

T I C

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Friends :

The Economic World Crisis obviously impinges on tantalum and niobium but (to your relief) I shall manfully resist the temptation to philosophize.

Regrettably but inevitably we have lost a number of members – those whose interest in tantalum and niobium is marginal rather than vital – but we have also gained some new ones from "new territories" making us more of a global organization; after pruning a tree grows more vigorously !

We are lucky in many respects; we have : an Executive Committee whose roster reads like a tantalum and niobium "Who's Who" as well as our Great Lady, Judy Wickens and our Technical Adviser, George Korinek. To be sure we shall miss Messrs Maden and Tolley, previous President and Technical Adviser, however, Peter's term is over and Rod's wish to retire after all these years is understandable.

The papers given in Vienna show that tantalum and niobium are still at the cutting edge (a metaphor for the Carbide Crowd) of modern scientific development. Many thanks are due to Treibacher for the plant tour and for adding the spectacular bus trip.

The next General Assembly will be in Aizuwakamatsu, Japan, near the Showa Cabot plant, if we find the place suitable for such convention. As this is written our hosts are inspecting the hotel and facilities. If that place does not meet our needs we shall convene in Tokyo. I, for one, hope for a positive report : all of us will find our way to Tokyo at some time or other, but to Aizuwakamatsu ?

The 1995 General Assembly is scheduled for Goslar and promises to be festive because Starck is commemorating its 75th anniversary in that year.

By the time you read this we will be in the Holiday Season. Since this Bulletin enjoys a small but world-wide distribution,

the Holidays and the way they are observed will differ. Whichever way you label the next year, such as 1994 (Gregorian), 5755 (Hebrew), 1415 (Mohamedan), Year of the Monkey (Chinese) or New Fiscal Year (Materialist) we wish you happy holidays and a healthy and prosperous New Year.

Sincerely,

Hubert Hutton
for the T.I.C.

T.I.C. IN VIENNA

The annual conference of the Tantalum-Niobium International Study Center was held in Vienna, Austria, from October 4th to 6th 1993.

Participants were welcomed on Monday evening with a cheese and wine party sponsored by Alex Stewart (Assayers), Sogem-Afrimet and Sogem (Brussels), and the T.I.C. On Tuesday the General Assembly of the association was followed by an excellent technical programme, and in the evening a gala dinner was accompanied by Viennese music played by a small orchestra of Austrian ladies.

On Wednesday participants enjoyed a fine drive through beautiful scenery to Treibach, where they were treated to a splendid lunch and a plant tour of Treibacher Chemische Werke.

Sightseeing tours for those people accompanying delegates to Vienna were highly praised, thanks to a first-class guide and an original presentation of Austrian history through music and dancing as well as visits to the impressive buildings in the city. Many delegates took advantage of the rich cultural life of Vienna to go to the opera and to concerts, and see performances by the Spanish Riding School, as well as exploring parks and palaces.

GENERAL ASSEMBLY

Mr Peter Maden of Vishay Sprague, President of the association, chaired the Thirty-fourth General Assembly which carried out the formal business of the T.I.C. and approved the audited accounts. One new member was elected, Ulba Metallurgical Plant, of Kazakhstan, and six resignations were accepted, bringing membership to fifty companies.

A new category of membership was created for individuals and not-for-profit institutions : details will be available shortly and anyone interested should request information from the secretariat.

Dr George Korinek was appointed as Technical Adviser, succeeding Mr Rod Tolley who was taking well deserved retirement and whose work for the association had been greatly appreciated.

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T.I.C. STATISTICS

TANTALUM

PRIMARY PRODUCTION

<i>(quoted in lb Ta₂O₅ contained)</i>	3rd quarter 1993
Tin slag (2 % Ta ₂ O ₅ and over)	146 616
Tantalite (all grades), other	120 478
Total	267 094

Note : 12 companies were asked to report, 12 replied.
The companies which reported included the following, whose reports are essential before the data may be released :
Gwalia Consolidated, Malaysia Smelting, Mamoré Mineração e Metalurgia, Metallurg group, Pan West Tantalum (Wodgina Mine production), Tantalum Mining Corporation of Canada, Thailand Smelting and Refining

QUARTERLY PRODUCTION ESTIMATES

<i>(quoted in lb Ta₂O₅ contained)</i>				
LMB quotation :	US \$ 30	US \$ 40	US \$ 50	
4th quarter 1993	231 500	314 500	374 500	
1st quarter 1994	231 500	314 500	374 500	
2nd quarter 1994	231 500	314 500	374 500	
3rd quarter 1994	231 500	314 500	374 500	
4th quarter 1994	231 500	314 500	374 500	

Note : The quarterly production estimates are based on information available, and do not necessarily reflect total world production.

PROCESSORS' RECEIPTS

<i>(quoted in lb Ta contained)</i>	3rd quarter 1993
Primary raw materials (e.g. tantalite, columbite, struverite, tin slag, synthetic concentrates)	759 096
Secondary materials (e.g. Ta ₂ O ₅ , K ₂ TaF ₇ , scrap)	141 536
Total	900 632

Note : 17 companies were asked to report, 16 replied.

PROCESSORS' SHIPMENTS

<i>(quoted in lb Ta contained)</i>	3rd quarter 1993
Product category	
Ta ₂ O ₅ , K ₂ TaF ₇	85 102
Alloy additive	8 213
Carbides	48 986
Powder/anodes	258 219
Mill products	86 293
Ingot, unworked metal, scrap, other	86 873
Total	573 686

equivalent to 774 477 lb Ta₂O₅.

Notes :
In accordance with the rules of confidentiality, categories have been combined as shown.
Response : July 17/18, August 16/17, September 16/17.
For both receipts and shipments by processors, reports by the following companies are essential before the data may be released :
Cabot Performance Materials, W.C. Heraeus, Kennametal, Metallurg group, Mitsui Mining and Smelting, Ningxia Smelting Plant, H.C. Starck Inc. (NRC), Showa Cabot Supermetals, H.C. Starck, Thai Tantalum, Treibacher Chemische Werke, Vacuum Metallurgical Company, H.C. Starck - V Tech

NIOBIUM

PRIMARY PRODUCTION

<i>(quoted in lb Nb₂O₅ contained)</i>	3rd quarter 1993
Concentrates : columbite, pyrochlore	8 295 878
Occurring with tantalum : tin slag (over 2 % Ta ₂ O ₅), tantalite, other	114 365
Total	8 410 243

Note :
13 companies were asked to report, 13 replied. The companies which reported included the following, whose reports are essential before the data may be released :
Cambior, Mineração Catalao de Goiás, Niobium Products Co. (CBMM)

PROCESSORS' SHIPMENTS

<i>(quoted in lb Nb contained)</i>	3rd quarter 1993
Compounds and alloy additive : chemical and unwrought forms (e.g. NbCl ₅ , Nb ₂ O ₅ , NiNb, FeNb [excluding HSLA grades])	574 607
Wrought niobium and its alloys in the form of mill products, powder, ingot and scrap	
(i) Pure niobium	28 074
(ii) Niobium alloys (such as NbZr, NbTi and NbCu)	58 943
HSLA grade FeNb	6 687 079
Total	7 348 703

Note :
18 companies were asked to report, 18 replied. Reports by the following companies are essential before the data may be released :
Cabot Performance Materials, W.C. Heraeus, Kennametal, Metallurg group, Mitsui Mining and Smelting, Niobium Products Co. (CBMM), H.C. Starck Inc. (NRC), H.C. Starck, Teledyne Wah Chang Albany, Thai Tantalum, Treibacher Chemische Werke, Vacuum Metallurgical Company

CAPACITOR STATISTICS

CONSUMPTION BY AREA

(figures in millions of units)					
		Average per quarter			
	1989	1990	1991	1992	
North America	302	337	356	425	
Europe	206	232	230	228	
Japan	681	808	965	773	
Rest of world	287	411	494	571	
World	1476	1788	2045	1997	

		1993			
Quarter :	1st	2nd	3rd	4th	
North America	510				
Europe	266				
Japan	759				
Rest of World	626				
World	2161				

Source : Members' estimates

Note : Minor revisions have been made to the previously published figures for 1989-1992.

Mr Hubert Hutton of Sogem-Afrimet took over the Presidency for the coming year. Mr Mark Hague, Mr René Van Achter and Dr Korinek resigned from the Executive Committee, and Mr Robert Barron, Mr Peter Kahlert and Mr Jacques Hennevaux were elected. Members of the Committee re-elected for a further term of office are Mr John Linden, Mr Peter Maden, Mr David Maguire, Mr David Ratcliffe, Dr Harry Stuart, Mr Yoichiro Takekuro and Mr Yeap Soon Sit.

FUTURE MEETINGS

An informal meeting will be held in Brussels on April 19th 1994, following a meeting of the Committee on April 18th.

The Thirty-fifth General Assembly is planned for the end of October 1994 in Japan, and the Thirty-sixth General Assembly will be part of a conference in Goslar, Germany, in September 1995.

STATISTICS

The Tantalum-Niobium International Study Center has decided that the quarterly statistics collected by the association will no longer be published in the Bulletin after this issue. The statistics will be circulated to members by mail, as before.

They will also be available outside the association on subscription: those interested in subscribing should apply to the T.I.C. secretariat for terms and conditions. The data published in 1994 onwards may not be copied or re-printed without the express permission of the T.I.C.

ABSTRACTS FROM RECENT LITERATURE : NIOBIUM AND TANTALUM

NIOBIUM

1. Lithium secondary batteries can be produced with improved charge and discharge cycle characteristics, and a higher discharge voltage, by the use of heat-treated niobium pentoxide in the negative electrode. The crystal size of the Nb_2O_5 is critical, and it can be monitored by X-ray diffraction. Treatment is performed in the range 850 - 1100 degC: the electrolyte of the battery is mainly composed of a lithium salt in a non-aqueous solvent.

*Matsushita Electric Ind. Co. Ltd.
Japanese Patent 05-13080 (22.1.93)*

2. A squid (short for superconducting quantum interference device) is a very sensitive detector of small electric currents, and (with the addition of a loop or gradiometer) of small magnetic fields. It uses a superconducting alloy in its construction, and so has to operate at 10 deg Kelvin or less.

Weak magnetic fields are emitted by the human body, and their intensity is related to its state of health: the squid can therefore be used as a biomagnetometer. It needs a shield to avoid being swamped by extraneous fields, and this is most effective if made of a superconducting material: not only has it a low electrical resistance, but it also excludes fields by the Meissner effect. At present, the shield is fabricated of machined niobium and lead-plated

machined brass: these are expensive to manufacture and repair. The patentee has now developed a packaged squid in which niobium foil is used for the shield (0.01 - 0.50 mm thickness).

*Biomagnetic Technologies Inc.
World Patent 92/12436*

3. Mitsubishi Heavy Industries has been developing since 1986 a superconducting magneto-hydrodynamic propulsion system for use in ships, and has built a vessel, the "YAMATO 1" to operate with it. It had its first sea trial in June 1992, and the results have been very encouraging. It uses in its construction niobium-titanium/copper superconductors, aluminium base alloys, and titanium base alloys coated with platinum or PFA.

*H. Sakai et al (MHI)
Mitsubishi Juko Giho 29(6)473-479*

4. Superconducting triniobium-tin tape may be made by coating a niobium tape with tin in a tin bath, and then reaction annealing it. This method is improved by alloying 5-25% copper and 5-25% lead with the tin, which appears to promote rapid formation of fine grained Nb_3Sn . The fine grain size improves the current carrying capacity of the tape and the Pb+Cu+Sn alloy coating remaining on the annealed Nb_3Sn improves solder bonding to the non-superconducting copper outer elements.

*Benz and Rumaner (General Electric)
U.K. Patent 2257437 (13.1.93)*

TANTALUM

1. A tantalum powder with a low carbon content and good flow properties may be obtained by granulation in a fluidized bed with an inorganic binder, and then again with an organic binder. This produces a powder with good grain size distribution, and low carbon content, very suitable for sintered capacitors.

*Shiyouwa Kiyabotsuto
Japanese Patent 05-65502 (19.3.93)*

2. Tantalum powder with a high CV value, and low current leakage, may be obtained by heating the powder with either elemental phosphorus or a phosphorus compound (e.g. ammonium phosphate) at a phosphorus concentration of 40-150ppm at 1200-1600 deg C in a vacuum of 10^{-4} Torr. The powder is then disintegrated and brought to below 60 mesh. It is finally treated with 3-10 vol % HF (with or without sulphuric acid).

*Shiyouwa Kiyabotsuto
Japanese patent 04-362102 (15.12.92)*

*R.J. Tolley
22.10.93*

SUPERCONDUCTING ALLOYS : THE CURRENT STATE OF DEVELOPMENT

At the technical session of the T.I.C. meeting in Vienna, five of the eleven papers given were related to superconductivity, in which niobium alloys play the crucial part. Two of the papers were concerned with their use in high energy physics accelerators. The other three were concerned with

recent developments in the composition and working of the niobium-based compounds for use in superconducting magnets and similar applications. The papers were :

1. "Recent Achievements in the Development of Metallic Superconductors", by Dr Kiyoshi Inoue of the Tsukuba Magnet Laboratories, National Research Institute for Metals in Japan.
2. "New Developments in niobium-based alloy superconductors", by Dr Eric Gregory, IGC-Advanced Superconductors Inc.
3. "The role of tantalum in improved Nb₃Sn solid diffusion and A15-phase superconductors", by Dr Hans Hillmann, Niobium Products Company.

Copies of any of these complete papers (which are very comprehensive) are available on request from the T.I.C., but we give below our brief summary of the salient points made by these three distinguished contributors.

For some time it has been the practice to use the ductile NbTi alloy for relatively low magnetic fields (up to 9 Tesla), and the brittle Nb₃Sn alloy (which is much harder to fabricate) for higher fields. Development work on improvements in these and other alloys has been diverted in recent years to high critical temperature mixed oxide superconductors, but now there is a realisation that much more work, perhaps over the next ten years, will be required to bring the latter to large-scale commercial use.

Niobium titanium alloys are the mainstay of smaller scale applications, and work on them has focussed on (a) methods for raising the critical current density at liquid helium temperatures with a view to replacing in some cases the more expensive niobium-tin; and (b) the preparation of finer filaments principally to facilitate use in alternating current devices.

- (a) A remarkable enhancement of the c.c.d. has been obtained by the use of ribbon-shaped artificial pins of niobium in the construction of the wire billet.^{1,2} In this fabrication process, the elementary composite rods assembled with Nb plates and Nb-Ti plates are prepared and drawn. Then, many of the elementary rods are inserted into a copper tube and cold drawn to wire. This is cut into many pieces, bundled into a further copper tube and drawn again. Figure 1 shows a cross section of the artificial pins embedded in the NbTi filament. When the thickness of the niobium and the NbTi were 32nm and 62nm respectively, very high critical current densities were obtained, such as 13 900 A/mm² at 2 Tesla, and 3780 A/mm² at 5 Tesla.

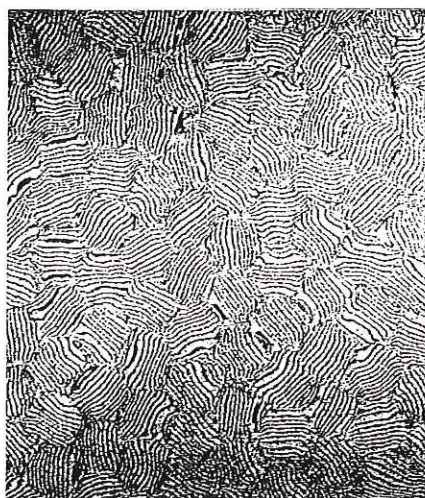


Figure 1

SEM photograph of the cross-section, before final drawing, of artificial pins embedded in a NbTi filament (dark layers are of NbTi, bright layers are of niobium)

- (b) When fine filaments are required in a superconducting application, it is necessary to ensure that the quality of the filaments is maintained as their size is reduced, and it is also important that they behave electrically as single filaments, and are not linked by proximity coupling. Such coupling is the result of the super-electrons passing from one filament to another through the matrix. These objectives are generally accomplished by the use of several approaches :
 - (1) Reducing the formation of hard compounds such as CuTi intermetallics on the surface of the filaments by either the use of a barrier of niobium or the addition of an element such as silicon to the matrix.
 - (2) Placing the filaments as close together as possible to enable them to support one another even in a relatively soft matrix.
 - (3) Using as hard a matrix as possible to enable larger spacing to be employed without the accompanying filament sausageing (this can be effected, for example, by adding silicon to the copper matrix).
 - (4) Using a high resistance matrix to provide resistive scattering of the super-electrons (copper/nickel 70/30 is often used, but Cu/Si (2.5-3.5%) appears to have advantages).
 - (5) Using a matrix alloyed by an element such as manganese which provides spin flip scattering, an even more effective method of limiting the path of the super-electrons than resistive scattering.
 - (6) Using as tight a twist as possible to reduce the losses resulting from both eddy currents and proximity coupling.

All these advances should make possible the early commercial use of a.c. superconducting power transformers, limiters and armatures.

Tantalum addition to NbTi produces an improvement in superconducting performance, but it is sensitive to the amount of niobium displaced (Figure 2) and the operating temperature. Nb 19% Ta 40% Ti appears optimum at 4.2K, but more tantalum is needed at lower temperatures.

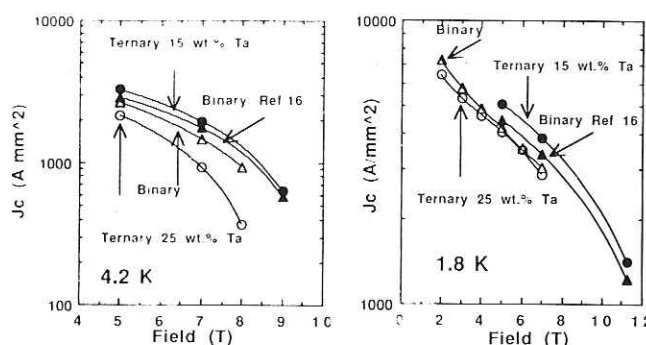


Figure 2

(a) J_c vs field at 4.2K, (b) J_c vs field at 1.8K for the NbTi binary and two different Ta containing ternaries

Recent research on niobium-tin superconductors has concentrated on two general aspects : the effect of the addition of other metals (principally tantalum and titanium) to the alloy, and the physical improvements in the final product resulting from changes in formation and fabrication procedures. As mentioned above, Nb₃Sn is brittle so ideally the product should be in its final shape before the compound is formed by

diffusion. This is clearly not completely practical, but the number of annealing steps required can be reduced by changes in the construction of the original composite.

The bronze process in which niobium wires are set in a CuSn bronze matrix, drawn down with intermediate annealing and then heat treated at 650-800 degC to form the Nb₃Sn by diffusion, has been in use for some years. Improvements in the product, particularly in critical current density, have resulted from the addition of titanium or tantalum to the niobium.

However, the bronze process has some weak points such as the need for many expensive annealing steps, and the relatively small volume fraction of Nb₃Sn in the finished product (resulting from an upper limit of 8% tin in the bronze due to the poor cold working properties of tin-rich bronze). To overcome these weaknesses, several alternative processes have been developed. They are shown diagrammatically in Figure 3. In these, copper and tin instead of bronze are assembled into the starting composite. Unlike bronze, both copper and tin can be cold drawn without annealing, and the tin content of composite can be set at whatever is needed without cold workability problems.

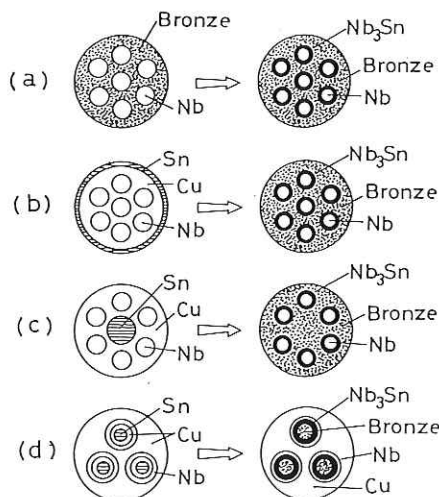


Figure 3

- (a) Bronze process and deformed bronze process
(b) external Sn diffusion process
(c) internal Sn diffusion process
(d) Nb-tube process

The desirable combination of a titanium addition and the niobium tube process has enabled a critical current density of 500-700 A/mm² to be obtained at 4.2K, 16 Tesla with a Nb₃Sn multifilamentary conductor, the best high field performance of any commercial multifilamentary superconductor (Figure 4). The typical niobium tube process is as follows : several single-core wires, consisting of a Nb-1% Ti (or Nb-7.5% Ta) tube with a copper-sheathed tin core bundled together in a copper tube, and reduced by hydrostatic extrusion. The resulting wire can then be drawn down without any intermediate annealing before finally being heat treated to produce the superconducting alloy inside each niobium tube (this final step is usually performed after the magnet has been wound, in order to avoid damage to the brittle phase).

A major improvement has been reported in the performance of a bronze processed Nb₃Sn conductor by the simultaneous addition of tantalum and titanium.³ In the fabrication process Ti-bronze, and a Nb-0.5% Ta were used as the matrix and core materials respectively. A 21.1 Tesla superconducting magnet, with a clear bore of 50mm, operating at 1.8K has been made with the resulting wire. This is the highest field so far generated by a superconducting magnet.

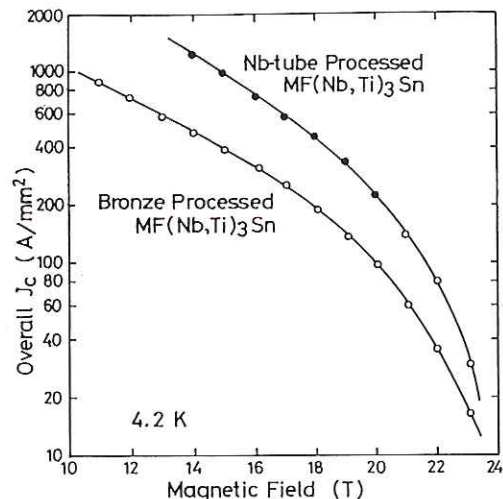


Figure 4

Overall J_c (without Cu) vs magnetic field curves at 4.2K for Nb-tube processed and bronze processed (Nb, Ti)₃Sn multifilamentary conductors

Tantalum is also added to Nb₃Sn composites in the form of thin layers integrated into the conductor to prevent tin diffusion into the stabilizing copper area.

Other intermetallic compounds (many containing vanadium, gallium and germanium) are known to be superconducting, and some have critical temperatures higher than niobium-tin, but their formation rate through a diffusion process is very low, and other processes (such as physical or chemical vapour deposition) for preparing them are not amenable to the production of multifilaments.

Nb₃Al conductors are very promising for general use, and diffusion has been investigated for making them by two different methods. The first involves powder metallurgy in which a niobium and aluminium powder mixture is packed into a copper alloy sheath, cold worked into wire, and finally heat treated to form Nb₃Al filaments. Alternatively the conductor can be made by the jelly-roll process in which two thin foils of niobium and aluminium are superimposed, wound round a small copper cylinder, inserted into a copper sheath, cold worked to wire and finally heat treated to form the Nb₃Al layer. The cold working has not proved easy, but it has been greatly simplified by hardening the aluminium cores with magnesium, silver, copper or zinc.

SUMMARY

Great strides have been made in the past twenty years in the development of superconducting alloys for the fabrication of powerful electromagnets, but niobium-titanium and niobium-tin are still holding their position as the basic alloys of choice. This has been effected by major modifications in processing and fabrication of the conductors, and significant additions to their formulation, and that of the matrix material.

R.J. Tolley
22.10.93

- 1 Matsumoto et al, IEEE Trans on Appl. Supercon; 3, 1362-1365 (1993).
- 2 Kanithi, Adv. Cryo Eng 38(B) 675-683 (1993).
- 3 Kiyoshi, Inoue et al, to be published IEEE Trans on Magn (1994).

SUPERCOLLIDER PROJECT TERMINATED

In late October the Congress of the United States of America terminated the financing of the Superconducting Supercollider (SSC), after it was completed by about 20%, and expenditure of approximately \$2 billion.

The SSC was the largest fundamental science project ever attempted, according to the New York Times.

The Supercollider would have accelerated two beams of protons to such speed that, on collision with each other, energy of several trillion electron volts would result. Energy conditions which existed when the universe was only a micro fraction of a second old would be re-created.

The SSC would have been a major user of Nb-Ti superconducting wire for its dipole and quadrupole magnets.

Unfortunately, since its conception the SSC project was plagued by ever-increasing cost estimates and overruns. The latest estimate was about \$13 billion. As the cost of the project continued to increase, the SSC management tried to interest foreign governments in participating in the SSC. In the end, one third of the project was required to be financed by foreign contribution. However the support never materialized at the level needed.

Whereas the Clinton administration supported the SSC until the end, the political atmosphere in Congress was such that opinion prevailed that the country can not afford, under present economic conditions, such an expensive project.

THE IMPORTANCE OF TIN MINING AND SMELTING TO THE TANTALUM INDUSTRY

This is a shortened version of the paper presented to the meeting in Vienna, October 1993, by Mr Michael Taylor, Sogem.

Sogem has a long tradition not only in the supply of tantalum-bearing raw materials used in-house until the early seventies for the production of tantalum powder in joint-venture with Fansteel, but also in the production of tin metal until our Hoboken smelter was closed some 12 years ago. The reason for the closure is a valid today as it was then : the instability of supply of raw materials from Africa.

Sogem, benefiting from the flexibility and financial resources enjoyed by the trading arm of a major industrial concern, Union Minière, has maintained its tin and tantalum raw material procurement, often pre-financing its smaller suppliers and providing transport advice and having the concentrate toll-smelted into both tin metal and tantalum slags. At the same time we have assisted some of our miners in separating the tantalum oxide contained in the tin concentrate prior to smelting to provide a more flexible raw material, tantalite, which has greater appeal to a wider variety of end-users than the more complex slags.

Three thousand years ago bronze-age man discovered tin whose development would eventually and quite unintentionally give rise to nearly all the world's supply of tantalum raw materials : tantalum, a high performance metal not even produced in the laboratory until the 20th century.

Wherever tin is mined in Malaysia, Thailand, Rwanda, Zaïre, Nigeria, Spain, tantalum is usually to be found, and it is

usually separated from the tin oxide *in situ*. Until tantalite prices and electromagnetic separation techniques provided sufficient incentives, the tantalum remained in the rejected slags as tantalum oxide.

During the late seventies and early eighties, prices shot up from about US\$6/lb to US\$120, already a stunning 20-fold increase, but they were restrained from going any higher by the availability – and, at these high prices, economic viability – of tantalum slags. There were thousands of tons lying in tin smelter sites around the world and large quantities had even been disposed of altogether as landfill and aggregates for road building, from which they were hurriedly re-excavated.

In view of this history it was surprising that a tin smelter, Thaisarco, was built, not for the principal purpose of producing tin, but for producing tantalum slags out of tin concentrates by extracting the tin as ingots. The same logic has been applied by Greenbushes in Western Australia to produce a small tonnage of tin in order to generate high value slags.

The tantalum industry was lucky during the tantalum crisis of 1979-1982 : not only had supply shortages been met by the almost forgotten slag stockpile but the tin market itself had been for years maintained at artificially high prices which had, again quite accidentally, been subsidising tantalite and slag production.

In October of the fateful year 1985 the world finally woke up to the fact that a scheme devised originally to regulate the tin price so that it would remain attractive both to producers and consumers had metamorphosed into a price support scheme and, worse, one with no money, no credit to continue purchasing tin or even meet its existing commitments. The effect was immediate : the tin market collapsed.

The subsidised world tin prices had attracted a newcomer, Brazil, with massive low-cost tin reserves but relatively low tantalum content. Brazil is now the largest producer of tin in the world but apart from its enormous reserves of niobium in pyrochlore it is not an important factor in tantalum supply.

A worldwide recession and a relative decrease in international political tension have come to the rescue of a delicate supply/demand balance for tantalum raw materials. Defence budgets have a lower priority and researchers are finding increasingly efficient ways of using tantalum in smaller quantities.

But tin prices at one quarter of their former level have devastated the tin mining and smelting community. Even those producers blessed by nature with co-product or by-product tantalum may not find that this is enough and indeed Malaysia, once the world's largest minder and smelter of tin, has officially declared its production as a sunset industry. Malaysia, however, is forging ahead into high-tech industries and is currently enjoying an electronics boom.

Many other tin producers do not have this luxury of being able to turn their backs on tin :

- Bolivia is a subsistence producer and struggles on as there are so few alternatives, and it does not even have the consolation of a tantalum production;
- Indonesia too is very reliant on its tin production as a hard currency earner though it lacks tantalum;
- In Africa the story is somewhat different : production is dependent not only on price (and in many cases both tin and tantalum are present) but also on the time of year. Agriculture offers not only alternative employment to many miners but also food, and although a mine can wait crops cannot.

It is important to realise not just how fundamental the tin-tantalum connection is to guaranteeing a regular supply of tantalum, but also the fact that those tin producers most likely to

stay the course in the long term just happen to be those who rely most on tin and least on tantalum.

There are a number of predominantly tantalite mines around the world, notably in Canada and Australia which fortunately happen to be among the most politically stable countries. Then again a large number of tin-tantalum producers rely not only on tin credits as already discussed but are located in countries whose very existence is threatened by political turmoil. African countries such as Zaïre, Rwanda and more recently even Nigeria spring to mind.

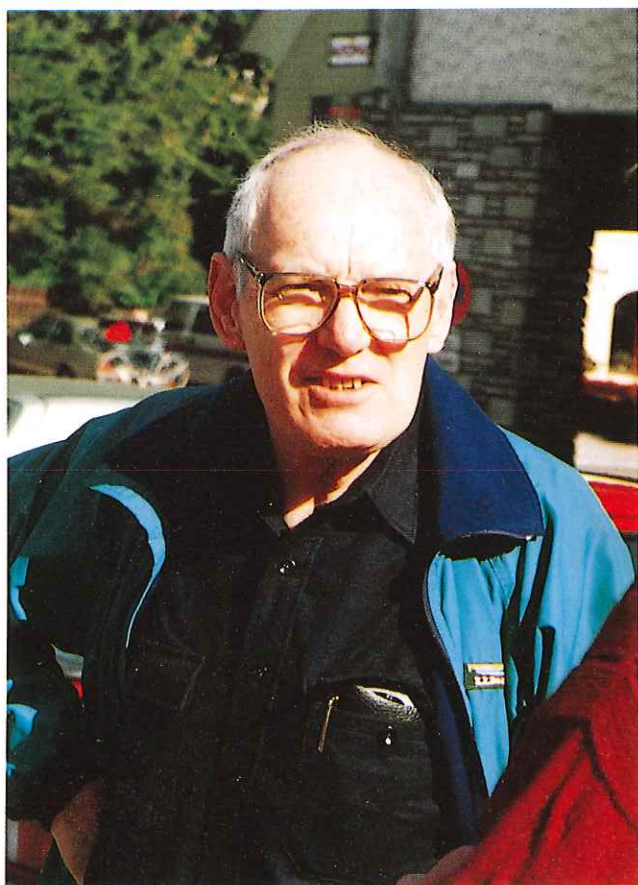
Without the pioneering of the poor tin-tantalum producer, and a little help from Mother Nature, there would have been no tantalum industry to discuss. The tin price should also be borne in mind : any upward movement is good news for the tantalum

industry too, especially as any new tantalum crisis (though hardly imminent) will not have the old tantalum slag stockpiles waiting to rush to the rescue again.

TANTALUM/NIOBIUM NECKTIE

The fashion for these very special ties is now well established – a good many were sold and worn in Vienna. Don't be left out ! Send your order to the T.I.C. now, with payment of \$25 plus \$4 postage and packing. Colours are navy blue or wine red : please say which you would like us to send.

Seasonal greetings from newly-elected T.I.C. President Hubert Hutton, pictured here with his friend Santa Claus



Technical Advisers Rod Tolley (left) and his successor George Korinek (right)

PLANT TOUR TO TREIBACH



Managing Director of Treibacher Chemische Werke Michael Ehrenfried (right) in conversation with T.I.C. past President Peter Maden



... and back in Vienna, the ladies were sightseeing



Group setting off to see the plant

MEMBERSHIP

Elected to membership by the Thirty-fourth General Assembly :

Ulba Metallurgical Plant

102 Shkolnoye Shosse,
492026 Ust-Kamenogorsk, Kazakhstan Republic.

The following companies have resigned from membership :
Cerex, Datuk Keramat Smelting, Gesellschaft für Elektrometallurgie, Malaysia Mining Corporation, National Resources Trading, Thai Pioneer Enterprise.

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1050 Brussels, Belgium.
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Telex : 65080
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Imprimerie Puvrez

AMENDMENT

The figures for **Tantalum processors' receipts** should be as shown below, and not as printed in Bulletin no. 76:

TANTALUM PROCESSORS' RECEIPTS

(quoted in lb Ta contained)

	3rd quarter 1993
Primary raw materials (e.g. tantalite, columbite, struverite, tin slag, synthetic concentrates)	314 733
Secondary materials (e.g. Ta_2O_5 , K_2TaF_7 , scrap)	<u>141 536</u>
Total	<u>456 269</u>

Note: 17 companies were asked to report, 16 replied.