red Sands) desert at the foot of Muruntau (Nose Mountain), which is at the South East extremity of the Tamdytau ridge of mountains. Gold was discovered here in 1958 and the subsequent widespread exploration that was carried out, largely by trenching through the 1-2 metres of red sand overburden and by core drilling the underlying bedrock, ultimately revealed the largest gold deposit yet discovered in the Soviet Union.

The Muruntau deposit has been described as tree-shaped. The trunk (which extends down to a considerable depth and will be mined by underground methods) contains a significantly higher grade of ore than the branches, which constitute the part of the deposit now being exploited by an open pit operation.

The gold at Muruntau occurs both in large quartz veins (up to 20 metres thick and 300 metres long) and in the stockwork formed by smaller quartz and sulphide (pyrite and arsenopyrite) veins. In fact, the ore zone as a whole constitutes a large stockwork that covers an area of about 4 km^2, within which the gold-enriched areas are distributed very irregularly. In all, there are five ore zones, separated from the comparatively barren zones by indistinct and indefinite boundaries that can be established only by sampling. Soviet geologists who have been working in the area since its discovery still do not agree completely on the detailed genesis of the Muruntau deposit, but most believe it to have been a complex, multistage process that involved repeated metamorphic and hydro-thermal activity.

Free gold, which accounts for virtually the entire gold content at Muruntau, occurs in two varieties: one averaging about 900 fine, the other about 750 fine. The higher-purity gold occurs in the upper part of the deposit and is believed by some researchers to have a different origin than the lower-purity material found at depth. The gold ranges in size from very fine (less than 0.001 mm) to relatively coarse (up to 1 mm).

Gold typically occurs in the quartz veins in unevenly disseminated, fine inclusions and veinlets located between the individual quartz grains and also where sulphides have formed. The sulphides, which account for only 0.5 — 01.5% of the Muruntau ore, also contain very fine gold, again located in the grain boundaries and associated particularly with the arseno-

pyrite, which accounts for about 20% of the total sulphide content.

The development of Muruntau has been a major undertaking. In the early years, water was trucked to the construction sites from an artesian well in Tamdybulak, 50 km to the north. Before the mill could begin, however, a 1.2 metre water pipeline had to be laid from the Amudar'ya River 220 km to the South West. Now, two parallel water lines serve the area. The construction programme has received much local recognition — especially Zarafshan, a new city of 3 to 9 storey apartment buildings constructed 30 km west of Muruntau to house 40,000 inhabitants. Zarafshan is regarded as the gold centre of western Uzbekistan, serving not only the Muruntau complex, but also the other gold-producing areas in western Uzbekistan and the uranium operations also believed to be in the region.

Located just north of the Muruntau open pit is the town of Muruntau, which consists of a few hundred small, one-storey houses where the miners and some of the mill personnel live. Construction of both the open pit and the mill-refinery processing complex started in the spring of 1967, and the first gold bar was poured on July 25, 1969. The first phase of construction was completed in the early 1970s, with a two-or-three-fold expansion in both the mine and mill facilities begun immediately thereafter.

The Muruntau deposit is being exploited by both open pit and underground workings. Measuring about 1 x 2 km the open pit operation also is notable for the waste dumps rimming the edge of the pit to the west, south and east, some of which rise 100 metres above the desert floor. Mining is carried out using 4.6 m^3 and 6.0 m^3 shovels that load 27 ton and 40 ton trucks. Ultimately, the open pit will be developed to a depth of 300 metres. There is the possibility that selective mining is being practised here, with marginal ore being stock-piled.

Undergound, the mining shaft presently extends to 500 metres, with workings at various levels. Figure 2, a plan of the Muruntau region, shows the town of Muruntau, the mining areas, processing facilities, settling ponds and the various interconnections.

It is estimated that the output from Muruntau is about 80 tons per annum and that this level of production can be maintained for many years to come.

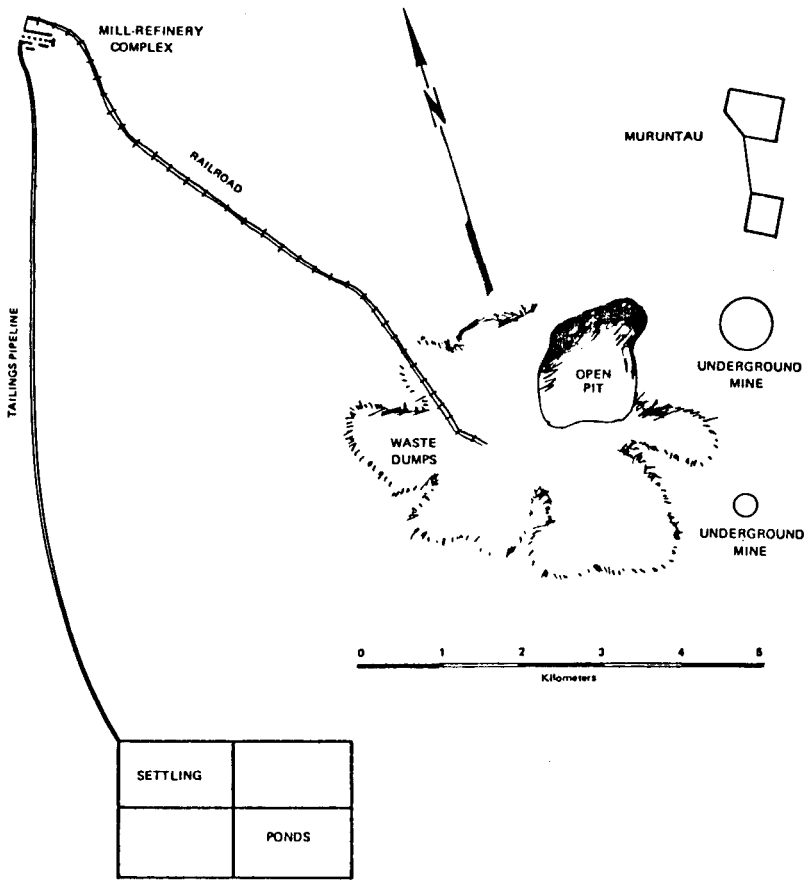

Fig. 2 – The Muruntau Mining Area
An interpretation of Landsat image.

The Zod Combine

Zod is one of several gold deposits that have begun to be exploited in Armenia. In contrast to the low-grade but very large deposit at Muruntau, these deposits are small but quite high-grade. Zod, the largest of these, justified the formation of the Zod Combine which recently constructed a mining-milling refining complex at a cost of 160 million roubles.

The Zod gold deposit is located in a mountain divide 110 km north-east of the Turkish border at an elevation of 2,200-2,500 metres. Placer deposits in nearby rivers were worked in Neolithic times (the late Stone Age) and by 1200 BC the outcroppings of the Zod deposit had been discovered and were being worked by trenches 1 metre wide and 5-6 metres deep. By 200 AD the richest ores from this deposit were being exploited by extensive underground mining operations. When the richest ores were exhausted, these underground workings were abandoned. Rediscovery of the Zod deposit in modern times dates only from 1951 when investigation, first of the river placers and then of the ancient mountain workings, pointed the way to the underlying ore.

The Zod deposit consists of oxidized ore near the surface, primary sulphide ore at depth, and a mixture of both types of ore in between. These mixed ores reportedly comprise the bulk of the ore in the Zod deposit. Mineralization is localised mainly in four fracture zones which dip steeply (70-85°) to the south, and within which 28 discrete ore bodies have been delineated. Gold occurs in these ore bodies in four forms – coarse native gold located between the grains of vein and ore minerals, native gold finely dispersed in sulphide minerals, discrete gold telluride minerals, and gold derived from the disintegration of telluride and sulphide minerals. Although finely dispersed gold predominates, some of the coarse flakes measure over 1 cm across. Polymetallic ore from this deposit averages 20 grams of gold per ton, pyrite-arsenopyrite ores average 40 grams per ton and gold telluride ores average about 300 grams per ton; in all cases the free gold ranges between 850 and 950 fine. Tellurium as well as silver occurs in economically recoverable quantities in these ores.

The Zod deposit is being mined by both open pit and underground (adit) methods. Originally, the Zod ore was to be processed in a small facility, only 5 km from the deposit, where a

beneficiation pilot plant was set up in 1967. However, similar gold ores soon were discovered to the west of Lake Sevan, relatively close to an existing rail line and, after considering the possibility that Lake Sevan could be contaminated by cyanide-containing effluent if the plant were located near the mine, the decision was made to construct the beneficiation facility to handle all these ores in the towns of Ararat.

Ararat lies 30 km to the south-east of Yerevan, the capital of Armenia, at the foot of Mt Ararat. To transport the Zod ore to the Ararat mill required construction of 122 km of track to connect the mine with the existing rail line which runs up the west side of Lake Sevan. This connection was completed and the first ore delivered to the Ararat plant in February, 1976.

The Ararat facility also treats ores from Megradzor, Kefan, Kirovakan, Razdan and Stepanavan.

Other Armenian ores in which gold is associated principally with copper minerals are handled in separate beneficiation facility located in the town of Agarak in the southern part of Armenia.

In the Ararat mill primary grinding of the ores takes place in two semi-autogenous cascade mills. The ore then is treated in jigs and shaking tables to produce a gravity concentrate containing the coarse native gold and tellurides. The tailings from this operation (with sulphide and mixed ores) are treated by flotation to produce a concentrate which contains the gold-bearing sulphides and finer telluride minerals, The flotation tailings (the tailings from the shaking tables with oxidized ores) are reground in four ball mills and cyanided to recover additional gold values.

Original plans called for the Zod Combine to use the traditional method of precipitating the gold from the cyanide solution with zinc dust. In fact, this process was used in the pilot plant at Zod to produce metallic gold. However, following the successful introduction of RIP ion-exchange techniques into the Soviet gold industry at Muruntau and other facilities, the Zod Combine adopted this technology for its Ararat facility.

All of the gold-producing facilities in Armenia come under the administration of Armzoloto — one of the newest additions to the administrative organizations of the Soviet gold industry. Formed to oversee the development of gold in Armenia, Armzo-

loto is a product of the trend in recent years toward the development of lode deposits in the South Western Soviet Republics.

The estimated output of gold from the Zod Combine is 10 metric tons per year and it is believed that reserves are adequate for 20 years of operation at this rate of production.

By-Product Gold

By-product sources of gold have long been important in the Soviet Union. In recent years copper ores have accounted for about 75% (44 tons in 1977) of total Soviet by-product gold production. The two largest producers are in Kazakhstan. The major Kal'makyr deposit, which produces 23 million tons of copper ore per year, is the principal source of by-product gold – more than 17 tons per year. The Kounrad deposit yields about 8 tons. The numerous copper deposits of the Urals are next in importance, yielding as a group about 13 tons of gold. The copper deposits of southern Armenia are the other important sources of by-product gold in the copper industry.

TABLE I

Estimated by-product gold from copper ores in 1977

Deposit	Ore Production (tons per year)	Gold Analysis (grams/ton)	Recovery (%)	Production (tons)
Gay	6,000,000	1.2	70	5.04
Sibay	4,000,000	0.8	70	2.24
Degtyarsk	1,500,000	1.4	70	1.47
Pyshma	3,500,000	1.0	70	2.45
Buribay	300,000	1.2	70	.25
Turinsk	1,100,000	1.0	70	.77
Levikha	1,000,000	0.8	70	.56
Blyavinsk	800,000	1.2	70	.67
Urals total				13.45
Kounrad	14,000,000	0.8	75	8.40
Kal'makyr	23,000,000	1.0	75	17.25
Kadzharan	6,000,000	0.6	70	2.52
Agarak	2,100,000	0.6	70	.88
Kafan	500,000	0.6	70	.29
Other	3,000,000	0.7	60	1.26
			Total	44.05

Lead-zinc ores (including a number of deposits of complex lead-zinc-copper ores) provide about 25% of the total production of by-product gold in the Soviet Union. The most important source in this group is the Almalyk complex, which recovers 4 tons of gold annually from 5.5 million tons of ore mined in the Kuramin Mountains of Tadzhik. The most important other source is the group of deposits around Ust 'Kamenogorsk in Kazakhstan, where over two-thirds of the Soviet reserves of lead and zinc are located. Other producers are found in Azerbaydzhan and Primorskiy Kray. All together, the lead-zinc ores of the Soviet Union in 1977 yielded about 16 tons of gold annually. In total, then, by-product sources yielded an estimated 60 tons of gold in 1977.

TABLE II

Estimated by-product gold from lead-zinc ones in 1977

Mill/Ore	Ore Production (tons/year)	Gold Analysis (grams/ton)	Recovery (%)	Gold Production (tons)
Leninogorsk				
Leninogorsk Mine	700,000	1.0	75	.525
40-Letiye VLKSM	500,000	1.0	75	.375
Open Pit 1	1,000,000	0.9	75	.675
Tishinskiy Open Pit	2,500,000	0.6	75	1.125
Zyryanovsk	3,000,000	0.8	75	1.80
Belousovka	900,000	0.8	65	.47
Berezovka	500,000	0.8	69	.28
Zolotushinskiy	700,000	0.8	55	.31
Achisay	3,400,000	0.8	75	2.04
Almalyk				
Altyn-Topkan	1,500,000	1.2	75	1.35
Kurgashinkan	4,000,000	0.9	75	2.70
Filizchay	2,500,000	1.4	70	2.45
Tetyuke	1,500,000	1.0	75	1.13
Other	2,000,000	0.8	50	.80
			Total	16.03

Although by-product gold is important to the Soviet Union it is negatively influenced by some of the unusual accounting practices employed in the Soviet nonferrious metals industry. For example, often a mine-mill manager receives no credit for gold contained in the base metal concentrate he produces because the concentrate is sent to a base metal smelter which does not have integrated gold recovery facilities and therefore that concentrate is valued only according to its copper or lead and zinc content. Likewise, base metal smelter managers are judged primarily by the output of their principal products, so the content of other valuable metals in their product is of only secondary importance and unrelated to their inherent value. Also, in existing base metal concentrators, the prices paid for the gold produced do not allow for compensating the concentrator for capital expenditures required to increase recoveries. Finally, in contrast to the capitalist system, where prices depend on supply and demand, in the Soviet economy the price depends on production costs. It is recognized that a profit is required for the industry to generate the funds needed for future expansion, but this again is an average profit. In fact, in the 1960s five of the six largest copper mines in the Urals were losing money. And losses are not necessarily minor. Examples may be found in which the production costs of even major mines, equipped with modern equipment, are double the sales value of the ore being recovered.

This paradoxical situation is resolved by subsidizing the high cost operations to whatever degree is required to bring them into line. This practice applies throughout industry, to all aspects of mining and manufacturing, and its effects are magnified by the practice of stable prices fixed by what is equivalent to law.

Administrative Organization of the Soviet Gold Industry

All segments of the Soviet gold industry ultimately report to the Council of Ministers whose policy is coordinated with the Communist Party of the Soviet Union (see Figure 3). The agency directly responsible for gold output is the Ministry of Nonferrous Metallurgy. The annual production goal is strongly influenced by Gosbank and the Ministry of Foreign Trade, which each year have the task of balancing Soviet hard currency imports and exports. External sales of gold bullion are the

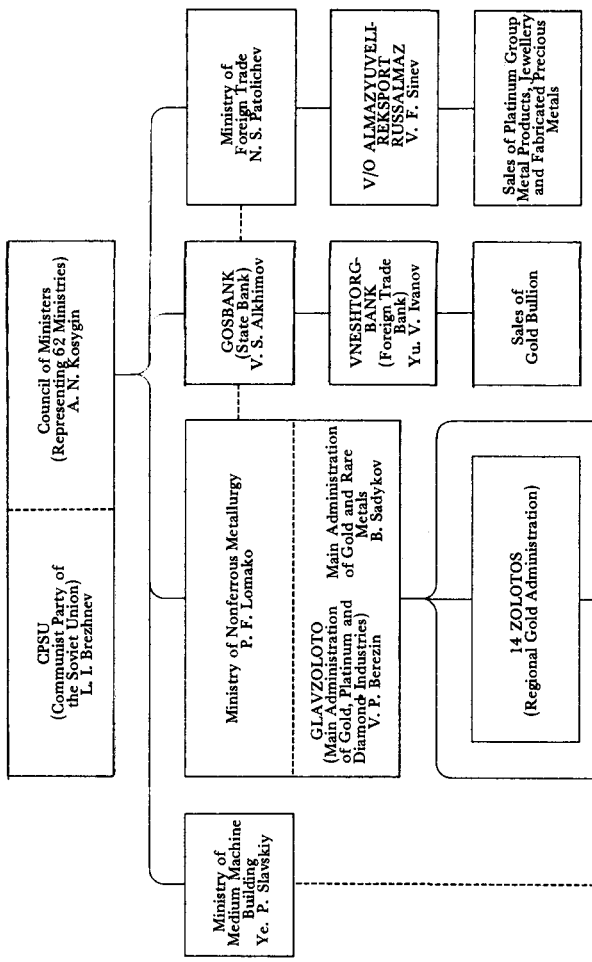

Fig. 3 – Administrative Organization of the Soviet Gold Industry

responsibility of Vneshtorgbank's worldwide organization. Sales of fabricated gold products to the West are handled by Almazyuvelireksport which also maintains offices in each of the industrialized countries.

Within the Ministry of Nonferrous Metallurgy, Glavzoloto and the Main Administration of Gold and Rare Metals are responsible for meeting established production goals for gold. This task is accomplished principally through 14 regional administrative organizations known as 'zolotos'. While zolotos do not envelop the entire Soviet Union, they do cover and are responsible for most gold producing regions. (see Figure 1)

The zoloto administrative system has been developed mainly to facilitate the management of the large number of far-flung placer deposits which are worked in the Soviet Union. Typically, however, each zoloto is responsible for the discovery, exploitation and recovery of any primary gold deposit which occurs within its borders. Thus, all the gold lode and placer deposits in the Urals come under Uralzoloto, Lenzoloto supervises those which occur on the upper reaches of the Lena River and its tributaries and Severovostokzoloto administers the gold industry in the Magadan Oblast in the north-eastern corner of the country.

There are exceptions to this rule, however, the most important of which is Muruntau. It is probably administered outside the zoloto system more because of its pioneering use of RIP technology than its large size.

Administratively, by-product facilities seldom report through the zoloto system. However, if they produce only a gold-containing mud or other concentrate, these products can be sold to the appropriate zoloto to be refined.

Whatever its source, the refined gold ultimately is delivered to the national treasury where it is stored until needed for use by domestic Soviet industry or for sale to the West to earn hard currency credits.

HIGHER EDUCATION IN MAINLAND CHINA SINCE THE CULTURAL REVOLUTION

By Wang Hsueh-wen

It is significant to recall that in the days of the "cultural revolution" the implementation of a "revolution in education" centering on "reform of college education" was officially declared a task of paramount importance to be accomplished by all means and at all costs throughout the Chinese mainland.

The hostile attitude of Mao Tse-tung towards the Chinese intellectuals was in fact an important factor of the "reform." He once said: "Whereas in the past I had cherished the hope of cultivating from among the intellectuals a number of successors, I now no longer consider it wise to do so. In my opinion, the weltanschauung of the intellectuals either within the party or outside the party, including the educated young people still receiving education in schools, is the bourgeois weltanschauung. For more than 10 years since liberation, our culture and education were under the control of revisionism, and bourgeois thinking has therefore existed in the blood of our intellectuals." (1)

The policy of the regime towards the intellectuals was a self-contradictory one. It advocated that the intellectuals should be boldly offered jobs and used, but they ought to be watched and prevented from embarking on the road leading to a possible revival of the old world.

In the Shanghai *Wen Hui Pao* we read this description of the critical state of affairs in colleges and universities in mainland China: The paper wrote: "Colleges and universities are indeed beset with a series of 'old, big and difficult problems!' They are a good market place for enhancement of 'egoism', a place abounding with loafers, a cradle of "mountaintopism" (regionalism), sectarianism, and individualism. It's much more difficult and complicated to solve the problems of a university than the armed struggle of a factory." (2)

It was against the background of this deplorable state of affairs in the higher educational institutions that voices calling for abolition of colleges and universities were heard in 1967.