The New Johnson Matthey Research Centre

A COMMITMENT TO PROGRESS IN PLATINUM TECHNOLOGY

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For more than sixty years Johnson Matthey has appreciated that both the present and the future economic viability of the Company depends to a very significant degree on its research and development capability. Since its establishment at Hatton Garden by the late Mr A. R. Powell, F.R.S., in 1918, from where it moved to Wembley in 1938, the Research Department has made a notable contribution both by supporting the established manufacturing activities and by presenting opportunities for diversification of the Company's interests. As technology has advanced the amount of platinum group metals used for industrial purposes has greatly increased, and at the same time the research facility available within the Company has expanded and improved to keep pace with the ever growing demands made upon it. While trying to visualise the future is never easy, particularly in such a rapidly changing world, this must frequently be attempted if progress is to be made. To prepare for the future and to be capable of benefiting from change the Company has recently moved its laboratories to a new Research Centre at Sonning Common near the town of Reading. Here, in ideal surroundings, all those facilities likely to be needed to provide both basic scientific research and also early development work on projects of technological and economic importance to the Company over the next decade will be located.

The laboratories are contained in modern purpose-built blocks which include a spacious area suitable for pilot plant development projects, while the desk-based researchers who make up the Technical Intelligence Group, Patents Department and Safety of Materials Department are situated in a charming historic building which provides conference facilities and houses the administration personnel.

Johnson Matthey & Co Limited are distributors of platinum group metals from the Rustenburg Platinum Mines Limited, the world's largest producers, and the current work of the Research Centre, which is very closely related to the needs of their customers, demonstrates a growing concern for the quality of life—the wish to conserve energy and other natural resources, to protect the environment, to combat ill-health and to increase food supplies—while at the same time manufacturing goods at a price the consumer can afford. In short the Research Centre is geared to the utilisation of advanced technology for the benefit of mankind.

The results of a research programme frequently evolve over a considerable period of time and much of the present work of the Research Centre is of a continuing nature, some of which has already been reported on in previous issues of this journal. An outline of the purpose and the progress of a small selection of projects currently being undertaken is given below, while later in the issue a paper from the Metallurgy Department describes the development of a new material for high temperature applications.

Energy Production and Conservation

The use of hydrogen as an alternative fuel is currently a topic of considerable interest.

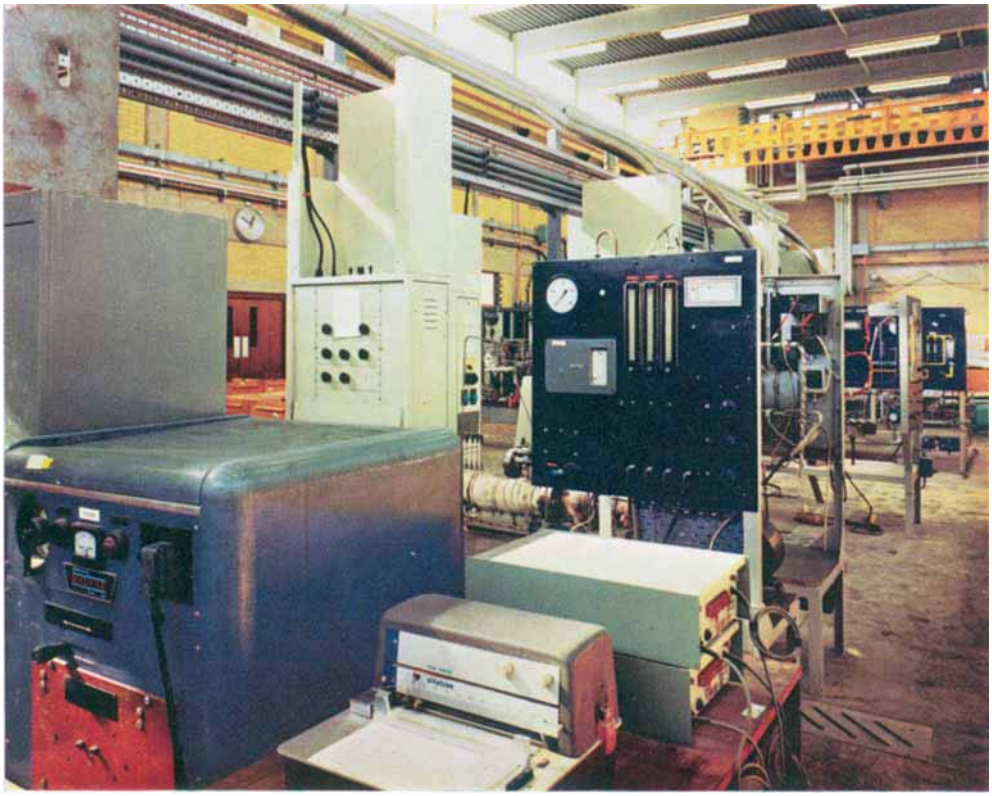
The laboratories are housed in three modern purpose-built blocks situated in eight acres of delightful gardens set in the beautiful Oxfordshire countryside. The blocks are linked by glass-walled corridors to the charming historic house, known as Blounts Court, where the information, administration and conference facilities are situated

For a number of years the development of palladium diffusion units for the production of high purity hydrogen has been progressing within the organisation and more recently this involvement has been extended to a system which uses the catalytic decomposition of a methanol/water fuel for the generation of hydrogen. Laboratory findings have now been further developed by Johnson Matthey Metals Limited who have started to manufacture a mobile generator for the small scale on-site production of hydrogen.

Laboratory work is currently being undertaken which, it is believed, will greatly reduce the hazard potential of hydrogen storage, and this is likely to be an important factor when decisions about the acceptability and use of this versatile fuel are being taken.

Fuel cells which enable chemical fuel energy to be converted directly to electricity can provide 30 per cent better energy utilisation than other methods of generation and this is done without smoke, without noise and without destruction of the landscape. Platinum metal catalysts have many advantages over other materials for such cells and a number of projects of great potential are being actively pursued, some in conjunction with other fuel cell developers.

The need to conserve natural gas and oil for future use as a raw material in manufacturing processes and food production, rather than burning it, and the wisdom of making better use of resources which at present are being wasted is likely to result in greater use being made of municipal refuse as a source of energy. One possible application, for which platinum metal liquid phase



A large project area suitable for pilot plant development, or readily adaptable to changing research requirements, is provided in one of the blocks. The equipment in this area, part of which is shown above, includes a number of test rigs used for the continuing investigation and evaluation of catalytic units for automobile emission control

catalysts are being developed, is for the production of low sulphur oil suitable for use in central heating boilers.

Many modern manufacturing processes use large amounts of heat and both economic and social considerations require that none should be wasted. This demands accurate temperature measurement and control, functions where platinum metal thermocouples and resistance thermometers have long played an important part. A thin film resistance thermometer recently developed in conjunction with Matthey Printed Products Limited, utilising platinum metallising on a ceramic substrate, has many excellent characteristics and a number of adaptations to enable the device to be used for a wider variety of applications, including the monitoring of engine exhaust gas temperatures, are at present being investigated.

Conservation of Natural Resources

Although conservation is now regarded as an essential feature of modern life, with recycling seen as the key to future industrial survival, the platinum metal industry has long practised the recovery and re-use of all available materials. However, refining technology is still being advanced as accepted ideas are challenged and fundamental scientific principles are re-examined for possible applications. Projects to increase the economies of the primary refining of the platinum metals are currently being undertaken on behalf of Matthey Rustenburg Refiners Limited while preparation is also being made for the time when scrap car exhaust catalysts will be available for recovery.

Corrosion, by destroying industrial plant and utilitarian structures, is extremely wasteful

of the natural resources used in the manufacture of such necessary assets. The non-corrosive properties of the platinum metals enable them to be used for many applications where other materials would be destroyed. While cost generally inhibits the use of platinum in massive form it can be used in many forms of coating to protect other materials and advanced methods of applying platinum metals are currently being energetically developed in the laboratories.

Environmental Protection

Air pollution resulting from manufacturing processes and internal combustion engines is rightly the subject of increasing attention by both the public and their legislative bodies in many parts of the world. The release to the atmosphere of fumes and vapours which, either by themselves or in combination with other substances already present in the atmosphere, are dangerous to life or damaging to buildings or equipment is obviously wrong. It is generally also unnecessary as the technology for eliminating or substantially reducing the pollutant often exists or can be readily developed, and its application may also result in improved process efficiency through energy recovery.

For a number of years laboratory projects have been directed at the problems of various forms of atmospheric pollution, and catalytic systems have now been developed for many applications. Successful research and development work on platinum oxidation catalysts for industrial applications, for petrol and diesel fuelled engines in both vehicles and stationary plant, have been reported in past issues of this journal and platinum catalyst units for the car industry are now in full-scale production at Johnson Matthey Chemical Limited and Matthey Bishop Incorporated. None the less, work is continuing both at the Research Centre and elsewhere to ensure that progress is maintained.

Practical means of reducing pollution by gas turbine engines are now being investigated and this is only one of many aspects of gas turbine technology where the unique high temperature and corrosion resistant properties of the platinum metals would appear to have much to contribute. A number of projects involving the use of platinum metals to increase the life and improve the efficiency of gas turbine engine components used for marine, industrial and high performance aircraft applications are progressing with considerable success at the Research Centre.

Medical Applications

The development of platinum compounds for the possible treatment of certain types of cancer is proceeding with cautious optimism at the Research Centre as part of an intensive but essentially long-term study of the biological application of the platinum metals, and compounds supplied by the Centre are among those being tested by the U.S. National Cancer Institute. Human clinical testing of a platinum compound *cis*-dichlorodiammine-platinum(II), now more generally abbreviated to *cis*Pt(II), is being undertaken by several major hospitals in the United States of America and in London, and Johnson Matthey are involved with scientists at several different universities and research institutes in attempts to improve, and to understand the working of, such anti-cancer platinum drugs.

Another promising biological application for platinum compounds is for the selective staining of cell specimens which are to be examined using electron microscopy, and it is hoped that the effort being put into current projects will result in the discovery of other worth-while applications for such compounds.

Food Production

The crop yield that can be obtained from the land depends on a large number of factors of which one is the amount of available nitrogen, one of the three essential elements of all plant food, present in the soil. The manufacture of nitrogen-containing artificial fertilisers is one of the major uses of nitric acid and enormous quantities of it are produced annually by a process which involves the formation of oxides

Comprehensive facilities are available for studying many aspects of the platinum group metals, for which increasing applications are continually being found in the advanced technology industries. In the furnace room, shown above, the unique high temperature properties can be investigated under a controlled atmosphere or in vacuum

of nitrogen as a mixture of air and ammonia is passed over platinum metal catalyst gauzes. Although platinum gauzes have been used for this purpose for over half a century, continuing development of the production process, to increase output and reduce costs, has resulted in the catalyst being subjected to more arduous conditions than was formerly the case. On-going research and development has enabled the platinum metal gauzes to operate effectively and efficiently under such conditions. Interesting examples of the interplay of technology from one subject to another are provided by this production process where platinum metal fume abatement catalysts can now purify the tail gas of nitrogen oxides which previously polluted the atmosphere, as they were discharged as waste. Furthermore, platinum metal losses have been reduced as noble metal catchment gauzes can now recover for recycling over 60 per cent of the gross platinum metal loss.

Conclusions

At the new Research Centre the efforts of the investigators are ably supported by a comprehensive range of analytical, engineering and information services which bring together a wide knowledge of traditional techniques and the advantages provided by the availability of the most sophisticated forms of modern equipment. Thus scientists, technologists and technicians of many disciplines are working together to ensure that future problems and opportunities are anticipated and prepared for. In this way people throughout the world will be helped to attain their legitimate aspirations.