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2011 Gaston Planté medal acceptance speech

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Vice President Popov, Professor Pavlov, ladies and gentlemen,

It is always a great pleasure to come to Labat and on this occasion of course, it is a much greater pleasure. I thank the Bulgarian Academy of Science for this award and the International Planté Committee for honoring me. To be selected by your peers increases my gratitude and when I look at the previous recipients of this medal, most of whom I know or knew well and greatly admired their work, I feel very proud. I should also pay my respects to the other nominees and hope their turn will come.

Probably the only benefit of growing old is that it provides a clearer vision or greater perspective of change. When I look at today's lead battery industry, the change is quite remarkable compared with when I started my industrial career. Not so much in materials or design or applications, we can see those changes almost daily, but in the way the structure of the industry has changed. In 1953, when I joined the Chloride Group, the industry was dominated by three companies, not just in their extensive manufacturing base but also in the technology and its development. The ESB Co in the USA had over 70% of the US lead acid battery market, AFA, now Varta, had manufacturing plants throughout Europe, and Chloride had plants throughout Britain and in all the old Imperial countries. But the unique feature of these companies compared to today is that they were mostly self sufficient in materials and components. The Clifton Junction plant which I joined, in addition to producing two million car batteries per year, tubular motive power cells, Planté and flat plate stationary cells, submarine, aircraft and defence batteries, had on the same site, smelters producing their own alloys, oxide, expander and additive preparation and separator production. In addition, they had a container plant just a few miles away. All the development work in selecting and approving these materials was done in-house. In this respect I was fortunate since it provided the best training possible and my early work involved the development and production of these essential materials.

I was also fortunate in that the three companies signed a technical exchange agreement in 1958 and for several years we had regular meetings with eminent electrochemists such as Hans Bode, Dietrich Berndt and Alvin Salkind, and Planté medal recipients, Paul Ruetschi and Ernst Voss, It was a fruitful period but of course it was quite illegal on monopoly and trust grounds and the agreement was terminated some years later.

Positive electrodes were the principal interest of researchers in the 1960s with studies on the polymorphs of lead dioxide, on how to increase cycle life and corrosion resistance, how to improve the efficiency of the active material and of course to develop and make low maintenance or maintenance free batteries. In the latter case the objective was not so much to limit water additions but to market a 'fit and forget' battery which was highly desirable to both the car makers and the private customer.

At that time I was also particularly interested in charge acceptance, not just of the cell or battery as a whole, but the individual charge acceptance of the plates and I measured this by monitoring the cathodic hydrogen and anodic oxygen evolution at different rates and temperatures and at different states of charge [1]. Of specific interest was the high charge factor of the negative plate with 100% charging efficiency, that is no hydrogen evolution, until the plates were almost fully charged over a wide range of charging rates and temperatures.

Also about that time sealed Ni/Cd cells were increasingly popular for use in cordless equipment and I started studies on similar constructions with wound lead electrodes. In a starved electrolyte system recombination efficiencies were good but with an unsaturated separator which was only 70% porous, capacities were poor and the work was discontinued but presented at the IPSS Conference in Brighton in 1970 [2]. I was approached by Don McClelland of Gates Rubber who with his co-inventor John Devitt had been working along similar lines. John is also a previous recipient of this medal. They also had in their laboratory a young lady named Kathryn Bullock who later became the president of the Electrochemical Society and is also a Planté medallist. So you can see I'm in good company. McClleland sent me some cells for testing. With highly porous, glass filter paper as separator, the cells had high power capability, cycled

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well and could be charged extensively without water loss. I suggested to my management that a similar approach, could be used in Chloride's main industrial and automotive business.

I had several meetings with Don and his team. They were keen to keep to their wound cell design but their manufacturing process was slow and scrap levels were high. It was difficult to see how this approach could be used to manufacture the larger batteries needed for industrial and automotive applications in the numbers required and at acceptable cost and we agreed to go our separate ways.

Thereafter, we worked intensively to define the design parameters for cells using glass microfiber separators and the more conventional prismatic plates, aiming initially for standby and automotive application. In particular we worked with a UK supplier to optimize separator structure and appropriate saturation levels for the duty. Glass microfiber separators were the main inventive claim of the Devitt and McClelland patent published in 1975 and the anisotropic and highly porous structure is ideal. The rate of oxygen transport through the separator is the controlling parameter and for standby and automotive duties adequate transport rates could be achieved when the separators were marginally below saturation. At this point, there are no continuous pathways for gas but in a compressed design bubble pressure creates pathways as we showed in several interesting experiments. At the other end of the range one has to avoid saturations below 80% when conductivity decreases rapidly and with the risk of thermal runaway.

At the same time we needed to develop processing methods. Acid filling was a major problem. Acid must be dispersed quickly and uniformally to avoid lead shorts and this was done by a series of rapid vacuum pulses. There was also the question of the assembly technique in order to get the correct compression and formation methods to get the desired saturation.

After trials with British Telecom for three years, production started in 1983 with British Telecom installing these batteries, built with initially 2 V/100Ah cells, in their System X digital telephone exchanges located in power racks in offices or where most convenient to the end user at a rate of 12,000 per year. The cleanliness and freedom of location of these batteries, particularly when compared to the noxious and hazardous standby previously used, was the principal benefit of this system and within a few years distributed power supplies with similar valve regulated cells were adopted widely.

Currently with this work we were developing valve regulated car batteries with similar beneficial features, i.e. leak and spill proof, zero maintenance, improved cycling and much improved cranking performance. From 1984 we produced this battery in Australia, USA, South Africa and Britain. Whilst the initial demand was good, the benefits did not warrant the higher cost and manufacture stopped after a few years. More recently similar valve regulated designs are used in advanced designs of cars, providing freedom for location, improved cycling performance, and supporting changes aimed to improve fuel economy and reduce emissions.

Perhaps the most remarkable characteristic of the lead acid battery is that it has fulfilled so many duties. Applications have continually changed with old uses constantly disappearing and technology being adapted to meet new requirements. For its continuing development and widespread use we must thank the generations of electrochemists, material scientists and battery designers who have identified the opportunities and responded to the needs. I wish you all continued success in your work and thank you again for this award.

References

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