

## T.I.C. Activities

The Thirteenth General Assembly will be held in Torquay, Devon, in the south west of England. On this occasion ITT Components Group have kindly invited the T.I.C. to visit their tantalum capacitor operation at nearby Paignton.

The programme for the meeting will open with a reception on the evening of Monday May 5th by the Mayor of Torquay in the Mayor's Parlour, and delegates should arrive on Monday afternoon in time to attend this.

The General Assembly will be held at 9.30 a.m. on Tuesday May 6th in the Haldon Room of the Imperial Hotel, the hotel in which participants will be staying. After the Assembly there will be presentations of papers on aspects of the tantalum industry and an opportunity for general discussion.

Following a buffet luncheon at the hotel, delegates will be taken by coach to Paignton, about eight kilometres away along the coast. Here ITT will provide a conducted tour of their tantalum capacitor plant. In the evening the participants will be the guests of the T.I.C. at a banquet dinner.

On Wednesday May 7th the T.I.C. hopes to arrange for a party to visit a tin concentration plant in Cornwall.

Invitations and general information have been sent to all member companies and delegates should confirm their attendance without delay to the Secretary. The Assembly is open only to the representatives of member companies, and the rest of the meeting has been arranged for those delegates and their invited guests.

### ITT UK TANTALUM OPERATION

ITT is a large international organization which trades in many products and which has manufacturing plants in numerous countries. Its major manufacturing business is in telecommunication and as such is itself a large consumer of electronic components. The component manufacturing divisions run as independent businesses and there is no compulsion either for them to supply to the ITT equipment divisions or for those divisions to buy ITT components.

In the UK there are five ITT capacitor manufacturing product lines covering aluminium electrolytics, plastic film, ceramic, mica and foil tantalum types as well as the solid tantalum capacitors. Taking into account factories in other parts of the world, ITT manufactures more than a million solid tantalum capacitors a day.

At the Paignton plant the following styles of solid tantalum capacitors are produced :

- TAA axial lead, metal case, hermetic seal
- TAG radial lead, resin dipped
- TAM miniature version of TAG
- TAP as TAG but tighter specification and wider range
- TAH axial or radial lead, box and end fill
- TAR axial lead, resin moulded, cylindrical
- TAY radial lead, resin moulded, rectangular

### T.I.C. THIRTEENTH GENERAL ASSEMBLY

The Thirteenth General Assembly will be held at 9.30 a.m. on Tuesday, May 6th 1980, at the Imperial Hotel, Torquay.

The agenda for the meeting will be :

1. Presidential Address.
2. Minutes of Twelfth General Assembly.
3. New membership.
4. Report of Executive Committee.
5. Report on quarterly Bulletin.
6. Accounts for 1979.
7. Budget for 1980.
8. Production statistics for 1979.
9. Study of tantalum industry, third phase.
10. Statutory elections.
11. Fourteenth General Assembly : place, date.
12. Other business.

The General Assembly will be followed by the presentation of papers on topics of current interest to the tantalum industry.

In the afternoon there will be a visit to the tantalum capacitor plant of ITT Components Group at Paignton.

ITT is one of the largest employers in Torbay, employing about 2,000 workers at the Paignton site. Torbay, which consists of the three holiday resorts of Torquay, Paignton and Brixham, is one of the largest centres of population in the county of Devon. The main industry of Torbay is tourism.



## Devon

The programme for the Thirteenth General Assembly of the Tantalum Producers International Study Center is to be carried out in the towns of Torquay and Paignton, on the south coast of the county of Devon in south western England. Devon, the largest county in England, is part of the south-western peninsula and has both a southern and northern seacoast. It is bounded on the west by Cornwall and on the east by Somerset and Dorset.

Devon has the boldest relief of the counties of southern England. Its coastline offers a great variety of colour and scene, with contrasts between rugged cliffs, broad sandy beaches and deep winding estuaries. Inland the country gives way to low hills and the wild, rolling moorland of Dartmoor.

Historically, Devon and Cornwall have been sources of many metallic ores, tin and copper in particular, but also lead, manganese and silver. Silver and lead mines were worked from the 16th century until the 1800's, copper and manganese were mined during the 18th and 19th centuries. Tin mining was an important industry from the 12th century to the 17th and is still continued today in Cornwall. Nowadays the principal mineral products are clays for the ceramics industry and ground limestone for agricultural use. The chief industries of the region are farming, fishing and tourism.

The climate of the peninsula is mild, the warmest in Britain, and extremes of temperature rarely occur. The south-facing coast around Torquay shelters palms and other subtropical plants. In May there should be some spring sunshine, although there is also a possibility of showers.

Torbay, consisting of Torquay, Paignton and Brixham, is a noted holiday and tourist centre. It is reached by a train journey of about 3½ hours from London. Paignton originated as a market town as early as 1294, and is now popular for seaside holidays. The Imperial Hotel is situated in wooded grounds overlooking the sea of Tor Bay. It is one of the few five-star hotels in England outside London and is a well-known centre for conferences and tourism.

Delegates may wish to take the opportunity of seeing more of the countryside known as "glorious Devon" and excursions to places of scenic or historical interest may readily be arranged before or after the T.I.C. meeting.

## Fansteel Expansion

*(The following article was provided by Fansteel Inc. expressly for publication in the T.I.C. "Bulletin".)*

Keith R. Garrity, President and Chief Operating Officer of Fansteel Inc., North Chicago, Illinois, U.S.A. and a delegate to the Tantalum Producers International Study Center, recently announced several projects his company's Metals Division had underway to improve the output of tantalum and columbium metal products. Mr. Garrity stated "Fansteel has substantial investments in the tantalum and columbium industries and believes additional investment is needed to meet the increasing and anticipated market demands".

Major projects currently underway in the company's Metals Division are as follows:

(1) Additional digestion facilities for dissolving various tantalum bearing raw materials. Tantalum and columbium are put in solution using hydrofluoric acid, extracted with Methyl Isobutyl Ketone, then purified and separated through a series of mixer-settler boxes. The company has operated a Liquid-Liquid System for recovery of tantalum and columbium since 1959 and the latest improvement represents the fourth major expansion since the initial installation. The improvements have increased capacity five-fold, improved yield and product quality and have allowed greater diversification of raw material feedstock.

(2) Improvement in Electron Beam Melting. The company has two electron beam furnaces used solely for the melting of unalloyed and alloyed tantalum and columbium. Since melting and purification are carried out on the principle of electron bombardment in a high vacuum environment, it is essential that pumping systems and high voltage power supplies be up-to-date and in good operating condition. In this regard, Fansteel has purchased and installed vacuum pumps having greater efficiency and is in the process of installing the latest in solid state power supplies.

(3) An expansion of the Sodium Reduction operation is on the drawing board and scheduled for completion in 1980. Fansteel has employed this process since 1967 with established procedures for producing capacitor, bar and melt grade tantalum powders. The emphasis on high-charge capacitor powders to offset increased raw material cost is the principal motivator for the sodium reduction expansion.

## «Joe» Abeles Retires

With the retirement of Joseph C. Abeles, Chairman of the Board of Kawecki Berylco Industries, Inc., an era in the tantalum business comes to an end. Joe is the last of the outstanding personalities who pioneered the development of the processing and marketing of tantalum which established the industry as we know it today. Although Kawecki Berylco Industries was not the first commercial processor of tantalum, under Joe's able leadership and countless contributions KBI became the largest fully integrated processor. A born salesman, Joe has earned respect throughout the world for his knowledge of special materials, his high degree of energy, and his technical competence combined with personal and business integrity.

Joe was born in New York on January 6, 1915. Attending New York University, he earned a B.S. degree in Chemical Engineering in 1935. After a short period as an industrial engineer for Parker Kaylor, Joe joined Fasey and Besthoff, Inc. in New York as salesman of chemicals. During his seventeen-year association, he established the firm as a vendor of chemicals to The Beryllium Corporation and as an agent for that company in the sales of potassium zirconium fluoride and potassium titanium fluoride. During the first post-war recession in 1949, Joe suggested the formation of a business to Henry Kawecki, his friend since 1941 when Kawecki was director of research for The Beryllium Corporation. The proposal was based on the idea that Joe would do the selling, Kawecki would do the research and a third partner, Philip Valeriano, would be responsible for production. Pooling \$30,000 from their personal savings along with funds from a handful of investors, Kawecki Chemical Company was founded on January 25, 1950. The first plant was established in a converted automobile shop in a swampy area off County Line Road in Boyertown, Pa. From this humble beginning, Joe has steered Kawecki Chemical Company through successive mergers with The Beryllium Corporation and Cabot Corporation to its present status as Kawecki Berylco Industries, Inc., a subsidiary of Cabot, commonly known throughout the world simply as "KBI".

Joe has been active in the T.I.C. since March 1976 when KBI became one of the first non-producers to join when the membership was expanded. In October 1978 Joe was elected President of T.I.C. for the year 1978-1979. He is presently a member of the Executive Committee.

(4) Installation of additional vacuum resistance sintering furnaces used in producing high quality powder metallurgy wire bars. The company has gained wide success with its patented TPX capacitor grade tantalum wire and has actually undergone expansion of this operation on several previous occasions. Mr. Garrity states that the latest addition is necessary to bring the segment of the product line in equilibrium with expansion of the wire drawing capability.

(5) Expansion of the wire drawing capability has just been completed with output increased some 25%, dependent upon wire diameter. The shift to the use of smaller diameter wire by the electronic industry to offset rising material cost was instrumental in Fansteel's decision to add to its capability.

(6) The installation of an additional annealing furnace will be completed in early 1980 and will release an existing induction furnace to augment the company's tantalum capacitor powder agglomeration capability. Mr. Garrity also noted that Fansteel is holder of several patents covering agglomeration and is currently marketing a high-charge sodium reduced powder (FGB-100) to help minimize the tantalum shortfall.

(7) Mr. Garrity emphasized the company's capability in the design and fabrication of chemical process equipment (heat exchangers, bayonet heaters, thermowells, etc.) and made reference to the paper Fansteel's Dr. Gerald Corey presented at the International Symposium sponsored by the T.I.C. in Rothenburg, West Germany, in May 1978. He also recognized the cost impact tantalum is having on this industry and felt Fansteel should take steps to improve its tube manufacturing capability. Accordingly, Board approval was received for a process for continuously forming and welding quality tubing. This process should help to control cost and improve flow through the shop.

Mr. Garrity stated that historically the tantalum producers have not been very profitable because of the capital investment required and the need to carry large inventories. On top of this, large investments in research and development and in equipment have been necessary to offset rising material costs. This vulnerability and the marginal return on investment could cause some managements, and with substantial justification, to hesitate to invest in tantalum operations. Mr. Garrity believes failure to do so would be hurting the growth prospects of tantalum and columbium products, and his Board of Directors shares his belief. In the final analysis, he believes the entire tantalum industry will not let this happen and will seek solu-



tions to preserve the tantalum market and its future growth. In closing, Mr. Garrity stated that his company was very active in searching for new raw material sources and felt optimistic they would be found and developed in the not too distant future.

## Tantalite from the Pilbara of Western Australia

*(The following article is based upon a presentation made by Mr. John Linden, Managing Director of Greenbushes Tin N.L., at the Eleventh General Assembly of the T.I.C., held in Perth, W.A., in May 1979.)*

There are only two significant tantalite producing areas in Australia, both located in Western Australia. The primary location is at Greenbushes in the southwest corner of the state and the other one is the Pilbara. The Pilbara is located 1,000 km. north of Perth and covers about 32,000 sq. km. with Port Hedland as the most important town servicing the area. The area can be divided into two parts on the basis of predominant tantalum mineralization, as shown on the map by the dashed line running south from Port Hedland down to Wittenoom. West of this line are the tantalite centers of Strelley, Tappa Tappa, Pilgangoora and Wodgina. East of this line are the tin centers of Mooleyella, Spear Hill and Shaw River. The tantalite areas produce only minor quantities of tin, having a tin to tantalite ratio of 1:5, while the tin centers have a ratio of 15 or 20:1.

### WESTERN AREA

Port Hedland is a town of 3,000 people and is the principal center for shipping the Pilbara iron ore. The tantalite centers of Pilgangoora and Wodgina are about 110 km. south of Port Hedland and are accessible by a gravel road. The country side consists of flat, sparsely vegetated plains covered with spinifex grass with occasional outcrops of boulder granites and greenstone ridges. At the Pilgan Mining Pty., Ltd. site there are low ranges which contain the mineralized pegmatites from which the eluvial and alluvial deposits of tritantalum bearing material have been formed. The pegmatite outcrop is a light colored rock in greenstone schists. The outcrops are from 1 to 5 meters wide and strike over a total length of about 10 km. Mineralization within the pegmatite is sporadic and generally in less than 100 meter segments.

The areas mined for tantalite and tin are the eluvial deposits immediately adjacent to the pegmatites. Narrow gullies contain the greatest concentration of the coarsest material. Creeks running away from the ranges are generally wider and deeper and carry finer material and have lower concentrations. Testing of the creek beds and flats is carried out by digging backhoe trenches either in discontinuous pits or in continuous trenches, depending on the nature of the expected mineralization. Closer inspection of the trenches shows layering in the wall of the bouldery wash containing rounded pebbles at the bottom overlain by finer pebbles and then silts and sands to the top. The layers are sampled separately and the samples are concentrated by means of panning, the action of washing with water in a dish to produce a concentrate. Panning simulates the actual concentrating process applied in the treatment plants. Identification of the concentrates is carried out by treating with hydrochloric acid in zinc blocks to coat the tin with zinc chloride and leaving the tantalite unaffected. After first removing excess iron ore minerals with a powerful hand magnet, the weight concentrate is mathematically converted to grade figures.

After this testing program, the mining is carried out by pushing up the flats, creek beds and creek banks into stockpiles. The average depth of the ore is generally less than 2 meters and confined to present and past drainages. Previously mined pit floors are re-sampled and re-mined if values continue to show up. Re-sampling and constant supervision during mining ensures that the grade control is maintained. Current mining runs about one-half pound tantalite mineral per loose cubic yard of one with no overburden. When the mining in an area is complete, the creeks and gullies are left as barren contoured drainages, ready for replenishing with the next season's rains.

The treatment plant consists of a feed ore bin with some 40 cu. m. capacity, a conveyor feeding a rotating trommel in which the ore is washed through minus  $\frac{1}{2}$ " mesh plate with the undersize going to a two state jigging concentrating process and oversize going to reject. The plant has been kept as simple and maintenance free as possible, minimizing operator requirements, reducing staffing problems which is very important due to the isolated local conditions. Only one operator is required per shift in the treatment plant and the whole operation is run with a crew of six people.

Tailings are pumped to a tailings dam where water is recirculated. Jig concentrates are collected in 44 gallon drums for transportation to Perth for further upgrading by electrostatic and electromagnetic means. Current production is running at approximately two to three tons per month of high grade concentrate.

The company has budgeted to spend up to \$2,000,000 doing exploration work in 1980. A geological firm has been hired to do preliminary sampling, and the company is currently recruiting trained geologists and mining engineers.

Water supply is a common problem in the Pilbara and all make up water for this operation comes from five operating underground wells which need to be run 24 hours per day to sustain a two shift per day treatment program. Living accommodations are not luxurious but are adequate for the crew of six.

The other operation in the Pilbara center is the one at Wodgina run by Goldrim Mining. It is located approximately 20 miles west of the Pilgan area. It is also based on an alluvial program, but has the distinct difference in that the tantalite shed from the main pegmatite source rock is plainly visible. The pegmatite has been weathered over the ages and there are only two creeks draining the hill and both run into one creek at the back of the hill. An operation at the back of the hill is the current source of the alluvial ore which is being treated. There are several old dumps of pegmatite which are the remnants of the hard rock mining operation which was carried out prior to the 1940's.

The current alluvial mining operation is slightly different from that at Pilgangoora in that the creek bed is much deeper and does contain overburden. The mining method employed is by backhoe. One strip pass is taken and the overburden is put alongside. Then the ore is mined and carted away. Then the next strip of overburden is placed on the area from which the ore has just been removed and this process continues on across the width of the previous deposition channel.

The treatment plant is located about 8 miles away on the edge of the major drainage, a river bed which is dry for 340 days of the year. The sands do, however, contain water and water is pumped out of the soak holes in the creek sands into a dammed lake. The plant is fairly simple and consists of a dry screening section to reject plus 2" material which goes straight to oversize and the minus 2" is split into four sizes for concentration by jigging.

Jig concentrates are also sent to Perth for further upgrading and the throughput capacity of the plant is approximately 10 cubic yards per hour and it is currently operating on two shifts per day. Production amounts to one to two tons per month of high grade concentrates.

### EASTERN AREA

Although there are no other current producers in the Pilbara of tantalite only, alluvial tin mining in the Pilbara produces tantalite as a by-product and this has been going on for about forty years. At Mooleyella, the operation is essentially similar to that previously described in that the mining is in alluvial deposits with the dirt being carted to a fixed treatment plant which concentrates by jigging. The normal production averages about 200 tons of cassiterite concentrates per annum assaying initially 54%  $Ta_2O_5$ . This is then reduced to about 2-3%  $Ta_2O_5$  leaving 5-10 tons per annum of tantalite concentrates, generally low grade.

Other prospective areas of the Pilbara are the areas at Spear Hill. A tailing dump containing some 2 million cubic meters of tailings from previous tin mining operations is currently undergoing a re-testing program. The interest is based on the fact that even at low concentrations, the mining has already been carried out. It would only be required to set up a treatment plant and facility to repass these tailings to recover tantalite.

Exploration is continuing elsewhere in the area and will be extended to re-test the 40 sq. miles of alluvial creeks and eluvial sheds from which the previous mining operations drew their ore. The task is a major one, considering that there are 32,000 sq. km. of Pilbara, a single company's resources could be tied up on just the 40 sq. miles for the next three years. Operations at Yule River, which have been closed for some time, are undergoing intensive investigation at the moment to see if they too can again become profitable.

### SUMMARY

Production in the Pilbara has risen from 1,000 lbs. of contained  $Ta_2O_5$  in 1977 to 60,000 lbs. in 1979, due to the successful completion of the two projects described. These projects have been several years in the testing and planning stages prior to making commitments to invest capital. The lead time to bring an alluvial operation of this nature into production after initial discovery is two years, but the discovery time may take anywhere from two weeks to ten years. As there are no current projects of discoveries which have reached the development stage, it will be a minimum of three years before another discovery could be imminent.



Exploration expenditures and efforts have increased proportionately to the rise in price of tantalite and considerable effort is currently going on to locate further deposits. Varying degrees of success have been attained and the general opinion of the exploration people is that other deposits of the order of size of Pilgan and Goldrim will be found, tested and developed. The chances of discovering a viable hard rock tantalite deposit of a size capable of supplying as much as 200,000 lbs. per annum of  $Ta_2O_5$  is much more remote and is much more costly than the exploration for the alluvial deposits. No exploration money is being spent currently in that direction. A reasonable estimate is that it would take one million dollars per year for ten years

## Positive Steps in the Tantalum Community

During the past two years there have been many forecasts that the tantalum industry was doomed. Short supply and rising prices have been considered to be the factors which would lead to almost total substitution of other metals for tantalum. There is no doubt that these factors have had an effect on the tantalum industry as it has been known to be for so long. But far from dooming it, there have been merely changes in direction in both the supply patterns and in the product markets.

Today there is an increasing number of people and companies who are taking positive steps in both the supply and use of tantalum because they believe strongly in the future of this commodity. Some of the steps evident during 1979 are summarized as follows:

- Union Carbide Corp. announced in June that it will build a major, solid tantalum capacitor plant in Greenwood, South Carolina, USA. The plant will begin operations in 1980 and will be about 9,000 square meters in area and will employ about 700 people.
- Plessey Capacitors, Inc. of the United Kingdom has started a plant near Los Angeles, California, USA to produce capacitors for missile and other aerospace applications.
- Fansteel, Inc., a major tantalum processor, is expanding its existing facilities adding new ore digestors and a separating line to increase capacity by about 25 percent. Further additions to produce tantalum products will include vacuum sintering furnaces and associated hardware.

## The U.S. National Stockpile

There has been no buying or selling activity for tantalum in the U.S. National Stockpile since 1975. Stockpile objectives have been revised and stand in relation to the stocks as follows (in m.t. of contained Ta):

Material form	Objective	Stock	Shortage
Carbide powder	403	13	390
Metal	748	91	657
Minerals	2,473	1,158	1,315

In February 1977 the Government established a moratorium for both acquisitions and disposals from the Stockpile to allow a planned review of policies and objectives. The moratorium was suspended in October 1977 without change of the objectives. It was planned that shortages of materials would be offset by surplus stocks of related materials. Such policy does not seem to apply to tantalum, however, as the Stockpile does not contain any materials which could be substituted for tantalum in the critical applications for which the tantalum would be used.

Another step has been taken, however, to assess the possibility of upgrading some of the tantalum materials in the Stockpile. To study and evaluate the feasibility of an upgrading program, the National Materials Advisory Board has established a "Panel on Upgraded Forms of Materials and Recycled Materials for the National Stockpile." The stated objective of this Panel follows:

**"PURPOSE:** To improve the production surge utilization in stockpile materials and to maximize the use of resources in time of emergency, this study will examine the options available for stockpiling additional upgraded material forms and the possibility of holding recycled forms in the National Stockpile in lieu of primary materials. Specific candidates for additional upgraded forms, and for recycled materials, will be identified by the sponsors from the viewpoint of national security, economic feasibility, energy conservation, and environmental effects. The issues to be addressed will be the problems associated with upgrading the forms of materials now stockpiled and the technical aspects of accom-

plishing this upgrading including the costs, the energy needs, the environmental impact, etc."

to prove such a body. Pilgan and Goldrim are new producers and account for 30 % increase in the W.A. output this year and they will produce longer than initially predicted because of increased prices. New production will result from new deposit discoveries financed by funds generated by present producing companies. The new production will take some time to reach the market and will only replace waning existing production rather than add to it. West Australia, however, will continue to produce tantalite at current levels through most of the 1980's, but the chance of doubling production in the foreseeable future is not likely even at the greatly increased prices of tantalite.

- Greenbushes Tin N.L. of Western Australia has built a solvent-extraction plant at its mine site to process low-grade tantalite/columbite to recover about one tonne per month of pure tantalum and columbium oxides. In addition, the installation of a new 750 KVA tin furnace will yield tantalum-containing slags.
- Kawecki Berylco Industries and Hudson Bay Mining and Smelting Co. have formed a joint venture which is engaged on a global-scale location and development of new sources of tantalite.
- The reprocessing of old tin mine dumps in Malaysia by BEH Minerals and in Thailand by local companies has developed a production level of over 150,000 lb.  $Ta_2O_5$  per year and is expected to be further developed by additional investment in processing plants.
- The tantalite resources in the Pilbara region of Western Australia have again been opened up for the first time since the late 1960's. Goldrim Mining Australia Limited and Endeavour Resources Limited have both installed plants to process cassiterite/tantalite ores and are in production.

All of these activities have required large investments of money. It is certain that the investors expect a return on their investments and would have engaged in these activities only by being secure in their belief in the strong future for tantalum. With an assured market demand well in excess of current supply, the conventional hesitancy of ore producers to invest in exploration and development is no longer valid.

plishing this upgrading including the costs, the energy needs, the environmental impact, etc."

In December 1979 the Panel invited Mr. Graham Brown, Technical Adviser to the T.I.C., to make a presentation covering the current state of the tantalum industry and recommendations relative to upgrading. Excerpts from that presentation are:

- The industry feels strongly that new sources will maintain the present level of supply and even possibly increase it somewhat. But there will not be any excess which could be purchased to add to the stockpile unless a severe recession cuts the demand drastically. Then the mining community would accept the stability which would be provided by stockpile acquisition.
- As in the upgrading of any basic material, flexibility of application is greatly reduced, particularly true for tantalum. The pattern of application is currently changing more than it has for several years because of the spectacular increase in the price of tantalum products. New technology is evolving which is reducing the amount of tantalum required in each application and effort to substitute other materials is producing results.
- There would be serious risk that some of the upgraded products produced now would be obsolete in just a few years. Capacitor powder quality is changing significantly, so much so that any capacitor powder now in the stockpile is probably obsolete. This trend of quality improvement will continue.
- The three companies in the U.S. who can perform the upgrading are operating near capacity just to meet current demands. There is no open capacity which could process the stockpile material. Such would require full capacity of U.S. processors for one to two years.
- It seems unlikely that consideration should be given to stockpiling of any other metal product. There are two principal uses of tantalum metal products, wire for capacitors and mill-shapes for fabrication of chemical equipment. It would be difficult to stockpile capacitor wire as there is no uniformity of specification and wire size among capacitor producers. Perhaps some quantity of metallurgical-grade powder or even sintered wire-bar could be stockpiled with low risk of obsolescence.