

T.I.C. Activities

The Twelfth General Assembly of the T.I.C. was held on Monday October 29th 1979 in Brussels at the Cercle Royal Gaulois. The membership conducted the business of the T.I.C. as follows :

- In view of the recent increase in the total number of member companies and in order to represent fully the various sectors of the tantalum industry belonging to the T.I.C., Article 13 of the T.I.C. Charter was amended to increase the number of members of the Executive Committee to seven, including the President.

- The new Executive Committee for the year 1979-1980 was elected by the membership

Mr. Brian Reynolds, President
 Mr. Joseph C. Abeles
 Mr. Herman Becker-Fluegel
 Dr. George J. Korinek
 Mr. Paul Leynen
 Mr. David E. Maguire.

One vacancy remains which will be filled at a later date.

- Two new companies were elected to membership.

Mamore Mineracao e Metalurgia S/A
 Minex Corporation Sdn. Bhd.

- The T.I.C. will sponsor an additional phase of the study made during 1976 which was the first comprehensive attempt to define the tantalum material supply and demand situation. The new phase will evaluate the changes in both the market and the supply of tantalum and identify the trends which will shape these factors during the 1980's.

- The T.I.C. will expand and improve its compilation of statistics to include those relating to the production and processing of tantalum.

The Assembly reviewed the recent activities of the T.I.C. under the able guidance of Mr. Abeles as President. Appreciation for his efforts was expressed by the membership. Mr. Brian Reynolds, the new President of the T.I.C., has long been associated with the tantalum industry, formerly as the Managing Director of KBI-Billiton in Arnhem, The Netherlands, and, for the past three years, as Head of the Tin and Special Metals Division of Billiton International Metals in The Hague. He is the official representative of the Thailand Smelting and Refining Co. Ltd. of Phuket, Thailand.

After the formal business of the Assembly, two presentations were made to the membership which reflected a generally optimistic outlook on the future growth of the tantalum capacitor market and emphasized the need for increased availability of tantalum at stable price levels. These presentations are published in this edition of the "Bulletin".

Discussions following the addresses indicated that the mining industry is already responding to the increased needs of the market by expanding production and conducting substantially greater exploration efforts toward the discovery of new properties with tantalum mineralizations.

After deciding that the Thirteenth General Assembly would be convened on Tuesday May 6th 1980, at a place to be selected, the Twelfth General Assembly was adjourned.

T.I.C. TWELFTH GENERAL ASSEMBLY

On October 29th 1979 the Twelfth General Assembly of the Tantalum Producers International Study Center convened at the Cercle Royal Gaulois in Brussels. Thirty of the present thirty-seven members were represented.

The membership elected the Executive Committee for the coming year, increasing the number of members to seven, but leaving one vacancy at present. Mr. Brian Reynolds, Head of the Tin and Special Metals Division of Billiton International Metals in The Hague, as the representative of the Thailand Smelting and Refining Co., was elected President of the T.I.C. for the year 1979-1980.

The Thirteenth General Assembly of the T.I.C. will be held on Tuesday May 6th 1980. The location of this meeting will be announced later.

Presidential Address to the T.I.C.

During the Eleventh General Assembly of the T.I.C. at Perth, Western Australia, on May 14th 1979, Mr. Joseph C. Abeles addressed the membership. Space limitations in issue no. 19 of the "Bulletin" precluded publication of that address before this time. Mr. Abeles' remarks follow.

In the last year, since the meeting in Rothenburg, there have been substantial increases in the prices of tantalite and tantalite products. Many consumers have become

seriously concerned about future price trends and the quantities of new supply which will be available.

Pricing of many metals, such as cobalt and molybdenum, has become very erratic. Because of the pricing and supply conditions, consumers of these metals have already begun to design products using alternative materials, an example is the substitution of nickel for cobalt in many applications. In contrast, even though tantalum prices have increased very quickly as a result of the current shortfall of supply, the price increases have not been erratic which gives tantalum fabricators an opportunity to adjust to the new prices in dealing with their customers.

The current short supply is the result of the continuing increase in the use of tantalum, the demand now at an annual level of about 3,000,000 lbs. per year. Raw material producers have not been able to increase the supply as rapidly and their production has only reached 2,500,000 lbs. annual rate. But the producers are responding and they are trying to demonstrate that they will be able to meet the increased demands of the consuming industry. If they do not do this quickly, consumers will find ways to substitute other metals for tantalum. Then the market will decrease in spite of the many advantages of tantalum in end-products.

Fortunately, during the short supply conditions of the past two years, producers and processors have had some inventories which were used to make up the amount needed to meet the demand. All requirements have been met and there is no real basis for panic buying. But it is critical to the tantalum industry as a whole that the raw material produced should be available for use and should not be traded and re-traded which only runs prices up artificially. The material serves no practical purpose by such activity.

Some processors are taking steps to ensure that consumers have an adequate supply. Kawecki Berylco Industries has de-

monstrated its interest in extending the availability of tantalum by further investment in the Tantalum Mining Corporation of Canada (Tanco). When Hudson Bay Mining and Smelting Company purchased the Chemalloy interest in Tanco, Kawecki purchased a part of that interest. Ownership of Tanco is now 37.5 percent by Hudson Bay, 37.5 percent by Kawecki, and 25 percent by the Manitoba Development Corporation. New exploration has been supported and the facilities at Tanco have been further developed. Tanco can now continue operations at the present rate until at least 1987. Additional reserves were developed by the exploration. And now with higher market prices lower grade ores can be economically processed, effectively extending the existing reserves.

But it has also been necessary to install new facilities capable of adequately processing the ores with the lower tantalum content. Thus the KBI and Hudson Bay investment has added to the available supply from Tanco an amount equal to four or five years at the present rate, 1,500,000 to 2,000,000 lbs. Ta_2O_5 contained, supply which was not considered available only a short time ago.

Since the Manitoba Development Corporation is an agency of the local provincial government, it cannot be concerned with exploration outside Canada. So, a joint venture has been formed by the other two partners, Hudson Bay and Kawecki, to extend exploration on a global scale for tantalite, columbite, beryl (as beryllium oxide), lithium (as spodumene and other ores), caesium, and rubidium, all of which are found in pegmatites.

Other members of the tantalum processing industry need to follow the example of Kawecki Berylco and band together with producers to locate and develop new sources of tantalum. This would fend off serious scarcity and would renew the confidence of consumers in the availability of tantalum.

The Short and Long Term Outlook for Tantalum Capacitor Demand

The following paper was presented at the Twelfth General Assembly of the T.I.C. by Mr. D.E. Maguire, Vice President, Electronics Division, Union Carbide Corporation, Greenville, South Carolina USA.

I would like to cover two items. The first is a message that the tantalum capacitor business is alive and well in spite of the severe shocks dealt to it over the past twelve months. The second item is a plea for some measure of **stability** within the tantalum industry.

The tantalum capacitor industry has survived a year of unprecedented shocks and disruption. The cost of tantalum capacitors to users had been declining for well over 20 years as is typical with an electronic component passing through its product life cycle. Suddenly, however, the price of ore quadrupled from \$25.00 to \$100.00 per lb. contained. Suddenly, the mining portion of the tantalum industry was demanding an extra \$150 MM for the same 1,000 tons of Ta_2O_5 which sold for \$50 MM in 1978.

The tantalum powder and wire producer sector of the tantalum industry began immediately to pass through their extra "costs" in various degrees to the capacitor producers. Union Carbide took the leadership role in passing through these extra "costs" to capacitor users. That leadership role was temporarily costly in terms of market share bookings; however, all of the business and then some returned as others were unable or unwilling to ship product at obsolete prices.

The impact on the capacitor industry was quite mild in terms of total volume, but the nature of the industry has changed. The consumer electronics portion of the tantalum capacitor industry is now **dead**. When the costs of the capacitors began to rise, they were simply designed out of the circuits and replaced primarily with aluminium electrolytics.

As this was occurring, the computer and automotive applications for tantalum capacitors were increasing rapidly. In these applications, the price-demand response curve is very in-elastic.

The cost differential incentive to design in aluminium capacitors in place of tantalum capacitors has always existed. Last year, large \$1.00 tantalum capacitors could have been functionally replaced with a \$0.20 aluminium electrolytic capacitor. Today, that same tantalum capacitor cost is over \$2.00 and the aluminium capacitor cost is \$0.25, so the incentive has increased. But the fact is that the aluminium capacitor will not fit into the package and its electrical and temperature characteristics, as well as its reliability, are inferior. Now, the aluminium capacitor makers have posed and continue to pose counter arguments, but the fact remains that the equipment manufacturers of the world decided to use about two billion tantalum capacitors this year.

On the low end of the tantalum capacitor range, there has been and continues to be a replacement of tantalum capacitors with monolithic ceramic capacitors. This replacement generally has been in values less than 1 μ f and will probably extend into the 1 μ f range as the manufacturing costs of monolithic ceramics

are reduced through improved materials and processing technology. But these tiny tantalums do not use much tantalum material and they do not generate very many sales dollars. Substitution of values much over 1 μ f will not be practical in the 5-7 year period immediately ahead.

In summary, the rising cost of tantalum capacitors will not be disastrous to the market demand growth for this state-of-the-art component. The real threat to long term market growth is the prospect of limited availability of the capacitors due to limited availability of tantalum materials! A rising price for a factor of equipment production can be absorbed or passed on to the ultimate consumer. But the absolute unavailability of a factor of equipment production is a disaster long remembered in the industry. For example, IBM, Western Electric, Siemens, and General Motors are examples of the world's major users of tantalum capacitors. If any of these companies are forced to delay shipments of computers, communication equipment or automobiles due to the lack of availability of a passive component such as a tantalum capacitor, there will be directives from the **highest** levels of management to design this component out of the system — even at the expense of end product performance! The occurrence of such a shortfall in availability is the primary threat to the long term growth of our industry.

Over the past six months or so, we have heard remarks to the effect that "maybe we should divert available supplies of tantalum metal into the tantalum carbide market rather than the electronics grade of tantalum powder and wire. After all, the price per pound is high and there is no need to worry about the electronics grade specification such as charge, breakdown voltage, green strength, etc., etc."

I would strongly suggest that this thought pattern is grossly in error. As astute businessmen, we should be cognizant of the long term prospects to generate the most "value added" to our basic raw materials supplies! I think the optimum prospect for maximum value added is in the electronic grade tantalum powder, wire and hardware. The resilience and price in-elasticity of the tantalum capacitor demand over the past year supports this opinion.

Now, as a tantalum capacitor producer, I am not inviting a further large increase in the cost of tantalum powder and wire. But, frankly, a 20,000 μ C/gram tantalum powder represents an increase in value added to the tantalum atoms which should and will be shared between the tantalum processors and the tantalum capacitor producers.

Union Carbide has supreme confidence in the future growth of the tantalum capacitor market demand. We built an ultra-modern tantalum capacitor plant in Columbus, Georgia, beginning at the onset of the 1975 recession. As a consequence, Union Carbide accounted for over 75% of the total added capacity in the United States since the 1974 cyclical demand peak. During the same time frame, we quadrupled our production of tantalum capacitors in a new plant in Aycliffe, United Kingdom, to serve the European capacitor market. Now, in the midst of the most

widely advertised recession in history, we have another new 100,000 square foot tantalum capacitor plant under construction in Greenwood, South Carolina.

Some have questioned the wisdom of continued expansion of capacitor production facilities when the supply of tantalum metal is limited. The fact is that we are building 75% more capacitors in 1979 than we did in 1974. But the amount of tantalum metal used is the same or slightly below the 1974 levels. This was accomplished by a joint effort: the powder producers made available higher charge tantalum powders and the capacitor producers developed new processing techniques to use the higher charge powder. We are confident that a similar rate of progress will be obtained over the next five years.

In the area of **stability**, let me give you a brief overview of the marketing and distribution of tantalum capacitors. I will use our Union Carbide facts which can then just be multiplied to get an industry viewpoint.

We have over 400 contract customers, each with a unique set of contractual obligations stretched out a minimum of one year and more typically out for 18 months for delivery. These customers typically have many using plants throughout the world. Then, we have a couple of thousand direct customers all over the world, and through our network of industrial distributors, we serve a total customer base of about 50,000 electronics firms.

Now, all of these customers expected the price of tantalum capacitors to continue downwards. There were no provisions for price increases in any of the contracts.

So, beginning in March of 1979, we deployed a virtual army of

professional salespeople and lawyers to renegotiate and rewrite the 400 contracts. Now, 6 months later the job is nearing completion.

But in order to provide some reference point for the cost pass-through type of price increases, the only published data was the London Metal Bulletin quotation for 30% Ta₂O₅ contained ore. This published number has now been built into hundreds of contracts for tantalum capacitors all over the world. Then in August, another disaster struck! The published LMB ore prices **quit** going up, but the prices for powder and wire started up even **faster**.

So now, the same army of salespeople and lawyers must embark on another round of contract renegotiation where the cost pass-through will have to be based on faith rather than any published and theoretically independent "market price". As long as the market demand remains close to the industry capacity, even this second round of cost pass-through can be accomplished. But just as soon as market demand slackens, there may be absolute chaos in the capacitor market place, the tantalum powder and wire market and the tantalum ore market itself. The disruption is caused by users, at the various levels of consumption, switching sources on a rapid time scale to take advantage of lowest temporary spot costs.

I do not have an ultimate solution to these sorts of problems other than to suggest that by some suppression of the human greed to make a "killing", there is room in this tantalum industry for participants at all levels to generate a gratifying return on their investments and their efforts.

The Effect of recent Tantalum Price Rises and Shortages on Capacitor Manufacture

The following paper was presented at the Twelfth General Assembly of the T.I.C. by Mr. R.W. Franklin, Principal Engineer, I.T.T. Components Group, Capacitor Product Group, Paignton, England.

Electronic component manufacture is a very competitive business and, in Europe at least, the return on sales for the industry as a whole is probably less than 5%. In order to control this business it is obviously essential to have a good estimate of the cost of production. As a capacitor manufacturer offers numerous combinations of capacitance and voltage in several different styles, the total costing exercise involves many assumptions about future product mix, output volumes, yields, special selections, material price movements, etc. It is usual to carry out this total costing exercise once a year and then to monitor performance against these standards throughout the year. Any serious discrepancies need corrective action within the production area, or, as a last resort, as a price increase. I say "as a last resort" because there is only a limited part of the trade

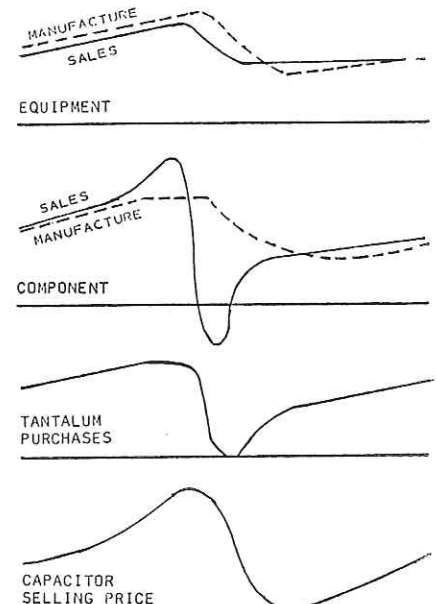
cycle when price increases are likely to be accepted without loss of business.

This point can be explained in more detail through two charts. In the first, the effect is shown of a drop in demand for electronic equipment on component production.

Consider a case where the demand for equipment is fairly steady until some disruptive event, such as a recession or government action, causes a drop in demand. Since there are unsold stocks in the warehouses, the equipment manufacturer cuts his output by more than the loss of sales. But, at the same time, he cuts down his inventory of components to a level related to this new output. As he already has stocks, his orders for new components cease for a period and he re-schedules orders already placed. In other words, the component manufacturer is at the whip-end and a change in equipment usage rate has an exaggerated effect on capacitor sales. The capacitor manufacturer, however, cannot turn off his output as rapidly as the change in orders and he overproduces for a period and builds up an inventory of finished goods. He too acts like the equipment producers and cuts his tantalum purchases sharply.

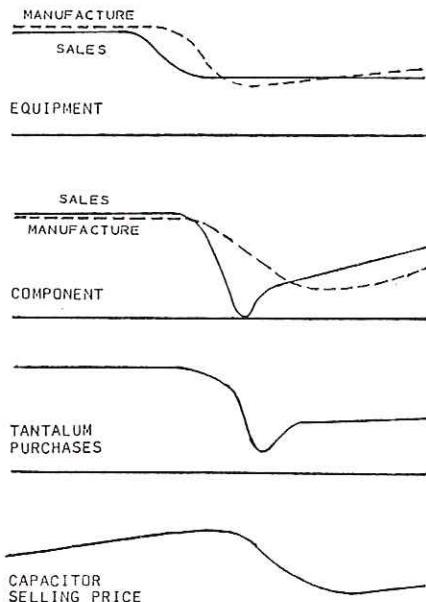
The second chart shows a variation where the cut-back comes after a period of increasing sales as happened a few years ago in the last major recession.

As the demand for components had been exceeding output capabilities, appreciable double ordering occurred as purchasing managers attempted to guarantee that their assembly lines were receiving adequate supplies. When the cut-back happened, not only were there no fresh orders but the excess orders also were cancelled. In one month, due to cancellations, our order intake went negative by an amount equal to our normal monthly sales. There was a scramble for the remaining capacitor orders and selling prices dropped. This happened at the time when costs were going up due to reduced volume and drastic action was needed within the manufacturing area to limit expense items and labour costs. Since the only time when an individual manufacturer can get a price increase



accepted by the market without loss of business to competitors is in a period of near capacity output, a situation now exists where the selling price does not logically follow the normal cost movements. As previously stated, the reaction to cost increase is normally within the production area first and as a price rise as a last resort.

Even when the market will stand an increase, every increase makes the tantalum device more liable to replacement by some other kind of capacitor, ceramics at the low CV end or aluminiums at the high end. By far the biggest single item in the cost make-up of tantalum capacitors is the purchase cost of tantalum powder and wire. Any significant price movement of these metal items will seriously erode profit margin. When calculating unit costs, we build-in anticipated shifts of costs in all items for the coming year, not necessarily all increases as there are appreciable cost improvements through materials development and mechanisation. However, the uplift in the tantalum price has so exceeded the anticipated move-



ments that this eliminated all of the margins built into the costings. Tantalum was not the only material to rise by more than our forecasts. Silver flake was almost £120 per kilogram at the beginning of the year and rose steadily to £160 by August. Then suddenly in September it jumped to £255.

Our reactions to material cost increases are always directed initially to finding ways of reducing our purchases. A few years ago we were faced with large increases in the price of nickel wire which was used as terminations. Now, in a large part of our range, the nickel has been replaced by much cheaper steel wire. This is performing the same function as the nickel, and the changeover created no difficulties in assembly. The main delay in the move was establishing suitable suppliers.

Similarly, with the silver, we have introduced big savings. Firstly we developed our own silver dispersion which was equivalent to the proprietary grade that we had been purchasing. That was a saving by itself. Then we modified the composition and, in so doing, halved the silver usage whilst also achieving an improvement in some of the electrical characteristics. None, however, that all of the savings which we made by halving the use of silver have been lost by the recent doubling of the metal price. So now we are back at the development stage with the aim of eliminating all use of silver.

In the case of tantalum with the introduction of higher CV powders we are naturally progressing by reducing our material purchases. We believe that we may have found a small but significant area where we can replace tantalum by niobium. If you read the patent literature you will have seen that our company has been carrying out extensive trials with a method for coating inert particles with tantalum in order to reduce the metal usage considerably. A tantalum capacitor only uses the outer regions of each powder particle and so, if the inner regions could be replaced by a cheap substrate, a substantial usage reduction could be achieved. By this means CV values of more than 40,000 $\mu\text{FV/g}$ of tantalum content have been consistently achieved although there are still some performance limitations to be overcome. The value of

40,000 $\mu\text{FV/g}$ should be compared with the region of 8,000 $\mu\text{FV/g}$ at present extensively used. Of course, this development would have proceeded without the recent price rises but it has been given fresh impetus by them.

In spite of all the development work that we have been carrying out we have not been able to react quickly enough to keep costs steady. Therefore we have been forced to pass on some of the price rises as a tantalum metal surcharge. As said earlier, our chances of getting more for our capacitors depends on the state of the market. Recently the demand for solid tantalum capacitors has been near to production capacity and delivery lead times have become extended. This has created the appropriate conditions for getting the surcharge accepted without an immediate loss of orders.

Naturally, all tantalum capacitor manufacturers are affected by the recent events but not necessarily to the same extent. At the beginning of the year the differential between the various powder suppliers was fairly small and contractual arrangements were set up based on individual preferences related to powder types. Now there is a substantial spread between the different suppliers and so manufacturers are seeing different costs, related to the contract volumes set up previously.

Why do we not all switch to the cheapest powder supplier? In the same way that capacitor manufacture is near to capacity, so is powder supply. There is no room at this present time for manoeuvre. However, if that situation changes, say due to a drop in capacitor demand, you can be sure who will lose their powder orders first, unless, of course, prices level off before then.

At this present time there is some concern regarding a material shortage but firms who have arranged adequate contractual supplies are not affected directly. However, indirectly the whole industry is affected because of the effect on capital investment. Injection of substantial capital would not be justified if (a) there is insufficient tantalum available to allow expansion or if (b) there is a loss of business to aluminium or ceramics due to increased price differentials. We need some indications of future price and quantity limits to clarify this situation. If there were a drastic cut-back in powder

supplies we would need to concentrate our product mix on those bringing in the biggest sales per kilogram of powder used. This would necessitate limiting the number of the higher CV capacitors and increasing the risk of permanently losing that part of the range to aluminium electrolytics. We have tried discreetly to assess our customers' intentions over the replacement of tantalum by aluminium electrolytics. All of our major UK customers have hinted that they are actively designing out tantalums.

Our estimate is that up to 25% of the present volume is at risk. In some cases the time scale for change is very short while in others the change will not come until the next generation of circuits. The competition from aluminium is present at all values above 1 μF .

Below 1 μF the competition is from ceramics but here it is interesting to note that that form of capacitor at present uses substantial quantities of precious metals whose prices have also been rising rapidly. It is common for the higher CV ceramic multilayer capacitors to have a material surcharge similar to our tantalum surcharge but this time related to the cost of the precious metal content.

It is too early yet to give a considered opinion on how much business will be permanently lost. A 25% cut would have a very substantial impact because in most cases this would take the volume down below the breakeven point at present selling prices. It would produce a substantial over-capacity in the industry if it happened suddenly. We are keeping a close watch on the situation but so far we can find only isolated cases of the change-over having happened. The next six months could be crucial in this respect.

To sum up the situation :

1. It has been impossible to absorb all the tantalum price increase and so a material surcharge has been added to the capacitor selling price.
2. It will be difficult to maintain these prices if the capacitor output volume drops.
3. Efforts to reduce the tantalum usage will continue at a faster rate.
4. Although there are hints of a replacement of tantalum by aluminium electrolytics, the change-over has so far been slight.

The T.I.C. is Five Years Old

The Tantalum Producers International Study Center was given official recognition under Belgian legislation and granted legal capacity by the Royal Decree of 24th October 1974. Thus the T.I.C. is now five years old.

The stated general aim of the T.I.C. was "to become a well established organization diffusing statistical, geological, technical and other information on tantalum and more specifically on the tantalum raw material market". Retrospect shows that the T.I.C. has been quite successful in attaining this aim. The T.I.C. has :

- held twelve meetings, as General Assemblies, to conduct the business of the T.I.C. and to provide a platform for the interchange of information;
- organized and sponsored the First International Symposium on Tantalum held in Rothenburg, West Germany, in May 1978;
- expanded membership from the original 12 producer members to 39 members including processors, consumers and merchants;
- sponsored two extensive studies covering the needs of the tantalum industry and assessing the supply-demand relations in the business;
- published twenty issues of the "Bulletin", the only international publication devoted solely to tantalum and columbium;
- collected and published data annually covering the production of concentrates and tin slags by producing members.

Nine of the General Assemblies have been held in Brussels, the headquarters city of the T.I.C. The other three provided members the opportunity to visit two mining operations, at the Tantalum Mining Company of Canada and at Greenbushes Tin N.L. in Western Australia, and one processing plant at Gesellschaft für Elektrometallurgie in Nuremberg.

The distribution of the "Bulletin" has reached four hundred copies per quarterly issue and is sent to all corners of the earth. Articles have been published covering every facet of the tantalum industry, from the geological aspects of tantalum resources to the end-use of products dependent upon tantalum. There has been considerable coverage of individual key companies and many general articles on processing and the market conditions. Through the "Bulletin", every reader has become familiar with the operations of both suppliers and consumers.

NEW MEMBERSHIP

During the Twelfth General Assembly the following companies were elected to membership :

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Sao Paulo, SP, Brazil.	Ipoh, Malaysia.