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This human energy that drives us to succeed has been there every day since the beginning. And it will be with us to shape many tomorrows to come.

So join us in tapping the most powerful source of energy in the world. Ourselves.

And watch what the human race can do.
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Proudly bringing the World Petroleum Congress to the Middle East for the first time.

For further information about Qatar's hosting of the 20th World Petroleum Congress please visit our website www.qatarwpc.com.qa

See you in Doha in 2011 for the 20th World Petroleum Congress.
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Unless otherwise stated, the dollar ($) values given in this book refer to the US dollar.
VISION, MISSION AND VALUES

The World Petroleum Council was founded in London in 1933. It is an international, unbiased, non-political organisation that provides a forum for global issues on energy and petroleum. The WPC is dedicated to scientific advancement, technology transfer and to promoting the management of the world’s petroleum resources for the benefit of all. Sixty National Committees currently comprise the decision-making body of the World Petroleum Council, representing over 95% of the world’s major oil and gas producing and consuming nations. Both OPEC and non-OPEC countries participate in the World Petroleum Council. As a neutral forum, the World Petroleum Council has been given United Nations accreditation.

The WPC’s prime value is to catalyse and facilitate dialogue amongst stakeholders aimed at seeking solutions to key technical, social, environmental and management issues. In doing so the WPC will contribute towards sustainable growth.

The WPC does not take a position on the key challenges facing the oil and gas industry; however we do provide a forum where the solutions to key challenges can be resolved.

THE WORLD PETROLEUM CONGRESS

Every three years, the World Petroleum Council organises the World Petroleum Congress as the principal meeting place for the international oil and gas industry. Following a 12-month campaign period, one of the candidate countries is selected by its fellow Council members to host the next World Petroleum Congress. Spain is the host of the 19th World Petroleum Congress in 2008 with Qatar already selected to host the 20th World Petroleum Congress in 2011.

Beyond the triennial Congress, the World Petroleum Council is regularly involved with a number of other meetings such as the WPC Youth Forum, the WPC-UN Global Compact Best Practice Forum and a joint WPC / OPEC workshop on CO₂ sequestration, reduction of methane flaring and opportunities for enhanced oil recovery. Other events so far have also focused on dispute resolution, calculating reserves and resources, regional integration and oil, gas and infrastructure developments in Africa.

MISSION

The WPC is the only global organisation that represents all petroleum aspects, with the purpose of providing:

◆ Enhanced understanding of issues and challenges
◆ Networking opportunities in a global forum
◆ Co-operation (partnerships) with other organisations
◆ An opportunity to showcase the industry and demonstrate best practice
◆ A forum for developing business opportunities
◆ Information dissemination via congresses, reports, regional meetings and workshops
◆ Initiatives for recruiting and retaining expertise and skills in the industry
◆ Awareness of climate change, energy conservation and sustainable solutions

VALUES

The WPC values strongly:

◆ Respect for individuals and cultures world-wide
◆ Unbiased and objective views
◆ Integrity
◆ Transparency
PRINCIPLES
The WPC seeks to be identified with its mission and flexible enough so that it can embrace change and adapt to it. The WPC has to be:

◆ Pro-active and responsive to market changes and not merely led by them
◆ Creative and visionary, so that we add value for all
◆ Challenging, so that our goals require effort to attain but are realistic and achievable
◆ Focused, so that our goals are clear and transparent
◆ Understandable to all

KEY STRATEGIC AREAS
◆ World-Class Congress
With the objective to deliver a quality, premier world-class oil and gas congress.

◆ Inter-Congress Activities
With the objective to organise forums for co-operation and other activities on specific topics of relevance to WPC members, particularly to encourage bi-lateral cooperation and communication between the industries in different countries through National Committees, broaden WPC involvement in other sectors of the industry, e.g. finance and gas, and to arrange youth activities in co-operation with other organisations and its National Committees.

◆ Outreach to Other Stakeholders
With the objective to let the WPC add value by co-operating with other organisations to seek synergies and promote best practice for the petroleum industry.

◆ Communication
With the objective to increase awareness, internally and externally of the WPC’s activities, through enhanced communication with its members, the industry and a wider audience, personally, directly and online.

◆ National Committees
With the objective to attract and retain National Committees, and to build stronger links with and amongst its members.

◆ Youth (and Gender) Engagement
With the objective to increase the attraction and retention of young people and women in the oil and gas industry, including the set-up of a dedicated Youth Committee and the development of active networking opportunities between the industry and young people.

◆ Finance
With the objective to continue making best use of WPC resources and the creation of a central WPC legacy fund.

STRUCTURE
The Council is the governing body of the World Petroleum Council which convenes once a year. Its members are the National Committees who elect the President and an Executive Committee every three years to develop and execute its strategy. The Council also selects the host country for the next World Petroleum Congress from the candidate countries amongst its members. To ensure the scientific and topical quality of the event the Council elects a Congress Programme Committee whose members are responsible for delivering the high-level content for its Congresses. The next generation is represented through the Youth Committee which co-ordinates and encourages young people’s understanding and involvement in energy and petroleum issues for the future.

The Secretariat of the World Petroleum Council is based in London, with the Director General and his team.

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Or visit the official website of the World Petroleum Council at www.world-petroleum.org
With the first World Petroleum Congress held in July 1933, it is now exactly 75 years later that the 19th Congress is taking place in Madrid. On this occasion it is fascinating to take a look back. You will find in this Anniversary book a walk through the history of the World Petroleum Council, its Congresses and the development of the oil and gas sector itself. It leads us through the early beginnings from the First Congress in London when the main issues centred around the initial steps of the developing industry and its technical capabilities, to today’s issues of technological breakthroughs in areas such as unconventionals, deep water drilling, the use of cleaner fuels and gas-to-liquid technologies. However, much remains the same: bio-fuels were already in use in the late 1800s, the issue of ‘peak oil’ has been recorded in virtually every Congress since 1933 and the petroleum sector has been at the forefront of developing alternative energy sources since the very beginning.

Today the focus is not just confined to technological and scientific achievements; equally important are deliverability and demand perspectives, as well as advancing sustainability in the oil and gas industry. The challenges of balancing economic, environmental and social considerations in decision-making, which is the essence of sustainability, are also being addressed and discussed at WPC events. Increasingly, partnerships are being developed between the industry and its stakeholders reflecting the oil industry’s evolving role in society.

Recognising the importance of involving the next generation in the industry, the World Petroleum Council has initiated a strong Youth representation, both within the Council and its events. Young people will have a significant presence at the Congress and the WPC European Youth Forum to be held in Strasbourg in 2009 will inform the next generation about the energy challenges of tomorrow and invite their participation in finding solutions for sustainable growth.

As the theme for the 19th Congress reflects, we are in a ‘world in transition’ where our strategies to meet growing energy requirements must acknowledge the role of our key stakeholders in finding solutions that will provide a sustainable energy future.

Dr Randall Gossen

President, World Petroleum Council

Dr Randall Gossen.
Seventy-five years ago Thomas Dewhurst urged his fellow members of the Institution of Petroleum Technologists to create a world-wide forum of thought between oil men of various nations. This resulted in the first World Petroleum Congress in London in July 1933. It brought together nearly 1,000 of the best and the brightest heads of their industry from 24 countries making it the first truly global event. Their first and foremost purpose was to discuss the scientific issues of the petroleum industry, in particular the challenges of production, of refining and especially of consumption of oil as questions affecting the well-being of not one but of all nations.

With an industry as dynamic as the global petroleum sector the science and technology of oil and gas has changed beyond recognition over the years, and the whole philosophy and indeed the structure of the petroleum industry has grown and developed with it.

The Congresses provide an excellent overview of a cross section of the key issues in the petroleum sector, both in the areas of expertise of our industry and its demographics. From its early audience of learned academics and experts with decades of industry experience a younger group of delegates has evolved, with many leaders of the future from around the world now participating in the Congress.

Seventy-five years on Thomas Dewhurst’s original concept remains, that the World Petroleum Congress should exist for the promotion and advancement of petroleum science and technology and the interchange not only of knowledge and information, but also of friendship between oil scientists of every country in the world, without political or racial barrier.

We, as the petroleum industry, have to find ways of producing oil and gas in an economically viable, environmentally acceptable and socially responsible way. The big issue is around our reputation and credibility. The WPC can’t solve the world’s problems, but we will listen to the industry and listen to the public and provide a meeting place for both.

Dr Pierce Riemer

*Director General, World Petroleum Council*
n 27 August 1859 a ‘Kentucky Colonel’ called Edwin Drake struck oil at a depth of 69.25 feet (21 m), on the outskirts of an insignificant lumber town called Titusville in Pennsylvania, USA. This well founded what was to become the world oil industry.

Up to this time the use of mineral oils, largely derived from seepages, had mainly been for the making of medicines, lubrication and burning in lamps. The technology required to satisfy these needs

**THOMAS DEWHURST 1881-1973**

Born in Blackburn in 1881, Thomas Dewhurst started work at the age of 12 in a cotton mill in Burnley, and attended night school. Later he went to Burnley Mechanics Institute and in 1902 won a National Scholarship to the Royal College of Science in South Kensington, London. He graduated with a first class honours degree in geology and became an associate of the college. He also lectured in geology at Queen’s University, Belfast.

In 1910 Thomas Dewhurst joined the Burmah Oil Company, and by 1916 he had risen to senior geologist, with an office in Rangoon. In 1922 he returned to London and became the first chief geologist of the company. At this time he was appointed geological adviser to the then Anglo-Persian Oil Company. He stood down as chief geologist to the Burmah Oil Company in 1938, but continued as a geological adviser until 1961.

As a keen supporter, Dewhurst agreed to join the then Institution of Petroleum Technologists before its actual foundation in 1913. He was elected to the Council in 1924, made a Vice President in 1931 and served as President from 1933-34 and 1934-35. During those 11 years on the Council, he was an active member of various committees. Under his presidency, the decision was taken to convene the first World Petroleum Congress in 1933. He served as President of the Congress and contributed much to its success and continuation. After completing his term as President, Dewhurst continued to be active in the affairs of what had become the Institute of Petroleum as a Past-president. He was made an Honorary fellow in 1954 for his services to the Institute.

Thomas Dewhurst’s original concept was that the WPC should exist solely for the promotion and advancement of petroleum science and technology, and the interchange not only of information and knowledge, but also of friendship between oil scientists of every country in the world, without political or racial barrier. On the last occasion that he ever wrote about the WPC, he said of these ideals: ‘They must remain forever the watchwords and the living spirit of the Congresses, so that all ulterior objectives may thereby be excluded and that everything said and done in connection with a Congress, could, if necessary, be written in letters of gold across the sky.’
was minimal. But in the year after Drake’s successful drill, the first motor car built by Jean Lenoir in France launched the motor industry, and with it the new petroleum age. By the 1890s the car industry was really starting to grow. In the next decade the first plane would fly, and turbine engines were introduced in ships.

In conjunction with these developments, petroleum technology was growing in importance. The infant petroleum industry recognised the need for its own international forum to discuss scientific and technical issues and so the first International Petroleum Congress, attended by 100 delegates, was held in Paris in 1900. Two others followed – Liège in 1905 and Bucharest in 1907. After this interest waned, although two international congresses were held on drilling technologies. The oil industry became more competitive and the mood among the larger companies turned away from the free interchange of technical knowledge.

So it was not until 1932 that the suggestion of holding another international congress was voiced. The idea came from the Council of the Institution of Petroleum Technologists* in London. As there was an enthusiastic response to the proposal, it was decided to hold the first World Petroleum Congress in London, in 1933.

A number of people played vital roles in the organisation, but if there is one man who stands out as founder of the World Petroleum Congress, it is Thomas Dewhurst, the then President of the Institution of Petroleum Technologists. He became the first Congress President and was largely responsible for the continuation of the Congress, and for the eventual setting up of a permanent body, with its own secretariat, to organise and mould future World Petroleum Congresses. In the dynamic oil industry, the science and technology of petroleum has changed over the years beyond recognition and the whole philosophy and structure of the oil industry has grown and developed with it, but the World Petroleum Congress remains true to the original ideals of Thomas Dewhurst.

* This became the Institute of Petroleum in 1938, which merged with the Institute of Energy in 2003 to form today’s Energy Institute.
50 YEARS AGO SHELL INVESTED IN THE ATHABASCA OIL SANDS IN CANADA WITHOUT KNOWING WHEN IT COULD VIABLY EXTRACT THE OIL. FIVE DECADES LATER, THANKS TO ADVANCING TECHNOLOGY, PRODUCTION IN THE OIL SANDS IS MAKING CANADA A GLOBAL PROVIDER OF OIL. SOMETIMES IT PAYS TO PERSEVERE – AND TO HAVE A LEAP OF IMAGINATION IN THE FIRST PLACE. WE’VE BEEN WORKING LIKE THIS FOR THE LAST 100 YEARS AND WILL CARRY ON DOING SO. REAL ENERGY SOLUTIONS FOR THE REAL WORLD. WWW.SHELL.COM/REALENERGY

DIFFICULT, YES. IMPOSSIBLE, NO.
In October 1932, at the usual monthly Council meeting of the Institution of Petroleum Technologists in London, a well-known petroleum chemist, Albert Dunstan, proposed the inauguration of an Annual Dinner. Thomas Dewhurst, in the Chair, suggested holding a general meeting the same afternoon. Lt-Colonel Samuel Auld had intended, later on the agenda, to suggest a one-day symposium on the international standardisation of petroleum test methods. Instead he proposed that the dinner be preceded by a one-day conference on the subject. Apparently, it took less than five minutes for a one-day conference on standardisation to be transformed into a proposal for a conference lasting a week and covering the whole field of petroleum technological activity, to be held in London, with leading international scientists invited to write papers and participate. The Council adopted this proposal with such enthusiasm that when the Institution’s journal was mailed out three days later, it carried with it, to the 50 countries in which it circulated, a questionnaire seeking support for such a conference. The result was overwhelming. So at the November Council meeting, with the full backing of the British oil industry and the government, it was decided to hold a World Petroleum Congress in London in July 1933, only eight months later.

The first appointment was to elect Thomas Dewhurst as President of the Congress, and James Kewley Chairman of the Organising Committee. George Sell was responsible for all the Institution’s
technical meetings and publication of their books and journal. He was appointed Joint Secretary of
the Congress and was given the mammoth task of producing pre-prints of the 250 technical papers
envisaged – with all the organisation involved in their invitation, writing, checking, editing, printing
and distribution. Commander R. E. Stokes acted as secretary to all the administrative committees.

Chairmen and rapporteurs were appointed to each of the technical sections, which were grouped
under the headings of: geology; production; refining; and transport and storage of oil. The rapporteurs
were outstanding British scientists who were given the responsibility of obtaining sufficient high quality
papers to cover the subjects listed. They achieved this by writing to oil companies in other countries,
asking them to invite papers from their experts, and also by direct invitation to well-known scientists
and technologists. In the event 244 papers were submitted, scrutinised, accepted and passed to George
Sell for editing and publishing as pre-prints.

The framework of the technical sessions was not completed until the end of January 1933, so the
invitations were not sent out until the middle of February. It is remarkable that George Sell, with some
help from a part-time typist, edited those 244 papers, checked all their illustrations, photographs and
diagrams, sent them complete to the printers, read and edited the pre-print proofs and finally despatched
the finished pre-prints to more than 800 delegates – by the end of June! At the closing ceremony his
work was acknowledged by Alfred Dunstan: ‘Mr George Sell has been faced with an enormous amount of
work in the preparation of the papers received. Whatever has happened at this Congress and however it
has gone, a vast amount of thanks should be given to Mr Sell; and his work is not yet completed because
there is still the problem of editing and issuing the Proceedings.’ George Sell went on to complete some
35 years service as Editor of the Institute of Petroleum (as the Institution became in 1938).
1ST WPC GETS UNDERWAY

The Congress was formally opened on 19 July 1933 at the Science Museum in Kensington, with the President, Thomas Dewhurst in the chair, and some 830 delegates from 35 countries present. There were only 35 accompanying persons, so no special ladies’ excursions were arranged; but there were several social functions at all of which wives accompanied their husbands. The Oil Industries Club held a conversazione and dance at the Mayfair Hotel, there was a boat trip on the Thames with lunch at Great Fosters and there was a welcoming banquet at the Mayfair Hotel.

The technical meetings began on 20 July. There had been massive developments in the oil industry since the last scientific oil conference, held in 1907. In addition, the Congress had been set up by a distinguished scientific society and backed by the oil industry, so there was much enthusiasm and lively debate. The sessions lasted for two hours each morning and afternoon. According to one eye witness account, the discussion on one paper on viscosity was so fiercely contested that, after over-running...
by a further two hours, it was only brought to a conclusion by the janitor of the building threatening to turn the lights off!

The Congress took large numbers of company reports on the geology of specific fields all over the world and the techniques used in exploration and development. The session chairmen were briefed to analyse the papers in the light of what each would learn from the others; their detailed summaries provided valuable comparative judgements and indicated the way forward for the industry. The satisfactory desulphurisation of cracked distillates and similar products without destroying unsaturated compounds of high anti-knock value was considered one of the most difficult problems in the refining of motor fuels. Other topics covered in equal detail were knock-rating in motor and aviation gasoline, the development of special fuels for high-speed compression engines, recent developments in lubricating oil and viscosity, hydrogenation and the testing of bituminous emulsions. The section on alternative fuels included papers on natural gas for the propulsion of heavy vehicles, power alcohol and petrol-methanol mixtures.

Two addresses were given on separate evenings in the Royal Institution. For these addresses, the lecturer and the entire audience were in formal evening dress. The first address was by Sir John Cadman on ‘Science in the Petroleum Industry’ and ranged from geophysics to the operation of an oilfield. The second was given by J. B. Aug Kessler on ‘The Rationalisation of the Oil Industry’. By all accounts this was a fascinating paper, which although largely a review of the current marketing problems of petroleum and especially fuel oil, launched a vigorous attack on the taxation of petroleum in general and the government of the day in particular. This well-reasoned attack was so effective, and the response of the British government was so negative, that the President noted that government policy and taxation were two topics to be kept off future WPC programmes at all costs. Taxation only returned to the agenda in the 1980s.

The final paper presentations and discussions on 25 July were followed by a Plenary Session of all the delegates, with Thomas Dewhurst again in the chair. The purpose of the meeting was to adopt resolutions that had been proposed by the various sessions. The first resolution was to the effect that all matters concerning international standardisation of methods of testing petroleum products should be put forward by national bodies to the International Federation of the National Standardising Associations’ (now the International Organisation for Standardisation) Committee 28, which should in
future be the co-ordinating body in respect of all standardisation activities. After unanimous approval this resolution was carried into international effect and became the basis for the standardisation of the methods of testing petroleum products.

The second resolution was proposed from the Chair. Dewhurst proposed that a World Petroleum Congress should in future be held triennially, and this resolution was carried. (Although, in the end, it was to be four years before the next Congress.) Before the meeting closed, it was agreed that the preliminary

THE SCHLUMBERGER BROTHERS

Conrad and Marcel Schlumberger with Henri-Georges Doll presented a paper at the First Congress on “The electromagnetic teleclinometer and dipmeter”. In this paper they described how the teleclinometer could determine the angle of inclination of the axis of a drill hole in relation to the vertical, and of the azimuth of this inclination in relation to the magnetic North. The apparatus was lowered into a drill hole and measurements were made at the surface. The dipmeter was an improvement to the teleclinometer, as it also had a pole for sending current into the ground and measuring electrodes. These provided information which could be used to deduce the direction of the dip of the beds.

Conrad was born in 1878 and his brother Marcel six years later. The family came from the Alsace region of France; their great-grandfather served as Prime Minister. Conrad Schlumberger was a talented scientist and became a professor of physics at the École des Mines in 1907. Marcel specialised in mechanical engineering and business. Conrad developed an interest in the electrical resistance generated by different types of rock formation. In 1914 he successfully completed the first commercial application of this technique, locating a body of copper ore for a client in Serbia. The business was held up by the First World War, but in 1919 Conrad and Marcel set up in Paris to develop further electrical prospecting, as they called it. In 1923 the brothers received their first order from an oil company and successfully mapped an oil-rich salt dome in Romania.

A few years later the Pechelbronn Oil Company of France asked the Schlumbergers to make measurements, not from ground level, but from the interior of an already drilled borehole. Conrad asked Henri Doll, his son-in-law and technical supervisor to design the necessary equipment, and in September 1927 the men compiled the first ‘wireline log’ by lowering an electrical recording device down an oil well in the Péchelbronn field in Alsace, France, and measuring the resistance every few feet. The results were accurate, which meant that oil deposits could now be located and measured without resorting to expensive and time-consuming mechanical coring.

The biggest break for the company came with its introduction to the US market in 1932, when Shell asked it to run logs in California and on the Texas gulf coast. These were successful, and Schlumberger soon picked up business among the many wildcatters in Texas and Oklahoma. In 1934 the brothers founded Schlumberger Well Surveying Corporation in Houston to meet the growing demand for their services. This US
steps toward the organisation of the Second World Petroleum Congress should be left in the hands of the Institution of Petroleum Technologists. They would confer with other countries regarding the venue, and when this had been decided they would then hand over all responsibility to that country.

Thus the first World Petroleum Congress took place in 1933, the year that Hitler came to power, when Britain’s Prime Minister was busy preaching disarmament to France and practising it at home, and the Americans were preoccupied with the ‘New Deal’.

division soon became the largest and most profitable of the parent company’s world-wide business.

Conrad died in 1936 and Marcel then took over the business until his death in 1953. The firm was left divided, roughly between Doll, who controlled technical research; de Ménil who controlled the business in South America and the Middle East; Seydoux who ran the Europe business; and Pierre Schlumberger who ran the company’s US operations.

A typical oil rig of the mid-1920s when the Schlumbergers and Henri-Georges Doll first trialled logging.

At the 1st WPC they presented their latest developments. The electromagnetic teleclinometer is seen with a man for scale at right in the picture and at left with its water-tight casing removed to show the components.
In a career spanning more than 40 years, Henri-Georges Doll invented, designed, built and field tested geophysical instruments, developed interpretation methods, created research and engineering centres, and guided young scientists and engineers. During the Second World War he formed a company for developing a detector for metallic land mines. This venture later produced automatic guidance and telemetry systems, industrial instrumentation, photomultiplier tubes and sealed-tube neutron generators. Even after retirement from Schlumberger, he worked at his own expense for more than a decade developing medical instruments for the in-situ measurement of blood-flow rate. During his working life he filed more than 70 patents and wrote over 30 publications.

Doll was born in Paris and studied at the École Polytechnique, and then at the École des Mines, both in Paris. While still a student there, he married Annette Schlumberger, Conrad’s daughter, and in 1925 he joined the Schlumberger’s small electrical prospecting group. By 1927 he had designed and tested equipment for Conrad’s newly conceived carrotage électrique, or ‘electric coring’.

Doll was the first to recognise the origins of small voltages called spontaneous potentials that appeared on the measurement electrodes of electrical logging tools even when no survey current was emitted – and to note that these differentiated shales from permeable conglomerates. He brought to fruition borehole measurements of temperature, dip and inclination. To measure inclination he used the first sonde containing complex downhole instruments, not merely wires and electrodes. He also developed a useful, simple method for detecting cable leaks.

Shortly after the start of the Second World War, Doll moved to Houston to establish Schlumberger’s first R&D centre outside France. When Doll retired in 1967, the Schlumberger Well Surveying Corporation’s research laboratory in Connecticut which he had founded, was renamed the Schlumberger-Doll Research Center.

In the 1950s Doll predicted the eventual demise of the slide rule and coloured pencil and that they would be replaced by truck-borne computers doing on-line interpretation. Doll’s crowning achievement was the invention of the induction log. Eventually induction logging became one of the most widely used logging methods in the world. It solved the oil-base mud problem, and overcame the obstacle presented to electrode methods by high-resistivity invaded zones.

He died in 1991 and was buried next to his mentor, Conrad Schlumberger, at the Schlumberger family estate in Normandy, France.
JOHN CADMAN, LORD CADMAN OF SILVERDALE, 1877-1941

John Cadman was born in 1877 in Silverdale in the English county of Staffordshire, and later lived next to the mine his father managed. At the age of 19, he was awarded the county’s first mining scholarship to study Mining and Geology at Armstrong College (Durham University). He graduated in 1899 with a first class honours degree, and became a Fellow of the Geological Society in 1900. He first became assistant colliery manager at Silverdale Colliery and then moved to Scotland as Chief Inspector of Mines. He almost certainly became aware of the significance of oil through the experience of the Staffordshire oilseeps at Longton and the Scottish oilshales.

In 1908 Cadman was appointed Professor of Mining at Birmingham. In 1912 he was the first person in the UK to develop a course in Petroleum Geology, supported by the Principal, Sir Oliver Lodge. Cadman advised the British government on the importance of securing Persian oil supplies before the First World War, as a consequence of which, British warships soon changed from coal to oil. He led the search for oil in Britain and was awarded a knighthood for these services in 1918. He was appointed Technical Advisor to the Anglo-Persian Oil Company in 1921, and rose to become Chairman in 1927. He was certainly one of the first people with any scientific training to hold such a major position in a multi-national company and was instrumental in initiating the application of geophysical techniques in the successful search for oil in Persia.

In 1927 Cadman suggested that the British Geological Survey should consider using geophysical techniques and this led to the first gravity and magnetic surveys in the UK.

Cadman was raised to the peerage in 1937 and became Baron Cadman of Silverdale. He became a Fellow of the Royal Society and died in 1941 in Bletchley.

Sir John Cadman addresses Congress delegates at the Royal Institution on 21 July. During his address he paid tribute to the chemist and physicist Michael Faraday (1791-1867) and the audience stood in a minute’s silence.
climate change and the demand for energy. To keep moving forward, we have to address both.

- Addressing the risks of increases in CO₂ emissions is an important issue facing our world.
- As global demand for energy is increasing every day, how does the world meet growing demand while reducing emissions?
- Here are some of the things we’re doing right now:
  - Partnering with auto and engine makers to research high-efficiency, low-emission engine and fuel systems
  - Partnering with the European Commission in a groundbreaking initiative to assess geological CO₂ storage
  - Balancing energy demand with the risks of increased emissions is a huge challenge. But with consumers, policymakers and industry all playing their part, we can keep things moving forward.

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The Second World Petroleum Congress was held in Paris from 14-19 June 1937 under the general administrative direction of the Association Française des Techniciens du Pétrole. The building used for the Congress was adjacent to the International Exposition. There was some doubt that it would be ready in time, but in the event it provided excellent accommodation. The number of countries represented fell to 27, but the number of delegates more than doubled. The Second Congress was held against a background of accelerating economic growth in Europe and North America, but growth that was due partly to rearmament. A civil war was raging in Spain and war clouds were gathering over the rest of Europe. In Latin America, Bolivia nationalised its petroleum industry in 1937 and Mexico followed suit in 1938.

There were three official social functions organised for the Congress. Albert Lebrun, the President of France attended the opening ceremony. There was a Ladies Committee which organised a programme for the accompanying wives in which ‘the great Parisian fashion houses figured prominently’.

The Congress took place alongside the International Exposition which was a great attraction. The outstanding social event was the banquet held in the Orangery at the Palace of Versailles. After the banquet there was a ballet performance of 18th century dance of the French court, performed against a background of illuminated fountains. The evening ended with a great firework display.
WPC BUSINESS

After the 1st WPC in London the Committee which had been set up by the Institution of Petroleum Technologists gave considerable thought as to how the Congresses could best be organised on a permanent basis. Much of this exploratory work was led by Thomas Dewhurst. The Committee’s first act was to appoint an Organising Committee to run the Second Congress. The Honorary Chairman was Colonel Louis Pineau of France, while the Executive Chairman was Charles Bihoreau and Joseph Filhol was Secretary. In addition, it was agreed that a Permanent Council would be formed to look after the interests of the WPC between Congresses, to arrange the dates and venues for future Congresses and to draw up the necessary rules for the organisation of the Council and proper procedures for electing members to it. The Permanent Council had nine members: Austria, Belgium, France, Germany, the Netherlands, Poland, Romania, the UK and the USA, with Louis Pineau as the President. A permanent secretariat was established, to execute the decisions of the Council. The secretariat was to be based at the Institution of Petroleum Technologists with S. J. Astbury as Secretary General.

Plans were made to stage the Third Congress in Berlin in 1940, and detailed planning continued up until early 1939, for the Congress to be held ‘under the distinguished patronage of Herr Minister-President Field Marshal Goering’ as the first circular put it. But the Second World War intervened and it was to be 14 years before the next Congress could take place.
PAPERS PRESENTED

In general, the Second Congress followed the pattern set in London in 1933, but there were nearly 400 papers accepted. Once again there were rapporteurs to present them, but the organisation for obtaining papers was changed.

There had been strong expansion in terms of the development of new oil and gas producing regions and a request for a geological assessment of petroliferous regions on a country-by-country basis resulted in replies from 23 countries. A paper on controlled directional drilling attracted wide attention. Refining topics dominated the technical papers, which gave a comprehensive review of new refining capacity and technology. A survey of legal requirements around the world pointed to many anomalies and the need for some form of International Petroleum Institute. Economics, statistics and training were also reviewed for the first time.

The technical side was grouped into five sections: 107 papers on geology and exploration; 127 papers on physics, chemistry and refining; 33 papers on materials and construction; 55 on techniques and utilisation of products; and 70 papers on economics and statistics, which was surprising in view of the emphasis on the purely scientific nature of the Congress. Each section had a committee and chairman, several technical assistants and not less than six rapporteurs. These committees decided upon their own authors and papers.

MIDDLE EAST EXPLORATION

The 1930s saw significant investments in petroleum exploration around the world. In the Middle East these bore fruit in four countries which joined the ranks of Iran and Iraq. Oil was discovered in commercial quantities in Bahrain in 1932, with production starting two years later, in Kuwait (ABOVE) and Saudi Arabia in 1938 and in Qatar in 1939.

Saudi Arabia exported its first oil on 1 May 1939 and the picture (RIGHT) shows King Abdulaziz Al Saud taking the salute onboard the tanker D. G. Scofield prior to its departure from the port of Ras Tanura.

Kuwait and Qatar did not begin production until after the Second World War, the former in 1946 and the latter in 1949.
After eight years of turbulent preparation, the last world exposition to be held in Paris took place in 1937, under the shadow of the growing power of European dictatorships. The Expo was divided into three sections: a thematic exposition on the intellectual world; an international peace congress; and a wide-ranging agricultural exhibition. Following several postponements, the Expo finally opened on 25 May 1937, and even then, some of the pavilions were not finished until several months later.

The Minister of Trade Fernand Chapsal said in his opening speech: ‘The 1937 World Exposition has brought together the flags of over 40 nations to the banks of the Seine…France’s decision to hold this major event in insecure and difficult times demonstrates faith in its fate and the future of peace. And by taking up the invitation, the peoples of the world have demonstrated their solidarity with this faith and that they also intend to direct their efforts to the same objective.’

However, by opening day only the German and Soviet pavilions were completed, the former designed by Albert Speer and the latter by Boris Iofan. This, as well as the fact that the two pavilions faced each other, turned the exhibition into somewhat of a personal competition between the two great ideological rivals. Speer’s pavilion for Germany was 150 metres high and completed by a tall tower crowned with the symbols of the Nazi state: an eagle and the swastika. They were faced by Vera Mukhina’s sculpture on top of the Soviet pavilion of a male worker and a female peasant, their hands thrusting a hammer and a sickle together, in a symbol of communist union.

Among the other pavilions Spain’s – designed by José Luis Sert – was notable for its artworks, the most famous of which was Picasso’s Guernica.

The Expo ran from 25 May to 25 November, over an area of 105 hectares in the city centre. Forty-six countries took part; there were 11,000 exhibitors and over 31 million visitors. During the Exposition, 602 congresses were held.

Numerous illuminations were organised to light up the many pavilions at night. The arches of the Eiffel Tower were lit up by 10,000 neon lamps in three colours. On the Seine there were 200 fountains, up to 60 metres high, which had to be submersible to allow safe passage for shipping. The synchronisation of light, sound and fireworks was carried out from two state-of-the-art electric control panels.
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The Third Congress in 1951 took place in the midst of rapid post-war reconstruction in Western Europe and the rebuilding of international trade. The Middle East was growing as a vital oil source. For example, in 1946, 77% of Europe’s oil supply came from the Western Hemisphere whereas by 1951, 80% was coming from the Middle East. Aided by the Marshall Plan, Europe was moving from a coal-based economy to one more reliant on crude oil and natural gas. Meanwhile, new tax deals were starting to favour the governments of major producers at the cost of consumer governments. These tax deals were led by Venezuela’s 50-50 Agreement of 1950. The 50-50 idea was the principle of equal sharing of the industry’s profits between the government and foreign interests. Also, in April 1951, Iran passed legislation to nationalise its petroleum industry, which was run by the Anglo-Iranian Oil Company. Against this background the Korean War had started in June 1950.

The 3rd WPC was held in The Hague from 28 May to 6 June 1951, under the patronage of the Royal Institute of Engineers in the Netherlands and was outstandingly successful, both administratively and technically. The bad luck was that the early part of June 1951 was the coldest in Holland in living memory, and as a result the outdoor excursions suffered. However, the Opening Ceremony, performed by His Excellency Professor J. R. M. van den Brink, in the Hall of the Knights in The Hague was an impressive occasion. On 1 June there was a reception given at Soestdijk Palace by Queen Juliana of the
Netherlands to prominent Congress delegates and their wives. In all there were 15 technical excursions and 16 tourist excursions, and two special events for the ladies.

It was a very enthusiastic and dynamic Congress. In the first place the war and its aftermath had restricted international meetings. In addition, petroleum technology and the sheer size of petroleum operations had developed in a dramatic way since the Paris Congress of 1937. There was an eagerness to read the papers and listen to the presentations, and an unprecedented vitality about the discussions. In the words of D. A. Hough, who served as WPC Secretary General between 1948 and 1973: 'The Third Congress reflected the mood of excitement and challenge that permeated the petroleum industry at this time.'

**WPC BUSINESS AND CONSTITUTION**

For the first time the WPC Permanent Council was asked to devise a framework for the Congress and a strenuous effort was made to limit the languages used to English and French. Another stipulation was that although the Dutch Committee should invite, edit and pre-print all the papers and organise the issue of the Proceedings (in 11 bound volumes) the new National Committees were charged with collecting the papers of their own country, screening them and approving them prior to delivery to the Netherlands. Thus the Permanent Council and National Committees were directly involved in the detailed planning of the Congress.

The 1951 Congress produced the first Constitution of the Permanent Council of the WPC, which had the following features:

- The officers would comprise a President, up to four Vice Presidents and a Treasurer, all elected by ballot of the Permanent Council. It was decided that while each National Committee might appoint up to three representatives to the Council, all Council matters would be decided by voting on a basis of one vote per country.
- The WPC Secretariat operating under a Secretary General should be based in London under the charge of the Institute of Petroleum.
- All countries of the world were invited to set up National Committees in order to promote attendance, organise formal representation, provide papers and to publicise each Congress.
- The host National Committee of each Congress would be responsible for its financial control with any surplus being passed back to the WPC.

On the last full day of the Congress, it was time for elections. Following Louis Pineau's death while preparations for the 3rd WPC

**LOUIS PINEAU (1888-1950)**

Louis Pineau was a distinguished French civil servant and a Commander of the Légion d'Honneur. At the time of the Second Congress he was Director of L'Office National des Combustibles Liquides. When the Permanent Council was set up at the end of the 2nd WPC, it was decided that the President of that Congress would be the Permanent Council's first President and, as the 1940 Congress was not held, Pineau automatically continued in the position. He served over 12 years as President and died while preparations were in hand for the Third Congress. Pineau was a very precise man and a most able administrator, who carried out the duties of his office with considerable dignity (Hough).
were underway, G. A. Tuyl Schuitemaker, Chairman of the Dutch Organising Committee, had become acting President of the Permanent Council. He stood for election under the terms of the new Constitution, but there was a feeling among several Council members that it was time for there to be a President from the New World. When the 12 votes had been cast, Schuitemaker had six votes, Eger Murphree of the USA had five and another American representative had one vote. Under the rules, Schuitemaker was declared the new President for the next four years. But Schuitemaker rose to his feet, amid acclamation, and flatly and firmly refused to accept. It was obvious, he said, that the odd vote was a mistake and was intended for the senior American delegate Eger Murphree. He then insisted that the result should be considered a tie. Eventually a second ballot was taken, and Eger Murphree was elected President.

Although the WPC was growing and 34 National Committees attended the Third Congress, membership of the Permanent Council remained at nine. Poland, Romania and Germany left, while Canada, Italy and Venezuela joined. In late 1951 Mexico became the 10th Council member, and in 1953 the post-war Federal Republic of Germany joined, bringing Council membership to 11.

PAPERS PRESENTED
The key issues addressed at the Third Congress were: research progress in the chemistry of petrol; the oil fields of the Middle East; heat and power from petroleum; and benefits from research in the petroleum industry.

Papers were presented under 10 technical sections, and the responsibility for inviting and accepting papers lay with the rapporteurs. Out of 305 papers submitted, 16 were rejected, and 111 were presented by the USA. In addition to the technical sessions, four general lectures were given:

- Recent progress on petroleum chemistry, by G. Hugel;
- The oilfields of the Middle East, by G. M. Lees;
- Heat and power from petroleum, by J. J. Broeze; and
- Benefits for research to the petroleum industry, by E. V. Murphree.

Papers were not read, to save time for discussion. Instead, preprints were distributed prior to the Congress. The papers to be discussed at a given meeting were introduced by the rapporteur, who stressed certain points of particular interest for the discussion.

The pace of technical advance increased rapidly during the early 1940s, as the result of war-time and post-war necessity. The supply of crude oil was broadened and strengthened by the fast development of new production areas in the Middle East.

Many importing countries took up oil refining. New techniques of liquid fuel manufacture were devised. It was the start of a new era of synthetics and petroleum-chemicals production.

**SAMUEL AULD**

Samuel Auld, who had a considerable influence on Congress affairs for over 30 years, was elected the first Honorary Treasurer of the WPC in 1951. Auld had been involved in the organisation of the First Congress in London, and served two terms as President of the British Institute of Petroleum. His outward appearance was that of a traditional peppery British colonel – complete with bristling moustache and monocle; but to all who knew him well he was one of the most kind-hearted of men, a tremendous character and a very distinguished scientist (Hough).
**The Middle East**

Dr G. M. Lees, Chief Geologist of the Anglo-Iranian Oil Company, presented a general lecture on the particularly favourable geological conditions and vast reserves of the Middle East. The global demand for oil in the post-war period could hardly have been met without the ability of the Middle East fields to increase output rapidly. The combined total oil output of the Middle East countries was nearly 85 million long tons (86.4 million metric tonnes – mt) in 1950, equivalent to 16.3% of world output, compared with 15.3 mt, or 5.4% in 1939.

In 1950 the total area of oil concessions throughout the Middle East, excluding Turkey and Iran outside the Anglo-Iranian area, was about 850,000 square miles (2.2 million km²), but much of this vast area had uncertain prospects. A large part of Syria had been tested extensively without result and parts of Iraq seemed to have only heavy oil. By 1951 successful exploration drilling had only extended over about 130,000 square miles (336,500 km²), and the proved reserves were estimated at 40,000 million barrels.

Lees considered it quite impossible to hazard a guess, with any accuracy, at the total ultimate reserves of the Middle East. However, if one-fifth of the total oil had been discovered, the total reserves would be of the order of 200,000 million barrels. In comparison, the proved reserves of the USA were estimated at 26,000 million barrels, with total ultimate production estimated at 100,000 million barrels.

**Drilling in the open sea**

In 1947 a new chapter in petroleum history was opened with the discovery of oil beneath the waters of the Gulf of Mexico, out of sight of land. By 1 September 1950 about 35 individual US operators had spent roughly $200 million in the search for oil in the Continental Shelf area of the Gulf of Mexico. Eleven oil fields had been discovered, with a total production of 16,500 barrels per day (b/d).
In the early 1950s offshore oil exploration was still at the experimental stage; it was confined to very shallow seas, not more than 100 feet deep (30 m), and usually much less. Offshore drilling presented many unique engineering and operating problems, which were discussed by L. S. McCaslin Jr.

The most widely used drilling method was that of the floating tender-platform combination. A platform on piling resting on the sea bed carried the derrick, engine and draw-works, while the remainder of the equipment and supplies needed for drilling the well were on the floating tender, tied up to the platform. It was possible to drill wells 12,000-13,000 feet (3,600-4,000 m) deep.

The most pressing problem in Gulf drilling and producing operations was that of obtaining more detailed and accurate data on wind and wave forces. The information was needed to avoid the over-design of offshore structures and to permit designers to develop cheaper methods of operation.

At the time there was no set pattern for producing and transporting the crude oil to the shore. Barges were the most commonly used means of transport, as production was not enough, in most cases, to justify the construction of pipelines.

**The fruits of research**

The benefits derived from petroleum industry research in the quarter century preceding the 3rd WPC were summarised by Dr E. V. Murphree. In 1925 the US oil industry had about 300 people engaged in R&D, with a budget of $1.5 million. By 1950 this had increased to 10,000 people and $100 million.

In the field of crude oil exploration, the major research effort was in the improvement of geophysical methods to determine underground structures where oil may accumulate, and the best methods of producing crude oil reservoirs. Research on geophysical exploration was mainly on the seismic method.
In 1925 refraction seismic surveying was used, but by 1950 the reflection method was in use. Progress had been made in well logging, to determine formation changes by instruments inserted in wells. Electric logs were widely used by 1950.

The additional oil made available in the USA between 1925 and 1950 was partly due to increased efforts in oil exploration, and also due to improved methods of finding oil. However, perhaps the greatest benefit of research in the area of crude oil production was from reservoir studies. In the 1920s many oil fields in the USA were normally drilled to a density of more than one well to 5 acres (2 ha) and were produced without regard to pressure maintenance or gas conservation. By 1950 new fields were being developed on a pattern of one well to 40 acres (16 ha) or more. The wider spacing resulted in a higher rate of recovery, and was the result of research-derived knowledge of the flow properties of fluids in reservoir rocks, and by conservation of reservoir energy and other production practices.

The extent of the petroleum chemical business in the USA at this time is shown by the following figures. The amount of organic chemicals produced from petroleum rose from less than 6 million lbs (2.7 million kg) in 1925 to 14,500 million lbs (6,580 million kg) by 1950. This aggregate production still represented only about 1% of the volume of petroleum produced.

**Scope for detergents**

Various papers given at The Hague discussed the transformed outlook for synthetic detergents. Before the Second World War there were fairly limited efforts to find alternatives to soap. Wartime fat shortages gave urgency to the search for other sources of cleansers, at a time when the potential for petroleum as a source of chemicals was being explored energetically, particularly in the USA. Between 1948 and...
1950, the output of synthetic detergent increased fourfold in the USA, to nearly half of soap production. Over half of the synthetic detergents were derived from petroleum products. Petroleum synthetic detergents were used for dishwashing, home laundering, paint cleaning, car washing and other domestic cleaning operations. Petroleum-based synthetics were also being used increasingly in a wide variety of other more specialised fields – as industrial wetters, in rust-preventive preparations, insecticides, fungicides and for detergent lubricating oils.

Among the competing petroleum bases, alkyl aryl sulphonates dominated in the US market, and accounted for about 70% of total US petroleum-based synthetic detergent output. Alkyl sulphates were more popular in Europe. The difference was probably due to local conditions of manufacture and availability of materials.

**Producing the products**

Many advances were made in petroleum technology between the Second Congress of 1937 and the Third of 1951. Those in the sphere of refining were the most revolutionary. What was once just fractionating distillation evolved into thermal and catalytic cracking and reforming, coupled with isomerisation, alkylation, hydrogenation, dehydrogenation and solvent extraction.

By 1951 there was a considerable catalogue of catalytic process techniques, with more than a dozen variants in regular use. The first commercial applications in the oil industry had occurred only 10-12 years earlier, but by 1951 they accounted for over 50% of the total capacity of conversion processes. Every new type of process adds to the flexibility of the industry’s operations, but the increased diversity was also a measure of the diversity of the refining experts’ views as to the most suitable ways of applying catalytic reactions to petroleum processing. Discussion at the Congress showed that the very complicated mechanism of catalytic action still required much investigation. Animated controversies arose out of the discussions whenever these touched upon the problems of catalytic reactions – thus the questions were far from settled.

One paper presented the results from the catalytic cracking of 41 pure hydrocarbons in the form of a survey enabling the pure hydrocarbon data to be applied to type analyses of feedstocks for the prediction of gasoline yields under given cracking conditions. Another paper summarised the findings of investigations into the factors determining the octane numbers of catalytically cracked gasolines in prediction charts. Under certain conditions, the charts permitted the estimation of octane numbers with an accuracy not far below that obtained from actual engine determinations.

Crude oils with a high sulphur content were forming an increasing proportion of global petroleum supplies. This stimulated investigations into the options for sulphur removal. Solvent extraction proved effective as a means of reducing the sulphur content of middle distillates. Furfural, already used for refining lubricating oils, was found to work equally well for the selective solvent treatment of diesel and gas oils.
EGER V. MURPHREE (1898-1962) AND FLUID CAT CRACKING

Eger Murphree was born in Bayonne, New Jersey, USA, and moved as a child to Kentucky. At Kentucky University he gained degrees in chemistry and mathematics, followed by a Masters degree in chemistry in 1921. After teaching at high school and working for several years, he joined Standard Oil of New Jersey in 1930. He served as president of the Standard Oil Development Company, (renamed Esso Research and Engineering in 1955) from 1947 until he died of a heart attack in 1962.

Murphree was widely recognised as a leader in the fields of fluid cat cracking, synthetic toluene, butadiene and hydrocarbon synthesis, fluid hydroforming and fluid coking. He was also a member of the committee that organised the wartime Manhattan Project, and served as WPC President from 1951-1959.

Over half of the world’s gasoline is currently produced by fluid catalytic cracking (FCC), a process developed in a cooperative effort set in motion in 1938 by the agreement of a number of petroleum, chemical and engineering companies to form Catalytic Research Associates.

The work involved many people but there were two key steps. Fixed-bed catalytic cracking was the then state-of-the art refining technology and it was Warren K. Lewis and Edwin R. Gilliland of the Massachusetts Institute of Technology who made the conceptual leap to a fluid bed by suggesting that a low velocity gas flow through a powder might ‘lift’ it enough to cause it to flow in a manner similar to a liquid, while Eger Murphree, Donald Campbell, Homer Martin and Charles Tyson – known as the ‘Four Horsemen’ of the Standard Oil Development Company – invented a fluidised solids reactor bed with a pipe transfer system between the reactor and the regenerator unit where the catalyst could be processed for re-use. Thus, the solids and gases were continuously brought in contact with each other to bring on the chemical change.

This development revolutionised the petroleum industry by transforming higher boiling oils into lighter, usable products more efficiently, and the world’s first commercial FCC facility began production for the Humble Oil & Refining Company (in which Standard

Oil New Jersey had a controlling interest) on 25 May 1942 in Baton Rouge, Louisiana. At this time, the USA had just entered the Second World War and was facing a shortage of high octane aviation gasoline. FCC, which was licensed to all the members of Catalytic Research Associates, allowed the US petroleum industry to increase output of aviation fuel by 6,000% over the next three years.

Apart from gasoline, FCC produces heating oil, fuel oil, propane, butane and chemical feedstocks that are instrumental in producing other products such as plastics, synthetic rubbers and fabrics, and cosmetics. The process has been steadily improved and is considered one of the most important chemical engineering achievements of the 20th century.
Solvent extraction had already been in use for a quarter of a century as a vital tool of lubricating oil refining, but the increasingly exacting performance required of lubricants had greatly increased its significance in the late 1940s. In the early 1950s there were four major solvent extraction methods in regular use:

- The Furfural and Phenol processes accounting for 70% of global total solvent plant capacity;
- The Duosol process, which was different in that it permitted the direct treatment of asphaltic residues owing to the use of two immiscible solvents; and
- The Edeleanu (sulphur dioxide) process, which was the oldest commercial process for solvent extraction and was first applied to kerosene. However, it was the least flexible of the four processes.

There were many papers on refining and manufacturing problems presented to the Congress, showing that in every sphere of liquid fuels and lubricants production the key problem was to reconcile

FROM ANGLO-PERSIAN TO BP

The Anglo-Persian Oil Company (APOCH) was the first company to exploit the oil reserves of the Middle East. It was founded in 1909 following the discovery of a large oil field in Masjed Soleiman, Iran. In 1935 it was renamed the Anglo-Iranian Oil Company, and became the British Petroleum Company in 1954, one root of the modern BP.

The control of Iranian oil reserves was effectively given to Britain for 60 years by the D'Arcy Oil Concession granted to the British during the reign of Mozzafar al-Din Shah Qajar. William Knox D'Arcy negotiated a 60-year oil concession with the Shah of Persia in 1901, but was almost bankrupted within a few years by the cost of exploration. He sold his interest to the Burmah Oil Company Ltd, which created APOCH as a subsidiary. Volume production of Persian oil products eventually started in 1913 from a refinery built at Abadan. After the First World War there was widespread opposition in Iran to the D'Arcy oil concession and royalty terms, whereby Iran only received 16% of net profits. The attempt to revise the terms of the oil concession on a more favourable basis for Iran led to protracted negotiations between Abdolhossein Teymourtash, the Iranian Minister of Court (1925-32) and John Cadman (Chairman of APOCH, 1928-32).

The Abadan oil refinery – at the time the world’s largest – closed during the crisis.
as well as possible optimum technical performance, the economic justification for investment and sales.

**Power from oil – today and tomorrow**

‘Oil is there primarily to be burnt, ... at least, it is by burning most of it that we seem to profit most by its existence.’ This was the introduction by Professor J. J. Broeze of Delft to his ideas on present and future problems of combustion. He recognised that the manifold applications of liquid fuels to heat and power production were inextricably tied up with the precise control of combustion.

**Potential of directional drilling**

Directional drilling represented a major advance in oilfield drilling practice and was discussed by H. John Eastman, who defined it as the positive control of the direction taken by the bit while drilling is in

Matters came to a head in 1931, when the combined effects of overabundant oil supplies and the Depression led to fluctuations which reduced the annual payments to Iran to only a fifth of what it had received in previously. APOC informed the Iranian government that its royalties for that year would be only £366,782, while the company’s income taxes paid to the British government were about £1,000,000. The dispute was taken to the Permanent Court of International Justice at The Hague. A new agreement was ratified in May 1933 which provided a new 60-year concession. It reduced the area under APOC control to 100,000 square miles (260,000 km²), required annual payments in lieu of Iranian income tax, and guaranteed a minimum annual payment of £750,000 to the Iranian government.

In 1935 APOC changed its name to AIOC. In spite of diversification AIOC still relied heavily on the Iranian oil fields for three-quarters of its supplies, and controlled all the oil in Iran. The Iranian government wanted to take a significant share in the company, and would not negotiate when only offered a larger share of revenues. As a result, legislation to nationalise the industry was approved in April 1951, which led to the Abadan crisis. Foreign countries refused to take Iranian oil, the Abadan refinery was closed and AIOC temporarily withdrew from Iran. Following a coup d’état in August 1953 the new government restored AIOC’s ownership in 1954, although it lost its monopoly. That was the year it became the British Petroleum Company.
progress. In 1951 there were more than 50 directional operations in progress in the USA, three in Canada, two in Mexico, five in Germany and one in Venezuela. Most directional drilling work arose from the need to drill a deflected well from an accessible surface site so as to bottom under an inaccessible location.

As well as the technical improvements in the tools and equipment used, developments in directional drilling practices also came from improved planning of directional programmes. Directional wells, drilled continuously since 1938 under the Pacific Ocean, west of Huntington Beach, California, were used to show what could be achieved. Paralleling the shore, wells were surface-spaced 27 feet (8 m) apart, so that a single steel derrick mounted on wheels could serve a group of five pumping wells. The new wells bottomed from 700 feet to a mile (200-1,600 m) from their surface locations at vertical depths of 4,000-5,000 feet (1,200-1,500 m). Each drained an area of 5-10 acres (2-4 ha). About 230 wells were drilled in the first 12 years of the programme.

**French refiners’ margin**

As at January 1951 annual French refinery capacity was running at 16 mt. Under the shelter of a carefully devised system of protection introduced in 1928, France was the first European country to build up a refining capacity able to meet nearly all the needs of the home market. A paper presented at The Hague reviewed the elements of French refinery economics and outlined some of the problems to be considered in determining the nature and scale of operations.

**The price structure**

Little had been published on the subject of oil pricing, so there was interest in the paper presented by Walter J. Levy on the subject. He cited four major changes in the demand/supply pattern that were likely to influence the price structure:

- The completion of Europe’s refinery programme would reduce imports of finished products to a minimum and lead to Middle East crude supplying most of Europe’s needs;
- Middle East refined products would find their main markets east of Suez;
- Caribbean crude oil and products would have only a small outlet in the Eastern hemisphere and would be sold largely in Western hemisphere markets; and
- The USA would remain a major importer, mainly of fuel oil and crude oil, and a very small exporter, mostly of special oils.

**New light on genesis of oil**

By 1951 the theory that petroleum had been formed throughout the geological ages from the organic remains of marine animals and plants was widely accepted, but there was still debate about the chemical reactions by which the organisms were transformed into oil. Two theories found strong support at The
Hague. One was that the processes of decomposition and reformation from the action of certain microbes entombed with the source materials resulted in petroleum. The second theory was that radioactivity provided the energy for the metamorphosis from marine organic animals to petroleum hydrocarbons.

**Economics**

The main purpose of the Congress was the discussion of technical subjects, but there were a number of papers on the economic problems of the oil industry. For example, the growth of motor traffic was seen to increase oil demand, and this in turn was linked closely to the condition of the road network. The importance of roads to the economic well-being of a country was examined and the case made for larger expenditure on road upkeep.

The maximum size of tankers increased from 12,000 to 30,000 deadweight tons (dwt) and the operating speed from 12 to 16 knots between 1930 and 1950. It was noted that ships become progressively cheaper per deadweight ton, both to build and to run, as the size increases. Significant economies in operation were also obtained with large ships due to the lower costs of discharging in harbour. In large installations discharge rates of 3,000 tons per hour were common by 1950. However, port facilities and the problems of increasing the water depth in certain harbours were factors limiting further improvement.

![Shell’s *Velutina* (29,648 dwt) was typical of a large oil tanker in the early 1950s. Built in 1950 by Swan Hunter & Wigham Richardson in Wallsend, UK, *Velutina* operated with sister ships *Velletia*, *Verena* and *Volsella 2.*](image)
We are in the business of designing solutions to energise the future, forever.

The vision of the Petroleum Federation of India remains to be a non-profit organisation to promote interests of the hydrocarbon industry in line with public/national policies, through a self-regulatory environment.

To achieve this goal, we are working towards global competitiveness of the petroleum industry. An act that makes us the rightful organisation to project views of the oil & gas industry to the Government, Regulatory Agencies and public.

As a conscientious organisation, we believe in optimising resources and integration of efforts. A process through which we can coordinate demand forecasting, supply plan, market and economic research, promote Safety, Health & Environment Protection and Energy Conservation.

As a representative of the industry, we are also actively coordinating with oil marketing companies to ensure compliance of "Good Business Practices". In the process, we have been able to provide a forum for deliberating issues of common interest to industry members and today act as an interface between the industry and the Government and Regulatory Agencies for resolution of issues/problems.

We have also created an information system that databases upstream/downstream sectors – another step that has made us the representative of the petroleum industry on Government bodies, committees and task forces, helping us to organise seminars, conferences, training programmes, lectures and publication of technical papers and newsletters.

In the process, facilitate evolution of policies and regulations and their implementation as an interface between the industry and the Government, coordinate between Indian Petroleum Industry and International organisations.

Sustaining efforts and means for social welfare and service.
The business of designing energy solutions

A preview of how PetroFed is taking forward the business of the energy sector by acting, providing, safeguarding, promoting, and helping create solutions

PetroFed, a non-profit, consortium of Indian and International Companies/Associations in the Hydrocarbon Sector is proactively promoting member interests in line with Public/National Policies through a self-regulatory environment with consumer interest in sight.

It acts as an oil industry interface with Government, regulatory authorities, and public and representative bodies of traders. It helps in resolution of issues and facilitates evolution of hydrocarbons related policies and regulations and their implementation. It represents the industry on Government bodies, committees and task forces.

Efficient and reliable energy supplies are a prerequisite for accelerating the growth of the Indian economy. While the energy needs of the country are going to increase at a rapid rate in the coming decades, the energy resources that are indigenously available are limited and may not be sufficient in the long run to sustain the process of economic development. In these circumstances the unified, focussed and pragmatic approach of PetroFed is providing sustainable energy solutions to the policy and decision makers.

PetroFed...Governance and Management

The Management and Operations of PetroFed are guided and overseen by a Governing Council. The Governing Council presently has 10 Members with Shri S. Behuria, Chairman, Indian Oil Corporation Limited as Chairman and Shri P. Raghavendran, President (Refinery Business), Reliance Industries Limited as Vice Chairman. PetroFed has a full time Director General, and currently two Directors, one Joint Director and two Assistant Directors.
India has an estimated sedimentary area of 3.14 million square kilometer, comprising 26 sedimentary basins. At present 1.38 million square kilometer are held under Petroleum Exploration Licenses in 18 basins. Before implementing the New Exploration Licensing Policy, or NELP, only 11% of Indian sedimentary basins were under exploration. Under NELP, which was approved by the Government in 1997 and operationalised since January 1999, 46 oil and gas discoveries have been made by private/joint venture (JV) companies in 15 blocks, which have added more than 600 million metric tonnes of oil equivalent hydrocarbon reserves.

One of the key issues, which is being addressed by PetroFed is to provide optimised E&P solutions.

It prepared a paper on review of E&P licensing policy which was considered by the Government. In the seventh round of NELP 60 blocks are likely to be offered by the Government of India at competitive terms. By now, 26 Coal Bed Methane exploration blocks are under operation and 6000 cubic feet reserves have been established in four of them.

India is slated to become a petroleum refining hub in the region. Even now the refining capacity of nearly 150 million tonnes per annum exceeds the annual consumption.

The country exported almost 20 million tonnes of petroleum products during the first six months of the fiscal 2007.

The Petroleum and Natural Gas Regulatory Board is in place and dynamic growth is expected in Natural Gas/LNG utilisation. Opportunities are available for investment in infrastructure development in the area.

Parameters are likely to be framed by the Government on an open acreage policy of exploration which was suggested in the PetroFed report.

**PetroFed...Main Objectives**

- To represent and project views of hydrocarbon industry to the Government, Regulatory Agencies and public
- To provide an interface between the industry and the Government for resolution of common issues/problems
- To promote the interests of member organisations
- To facilitate evolution of hydrocarbons related policies and regulations and their implementation
- To represent the hydrocarbon industry on Government bodies, committees and task forces
- To promote energy conservation and health, safety and environment protection measures
- To work for greater participation of Petroleum Industry to venture into alternate hydrocarbon sources
- To organise seminars, conferences, workshops, training programmes, lectures and bring out technical publications and newsletters
- To collect, analyse and disseminate information regarding petroleum industry and related sectors
- To optimise resource utilisation of members and assist in their professional development by broadening their knowledge and skills

**PetroFed Initiatives**

PetroFed has submitted several study reports which have been hotly debated for implementation. The first projection for India’s consumption of petroleum products till 2030 was undertaken by PetroFed when it produced two publications - “Fuelling India’s Growth: Past trends and scenarios 2011-2012” and “Fuelling India’s Growth: Vision 2030”.

A publication titled “Sustainable Imperative” focuses on economic, environment and social development goals of Corporates in the form of Triple Bottom Line Reports.

A recent publication “Green Imperative – Future of Natural Gas in India 2030” sensitises stakeholders in initiating actions for India’s gas market development for economic growth.

Reports have been developed on Petrochemical market assessment, opportunities for earning CERs through Clean Development Mechanism as well as on the Regulatory Issues on Oil & Natural Gas.

A Workforce Sustainability and Talent Management study delves into the human resource requirements and availability in the next decade in the upstream sector.

PetroFed has instituted annual PetroFed Oil and Gas Industry Awards to recognise individuals and organisations who have made significant contribution in implementing innovative, cost-effective and environment friendly energy usage.

PetroFed is all set to offer energy solutions, for sustainability!
The Korean War ended in an armistice in July 1953. The following year Iran signed an agreement with a new consortium of British Petroleum (40%), Royal Dutch Shell (14%), Compagnie Française des Pétroles (6%) and a number of US companies (40%), which controlled the production, pricing and export of Iranian oil. The UK’s share was reduced from the complete control it had enjoyed previously, but was still more than Iran’s original nationalisation plan. In the USA, the petroleum industry was marked by anti-trust litigation and the emergence of independent companies determined to capture market share from the majors.

The Fourth Congress was held in Rome from 6-15 June 1955. The venue was the Esposizione Universale di Roma (E.U.R.) complex on the southern edge of the city. The buildings were originally designed for a world exhibition scheduled for 1942, but were in fact only finished a year or so before the Congress. The delegates stayed in hotels in Rome, so coaches were used to take them to the venue, where all National Committees were encouraged to set up stands to act as national meeting points. For the first time a large oil equipment exhibition was held in conjunction with the Congress.

The official functions and entertainments were very successful. The Opening Ceremony took place on 6 June at the Capitol, built by Michelangelo. His Holiness Pope Pius XII received all the Congress
members in special solemn audience in St Peter’s on 10 June. The Pope addressed the assembly on the place of the petroleum industry in the world, and imparted to all His Apostolic Blessing. The President of the Republic, Giovanni Gronchi, received a delegation at the Quirinal Palace, which represented all the nations taking part in the Congress. On other evenings there were concerts, a banquet, a performance of La Traviata at the Rome Opera House and an official reception by the Ministry of Industry and Commerce at the Baths of Diocletian. Many receptions and cocktail parties were given by the French, Soviet, Belgian and Dutch embassies, and by various National Committees, associations, firms and organisations. In fact, there were two or three parties every evening and it was impossible for anyone to attend them all.

Unfortunately, many of the session halls were half full at best, despite the technical excellence of most of the papers, and the unheralded first appearance of a number of scientists from the USSR, a day or two after the start of the Congress, together with 20 papers. These papers were printed, but not presented, due to the time factor. The reason for the poor attendance at the sessions, despite the registration of 3,246 delegates, was fairly obvious. First, the sessions were held 5 miles (8 km) away from the centre of Rome, the weather was glorious, for many of the delegates it was their first visit to the city, and there were two or three receptions each evening. After the event, there were some criticisms from those who had
paid to send their delegates and found they had not attended all the sessions available. The Permanent Council took heed of this reaction and improved the planning of the technical side of subsequent Congresses.

A number of suggestions were made for future Congresses, some quite bluntly. For example, regarding the banquet: 'The number of speeches at the banquet should be greatly limited, even if this means that not everyone with a right to speak can be invited to do so. [...] Speeches should not take up more than half an hour in all, seeing that the attention of the audience dwindles rapidly after that time until, in the end, no one tends to listen any more'.

**WPC BUSINESS**

West Germany had been elected a member of the Permanent Council in January 1953. After the Rome Congress, the USSR became the 12th member of the Permanent Council.

At previous Congresses the various technical sessions had agreed a wide variety of resolutions, many of which were not followed up. These ‘wishes’ were for things such as the permanent establishment of an international body for a specific subject such as corrosion or evaporation loss. The ‘wishes’ had all been approved by the Plenary meeting, but then conveniently forgotten and nothing had been done regarding their implementation. Eger Murphree persuaded all parties to agree that, for future Congresses, ‘Recommendations’ to the Permanent Council would be welcome, but only the Council itself would have the right to put up ‘Resolutions’ to the Congress. Any action on ‘Recommendations’ would be at the discretion of the Council. The 18 resolutions from the Third Congress were then considered – six of them were referred to other bodies, seven were suggested to the Organising Committee of the Fifth Congress as the possible basis for invited papers and no action was taken on the remaining four.

**PAPERS PRESENTED**

This was the first Congress where each author was allowed to present their own paper, and 230 were accepted for presentation. The technical work of the Congress was subdivided into nine sections, rather than 10 as at the Third Congress, because physical and chemical methods were merged into ‘oil processing’ (*see Table*).

In the six-and-a-half days of technical work, over 100 meetings were held. Four general lectures were presented in the early evenings:

- The evolution of exploration for oil, by P. T. Cox;
- Leading principles in organising the research in applied chemistry, by J. C. Jungers;
Energy resources

The demand for commercial sources of energy globally was advancing steadily at a rate of about 3% a year, sufficient to more than double total requirements every 25 years. For many decades the demand for petroleum rose at almost twice this pace, bringing its consumption in 1955 to the level where it challenged coal as the world’s major source of energy. The persistent expansion of energy demand in step with economic growth and rising living standards raised questions about the future long-term adequacy of coal and oil reserves. Professor W. K. Lewis examined some aspects of the broad problems of energy supply.

The growing importance of energy prompted the question whether known resources could meet future requirements at acceptable prices. Professor Lewis thought that as the cheapest energy sources are used up preferentially, the cost of energy would inevitably rise. He pointed out that nuclear power had yet to be proven economically competitive.

In summary, Professor Lewis expressed confidence that supplies of energy, which would be a dominant factor in the pattern of future civilisation, would continue to be adequate provided only that suitable technologies could be developed for their production and use. In the overall picture, liquid fuels would long continue to play an indispensable and irreplaceable role.

The search for oil

Until roughly the end of the 19th century many thousands of wells were drilled without much reasoned forethought, but the foundations were being laid for orthodox petroleum geology. In the first 30 years of the 20th century the use of geological evidence was greatly developed, mapping by air photography was launched, regional tectonic and stratigraphical conceptions were applied and micropalaeontology came into use. Geophysics was born in the 1920s. The torsion balance, magnetometer, seismic refraction then reflection techniques, and the investigation of the electrical resistivity of rocks were all quickly adopted and developed in the USA. In 1955, however, there was still only one way of knowing for certain whether there was oil underground and that was to drill a hole at a selected spot fulfilling five conditions:
It must be in a region where oil is believed to have been generated in adequate quantity;

It must penetrate a porous reservoir formation;

The formation must be sealed by impermeable cover rock;

The well must enter the reservoir in an appropriate part of a trap structure; and

The geological history of the area must have been favourable both for accumulation and for retention of oil in the trap.

Knowledge of the controlling factors in oil accumulation had progressed. For example, there was confidence that oil was not generated within the crystalline rock masses of the earth’s crust, nor in certain types of sedimentary rocks such as wind-blown sands. However, the origin of hydrocarbons, the role played by bacteria and by biochemical change, and how and when these small highly dispersed droplets in the clays collect to give an oil accumulation all remained obscure.

There were hopes that the study of sedimentation would help solve the mystery of oil formation. In fact, an International Association of Sedimentologists had been formed in 1952. Great advances were expected in the field of micro-palaeontology.

Perhaps the most important of the five main controlling factors in the search for oil was that of geological structure, since ability to locate trap structures at depth must by itself reduce the number of wells required to find an oilfield. At the time of the Fourth Congress, seismic reflection prospecting was the mainstay of geophysical exploration activity. In 1953 the expenditure on geophysical exploration for oil throughout the world was estimated at about $400 million, about 90% of which was for seismic work. Areas, four years previously considered unworkable by the reflection work, were effectively surveyed by the ‘Pattern Shooting’ method which used arrays of many shotholes and detectors disposed over considerable areas.

Air photography had slashed the time spent in geological survey, and revealed trends and features unnoticeable from the surface, while Commandant Cousteau had invented the ‘aqualung’ which enabled a man to swim freely at depths of 100 feet (30 m) or more below the surface of the sea and to work there for periods of 15 minutes at a time.

By itself, geophysical exploration was expensive, time-consuming and often of little value. It needed to be combined with geology to give optimum value. As more of the less-difficult-to-find trap structures were found and exploited, the theoretical geologists, the ‘oil is where it ought to be’ school, increased in importance. Advances in geophysical techniques and geological points of view bring new areas into the category of promising prospects, and also provide impulses to fresh exploration in old areas as well. For example, in the 1950s the old salt domes in the US Gulf Coast were being regarded with new eyes.

By 1955 oil exploration had made available nearly 240,000 million barrels of crude oil, of which nearly one-third had been consumed. In terms of oil consumption in 1954, there were 31 years’ requirements of oil known to exist underground and to be economically producible, at a conservative estimate. However, it was known that there was much more oil underground, in addition to the ‘proved’ reserves.
Future hunting grounds for oil were thought to be the great geosynclinal troughs of sedimentations which had not been too disturbed by subsequent mountain building movements, their adjacent epicontinental shelves, and some of the great intra-continental basins.

**The changing scene of refining**

Nearly 40 papers were presented at the Fourth Congress on oil processing, which stressed the range and complexity of refining techniques. Some of the main topics at Rome were only just surfacing at The Hague four years previously. Involved in producing a wide range of products, the petroleum technologist’s key problem of reconciling changing demands with optimum technical performance and economic efficiency was never simple to solve.

Modern technology provided the means to vary the pattern and quality of refinery output by a variety of highly versatile processes, complementary to distillation. The advent of cat-cracking paved the way for the wider adoption of various complementary catalytic processes, such as polymerisation, alkylation, hydrogenation and catalytic reforming. All these developments added greatly to the flexibility of refining. By 1955 fluid catalytic cracking accounted for 70% of the total global catalytic cracking facility, which rose from 1.3 million b/d in 1946 to nearly 4.2 million b/d in 1954. During that time the physical size of FCC plants more than halved.

Combination processing was being developed in the 1950s. Esso Standard in Antwerp ran a whole refinery as a fluid combination unit. It comprised crude distillation, thermal-reforming of heavy naphtha, fluid cat-cracking of heavy gas oil, stabilisation of motor gasoline fractions and direct blending of part of the streams into finished products. The combination unit had a crude input capacity of 25,000 b/d, and was designed to produce from Middle East crudes two grades of gasoline, kerosene, jet fuel, three grades of diesel oil, two grades of residual oil and butane.

Catalytic reforming was devised originally for the upgrading of naphtha stocks to high-octane motor gasolines. Subsequently it became important as a source of by-product hydrogen for upgrading refinery charge stocks and for the manufacture of synthetic ammonia.

In the four years since the last Congress at The Hague, the process of Platforming advanced and increased in scope. At first it was used to produce high-octane gasolines from straight-run stocks. Then it was extended to the making of specific aromatic hydrocarbons and aviation gasoline components. By 1955 it was capable of processing naphthas and gasolines from virtually any source, including blends of straight-run and thermally cracked gasolines.

The removal of sulphur from petroleum products by using hydrogen for converting sulphur compounds to hydrogen sulphide was achieved by various methods, but their economic application was still limited by the high cost of the processing plant and of the hydrogen.

Hydrogenation was also useful as a means of enriching hydrocarbons with hydrogen without disturbing the basic set-up of the molecule. The requirement for fuels with high octane numbers
was met by the development of new hydrogenation catalysts, by modifications and simplifications of the original hydrogenation techniques, by the combination of hydrogenation with thermal and cat-cracking, and with catalytic reforming. In 1954 the world total of hydrogenation plants in operation or contracted for amounted to about 40 units, mostly in the USA, with a total charge capacity of nearly 350,000 b/d.

**Engines and fuels**

The internal combustion engine was by far the largest consumer of petroleum fuels, using well over half of total supply. Progress in engine design was matched with advances in fuels and lubricants.

**Gasoline engines**

Each type of internal combustion engine has its own problems of combustion. In the gasoline-fuelled spark ignition engine, they concern chiefly the control of knocking, pre-ignition and ‘running-on’, that is the continued idling of an engine at closed throttle and switched-off ignition.

By the mid-1950s experience showed that the octane requirements of new cars could increase by up to 10 points with accumulating mileage. This increase was due to the formation of lead salts and carbon deposits in the combustion chamber, and led to a loss of power, spark-plug fouling and pre-ignition. The deposits could have been caused by fuels as well as lubricants. Thus petroleum refiners were giving increased attention to the development of special lubricating oils and oil additives, as well as gasoline additives, such as tri-cresyl phosphate (TCP), ignition control compound (ICC), multi-propyl phosphate (MP) and various others. The incorporation of additives into motor oils and gasolines became standard practice.

**Diesel engines**

The small high-speed diesel made remarkable advances between 1930 and 1955. The rapid progress of the small diesel was partly due to the lower taxation of gas oil compared with gasoline. Later, the introduction of additive-type lubricants led to an appreciable increase in specific power output, which improved the overall economy and reliability of the engine.

**Gas turbines**

In 1955 the gas turbine was still a ‘junior’, but could be operated with the same degree of reliability as a large diesel or steam turbine plant. However, to be economically competitive, the stationary gas turbine needed improvements in thermal efficiency, and to be able to burn the cheapest fuel. In the USA,
industrial gas turbines were being adapted to burn natural gas, while in Europe they were depending mainly on liquid petroleum fuels. Installed industrial gas turbines in Europe exceeded 650,000 hp, and consumed 11,000 b/d of petroleum fuels.

**Refiners’ problem**

The persistent trend, identified at the Rome Congress, towards attaining maximum yields of gasoline from crude by cat-cracking led to an encroachment upon straight-run middle distillates, which formed an ideal cracking stock. However, the distillates were in growing demand as fuels for diesel engines and gas turbines, and for heating purposes. Thus it was thought that it could become necessary to widen the range of petroleum fractions regarded as middle distillates, and to make wider use of cracked distillates and residuals as diesel and gas turbine fuels.

**Capturing the oil**

**Drilling**

In 1955 there were only two methods of drilling holes in widespread use – conventional cable-tool drilling and conventional rotary drilling. Interest was growing in non-conventional drilling methods which offered possibilities for increasing the effective power at the bottom of the hole. The new methods included the use of shaped explosive charges, thermal drilling devices and vibratory drilling devices such as the sonic drill and the electric vibratory drill. A rotary drilling tool powered by an electric motor at the bottom of the hole had been developed, but size and power limitations had restricted the use of the tool to relatively shallow holes.

A distinctive method of drilling used in the USSR was being tested in the USA. It comprised a multi-stage hydraulic turbine suspended on the lower end of the conventional drill string. It was rotated by the circulating drilling fluid and driven by the bit exerting downward pressure on it. Various non-conventional drilling tools were at the experimental stage, including a 'rotary-percussion' tool, diamond drilling bits, a 'shale tool', jet-nozzled rock bits and other special bits to deal with particular formations.

**Swelling the flow**

Fracturing increases the productivity of wells by creating or extending fractures from the well into the reservoir so as to give greatly reduced resistance to the flow of liquids. The fractures are made by the rapid injection of a thickened fluid which forces open its own channels. Graded sand is suspended in the fracturing fluid and is deposited in the fracture to prop open the cracks. Formation fracturing aims to convert an un fissured or under-fissured reservoir into a fissured reservoir.

The commercial use of the hydraulic fracturing process first became significant in 1949. By 1955 almost 35,000 fracture treatments were performed per year in the USA. In Venezuela the first reservoir
fracturing treatment with sand as a propping agent was made at the beginning of 1951, and a total of 306 fracture treatments had been made by mid-1954.

The National Petroleum Council of the USA published a report which showed that the higher rate of increase of producible crude oil was largely due to technological factors such as pressure maintenance, secondary recovery and the increasing use of formation fracturing techniques to stimulate well output, rather than an increased number of well completions. In 1951 and 1952, 23,450 successful oil well completions each year added some 369,000 b/d net to crude availability, while in the following 18 months completions at an annual rate of 26,900 wells added 577,000 b/d. The rate of well completions went up only 14.7%, while the rate of additional crude availability went up by 56.4%.

**Western Europe’s future fuels**

Papers presented at the Rome Congress expressed diverse views on the prospects for Western Europe’s future energy supply. J. A. van den Heuvel, in a conservative and cautiously phrased forecast, predicted greatly increased volumes of fuel oils, with nevertheless a future decline in their share of Western Europe’s total petroleum consumption. P. H. Frankel anticipated a far bigger increase in the demand for fuel oils and a sharp increase in their share of petroleum consumption. Holaday and Albright agreed with van den Heuvel that the share of fuel oils in Western Europe’s petroleum demand might fall, but they reached their conclusion by assuming that the volume of future consumption of alternative petroleum and other fuels would be determined primarily by their relative technical advantages, which implied many changes in the systems of petroleum taxation.

Van den Heuvel thought it likely that Western Europe’s inland petroleum consumption would increase by at least 80% from 1953-65, to reach a total of 109-125 mt by 1965. Between 1953 and 1965 total Western European energy consumption would increase by 24%. In 1965 petroleum would account for less than a quarter of this total energy demand. However, in 1954 petroleum consumption in members of the Organisation for European Economic Co-operation (OEEC) actually increased by 15%, compared with the 7.6% forecast by the OEEC Refinery Committee, emphasising the conservative nature of van den Heuvel’s conclusions.

Frankel’s paper provided a sharp contrast. He threw the prospect of growing fuel oil needs into concrete statistical form, and portrayed an increasing energy gap due to a future shortfall of coal supplies which could only be filled by fuel oils.

An unusual paper was presented by W. J. Levy. He drew attention to the complex inter-relationships of the four main elements that participated in world oil operations: the oil-producing countries; the consuming and importing countries; the international oil companies; and the countries with which these companies were linked. He pointed to the effective working of world-wide petroleum supply as ample proof that these relationships were maintained harmoniously.
Petrochemicals

The role of the oil industry in petrochemicals was the manufacture and sale of hydrocarbons, of inorganic chemicals and of synthetic organic chemicals. The recovery of hydrocarbons from refinery streams or natural gas was the easiest and least risky form of oil industry participation. The hydrocarbons sold for chemical manufacture ranged from methane, propane and butane to the lower aromatics benzene, toluene and xylene, and to hydrocarbons produced by special processes, such as butadiene, dodecylbenzene and others.

The selling of petroleum hydrocarbons and inorganic chemicals by oil and natural gas concerns was already a big and fast-thriving business by the mid-1950s, but its importance was far surpassed by the volume of trade in organic petrochemical products. Most of these were derived from aliphatic hydrocarbons and were becoming invaluable in the manufacture of plastics.

For 1955 the US production of chemicals was estimated at 14 mt with a gross market value of $4,000 million, with oil companies’ operations accounting for a fifth to a quarter of the total. This output was twice that of 1950, four times that of 1945 and over 12 times that of 1939. By 1955 petrochemicals represented about 80% of all organic chemicals produced in the USA. However, the total volume of hydrocarbons absorbed by chemical manufacture was only equivalent to 3% of the total US production of crude and natural gas.

Outside of the USA, petrochemical industries were well-established in Belgium, Canada, France, Germany, Italy, the Netherlands, the UK and the USSR. Most of the facilities for large-scale commercial manufacture had come into being after 1950.

The world’s largest ethylene plant at the time of the Fourth Congress was the Gulf Oil refinery at Port Arthur, Texas, which could then produce up to 80,000 tons (72,500 tonnes) of ethylene a year by ethane cracking. In the UK, ethylene was produced by the direct cracking of napthas or gas oils, and then used principally to make polyethylene (approximately 45% of ethylene output) and ethyl alcohol (25%). The UK had pioneered the commercial production of polyethylene in 1939.

In more than one branch of petrochemistry, commercially successful operations have sometimes materialised well ahead of the scientists’ and technologists’ full understanding of the chemical
reaction mechanisms involved. As Professor M. J. C. Jungers explained at the Rome Congress, chemical engineering so far, had by and large, been more concerned with the development of industrial processes based on physics, than with the study of the underlying chemical phenomena in all their variety and complexity. In his view, a comprehensive knowledge of chemical thermodynamics and kinetics was indispensable if modern petrochemistry was to attain optimum efficiency in applying the technological processes for the exploitation of the chemical reactions in the industrial field.

**Utilisation of Italy's natural gas**

Signor Enrico Mattei, Chairman of the Italian state entity ENI addressed a full session of the Congress. ENI exercised a monopoly for the production of hydrocarbons in most of the Po valley. Mattei showed that gas production by ENI had risen from 12 million m³ annually in the period 1945-46, to 12 million m³ daily by the winter of 1954. In the last few years a 3,800-km pipeline system had been built with a carrying capacity of 20 million m³ daily. In the three years 1952-1954 the total supply of natural gas doubled in Italy and there was also a significant evolution in utilisation.

Italy's economic development had long been slowed down by the lack of adequate coal resources at home and elsewhere in the Mediterranean area. The development of the country's natural gas resources and the hoped-for development of her oil resources would be a partial remedy to the lack of coal, which, however, was becoming increasingly less important for the national energy budget.
Primadiesel.
Respecting nature.

Nature will only be good to us if we are good to her. The new Petrol Primadiesel is a sign of this respect - an enhanced fuel well suited to your diesel engine, protecting it from deposit build-up and corrosion, increasing its power and bringing down the cost of motoring. And because it reduces harmful emissions, it’s kinder to the environment.

Outstanding performance also in winter conditions.
Egypt held the world’s attention between the Fourth and Fifth Congresses. In 1956 the Suez Crisis shook the petroleum world, while a month before the 5th WPC the Arab Oil Congress in Cairo provided the opportunity for talks about setting up a new producers’ organisation. This led to the launch of the Organisation of the Petroleum Exporting Countries (OPEC) the following year.

The Fifth Congress was held in New York from 30 May to 5 June 1959, following an invitation from the US National Committee to mark the centenary of the first drilling of the Colonel Edwin Drake Well at Titusville. H. S. M. Burns, the Chairman of the Board of the American Petroleum Institute, was President of the Congress and Gene Davis, a well-known figure in USA oil circles, was Congress Secretary. Overall, the 5th WPC was very successful and proved to the oil industry that the World Petroleum Congresses were indeed dedicated to the advancement of petroleum science and technology. Much of this success was due to the relaxed and friendly manner of Sam Burns and Eger Murphree, with his quiet sense of humour.

The Opening Ceremony was held in the Grand Ballroom of the Waldorf-Astoria, with 2,500 people present. This was followed by a reception for all delegates and their wives. An official banquet was held at the same venue on 3 June. The following night 2,000 Congress members heard the New York Philharmonic Orchestra give a special concert at Carnegie Hall and there were visits to the Radio City Music Hall.
Industry and sightseeing tours were organised before and after the Congress period. The visits covered the whole spectrum of the oil industry’s activity in the USA and were well attended and enjoyed. The industry travel programme consisted of 11 technical tours and New York City sightseeing. Major installations of research, refining, production, exploration and atomic energy application were included. Tours started in New York and routes extended southward to the Gulf Coast, north into New England, west to the Great Lakes region, southwest to Oklahoma and New Mexico, and northwest into Wyoming and Montana.

The total registration was 4,410 delegates, up 36% on the Fourth Congress in Rome, and 919 accompanying persons. Publicity resulting from the programme reflected a measure of press activity, believed to be the largest in the history of industrial press relations in the USA at the time. Some 272 correspondents were at the Congress. Most of the leading oil trade publications devoted either special issues or substantial space to the Congress, while extensive radio and television coverage was broadcast to 40 countries.

The parallel oil equipment exhibition was successful and 364 companies were represented. Fourteen US oil companies, 10 of the largest refinery construction companies, practically all the larger geophysical and geochemical service groups, and the larger refinery and petrochemical equipment companies took space. Numerous exhibits cost between $15,000-25,000, and one or more of the exhibits featuring electronic computers represented a total value in the order of $500,000.

**WPC BUSINESS**

For the first time it was stipulated that each National Committee should be rooted in a national Institute of Petroleum, technical society or other scientific organisation. The functions of the National Committees were defined as: providing publicity for the Congress; representation and participation at the Congress; nomination of Committee members; and liaison between the WPC and all relevant national interests. Some 38 National Committees attended the 5th WPC.

At the Congress meeting of the Permanent Council Sir Stephen Gibson of the UK was elected President for the next four-year term of office and it was decided to hold the 6th WPC in West Germany.

**ARAB OIL CONGRESS 1959**

In the early 1950s international oil companies (IOCs) developed the posted price system to help host governments estimate oil revenues in advance. Posted prices were accounting devices that host governments used to calculate the amount of taxes the companies would pay under industry-wide 50-50 profit-sharing agreements. Despite normal fluctuations in the real price at which crude oil was traded, posted prices were not adjusted, and fixed posted prices became an industry norm. When competitive pressures forced the IOCs to reduce posted prices unilaterally in February 1959, there was an outcry from the affected host governments.

In 1959 the President of the USA, Dwight Eisenhower, imposed import quotas on crude oil which hit Venezuela particularly hard. As a result, Juan Pablo Pérez Alfonso, the Venezuelan Minister of Mines and Hydrocarbons, flew to the USA in an attempt to set up a Western Hemisphere oil system. The US government would not receive him, so Pérez Alfonso flew to the Arab Oil Congress, held in Cairo in April 1959. Delegates from oil-exporting countries were planning concerted action against the oil companies. Although he could not participate, a private meeting was held with Abdullah Tariki of Saudi Arabia and representatives from Iran, Kuwait and Iraq. The matters discussed became the framework for OPEC.
The Organisation of the Petroleum Exporting Countries (OPEC) is an intergovernmental organisation, created at the Baghdad Conference of 10-14 September 1960, by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. It currently has 13 members, the founding five plus Algeria, Angola, Ecuador, Indonesia, Libya, Nigeria, Qatar and the United Arab Emirates. Since September 1965 the OPEC headquarters has been in Vienna, Austria.

OPEC’s main objective is to co-ordinate and unify petroleum policies among member countries, in order to secure fair and stable prices for petroleum producers, an efficient, economic and regular supply of petroleum to consuming nations and a fair return on capital to those investing in the industry.

OPEC’s first resolutions in 1960 included calls to restore posted prices to their pre-February 1959 levels and to stabilise oil process by regulating production. At the start, the US government refused to recognise OPEC, forbade US oil companies to negotiate with it and imposed trade sanctions on OPEC members to discourage other countries from joining. This suited the IOCs, which saw an advantage in continuing their accustomed practice of dealing with host governments one at a time. OPEC responded creatively, developing joint negotiating positions with the understanding that any member able to gain an additional advantage on its own should do so. Any gains would constitute a new floor for bargaining in the next round. During its first 10 years this ‘leapfrogging’ earned OPEC members incremental gains in oil revenues, which increased OPEC’s international stature and attracted new members to the organisation.

Perhaps OPEC’s most significant contribution to the oil revolution was its support and implementation of ‘participation’, the gradual nationalisation of foreign-owned oil properties. Most members did not follow the participation strategy to the letter, but years of discussion provided an opportunity to prepare for the responsibilities that would come when they became full owners of their oil industries.

*Right, from top to bottom:* The delegations of Iran (headed by Fouad Rouhani), Iraq (headed by Dr Tala’at Al-Shaibani), Kuwait (headed by Ahmed Sayed Omar), Saudi Arabia (headed by Abdullah Al-Tariki) and Venezuela (headed by Dr Juan Pablo Pérez Alfonzo) at the Baghdad Conference of 10-14 September 1960.
PAPERS PRESENTED

The Technical Programme was organised into nine major sections of petroleum technology, plus an additional section on the applications of atomic energy to the industry (see Table). There were 278 papers contributed from 30 countries. Authors presented 20-minute summaries of these in either French or English, in 93 sessions. There were usually 10 sessions during each half-day. Attendance at technical sessions was lower than expected. In the majority of cases it ranged from 70-250 people.

A key issue discussed at the Fifth Congress was whether the industry could meet a projected increase in demand for oil from 20 million b/d in 1959 to 70 million b/d by 1979. The switch in Europe from imported to indigenous refined oil products was widely noted. In 1953 Europe’s refineries could only supply about 25% of the demand for oil products, but by 1959 the share was already about 85%. Other prominent issues reviewed were: health and safety; progress in the prevention of well fires and in reducing transportation spills and other accidents; and equipment standardisation. On the gas front, the ocean transport of liquefied natural gas (LNG) was reported to be technically and economically feasible.

Four subjects could not be contained within the main programme and were each allocated a full-day symposium of their own. They were: sedimentology and the oil industry; the viscosity/temperature relationship of lubricating oils; chemical approaches to the recognition of source rocks; and general petroleum geochemistry.

The traditional four general lectures were presented in Carnegie Hall and were as follows:

◆ Oil’s contribution, past and future, by L. E. McCollum;
◆ Standardisation, oil and noblesse oblige, by Lt-Colonel S. J. M. Auld;
◆ Oil in Africa, by R. Buttin; and
◆ Organometallic compounds in petrochemistry, by Professor Dr K. Ziegler.

Of all the agents of change affecting the oil industry in the late 1950s, technology was by far the most important. Above all, the application of the internal combustion engine to road transport was perhaps the most important agent of development of the age. It opened the way for markets for motor fuel, which accounted for one-third of the industry’s trade. The development of the various uses of the internal combustion engine, the devising of techniques and equipment for burning oil fuels and the finding of ways of best applying hundreds of petroleum by-products all made the continuous rapid of oil demand possible.

ORGANISATION OF TECHNICAL SESSIONS

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Demand for oil
The atmosphere at the Congress was optimistic. Although Eger Murphree referred to the existing oil surplus and spoke of the need to find new outlets, there was generally little inclination to dwell on present difficulties. Most foresaw a bright future for the industry. Three papers were concerned with the future demand for oil: those by Guyol; Levy and Lipton; and de Ryckère. Although they were not based on uniform assumptions, and did not start from the same base year, their independent approaches resulted in a degree of unanimity, which was a surprise even to the authors themselves. Guyol conceded that oil might lose some markets to nuclear fuels and others to natural gas, but thought there would be gains in other areas. He thought the global requirement for oil would be 46 million b/d by 1975, representing 39% of a total energy requirement equivalent to 118 million b/d of oil. This compared with 19 million b/d of oil out of a daily requirement of 57 million b/d in 1958 – an increase of over 140% in 17 years.

Levy and Lipton envisaged a growth rate of 5.6% a year for the free world and a 1975 requirement of 41 million b/d, while de Ryckère’s forecast was of the same order of magnitude. These high estimates for future oil consumption depended in part on the assumption that nuclear energy would not be a serious competitor with oil in the next 15 years.

That the oil needed to satisfy the world’s growing requirements would in fact be found and produced was not questioned by any of the oil men gathered in New York. As was underlined by C. E. Reistle, (Humble Oil and Refining) the petroleum industry, faced with this sharp upward trend in energy needs, was staking a huge amount of time and money on research aimed at providing future consumers with
The world’s first full-scale nuclear power station started generating electricity for the UK national grid between the Fourth and Fifth Congresses, but discussions at the latter concluded that nuclear energy would not be a serious competitor with oil for the short-to-medium term. The picture shows Queen Elizabeth II inaugurating the plant at Calder Hall on 17 October 1956.
abundant supplies as efficiently as possible. Sir Stephen Gibson, speaking at the banquet, foresaw radical changes in drilling methods, further improvement in bits, more automatic control, better quality materials and further increases in the depth of wells.

**The dynamic art of exploration**

Searching for oil is always breaking new ground, in a literal sense, and in the sense of using new knowledge and techniques in conjunction with existing ones to resolve problems. Dr Levorsen presented a paper that tried to discern the techniques, concepts and factors that were most likely to guide and control oil exploration in the 1960s. He identified that the technologies that offered the greatest promise of usefulness centred around such problems as better correlations, more and improved data on fluid conditions underground, more drilling for purely stratigraphic control, and better oil and gas identification. He thought that to be fruitful, all data needed to be brought into a pattern and utilised, and theories and concepts developed to use this improved information effectively. The past and present preoccupation with purely structural traps would have to cease, and thinking be orientated towards the realm of stratigraphic and fluid phenomena. As Levorsen said, depth in geological thinking is as important as depth in drilling.

He identified that the intensity with which oil exploration is carried out depends a great deal on the prevailing economic and political climates. When supply and demand are seen clearly far ahead, exploration can proceed under long-range planning. But when either supply or demand changes abruptly, exploration can change abruptly too. For example, a breakthrough in the development of
atomic power could affect the extent of exploration of oil, as could the discovery of a mammoth new oil supply within the area of greatest market demand. Current estimates of ultimate reserves also affect the incentive to explore. In the USA, where experience is greatest, predictions of reserves come almost annually, and generally set a date of about 10 years ahead when the curves of discovery and reserves will turn downwards. This had been going for decades, but discoveries and reserves continued to rise each year.

**Economic factors in refinery location**

Marked changes in the distribution of the world’s oil refinery capacity occurred in the post-war era. Plants located in or near the centres of crude oil production represented a diminishing proportion of the total, whereas those located in consuming areas became more dominant. Frankel and Newton presented a paper on locating refineries in Europe, and Livingston presented one based on the USA.

Total refinery capacity in the non-Communist world outside North America quadrupled between 1939 and 1959. The proportion accounted for by resource-oriented plants fell from 70% (1939) to 35% in 1959, while market refineries increased from 30 to 56%. In 1939 Europe imported a quarter of its oil requirements as crude and three-quarters as finished products. By 1959 the proportions were 85% for crude and 15% for products.

Decisions on locating oil refineries are influenced by two opposing sets of forces – the pull of the raw material, i.e. the source of the crude, and the pull of the market. In the years up to 1959, outside the USA, it was the pull of the market that exerted the stronger force. The main economic considerations involved were the potential economies of large-scale operations, the relative cost of transporting crude and products, and the possibility of matching the refinery output pattern with the pattern of demand by product in the consuming area. When a balance has been struck between economies of scale and economies of transport, and when due account has been taken of the pattern of present and future market demand, the problems of refinery location are not yet solved. There are other considerations such as political factors and government policies.

Frankel and Newton thought the situation in Europe was still in a state of flux, despite the enormous expansion of refinery capacity since the war. In the 1950s refineries were planned for land-locked sites, fed with their raw material by large diameter pipelines. Frankel and Newton
called these ‘cul-de-sac’ refineries because of the difficulty of disposing economically of any products surplus to local requirements. Their conclusion at the New York Congress was that in the next 15 years (up to 1975) the free world would need at least a further 800 mt of annual refining capacity. Much of this could be provided by expanding existing refineries, but new refinery locations would also need to be chosen.

**Market research in the USA**

In 1959 selling was the oil industry's most crucial task, and market research was needed for it to be as effective as possible. Indiana Standard was one of the more advanced companies in terms of market research at the time, and so presented a paper on the subject.

Before 1930 not one company had a formally established marketing research department. By 1959 no less than two-thirds of integrated companies had one and most of the remaining third carried on similar activities organised in a less formal way.

**Open earth storage for residuals**

Only rarely is there a new development in oil storage. D. O. Wilkes of the Creole Petroleum Corporation presented a paper co-authored with two colleagues on the construction of open earth storage for black oils in Venezuela.

In the summer of 1955 additional fuel oil storage capacity was needed at the Amuay refinery to meet the high sales forecast for the winter of 1955-56. There was not enough time to build conventional steel tankage, so it was decided to build an earth reservoir. The reservoir was formed by enlarging and enclosing a natural indentation in a cliff line near the refinery with an earth wall about 13 m high. About 340,000 m³ of materials were excavated, of which 150,000 m³ were used to build the surrounding wall. The total capacity was about 3.75 million barrels of oil. Construction took only eight weeks and by 21 October 1955, 3.5 million barrels were in storage.

The reservoir was given a lining of specially compacted clay. After the reservoir was emptied in March 1956, it was found that the average depth of oil penetration in the floor was only about 5 cm; true leakage was concluded to be essentially nil. The plan had been to build a shed roof to protect the oil from contamination by sand and rainwater, but lack of time prevented construction and subsequent operating experience proved it to be unnecessary. This saved time and construction costs, reducing it to only about $0.29/barrel of storage, compared with $2 or more for steel tankage.

**The appeal of the diesel tanker**

In 1959 motor vessels accounted for 40% gross tonnage of the world’s shipping. It was a different story for larger tankers. Of the 253 tankers above 30,000 dwt delivered between 1952 and July 1958, only 29 were motor vessels, the rest were steam turbines. H. Andresen from Burmeister & Wain thought
that the chief reason for this was that when the supertankers were being planned, the diesel engine industry was not geared to produce plants on the scale needed. However, by 1959 a 21,000 hp engine was available. Although diesel engines were heavier, they required a lighter mass of fuel for a given journey, and had lower fuel consumption than turbines. In addition, diesel engines were very reliable. In the USA a diesel plant was cheaper than a steam turbine, but in Europe there was little difference. Andresen thought that a major reason for the choice of turbine over diesel engines was the advantage of speedy delivery and habit. Looking to the future, Andresen mentioned the interest being shown in a new B&W 12-cylinder engine which was designed for use in single-screw tankers up to 65,000 dwt.

The rise of the computer

‘Among the marvels to which the modern science of electronics has given birth few are more revolutionary in their implications than the electronic digital computer.’ By 1959 computers had already proved their worth in several aspects of the oil industry, as presented in a number of papers in New York.

Computers were used to simulate the operation of a complete plant unit, such as a refinery, with a view to maximising its efficiency. Tidewater’s Avon San Francisco refinery used computers to study how the yield of each of the main processing units and the yield of the final products varied with changes in the proportion of each of the components in a blend of crude oils. Five man-years of preliminary work were required before the routine could be put into regular use. But once the program was available, ‘only’ 25 hours of computer time was needed each month to do calculations which would otherwise require a staff of at least 10 full-time analysts and clerks.

By the Fifth Congress computers had proved their worth in several aspects of the oil industry – this IBM installation was used by Socony Mobil.
Another application for computers was in the design of large units of plant. The Esso Research and Engineering Company had worked for three years on computer programs for engineering calculations and used the results in designing refinery units.

The Plantation Pipe Line Company used computers to schedule and control the movement of products through its pipeline system. Between 1942 and 1959 the capacity of the system increased from 60,000 b/d to 334,000 b/d. Nearly 70 different kinds of products were transported through 10 inter-connected pipelines.

**THE SUEZ CRISIS**

The Suez Canal is a narrow waterway, 120 miles (190 km) long, dug through the Egyptian desert to link the Red Sea to the Mediterranean. It was opened in 1869 and the Suez Canal Company became an Anglo-French concern in 1875. The Canal was important to Britain as it halved the journey time to India, then part of the British Empire. However, in 1947 India gained independence and the Canal lost its traditional purpose. Meanwhile it had gained a new role, for the transport of oil. By 1955 petroleum accounted for two-thirds of the Canal's traffic, and in turn two-thirds of Europe's oil passed through it. The Canal was a critical link in the post-war structure of the international oil industry.

By the 1950s Britain had exercised control over Egypt, and thus the Suez Canal for three-quarters of a century. By treaty, the concession was due to end in 1968, and British influence was already in retreat. Anthony Eden, Prime Minister of Britain, was concerned when Colonel Abdel Nasser, a strong Arab nationalist, emerged as leader of Egypt in 1954. Alarm about Nasser grew in London and Washington in 1955, when it was learned that he had turned to the Soviet Bloc for weapons. Oil companies were also worried about the possibility of disruption of supplies.

Eden did not want the Suez Canal to be run by Egypt. When Nasser announced that he was nationalising the Suez Canal Company, in which Britain and France had controlling interests, Eden devised a secret plot with France and Israel whereby Israel would invade Egypt across the Sinai Peninsula. Britain and France would then give an ultimatum to the parties to stop fighting, or they would intervene to protect the Canal. On 29 October Israel launched its attack into the Sinai. The next day London and Paris issued their ultimatum and announced their intention to occupy the Canal Zone. This took place, but France and Britain had not informed the USA. President Eisenhower was furious. Before Britain and France had entered the Canal Zone, Nasser had scuttled enough ships to effectively block the waterway. Syrian engineers sabotaged the pumping stations along the pipeline of the Iraq Petroleum Company, which further reduced supplies. By the beginning of December 1956, the Canal had been closed for a month and Western Europe was on the brink of an energy crisis, when an emergency supply programme finally swung into operation. The Oil Lift was a co-operative venture between governments and oil companies in both Europe and the USA. Its main focus was to redeploy tankers so that the Western Hemisphere once again became the main supply source for Europe rather than the Persian Gulf. In addition, rationing and other oil saving measures were put in place. By the spring of 1957 the oil crisis was finally coming to an end, due largely to the effectiveness of the Oil Lift, which was suspended in April 1957. Overall, Europe was not as vulnerable to oil disruptions as it would later become as in the 1950s; it was still primarily a coal economy.

Harold Macmillan, then British Chancellor of the Exchequer, told the Cabinet that the only way to save the situation was for an IMF loan backed by the USA. The Americans refused to back the loan, and insisted that the European forces evacuate. British and French troops left Egypt by December 1956, and Eden resigned early in 1957. In March 1957 the Iraq Petroleum pipelines were partly reopened, and by April the Suez Canal had been cleared enough for tankers to resume passage. Nasser had won – the Canal was owned and operated by Egypt.

The Suez Crisis was a watershed for Britain. It highlighted the fact that Britain was no longer a top world power. *The Times* newspaper said of Anthony Eden, when he died in 1977, ‘he was the last prime minister.
on behalf of 16 marketing companies. A digital computer was installed in 1956, which made delivery forecasts twice a day and corrected them by tracking the actual movement of the batches through the system.

Computers were also used in operational research. Operational research frequently investigates the behaviour of a system by constructing a mathematical model and studying the effect of altering the variables. Several papers described the application of this technique to budgeting and to various marine transport and tankage problems.

to believe Britain was a great power and the first to confront a crisis which proved she was not’.

There were also repercussions for the oil industry from the Suez Crisis. Despite the reopening of the Canal, oil companies were no longer confident that they could rely on it. They were also aware of the vulnerability of pipelines following the disruption of the Iraq Petroleum Company’s line. A safe route for oil was around the Cape of Good Hope. However, the general view was that it was not possible to build tankers large enough for this journey to be economical and practical. Japanese shipyards soon proved otherwise.

Scuttled ships blocked the Suez Canal during the 1956 crisis.
CELEBRATING
75 YEARS OF
THE DISCOVERY
OF OIL IN BAHRAIN

The year 2007 has been the year of achievements for Bapco and the Kingdom of Bahrain - foremost of which is the successful completion of one of the largest projects in Bapco’s history, the construction of the Low Sulphur Diesel Production (LSDP) complex, a significant milestone in Bapco’s ongoing Strategic Investment Programme.

The project, at a total estimated cost of US$725 million, will produce low and Ultra-Low Sulphur Diesel, down to 10 ppm, to meet the most stringent market specifications.

It is also the year when Bapco achieved the distinction of being the first company outside North America to receive the prestigious R.W. Campbell Award, the National Safety Council’s international award for business excellence through Safety, Health and Environment (SH&E) management.
World oil consumption increased by a third in the four years following the New York Congress. Oil prices also changed between 1959 and 1963 as the oil markets were weakened after the Suez Crisis of 1956-7. In both the Middle East and Venezuela posted prices for crude oil were reduced in February 1959. Further reductions were made in 1960. The price cuts had not been restored by the time of the Frankfurt Congress of 1963. Crude oils were sold at considerably lower prices than in 1959. It was not only the growth of competition that caused problems for oil executives. The increasing complexity of industry/government relationships added to the difficulties of doing business. And OPEC was created in 1960.

The Sixth World Petroleum Congress was held in Frankfurt am Main from 19-26 June 1963. The public relations and press committee had worked hard, and there was a major media presence with 437 journalists from 25 countries covering the Congress.

The Opening Ceremony was presided over by Professor Dr Ludwig Erhard, then Vice Chancellor of the Federal Republic of Germany (he would become Chancellor in October 1963). The main social

The Executive Committee of the Permanent Council held several meetings to prepare for the Sixth Congress. The last was held in Kronberg, 17-18 January 1963, and the picture shows from left to right: Derek Hough (Secretary General), Sir Stephen Gibson (WPC President) and Erwin Bockelmann (President of the Sixth Congress).
events were a reception and dinner in the main Congress hall for 1,300 delegates and their wives, with a dinner dance at the Palmengarten for a further 1,000. During the middle weekend there was a performance of *Cavalleria Rusticana* at the Frankfurt Opera House. The sheer numbers of delegates and their wives swamped these social events and many delegates had to find their own entertainments. A boat trip on the Rhine attracted some 3,500 people. The Committee members and their wives attended a reception hosted by the West German President, Dr Heinrich Lubke.

There was a large exhibition of petroleum equipment together with petroleum books and journals, which was very successful. Six thousand delegates walked round the exhibition at least twice, and 75,000 other people also visited it, which caused some overcrowding.

**SIR HORACE STEPHEN GIBSON 1897-1963**

Stephen Gibson, who was knighted in 1956, looked the very picture of a prosperous British farmer – which is what he was in his spare time from being the Managing Director of the Iraq Petroleum Company. He was also an enthusiastic and knowledgeable wine connoisseur, a good raconteur, and a diplomat and negotiator of the highest distinction.

Gibson was WPC President for four-and-a-half-years until his death in 1963. During his Presidency, every problem that came before the Permanent Council was agreed amicably, without ever once being put to the vote. His infallible method, when an impasse seemed to be reached, was to call a tea or coffee break, when he would amble cheerfully from group to group, cup in hand. Always, a unanimous solution of some sort or other was forthcoming. During the discussion on whether or not to hold the Petroleum Equipment Exhibition in Frankfurt, the dissenters, with some reluctance, agreed to withdraw their objection in the face of a considerable majority for accepting the German proposal.

At the meeting of the Permanent Council held during the Frankfurt Congress, Gibson was re-elected President but died before the first meeting of the new Executive Committee was held. Jan Beukers of the Netherlands stepped in as acting President until the convening of a special meeting at which Erwin Bockelmann was elected the new President. (Hough).
WPC BUSINESS

A lively debate took place in Frankfurt on the size of the Permanent Council. Iran and Japan had joined making a total of 14, while other members wanted to join, and the size of the Council was threatening to hamper its effective functioning. It was decided to open up the Permanent Council to all countries ready to create a WPC National Committee and to accept the WPC Constitution and guidelines, while at the same time creating a new Executive Board. This would have 12 permanent members (the 12 pre-1963 Council members) and four others. The 12 permanent members were: Austria, Belgium, Canada, France, Italy, Mexico, the Netherlands, UK, USA, USSR, the Federal Republic of Germany and Venezuela.

A system of annual dues to be paid by WPC members was agreed with a minimum of $2,500 and a maximum of $20,000 per country.

It was decided that in future the range of views expressed at Plenary sessions could be widened by inviting ministers, international organisations and national oil companies as well as the chief executives of the large corporations to speak, the aim being to develop dialogues between consumers and producers and among the nations of the north/south divide.

One of the great successes of the Frankfurt Congress was the introduction of simultaneous translation. Another innovation, which had a major influence on the planning for the Seventh Congress, was that the presentation of some papers was organised into panel discussions. At Frankfurt the panels were made up of independent papers that were not specially prepared for this purpose. Based on this experience, at the Seventh Congress a larger number of papers were presented in panel form. But, only after suitable topics were chosen for each panel, were papers sought to fit in with each panel theme.
**PAPERS PRESENTED**

**West Germany**

By 1963 West Germany was one of the world’s leading oil markets. In 1962 inland sales of petroleum products reached 43 mt in Germany, making it the third largest consumer in the free world after the USA and the UK. In 1950 West German oil consumption had been only 3.5 mt. In common with other countries, the primary factor in the fast expansion of oil consumption in West Germany was the rapid growth in the demand for light fuel oils, mainly for heating, and heavy fuel oils for industrial purposes. Total crude capacity increased from less than 15 mt at the end of 1956 to 46.7 mt by the end of 1962.

**R&D**

Several plenary speeches drew attention to the acceleration in world-wide research spending. In the USA, R&D expenditure by government and business grew from $2,800 million in 1950 to $15,700 million in 1962. This was 3% of GNP, compared with 1% in 1950. Delegates discussed whether this increase was sustainable and whether it could be translated into lower costs and greater efficiency in the industry. The pace of technological change resulted from the increased investment in research.

André Giraud listed some of the innovations in the oil industry that had occurred in the 30 years up to 1963:

- **1930s** – electric well-logging, deflection drilling and catalytic cracking;
- **1940s** – various catalytic processes, synthetic rubber, secondary recovery methods and electronic controls;
- **1950s** – miscible gas injection, offshore drilling, development of chemicals from petroleum, and stereospecific polymerisation;
- **Early 1960s** – hydrocracking.

Prospective new uses for petroleum were discussed by Giraud and Rathbone. Rathbone considered the development of a petroleum-based protein that could be a food for human consumption.
New trends in product usage
In the free world, just before the 1959 Congress, the percentage of total energy consumed in the form of petroleum fuels, not including natural gas, exceeded that of solid fuels for the first time in history.

Gas
By 1963 natural gas was already significant in the USA and assured of expanding markets elsewhere due to new gas discoveries, plans for new pipelines, such as from the Sahara to Southern Europe, and the export of LNG from Algeria to Northern Europe. At the time the intention was to use the material for making town gas, but it was thought that other applications would be developed.

World-wide sales (excluding the Soviet Bloc) of propane and butane doubled between 1959 and 1963, mainly through agricultural and industrial uses and new procedures for enriching or manufacturing town gas. Experiments indicated that it might be possible to use these liquefied petroleum gases to desalinate water at a low cost.

Cars
A major theme was the need to develop new and more stable lubricants to meet the constantly rising specifications of the automobile industry and other large-scale users.

After 35 years of supremacy as a practical anti-knock additive, tetraethyl lead (TEL) was supplemented or sometimes replaced by the more volatile tetramethyl lead (TML). This was brought to the fore by
California Standard, and had intrinsic advantages as an anti-knock in highly aromatic gasolines of high octane numbers.

Air pollution studied in California led to the observation that a large proportion of the unburnt hydrocarbons released into the air by motor vehicles came from the crankcase due to blowby past the pistons. As a result, crankcases were modified so that all crankcase fumes were vented to the engine induction system from which they passed on to the combustion chamber to be consumed. Meanwhile in mid-1960, a Bromine Number limit of 30 for gasoline (implying an olefin content of not more than 15%) was imposed in Los Angeles County, in the belief that some of the worst constituents of smog arose from the atmospheric oxidation of unburnt olefins.

There were very few private diesel cars in the USA in the early 1960s. The possibility of the gas turbine ousting the gasoline engine from the private car came little nearer between 1959 and 1963, presumably owing to difficulties in developing heat exchangers and control systems applicable to road vehicles. The large-scale use of fuel cells in vehicle propulsion is generally believed to be a long-term matter, of perhaps 10-15 years’ (C. B. Davies, Shell).

**Inside the USSR**

One great merit of the Congress was that it provided a venue for ‘East’ and ‘West’ to meet. About 30 Russian specialists attended the Frankfurt Congress. The recent achievements of the USSR included the development of natural gas reserves and an increase in the output of crude oil from 37 mt in 1950 to 186 mt in 1962, with its share in total energy production rising over the same period from 18.4% to 35%. Over 70% of the crude oil output in the early 1960s came from the highly productive and relatively recently opened Ural-Volga area. As a result, the average cost of crude oil production in the USSR was cut by a half between 1950 and 1963. Some 70% of all crude was produced in fields where waterflooding or other techniques to maintain pressure were in use – these methods prolonged the economic life of many fields four- or five-fold.

The expansion of crude oil production created a need for transport and refining. By 1960 there were 17,200 km of crude and products pipelines in use throughout the USSR, compared with 6,000 km in 1950.

**Precision in E&P**

Scientific aids were used increasingly in exploration and production. Better instruments and the automatic handling of data enabled these operations to be planned with greater precision. Geophysical prospecting in the early 1960s entailed modification of field techniques and the introduction of new ones. Developments had taken place in every branch of geophysics. In seismic exploration, magnetic tape used with computers enabled new techniques for interpretation. The use of sources other than conventional dynamite explosions was increasing, and the number of weight-dropping crews grew from 15 to 45 in the Western world between 1959 and 1963.
The use of digital methods for processing was growing rapidly because computers were more accessible and because high-speed analogue-to-digital converters were available. One paper studied the potential and limits of the new methods for processing seismic data. The speed of computers invited new approaches in interpretation, both in gravity and magnetics. For well logging too, a notable development was the electronic digitising of well logs and the use of computers in log evaluation. The nuclear magnetism log was a new device.

Among the most interesting papers dealing with drilling were those relating to the use of the turbine, much preferred by the Russians. The performance of the electrodrill was being improved for use at greater depths. The design and operation of turbo-drills and mud-pumps was being modified for turbo-drilling with rock-bits. The progress of turbo-drilling was slow in the West for a number of reasons, principally economic – in France it only accounted for 3-5% of footage drilled.

‘Optimisation of the drilling parameters’ was the term for a new technology in the USA. It aimed to increase the economic efficiency of the bits by determining at every stage the best combination of speed of rotation and weight on the bit throughout its life. In many cases, it permitted a reduction of 25% in the cost per foot drilled with the rotary. It could also be extended to turbo-drilling with a diamond bit, the working of which was easier to formulate.

Drilling at sea had also advanced. By 1963 it was possible to drill from floating platforms in potentially any depth of water without needing divers.

**Completion to depletion**

A paper from Colombia put forward an improved oil well completion technique to permit control of reservoir pressure, flow volume and temperature. It proposed a novel way of controlling the flow of oil and gas from a pool by utilising the reservoir energy, namely gravity and heat. All associated gas was re-injected under a hydrocarbon fluid gas and/or oil injection system at the well site without the use of mechanical compressors or pumps.

**Mathematical models for management**

There was much discussion at Frankfurt about how mathematical techniques, such as linear programming and simulation, could be applied to managerial problems. By 1963 linear programming was used to tackle problems in every sector of the petroleum industry. ‘Using modern computer techniques and procedures, supply models with over 600 equations, including more than 4,000 variables, have been successfully solved in less than 20 hours. The technique employed was known as LP/90, a system devised under the sponsorship of a number of American oil companies, Esso, Shell, Socony Mobil, Gulf, Texaco and Union Carbide’ (R. V. Kahle).

Linear programming was also used in the planning of refineries. A paper by G. L. Farrar discussed several examples of computer-controlled refinery units. The first was the catalytic polymerisation unit
of Texaco’s Port Arthur refinery, which made history when it switched to computer control in March 1959. This was responsible for increasing propylene conversion in the unit from 80% to 91%, each additional barrel representing about $3.50. The paper listed 32 applications of digital computer control in petrochemical plants.

**The case for better statistics**

The case for improvements in oil statistics was strongly argued at Frankfurt by Professor R. Wagenfuhr and G. F. Eich. The Statistical Office of the European Communities, with which the authors were connected, prepared a regular survey of product prices. Work on oil statistics started in the early post-war years in connection with the various programmes for European refinery expansion, but it was widened significantly after the Suez Crisis. The periodical publications of the OECD on oil production, refining, trading and consumption in Europe, and sometimes in North America, had become important sources of information.

**New perspectives in refining**

Foreseeing no fundamental change in the pattern of demand for products over the next 10 years (to 1973), a group of research workers from Socony Mobil, anticipated major innovations in refining technology, in response to the quest for better quality and lower cost. Frankel and Newton took a
cautious approach, and predicted that between 1963 and 1973, oil consumption would rise at a lower percentage rate than in the recent past. Even so, they thought that in 1973 oil consumption in the free world would be 33.8 million b/d, compared with an estimated 22 million b/d in 1963 and 12.1 million b/d in 1953.

The paper by Elliott and others (see Table 1) forecast that between 1963 and 1973, many new refineries, usually without catalytic cracking, would be built in Europe, and also in developing countries. However, in North America, there was already excess capacity, and the emphasis would be on improving existing plants.

### Table 1

**OIL DEMAND IN THE NON-COMMUNIST WORLD, MILLION B/D (ELLIOTT, PORTER AND KESSLER, 1963)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Region</th>
<th>Gasoline</th>
<th>Distillates (including jet fuels)</th>
<th>Residuals</th>
<th>LPG</th>
<th>Other products</th>
<th>All products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>North America</td>
<td>3.5</td>
<td>1.9</td>
<td>1.6</td>
<td>0.3</td>
<td>0.7</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Europe</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
<td>0.1</td>
<td>0.3</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Remainder</td>
<td>0.5</td>
<td>0.5</td>
<td>0.9</td>
<td>&lt;0.1</td>
<td>0.3</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>4.5</td>
<td>2.8</td>
<td>3.0</td>
<td>0.5</td>
<td>1.3</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>37</td>
<td>23</td>
<td>25</td>
<td>4</td>
<td>11</td>
<td>100</td>
</tr>
<tr>
<td>1963</td>
<td>North America</td>
<td>4.7</td>
<td>3.1</td>
<td>1.8</td>
<td>0.7</td>
<td>1.1</td>
<td>11.4</td>
</tr>
<tr>
<td></td>
<td>Europe</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
<td>0.1</td>
<td>0.8</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Remainder</td>
<td>1.1</td>
<td>1.2</td>
<td>2.1</td>
<td>0.1</td>
<td>0.7</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>6.8</td>
<td>5.8</td>
<td>5.9</td>
<td>0.9</td>
<td>2.6</td>
<td>22.0</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>31</td>
<td>26</td>
<td>27</td>
<td>4</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td>1973</td>
<td>North America</td>
<td>6.2</td>
<td>3.6</td>
<td>2.2</td>
<td>1.2</td>
<td>1.6</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>Europe</td>
<td>1.7</td>
<td>2.6</td>
<td>3.8</td>
<td>0.2</td>
<td>1.2</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>Remainder</td>
<td>1.9</td>
<td>2.4</td>
<td>3.7</td>
<td>0.3</td>
<td>1.2</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>9.8</td>
<td>8.6</td>
<td>9.7</td>
<td>1.7</td>
<td>4.0</td>
<td>33.8</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>29</td>
<td>26</td>
<td>28</td>
<td>5</td>
<td>12</td>
<td>100</td>
</tr>
</tbody>
</table>
Frankel and Newton updated their 1959 paper on the trend to build refineries in or near areas of consumption, instead of concentrating refinery constructions in major producing/exporting areas. Since 1959 the trend towards the dispersion of refineries had gained further momentum. Virtually all the new capacity under construction in 1960-65 was ‘market-orientated’. By the end of 1965 market refineries would account for nearly 80% of the capacity in the free world outside North America (see Figure 1 on page 81).

A feature of the late 1940s and 1950s was the construction of ‘intermediate’ refineries, en route between the oil-producing and consuming areas, and designed to give more flexibility to refining and marketing operations. The share of such refineries in total capacity reached a peak of over 9% in 1958 and then declined rapidly. Some of these refineries then served expanded local markets, primarily.

The dispersion of refineries into the markets also produced a trend whereby several companies combined forces in refining operations in order to enjoy some economies of scale. The number of jointly owned refineries in the free world outside North America was expected to increase from 20 (with a combined capacity of 730,000 b/d) at the end of 1959 to 42 (2.1 million b/d) by the end of 1965.

Providing talent for the industry
The rapid expansion of the oil industry and the increasing complexity of operations created problems in education and training, particularly in developing countries.

How much oil?
Among the papers presented at the Frankfurt Congress was a new and exhaustive review of exploration activity throughout the world which described developments in 110 countries. L. G. Weeks’ estimates of reserves are shown in Table 2, together with figures of cumulative production. It shows that proved reserves were equivalent to 40 years’ production at the annual rate of 1963, and were four times as great as those proven in 1950, despite a rate of production which more than doubled in that period.

The impression left by the papers at the 1963 Congress was that in every stage of oil exploration and production, former arts were turning into modern sciences. There was more accuracy, more mathematics. Better instruments of measurement supplied more data which could be handled by computers to balance the many variables. It should then be more straightforward to choose rationally the best course.

<table>
<thead>
<tr>
<th>World Oil Production and Reserves, Million Barrels (Weeks, 1963)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative production to 1/1/1963</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>North America</td>
</tr>
<tr>
<td>South America</td>
</tr>
<tr>
<td>Europe</td>
</tr>
<tr>
<td>Africa</td>
</tr>
<tr>
<td>Middle East</td>
</tr>
<tr>
<td>Far East</td>
</tr>
<tr>
<td>Soviet Bloc</td>
</tr>
<tr>
<td>Total World</td>
</tr>
</tbody>
</table>
Nigerian National Petroleum Corporation

... we touch your lives in many positive ways

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Adding Value to Your Investments in Nigeria’s Hydrocarbon Resources
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The Seventh Congress was overshadowed by war, with the build-up of US forces in Vietnam and tensions rising in the Middle East, which led to the Arab-Israeli Six Day War in June 1967. Despite some reservations, the Congress was held in Mexico City from 2-9 April 1967. It was officially opened by the President of the Republic of Mexico, Gustavo Díaz Ordaz. The ceremony took place in the grounds of the colourful National Museum of Anthropology and History, and some 6,000 people took part.

The official social events were well conceived and presented. A typical Mexican fiesta was held on the lake shore of Chapultepec Park, with singing and dancing on floats on the lake, a firework display and a buffet. There were a number of performances given at the Palace of Fine Arts by the Folkloric Ballet of Mexico. On the last evening there was a farewell dinner in the courtyard of the 18th century Colegio de las Vizcainas. The dinner was served by candlelight to 3,000 people at tables set in the old courtyard and the surrounding flower-bedecked balconies, accompanied by Mexican folk music.
Ten excursions and technical visits were included in the programme to give interested participants a general idea of the Mexican oil industry. During the week of the Congress, excursions were organised to visit industrial facilities in the neighbourhood of Mexico City, and afterwards there were trips to oil fields and installations located in other parts of the country.

**WPC BUSINESS**

Prior to the Mexico City Congress, the Permanent Council had decided to set up the Scientific Programme Committee (SPC) under the Chairmanship of René Navarre of France and with Bruno Mascanzoni of Mexico as Secretary. The SPC members were from France, Italy, Mexico, the Netherlands, USA, USSR and West Germany. At the Seventh Congress, Argentina, Iran and Japan were elected to the Permanent Council. A procedure was agreed for the selection of venues for future Congresses. The Permanent

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**ARAB-ISRAELI SIX DAY WAR**

The Six Day War erupted in June 1967 between Israel and the Arab states of Egypt, Jordan and Syria. Israel and its Arab neighbours had been hostile towards each other since 1948, when Israel became a nation state. In 1956 Israel over-ran Egypt in the Suez-Sinai war. In retaliation Gamal Abdel Nasser, President of Egypt organised an alliance of Arab states surrounding Israel and prepared for war. On 22 May 1967, Nasser announced the closure of the Strait of Tiran, a vital shipping corridor for Israel with links to the Red Sea and major sources of petroleum. A similar closure of the Strait had been a major cause of the Suez Crisis in 1956 – when Israel declared that it would regard another closure as an act of war. So Israel attacked first on 5 June 1967 and drove Arab armies from the Sinai Peninsula, Gaza Strip, West Bank and Golan Heights, which it then occupied. On 7 June the UN arranged a cease-fire between Israel and Jordan that went into effect that evening. On 10 June Israel and Syria reached a cease-fire agreement. Egypt, Jordan and Syria had lost almost all of their air forces and much of their armed weaponry. In all, Egypt lost about 11,000 troops, Jordan 6,000, Syria 1,000 and Israel 700. The Six Day War was viewed as an enormous victory for Israel.
Council at one Congress would decide by vote on the venue of the next Congress. Invitations had to be lodged four months before the Council vote.

Rien Tuyn (one of the Dutch representatives on the Permanent Council) was asked by the Executive Committee to write to all the National Committees, setting out the broad principles upon which the technical sessions of the Seventh Congress would be based. Rien Tuyn had joined the Executive Committee in 1961 and from his first meeting had shown that he held very positive views on most subjects and an uncompromising regard for the original basic concept of these scientific Congresses. He was once described by Erwin Bockelmann (President from 1963-1966) as 'the Congresses' scientific conscience', as he never allowed political, commercial or any other kind of expediency to divert him from the Congresses' scientific ideals.

**PAPERS PRESENTED**

For the Seventh Congress, the SPC decided to invite renowned men of science to present a review of the latest developments in their own field. Sixteen final subjects and their authors were chosen. In addition, and to complement the Technical Programme, the SPC organised a number of individual papers that dealt essentially with original developments, and made valuable contributions to matters not covered specifically in the Panel Discussions. There were 64 of these individual papers, organised into 16 sessions:

1. Geochemistry
2. Regional problems – exploration and drilling (special reference to offshore aspects)
3. Regional problems – exploration and drilling
4. Drilling
5. Special aspects of production
6. Gas fields and underground storage
7. Some aspects of the use of mathematical methods and computers in exploration and production
8. Some special aspects of refining
9. Petroleum-based intermediates for chemical manufacturing
10. Petrochemistry
11. Engineering and related physical matters
12. Problems related to the use of hydrocarbons at low temperatures
13. Combustion – special reference to engine problems
14. Some aspects of engine problems
15. Pipeline transportation – special aspects and projects
16. Some special aspects of water conservation and air pollution

There were 42 Panel Discussions, each handled and organised by a Chairman of scientific merit in the field, and 299 papers were presented in total. The actual sessions of Panel Discussions were
scheduled to last an average of three hours, but some took up to six
hours. In all of them, there was time for general discussion.

During the Seventh Congress a serious attempt was made to
quantify proven, probable and possible reserves of oil. A firm link was
established between the latest university research in the USA and
Europe and research within the petroleum industry. An overview of
developments in catalysis which had been commissioned in 1964-5
was presented in detail. Advances in conversion processes in refining
papers were grouped together for analysis and discussion.

**New producing regions**

Wildcat discoveries are always exciting and a few barrels a day in a
new area arouse as much interest as an extra 10,000 in a known oil
region. Some time then elapses before intensive exploration allows
an estimate to be made of the true potential of the new find and of
the surrounding territory. Nineteen papers at the Mexico City
Congress analysed the geology, and in some cases estimated the
possibilities, of some new producing areas. In several cases the new
area was an extension of an oil province which itself was new only a few years earlier.

The characteristics of the Anticlinorium of Hassi Touareg and the new petroleum province of
Hassi Touil in the Algerian Sahara were described by J. Claret and C. Tempère of ERAP (Entreprise
de recherches et d’activités pétrolières). A fault was revealed by photogeology and gravimetric survey,
leading to the drilling of the first well in 1959. The structure was defined by seismic refraction and
reflection. By mid-1966, 12 structures or distinct parts of a structure had been established, partly by
drilling, and seven fields had been discovered.

Seismic surveys were the main instrument for detecting the Tertiary sediments of the Niger Delta,
followed by exploration and appraisal drilling, according to E. J. Fränkl and E. A. Cordry (Shell-BP
Petroleum Development Company of Nigeria and Nigerian Gulf). Multiple reservoirs were often
discovered only during drilling and, owing to minor faults and other characteristics, constant subsurface
geological analysis was necessary when developing a discovery – surprises, both positive and negative,
were not uncommon. The success ratio was high: in mid-1966, out of 277 exploratory tests nearly half
(136) had been successful, while the statistics for offshore taken by themselves were even better – 25
discoveries out of 48 wildcat wells.

M. F. Mirchink and others (USSR Academy of Sciences) discussed new major oil- and gas-bearing
areas of young platforms. In the USSR this included the West Siberian depression, the plains of Central
Asia, the Cis-Caucasian belt and the Crimean steppes. These regions were investigated by drilling and

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**EXCELLENT PLANNING AND EXECUTION**

Jesús Reyes Heroles (1921-1985),
President of the Mexican
Organising Committee and the
Director General of Pemex, was the
grand architect of the very fine
administration which made it all
appear so effortless, and Francisco
Corcuera, the Executive Secretary, put the planning into
operation. Francisco Corcuera was a tremendous character
and a great sportsman. He had represented Mexico both in
sailing races and in the Pacific Ocean international tuna
fishing championships. He played golf off a very low
handicap and was a famous shot (Hough).
geophysical methods in the decade up to 1967. The range of occurrence of oil and gas was found to be very wide, from Lower Jurassic strata to Pliocene, but the bulk of reserves were found in Mesozoic strata. Major oil- and gas-bearing areas were discovered within the West Siberian depression, the Bukhara-Khiva area, Southern Mangyshlak, and the Cis-Caucasian area. The extent of the reserves discovered in only 10-15 year’s work suggested that the vast territory of the young platforms would be a rich source.

Two major gas- and oil-bearing provinces in Siberia were described in another paper. The West Siberian lowland had 675,000 square miles (1.75 million km²) of prospective oil land, in which 36 gas and gas-condensate, 44 oil and two oil-gas deposits had already been discovered. About 15 new accumulations were being discovered each year, most of which were large. The East Siberian province, a total prospective area of 1.3 million square miles (3.4 million km²) was considered equally promising. It was thought that these two Siberian provinces could be the main source in the future of increases in oil and gas output. In general, it was felt that the Russian delegates gave very large estimates of the potential reserves in some oil provinces of the USSR.

The search for oil in Alaska was described in a paper by Indiana Standard. Up to the end of 1966 the industry had invested about $700 million to achieve Alaskan production of about 50,000 b/d. The ultimate reserves in the Cook Inlet Basin were estimated at 1.5 billion barrels of oil and 5 trillion ft³ (0.14 trillion m³) of gas.

The Congress concluded that although the search for oil and gas had been going on for so long, many areas of the world had still not been explored by modern methods. It was thought that whole new provinces could exist in areas such as Thailand, where little deep drilling had been done in geologically active territory.

**Offshore exploration**

By 1967 the continental shelves of the world had been explored unevenly. This was evident from the Congress papers, which dealt with areas ranging from the Gulf of Mexico, with 24 seismic crews, 58 mobile rigs, 390 geologists and 520 geophysicists at work in 1966, to the barely surveyed Hudson Bay. In between were areas with considerable activity, such as the Caspian Sea and the North Sea. The Gulf of Mexico had been explored more thoroughly than any other continental shelf area by 1967. It occupies a huge sedimentary basin, 1,000 miles (1,600 km) long and 600 miles (960 km) wide; the flat continental shelf areas cover about 225,000 square miles (580,000 km²) to the 100 fathom (180 m) water line.

By the end of 1965 proved reserves totalling 2.2 billion barrels of oil and 20.7 trillion ft³ (0.58 trillion m³) of gas had been discovered, including seven major oilfields and 12 major gas fields. The
costs of drilling and production were very high, so more effective exploration techniques were being researched. Computers were being used to improve techniques.

One of the best explored offshore areas of the USSR was the Caspian Sea, with a surface of 430,000 km² and a maximum depth of 1,020 m. The world’s first commercial production of offshore oil began in 1922 in the Ilych bay region, south of Baku. In 1965 some 10.6 mt of oil and 2.2 billion m³ of gas were produced from offshore Azerbaijan. By 1967 nearly 20 highly productive oil and gas fields had been found entirely or partly under the Caspian Sea, mostly off the west coast.

It was understood at the Mexico City Congress that they were still in the early days of offshore work, and that the next few years were likely to see a great development in work on the continental shelves, both in geographical spread and in the techniques of operation.

**World reserves**

The significance of world oil reserves was discussed by D. C. Ion. He explained that estimates of world reserves were not consistent, because methods of measuring and estimating varied in different parts of the world. Definitions could differ as well. Thus it would be a long time before an accurate, uniform calculation of world reserves would be possible. As Ion said, ‘reserves are valuable only as the source of potential supply to meet potential demand’. For this reason, their value varied according to their location and quality, and to the pattern of demand, governed by the availability of alternative forms of energy, together with economic and political considerations.

The table on page 92 shows estimates of ultimate reserves, discovered reserves and Ion’s extrapolated estimate of discovered reserves. One anomaly results – in the Middle East, the volume of oil estimated to be in place exceeds the level Hendricks thought ‘discoverable’.

Proved reserves were defined as the volume of oil or gas remaining in the ground, which geological and engineering information indicated with reasonable certainty to be recoverable in the future from known oil reservoirs under existing economic and operating conditions. The basis of estimating varied from country to country. Between 1961 and 1965 proved reserves increased by 43 billion to 348 billion barrels, while production was 40 billion barrels.

In assessing the volume of reserves, every barrel was treated as the equal of every other barrel, though in the industry, the quality and specification of the crude was very important. As important was the

A notable petroleum event of 1967 was the start-up of the Great Canadian Oil Sands (now Suncor) mine at Fort McMurray in Alberta.
location of reserves – their geographical position, their depth and, for offshore fields, the distance from the coast. Twenty years earlier the potential of offshore areas and outlying territories such as Alaska and Australia had been disregarded. By 1967 it was an important feature of the world total.

Continual changes in the pattern of market demand also affected the relative value of each barrel of crude. The increasing number of uses for the wide range of petroleum products had created – and was still creating – new markets, with the result that more oil was required.

Thus for a number of reasons, the significance of reserves was constantly changing, which precluded mathematical accuracy in their assessment. Ion concluded that proved reserves statistics were sufficiently accurate for short-term considerations, but ultimate reserves were less easy to estimate and the figures therefore needed to be treated with caution.
Thanks to its advanced storage facilities and its network of underground pipelines, CLH can guarantee safe, high quality fuel supply. In fact, CLH has the most extensive network of pipelines in Western Europe, managed by state-of-the-art technology through satellite-guided information systems.
Since the Seventh Congress the petroleum world had been subject to a number of serious geopolitical shocks. The Suez Canal was closed as a result of the Six Day War and was to remain shut until 1975, while there were changes of government in Iraq in 1968 and Libya in 1969. On the positive side, oil was discovered on Alaska’s North Slope in 1968 and investment in North Sea exploration was accelerating.

By 1971 there was considerable interaction between the oil industries of the Communist and non-Communist parts of the world. The USSR was buying natural gas from Iran and Afghanistan and was on the verge of selling large volumes of gas to Western Europe. The Soviet Bloc’s export of oil industry equipment, and its participation in foreign development projects, was matched by its import of steel pipe and equipment from Western countries.

A distinctive feature of the free world’s oil industry was the dependence of major consuming areas on overseas resources, which were often under the control of unsympathetic governments. The situation
The drawbacks of over-dependence on overseas reserves were highlighted in the years between the Mexico and Moscow Congresses. In June 1967, a few weeks after the end of the Mexico Congress, a major crisis erupted in the Middle East, with the Six Day War leading to a temporary Arab export ban to some Western destinations and to the long-term closure of the Suez Canal. The situation was further aggravated by the cutback in Nigerian production during that country’s civil war. However, oil supplies were restored by a temporary shift to other production areas, while the economic effect of the Canal closure was reduced by the emergence of very large crude carriers.

In 1970 there was an unexpectedly rapid increase in oil demand in major consumer countries, coupled with the temporary closure of the Trans-Arabian Pipeline and the sudden imposition of restrictions in Libya. The result was renewed logistical problems, which strengthened the position of overseas producing countries, in relation to the oil companies and to the ultimate consumers. By the time of the Moscow Congress the threat of conflict between host governments and oil companies seemed to have been averted, but at the expense of a sharp rise in the cost of oil.

The Eighth World Petroleum Congress was held in Moscow from 13-18 June 1971. A focus of attention was the oil and gas industry of the USSR, together with Soviet petroleum research and engineering and the potential for the USSR to engage in more international co-operation.

The Congress was officially opened by Frederick Rossini, the President of the WPC, after M. F. Efremov, the Deputy Chairman of the Council of Ministers of the USSR, had read a greeting to participants from his Chairman, A. N. Kosygin. A buffet reception was held and there was a performance of ballet and folk dancing by some of the greatest dancers in the Soviet Union. The three main social occasions took place in the Palace of Congresses, the other side of Red Square from the Rossia Hotel where the technical sessions were held. The new Rossia Hotel was large enough to accommodate all the delegates as well as having good meeting rooms and registration areas, all under one roof. A popular innovation was an International Book Stand, where the latest scientific literature was on display. This had been done before, at Frankfurt, on a commercial basis.

Twenty-two main tours were organised, and an additional 17 tours were arranged because of the high level of demand. A total of 1,829 people from 41 countries took part in the technical tours to
various research institutes and training establishments. The most popular tours were to Leningrad, Central Asia, Volgograd, Baku and a multi-centre Tbilisi-Yerevan-Sochi trip.

There were 178 journalists from 94 different newspapers and magazines, including 74 foreign journalists from 17 countries present at the Congress. More than 20 interviews with ministers, deputy ministers, and prominent Soviet and foreign scientists were organised. A press conference attended by over 130 journalists was addressed by V. D. Shashin, Minister of the Oil Industry and Chairman of the USSR Organising Committee.

**WPC BUSINESS**

In the discussion of WPC business, a new and more elaborate WPC Constitution was approved which changed the organisation and control of future Congresses. Basically, it was agreed that Congresses should be organised by two separate committees. The Organising Committee of the host country became responsible for the general administration of the Congress. The Scientific Programme Committee (SPC) took over the organisation of the technical papers, from deciding the themes to be covered, through to the publication of the Proceedings. Both committees were to report at least once a year to the Executive Board, which took over from the old Executive Committee. A permanent and salaried Secretariat was established, headed by the Secretary General, to serve both the Board and the SPC.

The Dutch Congress in 1951 cost $150,000. By 1967 the Mexican Congress cost over $1,600,000. The new Constitution made provision for all the expenses relating to the pre-printing and to publication of the Proceedings, together with the expenses incurred in running a Secretariat to be borne by the Executive Board. The income from the Permanent Council countries would be paid to the WPC Central Fund in London. Geoffrey Dickins was elected to the Board as Treasurer. He used three factors: crude oil production, crude oil consumption (both from US Bureau of Mines data) and technological status (from UNESCO percentages) to produce his ‘Dickins Formula’ which assessed every country on the Permanent Council for appropriate annual dues.

**TOPICS**

For the first six Congresses papers dealing with the production side of the industry, from geology to producing crude oil, totalled about a third of the papers accepted; other broad categories fluctuated considerably. Papers dealing with refining and manufacturing totalled about 10% of the total for the first two Congresses, but rose steadily to 28% of the Panel Discussion papers in Moscow. The favourite topic at the First Congress was composition, analysis and testing – 44% of the papers were in this category. This fell subsequently, to 31% in 1937, 12% in 1951, one Review Paper at the Seventh Congress, and none at the Eighth. The share of papers on petrochemicals rose from 7% at the Second Congress to 15% at Frankfurt, and was 12% at the Seventh Congress. At the Seventh and Eighth Congresses, some 20% of the Review Papers were on products.
PAPERS PRESENTED

At the Moscow Congress, 15 Review Papers and 10 Special Papers were presented and there were 144 papers included in the 25 Panel Discussions. The interests of the delegates were divided as follows:

◆ 37% were primarily interested in refining and petrochemistry;
◆ 23% in drilling and production;
◆ 20% in geology and geophysics;
◆ 8% in economics, statistics and management;
◆ 5% in equipment and instrumentation; and
◆ 7% in other aspects of the industry.

According to the June 1971 issue of Petroleum Press Service there was probably not much point in staging debates about economic decision-making between oilmen operating under quite different politico-economic systems, and whose basic convictions were incompatible. At the earlier Congresses, papers were presented, and discussed, on topics such as the formation of prices, the location of refineries, and principles of management. However, the Congress at Mexico City was chiefly devoted to more specialised themes of a scientific and technical nature, and the same was true of the Moscow Congress. The subject matter for debate had to be restricted as the active membership expanded.

The most popular papers were the Review Papers on: the oil industry in the USSR; new oil regions in the USSR; new oil regions outside the USSR; petroleum-based industrial complexes; the storage of gas and oil; and new conversion devices for energy. The greatest interest in Panel Discussions was shown by participants in the discussions on: the question of origin of oil; the exploration on continental shelves; drilling and production in deep waters and hostile marine environments; the problems of

Flight testing of the first supersonic airliners began between the Seventh and Eight Congresses – one paper given at Moscow covered the development of a new fuel for the USSR’s Tupolev Tu-144 (pictured), while another dealt with a special engine oil for the Anglo-French Concorde.
The North Sea is a shelf sea that lies between Great Britain, Norway and the European Continent. The area is 575,000 km² and the average depth is 94 m. The deepest part is in the Norwegian Trench which is about 400 m deep.

At first, not many people expected to find oil or gas under the North Sea although large amounts of gas had already been found off the coast of the Netherlands, in the Groningen field. It was thought very unlikely that this geologic formation stretched north into the North Sea. However, the Balder field was discovered in the North Sea in 1967 and the Ekofisk field in December 1969. By 1970 it was evident that this was a significant discovery. It started to produce oil in 1971. In fact, the Ekofisk find proved to be the largest oil and gas discovery in the history of the North Sea, with a production lifespan of several decades.

Drilling in the Ekofisk area later revealed a number of other oil and gas fields, which in turn would be connected to the production and transport system at the Ekofisk centre. The installations were developed into a hub for oil and gas pipelines, which was an enormous undertaking, but necessary to recover and transport the petroleum resources to land. Development of the field took place in five phases. Ekofisktown, as it came to be called, became more than 1 km long.

The Ekofisk find proved to be the largest oil and gas discovery in the history of the North Sea.
The quest gets harder

Analysis of the main new oil areas outside the USSR, by A. Bouillot of France, showed the progress made in penetrating hostile areas and in geological and geophysical exploration. He thought the search for oil was entering a challenging phase, and fresh geological thinking exploration strategies would be needed. The new zones revealed in the later 1960s outside the USSR were:

1. North America, chiefly in the Arctic zones of Alaska and Canada;
2. South America, in the sub-Andean basin of Ecuador and Colombia and off Trinidad and Brazil;
3. Europe, in the underwater basins of the North Sea and the Adriatic;
4. Northern Africa, in the Western Desert of Egypt and in Tunisia;
5. Equatorial Africa, in the waters of the Gulf of Guinea area and adjacent seas;
6. The Far East, in the seas surrounding the islands and peninsulas of Southeast Asia; and
7. The coastal waters of Southern Australia and of New Zealand.

The difficulties encountered in the Santa Barbara Channel, off the coast of California, due to the danger of pollution were seen to foreshadow the restrictions which could be imposed on exploration almost everywhere in the years to come. The Ekofisk oil discovery in the Norwegian zone of the North Sea in 1969 indicated a petroleum province in a class apart from anything found to date in Western Europe. In the Adriatic the series of discoveries made from 1960 onwards – Ravenna Mare, Porto Corsini Mare, Porto Garibaldi Mare – showed that sediments less than 10 million years old could give rise to important accumulations of methane. The advance of knowledge about the formation of the Atlantic Ocean and continental drift gave a new framework to oil exploration in coastal basins like those of Cabinda and Brazil.

Although world reserves continued to increase and discoveries, some important, continued to be made on land and offshore, Bouillot thought the exploration era characterised by drilling according to surface indications was over. It seemed probable that only a small number of classic basins remained unexplored, except in parts of the interior of Asia, South America and the Antarctic. Perhaps there was no other 'Middle East' to be found in the world outside the USSR and possibly China.

Meanwhile, demand was ‘swollen by the delay in the development of nuclear power’ (Bouillot). World production passed 2 billion tonnes (bt) in 1969, only nine years after having passed the 1 bt mark. Despite some reduction in the rate of growth, 100 bt would have to be found during the next 20 years, as much as had been found to date.

Recent discoveries appeared to be the result of conventional exploration in basins of classic type but mostly located in areas difficult to penetrate – continental shelves, Arctic regions and so forth – and resulted from progress in coping with these environments rather than in new exploration techniques.
By 1971 exploration was moving towards the deep offshore, towards the continental slope at the foot of which accumulate sediments driven by currents and gravity. Seismic survey was possible at great depths, and exploration drilling was practicable down to about 400 m, if not further, but the establishment of production was so far possible only at a depth of 100 m or so.

Although no revolutionary techniques had been evolved, continuous improvements in conventional tools and systems had made it possible to define complex hydrocarbon traps at greater depth and with greater precision. Remarkable progress had been made in seismic work, in both the recording and processing of data. Refinements in seismic reflection permitted the delineation of deep and masked traps. Bouillot concluded, however, that it would be a long time before certain types of trap yielded to geophysical methods, and he thought that other approaches were necessary.

Professor P. A. Dickey observed that the industry was in the habit of finding oil using old ideas in new areas. He thought 1971 was the time to start using new ideas find oil increasingly in old areas. A return to basins partly prospected, whether or not productive, to seek the more subtle traps would require not only tools of greater precision but, above all, the effort of re-thinking.

In production, the necessity to husband reserves, and the rise in discovery costs, called for a sustained effort to improve the recovery ratio. In the USA, this had risen from 26% of reserves-in-place in 1945 to about 36% in 1965. A ratio of 50-60% appeared possible in the future.

**Offshore potential**

A paper on marine geology and petroleum resources by L. G. Weeks aroused great interest at the Moscow Congress. He looked at the likely potential of the world’s continental shelves to 300 m water depth. In this 26 million km² area, he said, could lie some 1,350 billion barrels of oil and the equivalent of a further 400 billion barrels in the form of natural gas.

Offshore production in 1971 accounted for about 20% of total production and proved oil reserves offshore were about the same proportion of total world reserves. Weeks devoted 40 years to studying the occurrence of oil world-wide and the factors controlling it. It had become evident by 1971 that the offshore areas of most coastal basins could provide greater average yields per well, per acre, per discovery and per wildcat than the land portions of the basins. The yields were also above the average for land basins generally.
Though the early Russians noted oil seepages on the land at Iniskin Bay and Cold Bay on the Alaska Peninsula during their 125-year occupation of Alaska, nothing was done about the fields. Following the USA’s acquisition of the territory in 1867, the first oil claims in Alaska were filed in the 1890s, on the Iniskin Peninsula. The first productive oil drilling operation was at Katalla, on the Gulf of Alaska, south of the Copper River Delta. A refinery was constructed there and oil was shipped by tanker-barge to Cordova, for nearly 20 years. However, the refinery was destroyed by fire in 1933. Subsequently, the Cook Inlet Basin in the Kenai area was developed and then attention focused on the Arctic.

In 1966 Richfield Oil, the discoverer of the Swanson River field on the Kenai Peninsula, worked with Humble Oil, and then merged with Atlantic Oil to become ARCO. By 1967 Richfield had drilled a number of dry holes on its North Slope leases along the edges of Prudhoe Bay, and was preparing to leave the area. Its final effort began with a freeze-up in 1967. On 26 December, the crew opened a rig to check the results. Natural gas burst into the air. When ignited from a two-inch (5 cm) pipe, it flared 50 feet (15 m) in a 30 mph (50 kph) wind. A second well was begun immediately to see if there was more gas and oil in the area. In March 1968 it provided confirmation. The early estimate for the field was 9.6 billion recoverable barrels.

Alaska changed dramatically with the discovery of North America’s largest oil field at Prudhoe Bay. Despite fierce environmental opposition, construction of the trans-Alaska oil pipeline began in 1974, and production commenced in 1977. Since then smaller, connected fields have added to the production on the North Slope and more than 10 billion barrels of oil have been pumped.
Table 1 shows the measurement of the world offshore area out to 300 m water depth, in 1971, along with a simple classification of the portion occupied by sedimentary basins. It shows that 19% of the shelf area, or one-third of the basin area was commercially attractive to the oilman. Of this area, one-fifth was described as ‘bonanza class’. Table 2 gives conservative estimates of the ultimate potential petroleum resources of the offshore area, with comparative figures for the land area of the world. Of the 790 billion barrels of petroleum liquids shown in the second table, 372 billion were estimates for the potentially highly productive areas and 418 billion for the much larger total are of lesser average unit potential.

Cost per barrel – the true measure of cost – depends not only on exploration and drilling costs but on the wildcat success ratio, the average size of discoveries and the average yield per acre and per well drilled. A high degree of exploration success and volume could compensate for the high cost of offshore work. There were a number of examples of greater offshore exploration successes, beginning with Lake Maracaibo, including Nigeria, Cabinda and other West African coastal basins, and New Zealand. Continuing success was achieved off the Louisiana coast and in the Persian Gulf, in spite of the fact that well over half of these very large basins is on land. Alaska’s Cook Inlet was the site of most of that basin’s oil.

In Australia’s Bass Strait, a major discovery was made in the first well drilled off a coast along which over 100 dry holes had been drilled in the same basin over a 40-year period. This was quickly followed by at least five other major offshore discoveries. Gross exploration and other costs over the 164,000 km² area, including those of 42,000 km of aerial magnetic survey and 14,000 km of deep seismic shooting, were only 5 cents per acre up to the time of drilling. At the time, no other petroleum exploration operation in a non-producing region had been carried to a similar stage at a cost anything like as low as this.

Dr Weeks considered that subsea sedimentary rocks favourable for petroleum were largely confined to the continental shelves and adjacent areas and to the partially enclosed seas, gulfs, bays, channels and estuaries. With a few exceptions, the beds of the major seas and oceans did not, in general, appear to have had a geological history favourable to hydrocarbon generation and entrapment. In reply to a question at Congress, Dr Weeks stated that he believed it would be possible to find oil at depths greater than 1,000 feet (300 m), but he thought the amount might be less.

### Table 1

**World Offshore Area Classification to 300 m Water Depth**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Thousand km²</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
<td>26,000</td>
<td>100.0</td>
</tr>
<tr>
<td>Total non-basin area</td>
<td>11,000</td>
<td>42.3</td>
</tr>
<tr>
<td>Total basin area</td>
<td>15,000</td>
<td>57.7</td>
</tr>
<tr>
<td>Commercially sub-marginal</td>
<td>9,990</td>
<td>38.4</td>
</tr>
<tr>
<td>Commercially attractive</td>
<td>5,010</td>
<td>19.3</td>
</tr>
<tr>
<td>Bonanza class</td>
<td>1,050</td>
<td>4.0</td>
</tr>
<tr>
<td>Moderately attractive</td>
<td>3,960</td>
<td>15.3</td>
</tr>
</tbody>
</table>


### Table 2

**Potential Hydrocarbon Resource Estimates**

<table>
<thead>
<tr>
<th>Class of source</th>
<th>Billion barrels of oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Offshore</td>
</tr>
<tr>
<td>Petroleum liquids</td>
<td>790</td>
</tr>
<tr>
<td>Petroleum gas</td>
<td>400</td>
</tr>
<tr>
<td>Secondary recovery oil</td>
<td>360</td>
</tr>
<tr>
<td>Heavy oil sands</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,750</strong></td>
</tr>
</tbody>
</table>

AT THE END OF THE DAY, CHEMISTRY IS WHAT BRINGS US TOGETHER.

Remember that funny feeling the first time your paths met? That's chemistry. The same chemistry that's behind our fuels, our bottles of butane or any of our lubricants. The same feeling you get as your car comes out of the wash, clean as a new pin. We at CEPSA know a thing or two about chemistry. Maybe that's why it's easier for us to understand life. Maybe that's why it's easier for us to understand you.

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In the four years leading up to the Ninth Congress, the petroleum world passed through a massive crisis of confidence, and a disruption of oil supply that damaged the global economy. In 1973 several Arab states imposed embargoes on the delivery of their oil to the USA, UK and West Germany. Just when the Arab producers had cut supply by 299 mt a year (6 million b/d), the Nigerian Civil War resulted in the loss of a further 25 mt (0.5 million b/d) of oil supply.

The Arab embargo ended in 1974 and in the same year the leading industrial countries founded the International Energy Agency (IEA). The IEA’s primary task was to devise and have ready at all times a well-rehearsed system of sharing oil supply and allocating strategic stocks of oil. Higher oil prices gave a major boost to investment in non-OPEC sources. The US Senate gave approval to build the trans-Alaska oil pipeline in July 1973, which was integral to the development of Alaska’s North Slope, while the first oil came ashore from the British sector of the North Sea in June 1975.

These major events were naturally at the forefront of delegates’ minds as they gathered for the Ninth Congress, held in Tokyo from 11-16 May 1975. The Opening Ceremony on 11 May was attended by approximately 5,000 people, who were addressed by HIH the Crown Prince of Japan, Professor F. D. Rossini, Mr T. Miki the Prime Minister, Mr V. D. Shashin, Minister of the USSR Oil Industry, HE Dr M. Eghbal, Chairman and Managing Director of the National Iranian Oil Company, and Mr C. B. Morton the US Secretary of Commerce. The Opening Ceremony was followed by a Welcome Reception at Chinzanso in Bunkyo-ward. The theme of the Reception was ‘Festivals in Japan’. The huge Japanese garden of Chinzanso was beautifully illuminated by Japanese lanterns.

Technical films from seven countries were shown at a theatre in the Imperial Hotel. There was an exhibition of nearly 700 books on petroleum from 12 countries and the OECD. There were tours of petroleum refineries and research centres in the Tokyo area. Luncheon meetings were held daily to enable scientists from various countries to exchange views and enjoy a buffet lunch.

**WPC BUSINESS**

Within the cycle of the Ninth Congress, Denmark, the German Democratic Republic, Hungary, India, Nigeria, Norway, the Philippines, Poland, Spain and Yugoslavia joined the Permanent
Council. At Tokyo the Permanent Council elected Dr Wilhelm von Ilsemann as the next President.

Frederick Rossini, President until the end of the Ninth Congress, emphasised the WPC policy of avoiding politics and focusing on technical and scientific discussion. As economics can lead to politics, there were few papers on economic matters. However, politics did intrude, inevitably. There was some discussion on the increasing involvement of governments in energy supply meaning that some decisions were being taken with more regard to politics than economics. It may have been due to a reluctance to be drawn into a debate on prices that so few Arab delegates attended, but the Iranians were present in full strength. China was also absent, despite being asked to participate.

**PAPERS PRESENTED**

Of the 151 technical papers presented, the widest interest was generated by those dealing with world oil and gas reserves, likely areas for further discoveries, trends in refining, and the development of alternative sources of energy. The papers were presented as 17 Review Papers, 11 Special Papers and 123 papers in 25 Panel Discussions.

Discussions centred on the impact of the oil price increase and investment in non-OPEC areas; analysis of the world’s largest and most proliferous sedimentary basins; petroleum prospects in deep-

**1973 ARAB OIL EMBARGO**

In 1967 Israel gained territory after the Six Day War. In 1973 Arab forces retaliated and the Organisation of Arab Petroleum Exporting Countries (a subset of OPEC) placed an embargo on the export of crude oil to Western nations. This was designed to punish Western states that had supported Israel. At the same time, the broader OPEC alliance used its new-found influence to force the large Western consumer nations to cave in to demands for price increases that quadrupled the price of a barrel of crude. In turn, the governments of these nations, facing spiralling inflation, imposed resource rationing and wage and price controls on domestic goods and services that, unexpectedly, boomeranged on their economies, suppressing growth. Moreover, the shockwave hit at a time when the USA had reached a peak in its own production of oil within its shores, threatening future shortages.

The immediate results of the oil crisis were dramatic. The action by OPEC shut off supplies and sent oil prices soaring up from $2.90 per barrel in September 1973 to $11.65 in December 1973. Prices of gasoline also quadrupled, rising from 25 cents to over a dollar in just a few months. In one week, up to a fifth of gas stations in the USA had no fuel. The total consumption of oil in the USA dropped 20%, as the public tried to conserve oil and money. A 55 mph (88 kph) speed limit was imposed on US highways. The energy crisis reached such a pitch that the USA opted not to switch on the national Christmas tree lights at the end of 1973.

The embargo lasted a year, and opened a new era in international relations and energy conservation.
ocean regions; new petrochemical technology; the adoption of new techniques for heavy oil cracking and vacuum residue desulphurisation; and investments to eliminate lead in gasoline. Japan’s petroleum and petrochemical industries were also a focus of interest, and delegates discussed the expansion of Japanese exploration and production upstream companies – their domestic production in 1973 accounted for 1.3% of total Japanese consumption.

**Offshore work**

With world-wide exploration for oil and gas moving towards deeper waters offshore, a paper from Exxon highlighted the need for totally submerged drilling and production systems in areas beyond the technological or economic limits for conventional platforms, and described Exxon’s new integrated ocean-floor installation. It was estimated that, by 1980, production would be coming from depths of 300 m of water, and by 1990 development problems would have to be tackled for water depths of 3,000 m. Papers on oil production that could some day come from the deep oceans beyond the Continental Shelf discussed the potential of such areas as the Gulf of Mexico, the Shatsky Rise in the Western Pacific Ocean, the Red Sea, and off Antarctica and other places.

A general trend to deeper drilling was forecast by Exxon, which observed that the record drilling depth had increased by about 4,800 feet (1,500 m) every 10 years during the past 30 years, and would continue at something similar in the future.

**INTERNATIONAL ENERGY AGENCY**

The oil crisis of 1973-74 shocked the industrial world into taking action to ensure that it would never again be so vulnerable to a major disruption in oil supplies. The result was the creation of the International Energy Agency (IEA) in 1974, based in Paris. The IEA is a co-operative grouping of 26 member countries, which are also members of the OECD, which are committed to responding swiftly and effectively to oil emergencies and to reducing their dependence on oil. Under their 1974 agreement, IEA countries are required to hold oil stocks equivalent to at least 90 days of net oil imports and to release stocks, restrain demand, switch to other fuels, increase domestic production and share available oil, if necessary, in the event of a major oil disruption. The IEA has also elaborated flexible arrangements for the co-ordinated use of stockdraw, demand restraint and other measures which could be implemented even in any disruption. The IEA emergency measures are kept in constant readiness through periodic tests involving administrations and the oil industry. They have been mobilised on several occasions over the years and have contributed to restoring market stability in times of uncertainty.

IEA member countries co-operate to increase their collective energy security through diversification of their energy sources and improved energy efficiency, while ensuring economic competitiveness and protection of the environment.
World oil and gas reserves

The latest authoritative re-appraisal of the world’s reserves of conventional hydrocarbon fuels indicated that at least half the ultimate recoverable resources had been discovered and partly consumed. A paper on crude oil resources by Mobil Oil suggested that the world’s recoverable ‘P plus P’ (proved and prospective) reserves on 1 January 1974 totalled about 740 billion barrels, while accumulated production previous to that date had been 297 billion barrels.

Proven reserves alone were estimated, in several papers, at around 600 billion barrels, but the P plus P figures included additional quantities ‘which have a reasonable probability of being recovered with foreseeable technology and something approaching current cost/profit relationships’ (Moody, Mobil Oil). They also included the probable reserves in extensions to proved reservoirs and in undeveloped reservoirs which had been drilled, as well as gas reserves which were likely to be developed with the aid of fluid injection or other existing or prospective technologies.

### Table 1.

<table>
<thead>
<tr>
<th>Region</th>
<th>Cumulative production to 1973</th>
<th>P+P reserves 1/1/1974</th>
<th>Undiscovered potential onshore</th>
<th>Undiscovered potential offshore</th>
<th>Total ultimate reserves</th>
<th>Total ultimate reserves in billion tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>103</td>
<td>51</td>
<td>29</td>
<td>47</td>
<td>230</td>
<td>31.4</td>
</tr>
<tr>
<td>Canada</td>
<td>7</td>
<td>7</td>
<td>13</td>
<td>58</td>
<td>85</td>
<td>11.6</td>
</tr>
<tr>
<td>North Sea</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>30</td>
<td>50</td>
<td>6.8</td>
</tr>
<tr>
<td>Other West Europe</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>19</td>
<td>2.5</td>
</tr>
<tr>
<td>Middle East</td>
<td>69</td>
<td>430</td>
<td>104</td>
<td>27</td>
<td>630</td>
<td>86.0</td>
</tr>
<tr>
<td>North Africa</td>
<td>13</td>
<td>33</td>
<td>30</td>
<td>8</td>
<td>84</td>
<td>11.5</td>
</tr>
<tr>
<td>Gulf of Guinea</td>
<td>3</td>
<td>24</td>
<td>5</td>
<td>20</td>
<td>52</td>
<td>7.1</td>
</tr>
<tr>
<td>Other Africa</td>
<td>-</td>
<td>4</td>
<td>5</td>
<td>18</td>
<td>27</td>
<td>3.6</td>
</tr>
<tr>
<td>NW Latin America</td>
<td>35</td>
<td>32</td>
<td>44</td>
<td>9</td>
<td>120</td>
<td>16.4</td>
</tr>
<tr>
<td>Other Latin America</td>
<td>9</td>
<td>7</td>
<td>12</td>
<td>26</td>
<td>54</td>
<td>7.3</td>
</tr>
<tr>
<td>Far East*</td>
<td>9</td>
<td>27</td>
<td>19</td>
<td>74</td>
<td>129</td>
<td>17.7</td>
</tr>
<tr>
<td>Antarctica</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td>2.7</td>
</tr>
<tr>
<td>Communist countries</td>
<td>46</td>
<td>104</td>
<td>321</td>
<td>29</td>
<td>500</td>
<td>68.3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>297</strong></td>
<td><strong>740</strong></td>
<td><strong>585</strong></td>
<td><strong>378</strong></td>
<td><strong>2,000</strong></td>
<td><strong>272.9</strong></td>
</tr>
</tbody>
</table>

* excluding Communist countries. Source: Moody, Mobil Oil, 1975.
The Middle East had 11 of the world’s 15 largest oilfields and accounted for about 58% of all P plus P reserves. The Middle East, together with Africa accounted for virtually two-thirds. Communist countries had about 14% of the total, leaving 20% for the Americas, Western Europe and the Far East combined. Total discoveries by 1975, accumulated production and P plus P reserves together, were 1,037 billion barrels (141.5 bt).

Turning to the problem of ultimate recoverable crude oil resources, Moody gave a world estimate of 2,000 billion barrels, of which 963 billion barrels remained to be discovered (see Table 1). He stressed that, on this basis, crude oil production would probably reach its all-time peak by the late 1980s or 1990s. The apparent geographical distribution of the undiscovered 963 billion barrels differed significantly from that of P plus P reserves. A large part (36%) was believed to be in Communist countries where some of the more remote inland and offshore areas had yet to be explored adequately. About two-thirds of the undiscovered oil resources outside the Communist world were likely to underlie the oceans and their continental margins, up to water depths of some 6,000 feet (1,800 m).

A paper on natural gas reserves was presented by Adams and Kirkby, from BP. They estimated the world’s economically recoverable reserves of marketable gas in known fields at 2,300 trillion ft³, or 64 trillion m³ (see Table 2), and thought that total ultimate recoverable reserves were unlikely to exceed 6,000 trillion ft³ (168 trillion m³). By 1975 just over 10% of this ultimate volume had been consumed. Most of the exploitable gas was in areas such as the Middle East and the USSR, which are characterised by basins with giant fields and by a large trap potential.

As regards the potential of some new onshore and offshore areas, an estimate by Imperial Oil of Canada and the US Geological Survey, was that 100 billion barrels of oil and 100 trillion ft³ (3 trillion m³) of gas were contained in place in the North American Arctic. BP estimated that 15 billion barrels of oil and 18 trillion ft³ (0.5 trillion m³) of gas were recoverable from all sectors of the North Sea, with a potential production by 1980 of 2.9 million b/d of oil and 6 billion ft³/d (0.2 billion m³/d) of gas.

**Environmental research**

**Oil spills**

Results of a four-year, American Petroleum Institute-backed study of the biological effects of oil spilled in marine environments revealed that in most instances oil spills did not cause significant damage to marine life. Only rarely was damage sustained that persisted for as much as a year.
Clean car engines
Various devices had been developed to reduce automotive emissions of carbon monoxide, unburnt hydrocarbons and nitrogen oxides. In 1973 Honda launched commercial production of a new engine, called the compound vortex controlled combustion (CVCC) engine, which was capable of reducing these three emissions simultaneously without relying on catalytic after-treatment of the exhaust gases. In the engine an auxiliary combustion chamber was provided adjacent to the main combustion chamber, and rich and lean gasoline mixtures were supplied to each chamber respectively. The performance was equal to that of a conventional engine and good fuel economy was also achieved in tests.

Cavern construction
The trend to store liquid and gaseous hydrocarbons in underground caverns was expected to accelerate considerably in Western Europe, because of greater mandatory storage requirements. For example, in West Germany the storage requirements corresponded to 70 consumption days for imported products and 90 days for products manufactured in the country. At the end of 1974 there were 90 storage caverns in West Germany with a total volume of about 13 million m³, either completed or under construction. In Europe more than 200 storage caverns had been or would be built in the near future, totalling more than 70 million m³ of capacity. Petroleum storage was going underground mainly for economic reasons. The cost of leaching a cavern of salt deposits was about one-third less than building conventional storage tanks of the same capacity.

Aspects of refining
Among several technical papers on the oil refining industry presented at the Tokyo Congress, two of more general interest were concerned with the trend to large-scale plants and current and future refinery design and operating procedures.

The reduction of automotive emissions was firmly on the agenda by the time of the Ninth Congress. Honda’s new CVCC engine (seen below left being inspected by the company’s President Soichiro Honda) first went on sale in the Civic (below right) in Japan in 1973 and was subsequently introduced into export markets.
The paper by Brown of Continental Oil showed that the average capacity of new grass-roots projects announced in 1970 was 80,000 b/d, a figure which had risen to 130,000 b/d by 1974. If the trend continued, there would be an increase to 200,000 b/d before 1980. Owing to the huge capital requirements for such large-scale projects, which normally could only be afforded by the biggest companies, a move to joint ownership was thought likely. Cost advantages for larger refineries were thought theoretically possible up to capacity levels as high as 500,000 b/d, but in some respects the optimum size appeared to be 300,000 b/d. Technical limitations on the size of units at each stage of processing were examined, but were not seen as inhibiting the trend to larger projects.

Reviewing refinery developments since the 1971 Congress, Mills and Bunn described the technological progress made in such areas as residual oil desulphurisation, catalytic cracking, and catalytic reforming. The impact of environmental considerations on processes for treating pollutants in liquid effluents and atmospheric discharges, and also on noise attenuation and landscaping of new plants was examined.

Planning for new projects became increasingly complex in the 1970s due to growing intervention and regulation by governments, shortages of some crucial materials, and uncertainty about oil demand and prices in the turbulent conditions following October 1973.

It was thought in 1975 that the new emphasis could be on large export refineries in producer countries involving the creation of very large product carriers and the construction of bulk product terminals in consumer countries. In such export refineries, the crude distillation units would be limited to a capacity of 250,000 b/d, according to Mills and Bunn.

Another trend not previously envisaged was the increased availability of low-sulphur North Sea and North American crudes which, coupled with the lower predicted oil demand, would limit the requirement for Middle East crude. This, in turn, would greatly reduce the need for additional residual desulphurisation units in the USA and Europe. World-wide, the authors thought that plant completions of resid-desulphurisation units...
during 1975-76 could be only 40% of those previously forecast, while installed capacity by end-1976 could be only 650,000 b/d instead of 900,000 b/d.

Assuming little growth in fuel oil requirements in Europe between 1975 and 1980, atmospheric sulphur dioxide levels would remain relatively stable even if no additional residual oil desulphurisation capacity were built. But if sulphur levels in middle distillates were changed significantly by legislation, then additional desulphurisation capacity would be required.

**Enhanced oil recovery**

Increased oil recovery by the injection of hydrocarbon gas was described in a paper by Amoco Canada. At the South Swan Hills oilfield in Alberta, preliminary studies indicated a final recovery of some 65% of oil-in-place by gas injection, compared with an earlier predicted 45% using water flooding alone.

**Alternative sources of energy**

A number of papers dealt with the development of alternative sources of energy, including coal gasification and liquefaction, oil shale and tar sands. McKetta of Texas University emphasised the importance of pipelines in enabling the new era and predicted that coal slurry pipelines would be moving 150-160 mt a year of Western US coals to markets by 1980.
In 1979 the world reeled under a second major increase in oil prices from $13.5 per barrel to $34, which was largely due to the Iranian Revolution. By June the country’s exports of 199-224 mt a year (4-4.5 million b/d) had been cut to nil. Energy supply uncertainties had also been exacerbated by the Three Mile Island nuclear plant accident in the US in March, which posed serious questions for the development of nuclear power world-wide. It was broadly agreed that any slowdown in nuclear development would be rapidly translated into additional global demand for crude oil and natural gas.

The Tenth World Petroleum Congress was held in Bucharest from 9-14 September 1979. It was opened in the presence of President Nicolae Ceauşescu and Mrs Elena Ceauşescu at the Great Hall of the Palace, with an audience of 3,500 participants and accompanying persons from 70 countries. The proceedings were opened by WPC President, Dr Wilhelm von Ilsemann. He was followed by President Ceauşescu, who noted the special importance of the Congress, held at a time of energy crisis.
During the Congress, 12 technical films were shown daily in the Romanian Athenaeum. Again there was a book exhibition of 614 books on the petroleum industry and allied fields, supplied through the National Committees. Four technical tours were organised during the Congress. Three included visits to industrial sites and the fourth to the bubbling volcanoes at Berca. All the tours included industrial and geological sites and places of interest to tourists.

**WPC BUSINESS**

The election of the People’s Republic of China as a member of the WPC Permanent Council was announced. Australia and Brazil also joined the Permanent Council. Indonesia, Pakistan and China had all elected registered National Committees. Algeria was elected to join the Executive Board.

**PAPERS PRESENTED**

Some 154 papers were presented at the Tenth Congress: 10 Review Papers, 13 Special Papers, 16 papers in four Round Table Discussions and 115 in 23 Panel Discussions.

The Round Table Discussions were a new feature of the Technical Programme. Another first was the delivery of a special Plenary address on the subject of the financing of the global petroleum industry.

**THE IRANIAN REVOLUTION**

Throughout the 1960s the Shah of Iran increased his control over the government. He pursued programmes of agricultural and economic modernisation, but few benefits reached the ordinary citizens. Widespread opposition to the Shah grew, directed by Ayatollah Ruhollah Khomeni, a Muslim leader who had been exiled in 1963 and was living in France.

In the 1970s the Shah’s regime became increasingly repressive, and riots in 1978 escalated into virtual civil war. The Shah appointed a new prime minister and made an attempt to allow demonstrations to proceed without violence. But on 8 September, known in Iran as ‘Black Friday’, Iranian troops fired on a demonstration in Tehran and killed several hundred people. The Shah declared martial law the next day and imprisoned many opposition leaders. Demonstrations turned to strikes, including the oil workers, and the situation became critical. The Shah was forced to leave the country for good in January 1979. Hundreds of the Shah’s supporters were tried and executed, others fled the country, and the westernisation of Iran was reversed. Khomeni returned to Iran in February 1979 and presided over the establishment of an Islamic republic.

The Iranian Revolution affected the country’s crude oil production which declined from 5.3 million b/d in 1978 to 1.3 million b/d in 1981 before recovering, but not to the levels of the 1970s. Much of this lost production was initially offset by increases in output from other OPEC members.
Serious concerns had been expressed in Romania and other Eastern European countries that any cessation or major cut of oil and gas supply by the USSR would have disruptive regional economic effects, unless adequate capital could be attracted from external sources. Energy saving and efficiency featured on the prime agenda for the first time.

The greenhouse effect was addressed for the first time. It was agreed that the burning of fossil fuels, particularly coal, might produce profound climate changes such as the melting of the polar ice caps. Oil recovery factors were another key issue. It was pointed out that the average global oil recovery factor did not exceed 40% in spite of continuous development and new methods of increasing ultimate recovery technology. In his closing address the Chairman of the SPC, Dr G. Govier, identified development in a range of areas including data processing; remote sensing and seismic technology; advanced well logging and reservoir engineering, drilling, well completion and production in deep water; automated control of pipelines; and the upgrading of heavy oils and residuals.

THREE MILE ISLAND

The most serious nuclear accident to date in the USA occurred at 4 am on 28 March 1979, at the Three Mile Island nuclear power plant outside Middletown, Pennsylvania. Operator errors in dealing with a pump that had shut down caused the Unit 2 pressurised water reactor to lose coolant and overheat. The temperature of the reactor core then rose to the point at which some of the fuel cladding failed, fuel itself partially melted, and cladding reacted with steam to produce bubbles of vapour and hydrogen. The bubbles then escaped into the reactor building, along with fission products from the reactor core. Coolant was not restored to the reactor core until more than six hours after the accident, by which time enough hydrogen had accumulated in the building to pose the threat of a low-level explosion. The building had been designed to seal automatically in the event of a pressure rise, but no rise occurred, and four hours passed before the building was sealed, during which time radioactive gases escaped into the atmosphere.

Within three hours of the first sign of trouble, elevated radiation levels were detected in the reactor auxiliary building and a site emergency was declared. Although large amounts of radiation were released, the resulting exposure of the public was relatively slight, resulting mainly from xenon-133 that was present in the gaseous plume.

No demonstrable injuries from radiation were observed. However, the accident greatly increased public fears about the safety of nuclear power and strengthened opposition to its use. It effectively stopped the development and construction of nuclear reactors in the USA.
The papers were concerned with a wide range of technical subjects from the origin of petroleum to catalysis in refining. The main exception was a discussion based on four papers concerned with world demand for, and supply of, oil and gas. This was one of the most interesting and best attended of all the sessions.

**Demand and supply of oil and gas**

Energy forecasting was treated with some caution in Bucharest. Of the four main papers on the subject, only J. Roorda (Shell Oil) attempted to quantify in detail the future role of oil in world energy balances. D. Sternlight (Arco) explained the sensitivity of forecasts to key variables and assessed their value in ‘notional gap’ cases where supply and demand were not in balance. Sternlight highlighted the fact that there were 78 energy projections for 1985, issued between 1962 and 1978. His own supply scenario for 1978-1985 was based on production policies where announced and on known trends in capacity and output. It indicated a substantial drop in US domestic production by 1985, as well as some decline in OPEC exports. F. Parra tackled the practical problem of producing capacity. The significance of forecasting in general terms was examined by R. Belgrave (BP), while underlining the steps needed to avoid a future shortfall in energy supply.

M. T. Halbouty and J. D. Moody put ultimate world-wide recoverable crude oil supplies at end-1975 at 304 bt, of which 48 bt had been produced, leaving 115 bt of estimated remaining reserves (proven and prospective) and 141 bt of potential future recoveries. J. Roorda gave broadly similar estimates: 2,000 billion barrels of ultimately recoverable reserves and a further 400 billion as a speculative potential. He estimated unconventional oil resources at 3,000 billion barrels of oil shale, 200 billion exploitable by current technology, and 2,000 billion of oil sands and heavy oil, 400 billion of which was exploitable in 1979.

Reserve figures can be extremely inaccurate, even where said to be proven. Not only do reservoir engineers sometimes disagree amongst themselves, and certainly with geologists, when assessing the same data, but there is also lack of an agreed international system for defining just what is meant by the different classification of reserves. Thus all the speakers qualified their remarks. For example, Halbouty stressed the need for greatly increased exploration if potential reserves were to be tapped.
It was doubtful whether the world’s remaining oil resources would in fact be developed as rapidly as would be feasible from a purely technical point of view. Parra stressed that, with the supply situation tending to get tighter, exploration and development work would be gradually stepped up, but that this increase was unlikely to assume dramatic proportions, and that it could be accompanied by erratically decreasing yields.

The distribution of world crude oil resources is shown in Table 1. It shows that the Middle East was credited with about one-third of the total oil resources, the Communist countries with one-quarter, the whole remainder of the Eastern Hemisphere with one-fifth, and the same for the Western Hemisphere.

**Natural gas reserves**

The world’s natural gas reserves are hard to assess, but useful indications were given in a paper by A. A. Meyerhoff. He estimated that the existing overall potential of natural gas, excluding associated gas, at 6,950 trillion ft³ (195 trillion m³). He admitted his estimates (see Table 2) were ‘very conservative’, but stressed that his figures did not support the theory that natural gas was more abundant than oil.
The world’s proven and probable gas reserves, totalling about 2,500 trillion ft³ (70 trillion m³) would last until about the end of the 20th century if consumption were maintained at its present level. The USSR held the world’s largest gas reserves, mainly due to West Siberia. Other large resources existed in the Middle East, notably Iran, and, to a lesser extent, in Canada. Areas whose gas potential may have been under-estimated, included the continental shelf of China, the Gulf of Thailand, the Northwest Shelf of Australia, and the Papuan Basin.

**Investment required**

In his speech at the Opening Ceremony D. de Bruyne (Royal Dutch) spoke about the enormous investment required to find and develop new supplies of oil and gas.

Excluding the Communist countries and expressed in terms of capital cost per daily barrels (pdb) in 1978 dollars, existing low-cost oil such as that from the Middle East averaged $2,000, and this was thought likely to rise to $6,000 by 2000.

Medium-cost oil, from the North Sea for example, averaged $8,000 pdb, and was predicted to rise to $14,000 by the end of the century. High-cost oil, from regions such as the Arctic, or produced from tar sands averaged $20,000 pdb, and could rise to $33,000 by 2000. Costs of that order meant that a single project producing 250,000 b/d would cost $5 billion, compared with only $500 million in 1979. De Bruyne estimated that the industry’s total annual investment in developing new oil production, without providing for inflation, could move up from over $20 billion in 1980 to $70 billion a year by 2000.

The problem was how to finance this investment. Traditionally, investment came from the profits of private oil companies. The only real alternative was government funding or subsidy. Further capital was needed to develop natural gas and some of the newer energy sources. Another problem with high-cost production projects, noted by de Bruyne, was the sizeable expenditure of energy during the development phase. For example, an enhanced recovery project to produce 5 million b/d of oil by steam injection would require the amount of steam generated by 50 large power stations.
During Round Table Discussions of the World Supply and Demand papers, F. Naficy (Iranian Petroleum Institute) stated that all the papers ignored the imminent energy revolution, which he said would bring energy shortages for decades. J. Eibenschutz (Mexican Energy Commission) stated that while it might be possible for Mexico technically to export up to 4.5 million b/d by 1985, based on proven reserves of crude oil and natural gas, which stood at 45.8 billion barrels, it was more than likely that exports would be limited to a rate of 1 million b/d, based on Mexico’s own economic needs and also to avoid inflation. This example highlighted the problem. Even if there were sufficient capital and technology to find the predicted oil reserves, even if political constraints in producer and consumer countries could be overcome, the producer countries would increasingly tailor their exports to their own economic needs.

Belgrave’s main concern was ‘to consider the significance of supply/demand estimates, not to add to their number’. He pointed out that most of them assumed that oil and gas consumption at the end of the 20th century would not be markedly less than that of 1979. He thought the most likely outcome would be a ‘bumpy ride’ or ‘roller-coaster’ scenario, where sharp price increases were provoked by extraneous events, to be followed by economic recession, falling demand and price stagnation until the next incident set off the cycle again. Belgrave concluded that, even to sustain an increase in world GNP of 3% per annum, the energy industries needed to concentrate their efforts on productive work and have access to adequate capital.
Meeting the Challenge

40,000 employees working in 71 countries to design, build, maintain and provide new technologies for energy projects worldwide.

growth and development

sustainability
The run-up to the Jubilee Congress was marked by the corporate restructuring of the petroleum industry, with the result that many smaller entities went out of business. The Iran-Iraq War started in 1980 and dragged on for eight years. As a result of the Iranian Revolution of 1979 and the Iran-Iraq War, oil prices were again almost trebled in 1979-80 as fears of a shortage led to a scramble for supplies. Even after a price reduction, prices in 1983 were still 15 times the level of 1972. These events marked the end of the era of rapid economic expansion and rising living standards based on cheap energy. The sudden huge price increase brought about a major shift of purchasing power from the oil-importing to the oil-exporting countries; it cut living standards in the former group, brought industrial depression and unemployment, and reduced oil consumption. The 1982 estimate of oil demand was 58.5 million b/d, compared with 57 million b/d in 1973 and the peak in 1979 of 64.1 million b/d. This left the oil business with a huge surplus of tankers, refineries and downstream facilities, which brought increased competition, lower prices and reduced margins. The slump in prices and profits...
coincided with the need for large injections of capital into the industry. An urgent need, discussed widely at the 1975 Tokyo Congress, was for intensified exploration in countries outside the OPEC Bloc.

Though these developments left the industry’s leaders with a number of complex problems, there was still confidence in the future for oil. It was thought that the up-trend of demand would be resumed as economic recovery got under way.

The World Petroleum Congress returned to London from 28 August to 2 September 1983 to mark the 50th anniversary of the First Congress. A Congress symbol was chosen which represented humankind’s need for heat and light, depicted as a free flow of yellow merging into red and contained within a circle. This later became the official WPC logo.

The Opening Ceremony was performed by HRH the Prince of Wales at the Royal Albert Hall, London, on 28 August 1983. HRH was received by the WPC President, Dr Wilhelm von Ilsemann. Mr Ion, Chairman of the British Organising Committee, opened the proceedings and introduced the Minister of State for Energy, Mr A. Buchanan-Smith MP, who spoke about the involvement of the UK in the oil and gas industry and particularly of the recent offshore developments.

The Welcome Party followed on from the Opening Ceremony, and was held in the Barbican Centre, which was the venue for the technical sessions and related activities.

Located in the City of London, the vast Barbican complex, with a concert hall, theatre, cinemas, exhibition halls and an adjoining school of music and drama, had only been opened the previous year.

An evening was hosted at London’s historic Guildhall for members of the Permanent Council and officers of the WPC, the session chairmen, and other senior people at the Congress and from the British oil and gas industries. There was a buffet supper and dancing for the 550 people present. Other social events included an evening cruise on the River Thames, medieval banquets, a concert in the British Museum, an opera performance, musical comedy, a Scottish evening, dinner in a London club and a Son et Lumière performance. The Farewell Party was arranged within the Barbican Centre to begin immediately after the Closing Ceremony and was attended by about 2,300 people.

A large number of technical visits were offered. These included day trips to: British Gas Corporation, London Research Station; BP Sunbury Research Centre; Coal Research Establishment; Esso Refinery, Fawley; Esso Research Centre; Hunting Geology and Geophysics Ltd; Meteorological Office.

**IRAN-IRAQ WAR**

In September 1980 Iraq seized territory in the Shatt Al-Arab and oil-rich Khuzestan province. This led to a full-scale war which severely reduced Iran’s oil production and disrupted its economy. The war ended in a cease-fire in 1988, and cost the two nations an estimated 1 million dead and 1.7 million wounded.
Bracknell/London Weather Centre; Mobil Oil Company Ltd, Coryton Refinery; NMI Ltd (formerly the National Maritime Institute); and Shell Research Ltd. At the time of offering to host the Eleventh Congress, the British National Committee thought that the delegates’ main interest would be in Britain’s success in offshore oil and gas production. However, just over 100 delegates took part in a North Sea Operations tour to Aberdeen. They visited several local oil-related sites and the Offshore Europe exhibition on its opening day.

**PAPERS PRESENTED**

The Eleventh Congress noted that there had been a sharp decline in petroleum’s share of the global energy mix over the past 10 years with crude oil production falling from 2,938 mt (59 million b/d) in 1973 to 2,839 (57 million b/d) in 1983. One of the contributory factors was a dramatic curb in the use of fuel oil for electricity generation.

The technical papers at the 1983 London Congress indicated that crude oil recovery techniques would continue to improve, production from oil sands and shales might become more feasible, and refinery operations could be made even more efficient.

**Reserves and resources**

A paper on crude oil reserves by Masters, Root and Dietzman from the USA warned that it would not be wise to anticipate riches from areas which had not yet been properly tested, and that the need for alternative energy resources could become increasingly critical for most countries. As they said: ‘There

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**OPEC PRICING**

As a result of the Iranian Revolution, the Iran-Iraq War and other Persian Gulf countries reducing output of oil, OPEC crude oil prices increased to unprecedented levels between 1979 and 1981 while production fell in the same period from 29.8 million b/d to only 22.8 million b/d in 1981. While OPEC was reducing output, companies and governments began to stockpile oil and build reserve supplies. The result was an upward pressure on oil prices. The world price of crude oil jumped from about $14 a barrel at the start of 1979 to over $35 in January 1981. In 1983 prices stabilised at between $28 and $29 a barrel.

The high cost of crude oil stimulated exploration and production operations in non-OPEC countries, prolonged the life of marginal wells and made secondary and tertiary production techniques possible. In addition, projects in the North Sea, Mexico and the North Slope of Alaska began to make significant contributions to world crude oil supplies. By 1985 non-OPEC production was 69% of total world production, up from 50% in 1978.

The rapid increase in non-OPEC production caused OPEC, led by Saudi Arabia, to defend its official price of $34 a barrel by cutting output further. Between 1978 and 1985 OPEC production fell from 29.9 million b/d to 16.6 million b/d. Over the same period OPEC’s share of US crude oil imports fell from 82% to 41%. World demand for petroleum fell steeply in response to the rising crude oil prices. It dropped 5% from 63.1 million b/d in 1980 to 60.1 million b/d in 1985.
is an immense quantity of conventional crude oil in the world, but our capacity for consumption, however, is perfectly capable of challenging this immensity’.

It was generally accepted that the rate of oil discoveries had continued to decline world-wide in the two decades up to 1983, even though exploration activity had been stepped up. Moreover, although production was no longer rising, proved reserves had tended to decline over the past 10 years or so. Most of these reserves were still concentrated in the oil-exporting countries of the Middle East and Africa. The study presented at the London Congress supported these generalisations. Cumulative production to 1983 was assessed at about 64 bt, and demonstrated reserves at 103 bt. It was considered likely that undiscovered but recoverable reserves would be of the order of 78 bt.

At the Tenth Congress, Halbouty and Moody had suggested a modal value for undiscovered recoverable reserves of 141 bt, nearly 80% more than the new assessment, within a range of 40-345 bt. Masters and others thought that ‘to achieve the higher of the two assessments, a discovery of the dimensions of another Middle East province clearly must be considered, and our studies indicate no possibility for such an occurrence’.

Exploration efficiency appeared to be declining, and evidence from new frontier regions such as the Arctic, the Antarctic and the deep sea was not very encouraging. Halbouty and Moody thought their own assessment of 79 bt might turn out to be optimistic. However, there were large additional resources, which were sub-economic in 1983. The world’s demonstrated sub-economic resources were assessed at 324 bt. In 1983 the world output of oil through enhanced recovery methods was still low, 14.2 mt per annum – this advanced technology was regarded as still being in the pilot phase.

**Prospects for natural gas**

A study presented at the London Congress emphasised the firm prospects of quite substantial new gas discoveries in many parts of the world. It indicated that, even if production and consumption were greatly accelerated, it would probably be several decades before inventories of gas reserves would begin to be liquidated.

Halbouty reminded the Congress that, up to 30 years previously, natural gas was as a rule considered a ‘nuisance product of oil production’. Since then natural gas consumption and production had risen sharply, but world-wide exploration had made it possible to multiply the world’s proved resources about 11-fold since 1950. Since the 1979 Congress oil reserves had tended to decline, but discoveries of new natural gas reserves amounted to 525 trillion ft³ (15 trillion m³) and world-wide production was only 186 trillion ft³ (5 trillion m³).

The table on page 125 shows that the world’s ultimate reserves of natural gas were assessed at 9,585 trillion ft³ (271 trillion m³). Of this, only 13.7% had been used up, while one-third had been proved. Thus the quantities still to be discovered amounted to well over half the total.
CORPORATE RESTRUCTURING

The petroleum industry enjoyed high oil prices for 10 years after the oil embargo of 1973-74. Then market forces brought Brent crude prices down to around $20 a barrel. Although the industry was able to use advances in technology such as 3D seismic, horizontal drilling and computer processing to reduce its costs, which helped offset lower oil prices, the excesses of the late 1970s and early 1980s still necessitated significant restructuring. The global workforce for the largest 25 petroleum companies shrank by 50% from a high of 1.6 million in 1982 to less than 800,000 by 1996.

In early 1981 the US government responded to the oil crisis of 1978-1980 by removing price and allocation controls from the oil industry. For the first time since the early 1970s, market forces replaced regulatory programmes and domestic crude oil prices were allowed to rise to a market-clearing level. Export restrictions on petroleum products were also relaxed. Soon after deregulation, many small refineries and older, inefficient plants could no longer compete and were forced to close. Between 1981 and 1985 the number of refineries operating in the USA fell by 101 to 223, and operable crude oil distillation capacity fell 3 million b/d to 15.7 million b/d. The loss of so many small, low-conversion refineries, which were a large source of unfinished oils, sent many refiners overseas for intermediate oil supplies. From 1980 to 1981 import of unfinished oils more than doubled, jumping from 55,000 b/d to 112,000 b/d. Refinery utilisation increased between 1981 and 1985 as there were fewer in operation.

After the removal of price controls, residual fuel oil prices were allowed to rise to market-clearing levels, which accelerated fuel-switching and conservation in generating and industrial facilities. By 1985 demand for residual fuel oil of 1.2 million b/d was the lowest since the Second World War. Larger volumes of unfinished oils, motor gasoline, and distillate fuel oil began arriving from overseas and, by the mid-1980s, accounted for a larger share of imports than residual fuel oil.

Classification and nomenclature

Shortly after the Bucharest Congress of 1979, the Executive Committee of the WPC appointed a group of leading experts from Canada, the Netherlands, the UK, USA and Venezuela to study the world’s diverse classification and nomenclature systems for petroleum and petroleum reserves and, if possible, to recommend improvements. The group submitted its findings to the London Congress. The group provided clear, distinctive definitions for three major types of petroleum reserves – proved, unproved and speculative. It added that the boundaries even between these broad categories were shifting constantly with increasing knowledge and changing economic circumstances.

The concept of proved reserves was restricted to the amounts recoverable under the economic conditions at the time of making the estimate. Unproved reserves always refer to already-discovered oil and gas deposits but, in contrast to proved reserves, their existence can only be regarded as possible, or at best probable, not as reasonably certain. In view of the uncertainties regarding all types of unproved reserves, the group suggested that estimates be given as a range. They recommended that estimates of speculative reserves should always be given as a range.
Finance and investment

Delegates reviewed the future financial requirements of the global petroleum industry focusing on the specific needs of developing countries.

A growing need for capital investment to establish new production capacity remained a dominant feature of the outlook for the petroleum industry until the end of the 20th century, although oversupply and weak demand resulted in a temporary decline post-1980. The return in due course to a balance of supply and demand, along with a steep rise in the unit cost of new barrels added to reserves, was thought likely to boost the capital requirements of the exploration and production sector to as much as $200 billion (in 1983 dollars) in the year 2000, compared with outlays at current prices of $87 billion in 1981 and $79 billion in 1982. These were the main conclusions of a paper presented by Kassler and others from Shell International. The authors assumed a resumption in economic growth, with a modest long-term real increase in crude oil process, with ‘base prices’ sufficient to support the after-tax costs of new ‘conventional’ production. They thought that oil’s convenience and versatility would ensure that it was used to meet 40% of energy demand at the end of the 20th century, compared with about 50% in 1983.

In this context, large investments would be needed to satisfy oil demand for the rest of the 20th century. Unproduced oil resources in the non-Communist world accessible over the period could amount to some 1,500 billion barrels, against 440 billion already produced – this would be enough to support production at or above the 1970s level of 50 million b/d.

China

A review of the geology of Northern China indicated a great variety of traps, many of which were only in the initial stage of exploration. The detection of prospective areas through the synthesis of concepts and models aided by new techniques such as isotope geochemistry was discussed at length.

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**Estimated Reserves of Natural Gas by Geographical Areas, Trillion Ft³**

<table>
<thead>
<tr>
<th>Region</th>
<th>Cumulative production</th>
<th>Proved reserves</th>
<th>Potential reserves (including probable reserves)</th>
<th>Ultimate reserves</th>
<th>% of world ultimate total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>24</td>
<td>240</td>
<td>180</td>
<td>444</td>
<td>4.6</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>24</td>
<td>181</td>
<td>330</td>
<td>535</td>
<td>5.6</td>
</tr>
<tr>
<td>Canada</td>
<td>74</td>
<td>92</td>
<td>350</td>
<td>516</td>
<td>5.4</td>
</tr>
<tr>
<td>Latin America</td>
<td>81</td>
<td>207</td>
<td>250</td>
<td>538</td>
<td>5.6</td>
</tr>
<tr>
<td>Middle East</td>
<td>69</td>
<td>906</td>
<td>971</td>
<td>1,946</td>
<td>20.3</td>
</tr>
<tr>
<td>USA</td>
<td>691</td>
<td>206</td>
<td>600</td>
<td>1,497</td>
<td>15.6</td>
</tr>
<tr>
<td>Western Europe</td>
<td>109</td>
<td>171</td>
<td>220</td>
<td>500</td>
<td>5.2</td>
</tr>
<tr>
<td>Total non-Communist</td>
<td>1,072</td>
<td>2,003</td>
<td>2,901</td>
<td>5,976</td>
<td>62.3</td>
</tr>
<tr>
<td>Communist countries</td>
<td>241</td>
<td>1,188</td>
<td>2,180</td>
<td>3,609</td>
<td>37.7</td>
</tr>
<tr>
<td>World</td>
<td>1,313</td>
<td>3,191</td>
<td>5,081</td>
<td>9,585</td>
<td>100.0</td>
</tr>
<tr>
<td>Equivalent in trillion m³</td>
<td>37.18</td>
<td>90.36</td>
<td>143.88</td>
<td>271.42</td>
<td></td>
</tr>
</tbody>
</table>

Source: Halbouty, 1983.
Energy City Qatar

The Arabian Gulf is at the centre of a region considered to be the home of over 60% of the world’s oil reserves, and produces 30% of the world’s oil supply. Additionally, the Gulf holds 40% of the world’s natural gas reserves but only extracts 10% of world production. Hence the Gulf becomes more central to the energy needs of the world with each year that passes.

At the heart of the Gulf energy arena lies the State of Qatar, which although small, is now highly significant on the world energy map. Based on current and planned activity levels, international energy companies will be significantly increasing their staffing levels in the region over the coming years. With Qatar’s immense reserves of natural gas, its dramatic success in the monetisation of those reserves, its socio-political liberalisation and business friendly reformist identity, not to mention the government energy investment of approximately $80 billion dollars underway, Qatar’s pull as the energy centre of the Gulf is ever increasing.

Energy City Qatar is a $2.6 billion project that will comprise world-class offices for 20,000 people and luxury residences for 10,000 people. Located in Qatar, in the major new city development Lusail, being developed by Qatari Diar Real Estate Investment Company, Energy City Qatar will be the Middle East’s home for global players in the hydrocarbon value chain.

Energy City Qatar will be home to national and international energy leaders in Oil & Gas production, International Oil Companies (IOC), National Oil Companies (NOC), support services, infrastructure, downstream activities, shipping, market and resource data and energy trading when completed by 2012. It will cover an area of approximately 1.2 million sq. m in synergy with Qatar government’s drive to create a home for the Gulf’s energy industry and those who work in it.

Energy City Qatar enables the Energy industry players ease of interaction and communication, economies of scale and easier access to opportunities and decision makers at all levels. It offers fully integrated and dynamic business and residential hub purpose built for the Regional Energy Industry, access to decision makers, innovative technological solutions, ease of communication via ECQ Connect, IMEX trading platform, data services provided, conference a training center and procurement center.

“Energy City Qatar will become the Middle East’s 1st integrated business energy center, consolidating a range of industry and marketing services under one roof, attracting investment from significant global players in the hydrocarbon value chain and leading the development of the hydrocarbon industry.”

BILL GATES, Chairman, Microsoft

Energy City Qatar will be the 1st of its kind, purpose built business cluster dedicated to the energy industry, the 1st fully serviced eCity in the world, the 1st fully IT connected city in the world. ECQ plans to establish 10 Energy Cities in the world and has already started with Energy City India that will be developed on 300 acres of land near Mumbai with an investment of $2 billion.

Qatar is leading the Gulf in opening its oil and gas sectors to foreign investments. Qatar is developing a vertically integrated energy industry and creating world class industry giants such as QP, as well as pursuing horizontal integration through developing synergies and complementarities. In addition, new small and medium sized private sector projects are being encouraged to take advantage of downstream opportunities. Energy City Qatar was conceived with the aim of attracting global players in the entire hydrocarbon value chain, it will support the strategic diversification of the oil and gas sector in Qatar and generate new revenue streams for the economy from the energy sector.

“We are sparing no efforts to make Energy City Qatar into a smart, technologically, advanced city. Having already signed MOUs with two of the worlds foremost technology leaders, Microsoft and Cisco Systems to assist us in this endeavour, integrating all aspects of Energy City Qatar’s residents businesses. Energy City Qatar is the 1st energy cluster that has a unique IT infrastructure catering for the entire energy sector, with International Mercantile Exchange (IMEX), a dedicated energy trading platform with a broad range of energy products, right at the heart of Energy City.”

HESHAM AL EMADI, CEO, Energy City Qatar

Energy City Qatar (ECQ) plans to go green and only “Green Buildings” will be allowed in the 72 hectares where local and international oil and gas firms and other service industry and infrastructure companies will be setting up various facilities. The buildings in all the 92 plots at ECQ would be powered by alternate energy like solar and wind energy, if possible. It plans to reduce burning of oil and gas, thus reducing carbon emissions Energy City Qatar plans to get the US Green Building Council’s LEED Rating by 2010 or 2011, being the 1st energy city in the whole world to get such a prestigious rating.
Energy City Qatar

Bringing the energy industry together in one location

Energy City Qatar is the region’s first integrated business and residential hub dedicated to the hydrocarbon industry providing a single point of access to markets and expertise. Oil companies, Decision makers, Service companies, Traders, IT people, Engineers, Suppliers, Customers all have access to each other in the perfect place to do business.

Unique integrated services and products: IMEX, eCity, Smart Homes, infrastructure and IT solutions from Microsoft & Cisco.
The oil world changed considerably between 1983 and the Houston Congress in 1987. The scale of the industry was not very different, as global crude oil production rose by less than 6% to barely 60 million b/d, and was thus still below the 1979 peak of 65.8 million b/d. But the massive change in OPEC’s strategy, which was responsible for the price collapse of 1986, brought great problems for governments and company managements. By the time of the Houston Congress crude oil prices had recovered and looked fairly stable at around $18 a barrel. For industrialised countries with oil production of their own, such as the UK and USA, the price slump was a mixed blessing. The delegates in Houston had plenty of evidence of the traumatic effect on the American oil industry, including the closure of stripper wells, the 800,000 b/d decline in domestic crude consumption during 1986, the fall of over 40% in well completions, the huge increase in idle drilling rigs and the 40% cut in domestic oil industry investment. Meanwhile, the explosion at the Chernobyl power station had again raised serious doubts about the expansion of nuclear electricity generation.

The Twelfth World Petroleum Congress was held in Houston from 26 April to 1 May 1987 and coincided with the Offshore Technology Conference (OTC). Close association and joint promotion
SAUDI ARABIA AND OPEC

Faced with declining world oil demand and increasing production in non-OPEC countries, OPEC cut output significantly in the first half of the 1980s to defend its official price. Saudi Arabia played the role of swing producer in the group, and bore most of the production cuts. For example, Saudi Arabia’s crude oil production peaked at over 10 million b/d from October 1980-August 1981, and fell to just 2.3 million b/d by August 1985.

In late 1985 Saudi Arabia abandoned its swing producer role, increased production, and moved aggressively to increase market share. Saudi Arabia tried a netback-pricing concept, which tied crude oil prices to the value of refined petroleum products. This reversed traditional economic relationships by guaranteeing specific margins to refiners, and so transferred the risk from the crude oil purchaser to the producer.

In response, other OPEC members also increased production and offered netback-pricing agreements to maintain market share and to offset declining revenues. These actions resulted in a glut of crude oil in world markets, so prices fell sharply. By July 1986 the average price for OPEC crude oil was below $10 compared to $23 in December 1985. Prices for crude oil from non-OPEC countries went in a similar direction.

OPEC production rose from only 16.1 million b/d in 1985 to 18.4 million b/d in 1986. The result for OPEC oil revenues was disastrous. The total revenue fell from $279 billion in 1980 to $134 billion in 1985, and was little more than half that in 1986. At this point King Fahd of Saudi Arabia replaced his oil minister, Sheikh Yamani, and became responsible himself for the maintenance of a new system of government-administered prices, based on $18 a barrel.

However, against a background of excess oil-producing capacity, OPEC’s attempt to enforce a regime of fixed prices resulted in a reduction in its share of the world market, from 48% in 1979 to 30% in 1985. OPEC’s market share was improved to 32.5% by the netback pricing arrangements agreed in 1986, which restored profitability to the refining sector, at the expense of a price drop, which came to be regarded as intolerable. OPEC’s agreement of 1 February 1987 fixed OPEC crudes in a narrow band round $18 a barrel and set new production quotas in an effort to maintain this price.
resulted in higher attendance at both events. The Congress was held at the Houston Civic Center, and on the first day the formal Opening Ceremony was followed by a musical programme of American song and dance. Then the audience was taken to the opening of the OTC in the Houston Astrodome, where the welcome party was held.

For the first time a large flag bearing the WPC logo was flown outside the Congress halls. At the Closing Ceremony it was handed to the Chair of the Argentine Organising Committee of the Thirteenth Congress, a procedure which has been followed since.

WPC BUSINESS
The Houston Congress was Dr Wilhelm von Ilsemann’s last as President, having served for 12 years. Dr Klaus L. Mai was elected to succeed him, while Norway was elected to join the Executive Board.

PAPERS PRESENTED
The experiences of 1986 had some effect on the choice of subjects covered at the Congress. There was some emphasis on the contribution that technical advances could make to the solution of management problems. Attention was also given to the social implications and environmental considerations of the industry.

The Congress keynote address was delivered by the US Secretary of Energy, the Honourable John S. Herrington. He stressed the critical importance of advances in oil technology, and outlined the framework of US oil and gas policy which had the following objectives:

- To build a strong and viable energy industry free of government interference;
- To foster the economic climate and incentives that the industry needs;
To expand opportunities for exploration and production; and
- To guard against the disruption of oil supplies.

**Economic imperative**

The decline in domestic production coupled with the continued increase in oil consumption resulted in an increased reliance on imports, mainly from OPEC, and especially the five main Arab Gulf producers. A. O. Munk (Amoco) stressed that the key to reducing US dependence on OPEC oil was the provision of sufficient funds to finance exploration and development programmes aimed at opening up new crude oil resources.

As far as oil companies were concerned, the effects of OPEC’s new policy were mixed, though the wild price fluctuations of 1986 and uncertainty about the future disrupted long-term planning. The new economic imperative came as a stimulating challenge to all engaged in research and development, in the words of J. H. Choufoer (Royal Dutch/Shell). He suggested that the new circumstances offered important opportunities for well-targeted research efforts, both upstream and down. An interesting

**CHERNOBYL ACCIDENT**

On 26 April 1986 the most serious accident in the nuclear power industry to date occurred at the Chernobyl nuclear reactor. It happened during an experimental test of the electrical control system as the reactor was being shut down for routine maintenance. The operators, in violation of safety regulations, had switched off important control systems and allowed the reactor to reach unstable, low-power conditions. A sudden power surge caused a steam explosion that ruptured the reactor vessel, allowing further violent fuel-steam interactions that destroyed the reactor core and severely damaged the reactor building. An intense graphite fire burned for 10 days and large amounts of radioactive material were released to the environment.

The accident destroyed the reactor and caused the deaths within a few weeks, of 30 workers and radiation injuries to over a hundred others. In the immediate aftermath of the accident the authorities evacuated about 116,000 people who lived within a 30-km radius, and later 220,000 further people were relocated from Belarus, the Russian Federation and Ukraine. (At the time they were part of the USSR and went on to become separate states in 1991.) The accident caused serious social and psychological disruption to the lives of those affected and vast economic losses over the entire region. Large areas of the three countries were contaminated with radioactive elements, and radionuclides were measurable in all countries of the Northern Hemisphere.
upstream example of potential cost-cutting was that 3D seismic work could lead to substantial savings by reducing the number of wells that needed to be drilled. Similarly, the use of more powerful computers yielded improved models of reservoirs, allowing the selection of the most cost-effective solutions.

Downstream, the increasing demand for higher-valued products, such as automotive fuels, lubricants and specialised chemical feedstocks, implied the need for more sophisticated conversion and upgrading facilities. The pressing call for refinery flexibility, quality control and product differentiation posed fresh challenges to research scientists.

To safeguard the future of the industry, more effort and money was required for exploration for fresh reserves of oil and gas. In recent years some companies had not been replacing their ‘working inventory’ of reserves, although the estimated world total of proved oil reserves was 697 billion barrels, slightly higher than in 1983.

**Enhanced recovery**

Equivalent to the opening up of fresh oil reserves, pointed out L. G. Rawl (Exxon), was further advance with enhanced recovery techniques, to improve the extraction rate from existing fields. Better ways of utilising very heavy crudes would serve the same purpose. According to Rawl, the biggest economic and technical challenge could be to bring into play synthetic fuels from shale, coal and natural gas. Even with 1987 technology some synthetic fuels projects could, he thought, be practical with natural crude priced at $30-40 a barrel.

Other major issues discussed included exploration in the Arctic, Antarctic and deep offshore zones. Particular mention was made of major discoveries in Brazil in water depths of 250 to 1,800 m.

It was concluded that more stability was needed if the ‘strategy to secure tomorrow’s oil’ referred to in the Congress programme was to be successful, as long-term planning was impractical with continued uncertainty about the future course of demand and prices.
Meeting the world’s energy demands will require one thing. The world.

The world’s population grows by 250,000 people every 24 hours. It’s expected that 8 billion people will occupy the earth in 2030, up from 6.5 billion today. Affordable and accessible supplies of energy are essential to economic growth and a reasonable standard of living. With oil and natural gas expected to meet some 60 percent of the world’s demand in 2030, it’s a global challenge. Which is why Marathon is at work applying technology and building unique partnerships to deliver the energy people need. From advanced seismic and reservoir characterization tools and gas-to-fuels technology to biofuels development and heavy oil sands upgrading, Marathon is committed to not only producing energy, but doing so in an environmentally responsible way that creates long-standing, mutually beneficial results. Responding to realities. That’s Marathon.
he Iran-Iraq War finally ended in 1988, the year after the Houston Congress. But just two years later Iraq invaded Kuwait and started the Gulf War. The War subjected the oil industry once again to a major supply shock and, briefly, to a sharp spike in petroleum and product prices. Upstream operations around the world responded quickly to market conditions, so downstream operations were only briefly affected. Technology and advanced logistics systems played a major part in a rapid operational response.

In Europe, the Berlin Wall came down in 1989 and political change swept Eastern Europe. Off the coast of Alaska, the Exxon Valdez tanker disaster prompted a world-wide review of the risks of spills, new operational procedures and spill contingency plans. These events and the new relationships between many producing countries and oil companies gave urgency to the search for petroleum reserves throughout the world, to the development of new techniques and to the optimisation of existing ones in order to obtain hydrocarbons at the lowest cost. A key challenge for the industry was how to meet its capital requirements, estimated to be $2.5 trillion in the 1990s, a 50% increase over the 1980s.
This was the background to the Thirteenth World Petroleum Congress, held from 20-25 October 1991 in Buenos Aires. This was the first Congress in the history of the WPC to be held in the Southern Hemisphere and a strong focus was placed on Argentina, Bolivia, Brazil, Peru and Chile, as well as on South Africa, Indonesia and Australia.

At the Buenos Aires Congress there was a Trade and Technical Exhibition, such as had not been held since Frankfurt in 1963. Many companies participated in the Exhibition and 21 countries were represented.

There were a number of technical tours – to the YPF Technological Laboratory in Florencio Varela, YPF petroleum refinery in La Plata, Hughes Tool Co. plant in Escobar, Siderca plant in Campana and to the Ezeiza Atomic Centre. There were also tours to Iguazú Falls, Argentine Lake and Valdés Peninsula, Ushuaia, Bariloche and Mendoza.

**THE TORONTO CONFERENCE, 1988**

The Toronto Conference was convened by the Canadian government and brought together over 300 scientists and policy makers from 46 countries and organisations. It was unusual in that it addressed climate change, together with ozone layer depletion and the long range transport of toxic and acidifying substances. The Conference statement noted that ‘humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war’.

It also called for a ‘comprehensive international framework that can address the interrelated problems of the global atmosphere’, as well as the promotion of the new Intergovernmental Panel on Climate Change.

In some ways the Toronto Conference was a major forerunner to the 1992 UN Conference on Environment and Development. Already environmental atmospheric concerns were rising up the international agenda.

**THE BERLIN WALL FALLS, 1989**

The Berlin Wall was erected in 1961 on the orders of East Germany’s former leader Walter Ulbricht to stop people leaving the Communist Bloc for West Germany. Between 1949 and 1961 about 2.5 million people had fled East Germany for the West. The Wall and other fortifications along the 860 mile (1,380 km) border shared by East and West Germany virtually stopped this movement.

The opening of the Berlin Wall on 9 November 1989 was preceded by a number of momentous events in East Germany, including the removal of the Communist leader Erich Honecker, and the resignation of the entire cabinet. The new leader, Egon Krenz called for free democratic elections. But it was not enough, and once the Berlin Wall was breached, East Germany disintegrated. On 3 October 1990, the two Germanys merged to form a new, united country.
WPC BUSINESS

During 1989-90 the WPC’s Constitution was revised and the new Constitution was approved by the Executive Board in May 1990. New initiatives taken by the Executive Board and approved by the Permanent Council in Buenos Aires included:

◆ The Articles and By-laws were rewritten to encourage greater participation in all Congress activities by all member countries, with each enjoying an equal right of representation;
◆ A Development Committee was formed to enhance membership recruitment, services to members, and press and public relations;
◆ The Congress cycle was shortened from four to three years, to make programme activities more timely and resource utilisation more efficient;
◆ A Thomas Dewhurst Commemorative Lecture was instituted in memory of the first President.

In addition, an Environmental Affairs Committee was established. Regular publication of a membership newsletter was established, and background materials for the WPC were updated and published.

At the Thirteenth Congress Egypt, Israel, Malta, Oman, Peru, Turkey and Uruguay were elected to join the Permanent Council. China, Hungary, Indonesia, Peru, Spain, Saudi Arabia and Uruguay were elected to join the Executive Board. At the opening of the Congress there were 40 National Committees, of which 33 were members of the Permanent Council.

GULF WAR

Iraq invaded Kuwait on 2 August 1990, and rapidly overwhelmed the Kuwaiti military forces. Saddam Hussein accused Kuwait of keeping oil prices low and pumping more than its quota from the two countries’ shared oil field. In addition, Iraq had never accepted its British-drawn borders, which established Kuwait as a separate entity. So, when Kuwait refused to waive Iraq’s war debts, Saddam Hussein invaded.

The UN Security Council imposed economic sanctions and passed a series of resolutions condemning Iraq. An international coalition was formed, and hundreds of thousands of troops massed in the region, under the command of General Norman Schwarzkopf.

On 17 January 1991 US, British and allied planes launched a massive campaign of missile strikes and aerial bombing to destroy hundreds of targets. Allied planes flew more than 116,000 sorties over six weeks, and dropped an estimated 85,000 tonnes of bombs. On 27 February 1991 a ceasefire was announced. The allies had lost about 300 soldiers, while estimates of Iraqi deaths ranged from 60,000-200,000 soldiers. On 2 March the UN Security Council passed a resolution to establish the terms of the ceasefire, which were formally accepted by the Iraqi commanders.

The Gulf War caused crude oil and product prices to rise suddenly and sharply for the third time in 17 years. After the UN approved an embargo on all crude oil and products originating from either country, fears of shortfalls similar to 1979 caused a rapid escalation of prices. Between the end of July and 24 August 1990, the world price of crude oil climbed from about $16 a barrel to more than $28. In September it reached about $36 a barrel. Prices began falling when the UN approved the use of force against Iraq in October 1990. The cut-off of about 4.3 million b/d of Iraqi and Kuwaiti petroleum tested the markets. As a result, non-OPEC countries supplemented OPEC production to offset the 7% shortfall in world supplies.
ARGENTINA

Carlos Bechelli, Chairman of the Argentine National Committee concluded that three main factors seemed to account for the high level of response to the Thirteenth Congress:

1. Drastic reductions in oil production in Kuwait and Iraq due to the Gulf War, along with production declines in the USA and the USSR. These declines had to be offset by stepping up production both inside and outside OPEC countries, with prices settled by market forces. This fact highlighted the strategic value of hydrocarbon reserves existing outside possible conflict areas.

2. The inevitable appeal of the first Congress ever to be held in South America.

3. The changes that had taken place in Argentina since 1983, after the return to democracy.

In 1987 Argentina launched its ‘Houston Exploratory Plan’, the brainchild of Dr Raúl Alfonsin. This petroleum policy was designed to attract local and foreign risk capital, in order to exploit the continental and offshore sedimentary basins together with YPF. President Carlos Saúl Menem’s administration continued and accelerated the Houston Plan. As a result many contracts were awarded to oil companies and over $270 million were invested in exploration. By the time of the Thirteenth Congress Argentina was well on the road to deregulation of its oil and gas industries.

At this time the Argentine government was seeking to increase production, by intensifying and improving drilling methods, and by implementing improved recovery programmes. To achieve these goals the government issued a call for tenders for marginal areas under a concession system, it set up an association with YPF in the central areas, and it converted both current exploitation and Houston Plan contracts which arrived at marketable findings. All this was done within a framework of total deregulation in line with international prices, both in the upstream and the downstream sectors. President Menem chose the occasion of the World Petroleum Congress in Buenos Aires to launch ‘Argentina’s New Exploratory Plan’ aiming to intensify exploration on a nation-wide basis, in order to further extend the horizon of hydrocarbon reserves, as required by the industrial reactivation.

PAPERS PRESENTED

Estimates by WPC Review and Forecast authors, backed by the remarks of Plenary speakers and Sir Peter Holmes, the Dewhurst Lecturer, pointed to the need for a better investment balance to be achieved between the industrialised and the developing world. Otherwise, given the levels of energy demand predicted by the IEA, it was felt that there would be a serious risk of a lack of capital for investment in the poorest developing countries.
Octane race

The expected limitations on aromatics and potentially also on olefins were considered to make isoparaffins and oxygenated compounds the favourites in 'the great octane race'. Transforming straight-run gasoline or gasoline cuts from conversion into isoparaffins by naphtha ring cleavage and by hydroisomerisation of paraffins was seen as one of the options to replace the catalytic reforming process. It was felt that gasoil (diesel) production might turn to intensive desulphurisation and the partial hydrogenation of aromatics.

Environmental concerns and automotive fuels

Pierre Jacquard, Chairman of the SPC, referred to the 1988 Toronto Conference and rising environmental awareness in his closing address. He quoted the observation that pollution knows no borders, and that environmental problems testified to the reality of world-wide interdependence. He stressed the importance of the oil industry broadening its knowledge to be able to obtain ‘cleaner’ products without any significant trade off with refinery output.

He looked at transport, and ways to reduce fuel consumption. Solutions for a replacement engine under research included:

- The development of a new two-stroke engine;
- The development of new engines and vehicles which could be converted to run on compressed natural gas; and
- The design of hybrid vehicles equipped with two engines: a battery powered electric engine for urban use, and a thermal engine for intercity journeys.

Such developments required new fuels and led to discussions on the elimination of lead in gasoline and new compositions for diesel oils. It was noted that, while the use of lead-free gasoline in vehicles using exhaust catalysts enabled a significant reduction in emissions from spark-ignition engines, the robustness and efficiency of three-way catalysts had been far from optimal, especially in climates requiring cold starts. It was also felt that a better understanding of aromatic compounds was needed before attempting to specify optimised compositions for diesel oils to meet stricter legislation on emissions.
**Natural gas**

In the long term, Jacquard said, energy efficiency was still the best way to limit the increase in demand in order to preserve the environment, but for the short and medium term there were new market opportunities for natural gas. Those highlighted included natural gas for electricity production in combined-cycle power plants and as automotive fuels. Natural gas could gain a foothold as an automotive fuel in two ways:

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**EXXON VALDEZ**

On 24 March 1989, shortly after midnight, the oil tanker *Exxon Valdez* struck Bligh Reef in Prince William Sound, Alaska, and spilt more than 11 million gallons (nearly 42 million litres) of crude oil. It contaminated about 1,300 miles (2,000 km) of coastline and around 250,000 seabirds, nearly 3,000 sea otters, 300 harbour seals, 250 bald eagles and up to 22 killer whales died as a result.

The spill was the largest in US history and tested the abilities of local, national, and industrial organisations to prepare for, and respond to, a disaster of such magnitude. Many factors complicated the clean-up efforts following the spill, especially its size and remote location. Alyeska, the association that represents seven oil companies operating in Valdez, including Exxon, assumed responsibility for the clean-up, in accordance with the area’s contingency planning. Alyeska opened two emergency operations centres. Three methods were tried in the effort to clean up the spill: burning, mechanical clean-up and chemical dispersants. None were very successful.

The *Exxon Valdez* had an all steel construction, was 300 m long, 50 m wide and could transport a maximum of 1.48 million barrels (200,000 t). It was used to transport crude oil from the Alyeska consortium’s pipeline terminal in Valdez, Alaska to the lower 48 states of the USA. The vessel was carrying about 1.26 million barrels when it struck the reef.

The accident happened because the oil tanker encountered icebergs in the shipping lanes. Captain Joe Hazelwood ordered his helmsman to avoid the icebergs by taking the *Exxon Valdez* out of the lanes. The crew failed to make the ship turn back into the shipping lanes and it ran aground.

In the aftermath of the *Exxon Valdez* incident, the US Congress passed the 1990 Oil Pollution Act, which required the Coast Guard to strengthen its regulations on oil tank vessels and oil tanker owners and operators. In 2004 a federal judge in Alaska ordered Exxon to pay $4.5 billion in damages for the oil spill.
First, through direct market penetration by compressed natural gas (CNG). To achieve this market potential, distribution constraints needed to be lifted, improvements made to vehicles’ on-board storage tanks, and engines converted to run on CNG.

Second, natural gas would continue to make inroads into the market in its role as an additive to gasolines, in the form of oxygenated compounds, i.e. ethers, derived in part from methanol. Other possibilities concerned substitutes for middle distillates and for gasoline.

In the longer term, direct conversion to hydrocarbons, via oxidative coupling, could be a more competitive way of producing automotive fuels.

**Exploration**

There was optimism about further exploration and the potential oil reserves to be found. It was felt that the costs of recovery would fall as technology developed.

An R&D policy was the key to a consensus between all the countries involved, and thereby to international co-operation. Future imbalances in the oil market could be avoided by further investment in R&D.

Exploration success rates were improving due to the growing use of 3D seismic data acquisition. Seismic data processing techniques gave more accurate images of the subsurface, and so made it easier to avoid major errors in wildcat positioning.

Optimising drilling operations by applying the closed-loop philosophy – measurement/interpretation/instruction/measurement – was still possible, but was proving more difficult than expected on every level.

Horizontal drilling had made great progress over the last four years, and was another means of increasing reserves as it allowed the extraction of hydrocarbons impossible to produce by other methods, and this with lower production costs.
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THE FOURTEENTH CONGRESS,
STAVANGER, 1994

‘Petroleum in a world of sustainable growth – challenges and opportunities’

The Fourteenth Congress was held in Stavanger from 29 May to 1 June 1994 and was opened by HM King Harald V. Stavanger is known as the Norwegian oil capital and as the venue for the biennial Offshore Northern Seas (ONS) conference and exhibition.

The technical exhibition, staged in conjunction with the Congress, covered 3,000 m², and comprised 75 stands from 35 countries. Stands were taken by national and international companies, governmental bodies and institutions.

WPC BUSINESS

At the opening of the Stavanger Congress there were 40 National Committees, all members of the Permanent Council. The new members joining at Stavanger were Kuwait, Cuba and Slovenia. WPC business agreed at the Fourteenth Congress included recommendations to upgrade the headquarters in terms of staffing and infrastructure facilities. It was felt that a Congress Arrangements Manual would be helpful to pass on past organisational experience, that the choice of speakers and chairs should in

HM King Harald V (centre) opened the 14th WPC and afterwards toured the exhibition.
future include younger people and women and that the Ministerial Panel introduced at the Fourteenth Congress ought to be retained as a regular Congress feature. It was also felt that the usual three-and-a-half-day duration of the Congress was too short and that the meetings of the Permanent Council and Executive Board should be held just before or after the Congress, a feature that continues today.

Dr Klaus Mai retired as President at the end of the Fourteenth Congress and Dirk van der Meer, at the time SPC Chairman, was elected to succeed him.

**RIO EARTH SUMMIT**

The United Nations Conference on Environment and Development (UNCED) was held in June 1992 in Rio de Janeiro. It was the largest gathering of world leaders in history, attended by 117 heads of state and representatives of 178 countries. The subjects discussed included biodiversity, global warming, sustainable development and the preservation of tropical rain forests. Rio produced two international agreements, two statements of principles and a major action agenda on world-wide sustainable development. The five documents were:

1. **The Rio Declaration on Environment and Development** – 27 principles that define the rights and responsibilities of nations as they pursue human development and well-being;
2. **Agenda 21** – a blueprint on how to make development socially, economically and environmentally sustainable;
3. A statement of principles to guide the management, conservation and sustainable development of all types of forests;
4. **The UN Framework Convention on Climate Change**, which aims to stabilise greenhouse gases in the atmosphere at levels that will not dangerously upset the global climate system. This requires reductions in emissions of greenhouse gases, produced largely by the combustion of fossil fuels; and
5. **The Convention on Biological Diversity**, which requires countries to adopt ways and means of conserving the variety of living species, and to ensure that the benefits from using biological diversity are shared equitably.

The Earth Summit in Rio, held between the Thirteenth and Fourteenth Congresses, was a major milestone in the evolution of the path to sustainable development.
ENVIRONMENTAL PROTECTION

Environmental protection was recognised as a key factor in sustainable growth, so the Fourteenth Congress gave ample coverage to air, water and ground quality, new product specifications and the progressive tightening of safety and operating procedures, as well as the broader issues of global warming, ozone depletion, deforestation and climate change. Dr Eivald Røren, Chairman of the WPC Environmental Affairs Committee, reported on the work of the WPC’s two environmental task forces.

Task Force 1, chaired by Dr A. Salzaar of Venezuela, had drafted a WPC Code of Environmental Conduct based on an analysis of 20 existing codes prepared by petroleum associations, other industry associations and petroleum companies from a number of countries. The work took over two years to complete and involved experts nominated by the National Committees of Brazil, Croatia, France, Iran, Mexico and Poland. As the document was designed for world-wide use, it was decided that the conclusions could not be presented in a mandatory format without violating the commitment of the WPC, as enshrined in its Constitution and almost 60 years of operations, to absolute political neutrality and non-intervention in matters of policy. Thus, the report first identified eight key aspects of the topic and then nine underlying principles of the codes. The codes were not mandatory, but a series of suggestions and good intentions.

Dr G. Govier of Canada chaired Task Force 2. It had completed a fully-computerised index of national environmental legislation in force in 25 major member countries as it might be applied to the petroleum industry. This information was stored on a database at the WPC Secretariat in London. Summaries and an index were distributed to all WPC National Committees.

PAPERS PRESENTED

Dirk van der Meer identified the key themes of the Fourteenth Congress which included: changes in refining processes and modifications to the principal products under environmental and consumer pressure; the challenge of low oil prices and low margins; the average life of the various parts of the global capital stock of the petroleum industry; the impact of political changes; and market developments. High growth potential was seen downstream in the countries of the Pacific Rim and South Asia, while Europe and North America were showing signs of declining retail margins and cut-throat competition, leading to a diminution of further investment. Additionally, there were presentations of exploration potential studies of China, Venezuela, Siberia, Saudi Arabia, the Arctic and the Gulf of Mexico. The keywords for the Congress, van der Meer felt, were co-operation and technology, with ‘integrated multidisciplinary project teams’ as a buzz phrase.

Klaus Mai emphasised the close linkage between energy consumption, 80% of which was fossil fuel based, and economic activity. Various forecasts foretold a doubling to tripling of the world’s economic

PROFESSOR SALVADORI

By the time of the Stavanger Congress Professor Alessandro Salvadori had represented Italy for over 40 years, and it was his twelfth Congress. Salvadori had been a Viennese choirboy at Archduke Ferdinand’s funeral in 1914.
activity in the next 50 years. This was driven by a projected near doubling of the world’s population in the same timeframe, coupled with the economic improvement of developing regions and economic expansion of the developed regions. Even with aggressive energy conservation scenarios, the projections still led to a near tripling of world energy consumption in the next 50 years and a 2.5 fold increase in fossil fuel consumption. Fossil fuels, specifically petroleum, would continue to dominate the energy mix in this timeframe.

**Natural gas**

It was noted that gas development capital costs had been cut 25% since 1986 and that a further 20% cut over the next decade was considered feasible. The rapid development of gas pipeline technology was reviewed, which reflected improvements in materials, welding technology and pipe-laying. It was felt that natural gas conversion technologies – whether indirect such as the Fischer-Tropsch process, or direct involving catalytic redox reactions, might provide useful solutions for processing remote gas. Commercial syngas production at the time mainly involved methanol, but it needed a crude price of around $25 per barrel for long-term viability.

**Norway’s oil and gas industry**

One of the Plenary addresses was given by Mrs Gro Harlem Brundtland, Prime Minister of Norway and Chair of the UN Commission on Environment and Development. She had produced the Brundtland Report of 1987, which spelt out the need to achieve a sustainable world economy to meet the needs of the global population without compromising future generations.

Brundtland gave a brief account of Norway’s position as an exporter of energy, as well as the role of the oil and gas industry in the Norwegian economy. Estimates indicated that total oil and gas resources on the Norwegian continental shelf could amount to 10 bt of oil equivalents, which was about twice the world consumption of oil and gas during 1992. From another angle, by the end of 1993, about 10% of estimated Norwegian oil and gas reserves had been produced. Large investments in gas field development meant that Norwegian gas production was expected to increase to between 60-70 billion m³ after the year 2000.

All Norwegian gas and 70% of the oil production were sold to countries within the European Union. EU dependence on imported energy was expected to increase, and Norwegian exports would continue to make a considerable contribution to EU energy supplies.
By 1993 the oil and gas industry was a major factor in the Norwegian economy. The state’s net petroleum revenues amounted to slightly less than 10% of total revenues, while petroleum accounted for about one-third of Norwegian exports.

Thanks to major technological advances, the increase in environmentally harmful effluents from the Norwegian oil sector was lower than the increase in production in the years up to 1993. Through the Norwegian Oil Industry Association, the operators initiated an environmental programme designed to improve knowledge about effluents to the air and sea from Norwegian petroleum activities, and to evaluate technology and costs of potential measures to reduce effluents.

Brundtland emphasised the need for co-operation as ‘Unilateralist approaches to international issues will only prolong the current unsustainable trends’. She thought the following actions were essential:

- Economic policy must be reconciled with the laws and limitations of nature;
- More must be produced with less;
- The development of energy-efficient technologies must be accelerated; and
- Industry must integrate environmental objectives into policy planning and implementation of these objectives must be the responsibility of top management.

She concluded: ‘The best prospects for our future seem to lie in the inexhaustible potential of the human mind. It is not the natural resources themselves – such as oil and gas – that give us wealth, but the way we utilise these resources’.

**The US petroleum industry**

C. S. Nicandros (Conoco Inc.) gave a presentation on the state of the petroleum industry in the USA. As of 1993, industry investment in the US totalled about half a trillion dollars in wells, refineries and distribution systems. The industry employed 1.5 million people directly and 6 million indirectly. Even in 1993 the USA still claimed two-thirds of the world’s oil-producing wells, and sufficient volumes to make it the third largest oil producer and second largest natural gas producer. Moreover, 40% of the world’s reported active rigs were drilling in the USA. In 1993 the USA used one-quarter of the world’s oil and 65% of total oil consumption in the USA was used for transport.

Between 1973 and 1993 proved world oil reserves grew 50% to 136 bt, even though the world consumed more than 55 bt. Natural gas reserves more than doubled to about 115 trillion m$^3$, even though 37 trillion m$^3$ had been used. The price of oil in 1993 was roughly equal to that of 1973, in inflation-adjusted terms. In 1993 oil and gas continued to dominate the energy picture outside of electricity generation, although natural gas was expanding in that department too.

US oil reserves decreased some 30% between 1973 and 1993. Imported oil met about half of US requirements. But there was optimism about supplies of natural gas. By 1993 environmental protection was becoming an integral part of the industry. For example, drilling had become more
environmentally friendly and cost efficient with the use of drilling and completion fluids that were increasingly biodegradable.

New catalysis technology had revolutionised the refining business. In 1973 it was wondered if octane requirements could be met without lead. By 1993 the FCC process and its catalysts produced more lead-free gasoline at higher octane levels than was thought possible in the 1970s. Cleaner fuels and better cars meant that hydrocarbon exhaust emissions were reduced by 96% between 1960 and 1993 in the USA.

However, also between 1973 and 1993 in the USA, half a dozen major oil companies disappeared through mergers and 7,000 independent companies folded. The oil services sector was devastated and two million jobs vanished. The number of refineries shrank by 28%, but those remaining became more sophisticated and expanded capacity by 12%.

For the future Nicandros thought that technology would continue to be the best ally to push forward the frontiers for profitable developments in a low price environment. Advanced exploration tools reduce the cost of finding new oil and gas reserves. Interpretation techniques such as Sequence Stratigraphy helped with the correlation of sediments on both geological and geophysical data so that potential reservoirs in a basin could be spotted more accurately.

An advance by Conoco was the evolution of a deep-water tension leg platform (TLP). At the time of the Congress a third generation using concrete was being applied in Heidrun, Norway, and a fourth generation micro-TLP system was being tested by Conoco. It could be moved and re-used in stages to develop clusters of small reservoirs, which cut the costs of deep-water developments.
The Russian oil industry

A large delegation from Russia attended the 14th WPC. The Russian oil industry and its transition towards a market economy were discussed by Dr A. E. Putilov, (Rosneft). He outlined the crisis of the early 1990s. Between the Thirteenth and Fourteenth Congresses production of oil and gas condensate dropped from 462 mt to 351 mt. During this time the production rate of old and new wells declined.

There were major economic and political changes in the former Soviet Union and Russia in the early 1990s. The industry was damaged by the disruption of economic relations with Azerbaijan and Ukraine. There was also a crisis of non-payment in the Russian economy. These factors led to a sharp drop in investment which meant there was a reduction in the amount of drilling undertaken.

Putilov thought market relations and international co-operation were the best way out of the Russian crisis. By 1993 the Russian oil industry was in the process of setting up joint-stock companies and privatisation.

Enhanced oil recovery was increasing in importance as a means of stabilising oil production. The scale of application of hydrodynamic, chemical, thermal and gas-injection enhanced recovery methods was becoming more significant. By 1993 there were 333 projects that were either pilot tests or commercial operations. Thermal methods were widely applied for the production of highly viscous crude. Thermal recovery methods had the potential to extract 4 bt of reserves of Russian oils with a viscosity of 30 MPa and more.

Another problem in Russia was the reliability of pipelines for the transport of oil. The total length of pipelines in Russia increased by 29,600 km to a total of 50,000 km between 1970 and 1993. During this time the volume of oil pumped increased from 315 mt to 554 mt. As of 1993 there were 28 refineries in Russia with a total oil refining capacity in excess of 300 mt/y, although many of the plants were quite old.

At the time of the Congress the Russian government had a programme ‘On development of the oil refining industry in the Russian Federation’. It provided for the modernisation of operating plants. It planned to increase the depth of oil processing to 72-76% by 1997, to improve the quality of motor fuels, as well as to reduce pollution and the energy consumption required for oil processing.

The OPEC outlook

The outlook for oil supply was given by OPEC’s Secretary General, Dr Subroto. For the next 25 years they assumed a relatively steady rate of economic growth of 3% for the whole world, on average. Together with other assumptions, including some about energy efficiency, they calculated that world energy intensity, that is the amount of energy required to produce a unit of GDP, would decline by
about 24% in the next 25 years (from 1994). That represents a fall from the equivalent of about 0.58 t of oil to 0.44 t by 2020. Total growth in oil demand from 1992-2020 was expected to be around 20 million b/d, with around 4.7 barrels of oil demand growth in non-OECD countries for every barrel of oil demand in the OECD.

The oil reserve base in OPEC, estimated at around 787 billion barrels, out of a world total of about 1,043 billion barrels, would not limit levels of production. Dr Subroto felt that what was needed was an enhanced, dynamic and down-to-earth mechanism for co-operation between the oil producers and consumers, and among the oil producers themselves. The first area of co-operation could be about oil price and capital requirements for the oil industry, which is an industry characterised by long project lead times and high investment levels. Co-operation was also required to create a level playing field for all types of energy. In their analysis of future energy requirement patterns through until 2020, OPEC concluded that all energy carriers, or their production policies, could be geared towards a peaceful co-existence. The third area of co-operation would be to improve world trade. As it took seven years to complete the Uruguay Round of negotiations on world trade, OPEC was interested to see how the World Trade Organisation would develop.

The IEA and energy security
Energy security was the theme of the paper presented by John Ferriter (IEA) as he showed why it was still the number one priority of the IEA. The IEA was formed by members of the OECD in response to the oil crisis of 1973 (see box page 106). The crisis also changed OECD energy consumption. Economies had to adapt to the new price situation. This led to energy market deregulation, more efficient operation
of markets, improved technology, conservation efforts and structural adjustments in industry. Although this led to a striking reduction in oil demand, the ‘hard core’ uses of oil continued to grow.

The result was that OECD oil import dependence was expected to continue to increase from its 1994 level of about 60% to almost 70% by 2010. This would be the highest level of import dependence for the OECD since 1976. Ferriter concluded that IEA countries and other consuming areas, notably Asia, would face increased dependence on imports from the Middle East. Concern about import dependence is about the degree of vulnerability of a country or region to economic dislocation in the event of a supply disruption. Vulnerability is a function of two factors: the probability of a disruption, and the degree of protection that has been built up to deal with an emergency. The IEA countries agreed to hold emergency oil stocks equivalent to at least 90 days of net imports, as part of their emergency preparedness.

There were a number of major changes in the world energy scene between 1973 and 1993, such as the dissolution of the USSR, the Gulf Crisis and the agreement on the global Climate Change Convention. This led to the IEA pursuing its energy security mandate in a more broadly defined manner, recognising the globalisation of energy markets, the growing interdependence among participants in those markets, and the environmental imperatives which were shaping energy policies.

Ferriter concluded that:

- Oil consumption was up and in areas where it was difficult to reduce, such as transport;
- The greatest increase in energy demand was in non-OECD countries;
- Oil import dependence was up almost 70% in both the OECD and Asia; and
- Vulnerability was greater due to the heavy reliance on supplies from the Middle East and to the relative decrease in world-wide emergency stocks.

**EU energy policies**

The EU’s energy policies, with a focus on hydrocarbons, were presented by J. Sierra (European Commission), who explained that they were based on: the competitiveness of the EU economy, the security of energy supplies and the energy/environment relationship. To achieve these objectives, EU strategy was based on four pillars:

- The global nature of energy markets, particularly oil, and increasingly gas;
- The fact that energy is produced for and traded on the market;
- The increasing link between energy and the environment; and
- The increase of energy efficiency on both the supply and demand side.

Whatever the scenario, hydrocarbons, particularly oil, would remain the dominant world energy source for the foreseeable future. Net oil imports in 1993 accounted for 85% of the EU’s oil consumption and 38% of its energy demand. Thus the EU had a considerable interest in the stability of the oil market.
The tougher the energy demands, the smarter the solutions.

StatoilHydro is constantly seeking sustainable solutions to meet future energy needs. In fact, more research and development will go into the production of a barrel of oil tomorrow than a barrel produced yesterday. Our pioneering projects to capture and store carbon emissions put us in the front of supplying tomorrow’s fuel while reducing our impact on the environment. It’s just as well, as the next generation will measure our commitment to the environment by the projects we do today.

Discover more at www.statoilhydro.com
THE FIFTEENTH CONGRESS, BEIJING, 1997

‘Technology and globalisation – leading the petroleum industry into the 21st century’

The Fifteenth Congress was held from 12-16 October 1997 in Beijing. The '1997 International Petroleum and Petrochemical Exhibition' was organised in parallel, which was the largest such exhibition held in China since the country started to open up.

Jiang Zemin, President of the People's Republic of China, presided over the Opening Ceremony. Tianamen Square was especially decorated with flowers, illuminated and closed to the general public. A red carpet was provided for the delegates to take them from the Square to the still forbidden part of the Forbidden City, where, for the first time for this sort of purpose, The Temple of the Imperial Ancestors, built in AD 1250, provided a stunning backdrop to a reception and entertainment for 8,500 guests. This was followed by a comprehensive introduction to Chinese regional cuisine. Earlier the Great Hall of the People had provided an impressive venue for the Opening Ceremony and musical, gymnastic, opera and ballet entertainment, where 4,800 guests were served a 24-course banquet simultaneously. The finale was a half-hour fireworks display.
There was an exciting social programme, a number of technical visits designed to complement the technical discussions, and a variety of post-Congress tours to showcase the country and its petroleum industry. The Chinese hosts employed a staff of over 800 people to ensure the smooth running of the Congress.

**WPC BUSINESS**

By 1 January 1997 the Permanent Council of the WPC had 47 members, up from just nine in 1937 and 18 in 1970. All continents were represented. The new members for 1997 were Angola, Kazakhstan, the Republic of Korea and Papua New Guinea, while a further seven countries had sent formal letters of application.

Early in 1997 the Executive Board set up an ad-hoc study group which reported at Beijing on ways to sustain and improve the vitality of the WPC.

During the Congress the results of a joint study on the classification and nomenclature system for petroleum and reserves were presented. The WPC had worked with the Society of Petroleum Engineers (SPE) on this study.

During WPC business there was some discussion about how to improve the timeliness of the technical papers, with a Congress cycle of three years and a deadline for papers of one year before the
Congress. Proposals were given to the Executive Board to bring the deadline for papers closer to the Opening Ceremony.

The Congress programme was altered at Beijing in a number of ways:

- The programme reverted to four days, but with about the same number of papers as previously presented over three days, to allow extra time for presentation and discussion;
- A higher profile was arranged for the Review and Forecast Papers, so that they were no longer held at the same time as Forum Sessions;
- The Forum Sessions were scheduled so that there were no concurrent Exploration, Production or Downstream Sessions; and
- The Poster Sessions were scheduled so that they complemented the associated Forums.

**PAPERS PRESENTED**

The value of retaining the Ministerial Panel was proved here, where it was one of the highlights, with representatives from 15 countries. From a technology standpoint, the programme covered a broad range of advances in all core technologies. Topics covered in the upstream sector, for example, included: 4D seismic; multilateral, horizontal wells; new information management techniques and dynamic, integrated models; the use of microbes for improved oil recovery; and new sub-sea and deep water technologies.

In the downstream and petrochemicals sectors, new catalysts and catalyst design techniques such as those involving neural networks as well as advances in thermal processing were highlighted. The use of advanced reactor concepts including fine particle slurry systems and membrane reactors was discussed, as were new techniques for handling corrosive crudes and advanced computing, modelling and simulation systems for optimising plant operations on essentially a real-time basis.

Natural gas topics included emerging new end-use applications such as CNG as well as the latest advances in gas-to-liquids (GTL) processing and LNG.

Environmental topics cut across all areas and included the latest advances in site remediation and ground water clean-up technologies plus new environmentally enhanced petroleum products and improved processes for their manufacture. Environmental technologies related to production and exploration were also a major area of interest. As a whole, the programme had a strong environmental component. Specifically, three of the 10 Review and Forecast papers were devoted exclusively to environmental issues as were two of the 21 Forums.

Technology-related advances were also noted in other programme blocks, including Transportation and Pipelining, and Research Management.

The programme mirrored the continuing globalisation of the industry. About 45 countries participated directly as speakers and poster presenters, for example. From
an organisation perspective, private industry was responsible for about half of the programme, with about 30% coming from the majors, 11% from other oil companies and the remainder from service organisations.

The Plenary Addresses covered: oil and natural gas in China; technology in the 21st century; the restructured Russian oil industry; technology, globalisation and OPEC; and advances in transportation technology. The Dewhurst Lecture was presented by K. T. Kerr, Chairman and CEO of Chevron, on the theme of ‘On the threshold of growth: competitive imperatives and critical challenges for the global oil industry’.

The Chinese oil and gas industry
Dr Wang Tao (China National Petroleum Corporation) summarised the position of the Chinese oil and gas industry in his keynote address. He examined future prospects and called for international co-operation to develop oil and gas resources.

The expansion of the oil industry had accelerated since the reforms in 1978 which opened China to the outside world. Proved oil and gas reserves added in the last 18 years (back to 1980), were 1.27 times and 5.5 times the reserves found from 1949 to 1978. Oil and gas production in 1996 was 3.14 million b/d and 1.94 billion ft³ (50 million m³). However, the rapid growth of the economy was increasing oil demand and, since 1993, China had imported more oil than it exported. In 1996 net oil imports accounted for around 8% of total consumption.

On the other hand, Wang Tao pointed to China’s rich petroleum resources and cited recent assessments that the country’s ultimate recoverable oil resources were 102 billion barrels. By the end of 1996 the cumulative proved recoverable oil reserves were 38 billion barrels, with a further 64 billion barrels to be proved. He explained that China also had abundant non-conventional oil resources, such as extra-heavy oil, bitumen and oil shales. Oil shale resources alone accounted for 483.1 bt, 31.1 bt of which had an oil content of over 5%.

Oil production in China was increasing steadily, particularly in the East. Daqing, China’s largest oil field had maintained output at over 1 million b/d for 21 years, even though water cuts ranged from 60-80%. The production rate could be maintained until 2010 by water-cut control techniques and tertiary recovery technologies, which had been successful in pilot tests.

Western China was seen as a strategic area. Significant discoveries leading to new production had been made in the Tarim, Junggar and Turphan-Hami Basins of the Xinjiang Autonomous Region. By 1996 proved oil reserves in Western China had reached 4.93 billion barrels and production was at 396,000 b/d. In addition, China’s offshore oil industry had developed rapidly. Production had increased from 25,400 b/d in 1990 to 300,000 b/d in 1996 in co-operation with foreign partners.

On the gas front, China’s ultimate recoverable gas resources amounted to 370 trillion ft³ (10 trillion m³). Wang Tao expected that within 10 years, major gas-producing provinces with production capacities
of 500 million to 1 billion ft³/d (14-28 million m³/d) would come into being in Sichuan, Xinjiang, Erdos Basin and the South China Sea.

In 1997 the Chinese oil industry was facing new technical challenges. Exploration and development activities were moving into harsher environments. These included deserts and steppes, tidal zones and shallow seas, deeper target formations, low permeability and carbonate reservoirs.

The success of the state reform and opening policy was illustrated by the growth of the offshore petroleum industry in China. In 1982 offshore China was first opened for international co-operation. By 1996 126 petroleum contracts and agreements worth $5.38 billion had been signed with 67 companies from 18 countries and regions.

Technology in the 21st century

P. Jaffré (Elf Aquitaine) delivered the Plenary Address on ‘Technology: a global asset in the 21st century’. He began with a brief history of Elf Aquitaine. In 1952 a major gas field was discovered at Lacq, in southwestern France. The gas had a high sulphur content, so the company became experts in gas sweetening. They made horizontal drilling a commercial proposition, pioneered measurement while drilling, and developed offshore fields in Norway and the Gulf of Guinea in West Africa. In 1997 they were involved with deep offshore challenges in Angola, Congo and the Gulf of Mexico, as well as in high pressure/high temperature fields like Elgin and Franklin, in the North Sea. As Jaffré said, ‘oil and technology have been closely linked throughout the last 150 years’.

He forecast that ‘Growth, Price and Environment’ would be the words for the future, and that technology would be the key in facing these challenges. In 1997 the industry was still a long way from maximum yields and results. Although discovery rates had greatly improved, companies were still wasting two-thirds of their exploration budgets in drilling dry holes. And the average recovery rate of oil in place remained at around 35%.

The future would mean more multidrain horizontal drilling, FPSOs (floating production storage and offloading vessels), automated templates, unmanned platforms, multiphase production, downhole
separation, flaring reduction, gas re-injection and more sub-sea equipment. The challenges for clean air would involve desulphurisation units, deep conversion processes, petrochemical additives or fuel substitutes.

Natural gas would be encouraged for environmental reasons in many markets, especially for power generation. This would mean improvements in the pipeline networks, in liquefaction processes and, if possible, in on-site conversion from gas-to-liquid fuels, especially high quality middle distillates.

Jaffré concluded that technological improvements were not enough. He thought major management responsibilities would be needed as well. These responsibilities would include efforts to:

✦ Attract the best qualified people into the industry;
✦ Have a positive and informed approach to environmental questions; and
✦ Promote permanent innovation and flexibility in the areas of technology and organisation.

**Restructured Russian oil industry**

V. I. Ott (Vice Minister of Fuel and Energy, Russian Federation) gave an update on the restructuring of the Russian oil industry, first explained by Putilov at the 1994 Congress. The objective of the reforms was to create a competitive environment both in the upstream and downstream operations. By 1997 there were more than 15 vertically-integrated joint-stock companies in Russia, including big companies, such as Sidanco, Siberian Oil Co., Tatneft, Tyumen Oil Co., Rosneft and others.
Organisational changes in the oil industry entailed changes in all inter-related structures. The key problem of the Russian oil industry in the early 1990s was a decline of production as a result of reduced domestic demand, lack of investments and working capital, and non-payments for delivered resources. By 1997 Russia’s oil industry had reached the final phase of its restructuring and privatisation, which was the formation of transnational oil companies such as Slavneft. Beyond Russia, Russian oil companies were becoming integrated in international projects. For example, Lukoil was working on the development of oil fields in Azerbaijan with western companies. Lukoil was also pursuing business in Kazakhstan, Uzbekistan, Egypt and Libya.

The early period of reforms in Russia’s oil sector coincided with a drastic decline in production from 400 mt in 1991 to only 300 mt in 1996. One reason for this fall was the state of the raw material base. In 1997 the quality of explored and proven reserves continued to deteriorate. In addition, the depletion of the largest fields was high. For example, Romashkino was depleted by 87%. So the share of hard to recover reserves continued to increase. However, despite all the unfavourable conditions, only one-third of Russia’s reserves had been explored, and the unexplored reserves were estimated to be 60 bt. Major hydrocarbon resources were concentrated in West Siberia, the Siberian Platform, Arctic and Northern Seas. It was thought that enhanced oil recovery could boost production levels by 20-40 mt/y by 2010.

Research and discussion was underway on the best ways to improve the Russian pipeline network, in particular, the possible integration of the Druzhba pipeline with European pipeline systems. Design work had begun on the Baltic Pipeline System. Another key priority in the development of the product distribution networks up to the year 2000 was the reconstruction of sea terminals in the ports of Tuapse, Nakhodka and Archangel.

**OPEC and the IEA**

Both the Secretary General of OPEC, Dr Rilwanu Lukman, and the Executive Director of the IEA, Robert Priddle, addressed the Fifteenth Congress. Dr Lukman said that OPEC welcomed a fairer, more transparent system of energy taxation, in which no single fuel gained an unfair advantage over its competitors through subsidies to consumers. He pointed out that oil-producing countries have an interest in maintaining a stable oil market with reasonable prices, while oil consumers are interested in the stability of oil supplies. Priddle described the supply and demand outlook for the world energy sector and forecast that world oil demand would grow faster in the future than over the last two decades, from around 3,586 mt (72 million b/d) in 1996 to between 4,580 and 4,830 mt (92 and 97 million b/d) in 2010. Priddle was concerned that China, unlike other major importers, did not hold the recommended 90-day level of strategic stocks as a cushion against supply interruption.
ENERGY FOR THE FUTURE
THE SIXTEENTH CONGRESS, CALGARY, 2000

‘Petroleum for global development: networking people, business and technology to create value’

The Sixteenth Congress was held in Calgary from 11-15 June 2000. The National Petroleum Show, the world’s largest oil and gas technology tradeshow, ran concurrently at the nearby Stampede Grounds. Over 2,700 people attended the Congress Opening Ceremony, where they were welcomed by Prime Minister Jean Chrétien. The ceremony included fireworks, videos, dancing and singing over three acts to showcase the Land, the People and the Industry. In addition, a number of enjoyable receptions were held by some of the National Committees.

More than 400 people took part in the various tours, which included day trips to the Banff National Park, the Rocky Mountains, the Bow River for fly fishing and visits to the Royal Tyrrell Museum of Palaeontology.

New initiatives at the Calgary Congress included the popular Global Business Opportunities Centre (GBOC), an increased focus on networking and the very successful Interactive Technology Session. The GBOC was the WPC’s first international trade show and business centre. It was the focal point inside the newly-built TELUS Convention Centre, where 36 countries and 41 petroleum industry companies exhibited.

The Sixteenth Congress was held in Calgary (right) at the same time as the National Petroleum Show (opposite, top left).
The Interactive Technology Session (ITS) was organised previously as Free Poster Sessions. The format was changed to give more prominence to the posters. The sessions were held in the Poster Hall, and grouped together around eight themes and 50 exhibits. The themes included exploration, data management, expansion of pipeline networks, public involvement in decision-making, production technology, and resource evaluation and energy demand. The sessions helped delegates to discuss and solve key problems.

For the first time, it was an electronic Congress. The papers were provided digitally, authors and forum chairs were able to discuss issues prior to the Congress, interactively on-line, and delegates received pre-prints of papers on CD-Rom on arrival.

The massive attendance at Forum 1, where there was sometimes standing room only, was evidence of the growing interest and emphasis on environmentally responsible behaviour on the part of all sectors of the oil and gas industries.

**WPC BUSINESS**

Under the stewardship of President Ir. Dirk van der Meer, who retired at the end of the Sixteenth Congress, membership of the WPC increased from 26 to 59 countries. By 2000 members of the WPC represented over 90% of world oil and gas production, refining and consumption.
During its meeting at Calgary the Permanent Council elected Dr Eivald M. Q. Røren as the new President. Dr Røren had served for six years (1994-2000) as one of the three Vice Presidents.

The Calgary organising team put together a WPC legacy document to help future Congress organisers. It was agreed that the WPC would, as a pilot exercise, organise a regional meeting in China before the Seventeenth Congress.

**PAPERS PRESENTED**

The Plenary sessions were held in the Jack Singer Concert Hall, in the Calgary Performing Arts Centre. Well-attended plenary sessions addressed topics such as financing petroleum development, alternative sources of energy and the challenges of social responsibility.

The Dewhurst Lecture was delivered by Philippe Rogier, Head of International Affairs of the Institut Français du Pétrole (IFP), on behalf of Pierre Jacquard, former President of the IFP. Rogier called for people forecasting the future of the oil and gas industry to reconcile human and technological dimensions, balancing demand for energy with technological innovations that would have an impact on both supply and efficiency.

OPEC’s Dr Lukman and the IEA’s Robert Priddle returned to address the Congress where they presented differing views on crude oil price stability, taxation and production constraints. They were joined by the head of the United Nations Environment Programme (UNEP), Jacqueline Aloisi de Larderel, who called on the world’s energy industry to accelerate and broaden efforts to deal with environmental and social problems and warned that it would face increasing unrest if it did not. Liberalised trade had increased sources of wealth, but at the cost of social and environmental impact and the benefits were

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**PIERRE JACQUARD**

The French school system makes it possible to find each year who was the best student in physics and mathematics. Pierre Jacquard was the winner in 1954, and holds the all-time record. In fact, he broke the record set by the well-known mathematician Henri Poincaré in 1890. He won the Laplace prize from the French Academy of Sciences in 1956 and was awarded the Henri Poincaré medal. In 1960 he developed the first three-dimensional and three-compositional reservoir model called Tri-Tri.

Jacquard joined the IFP in 1962 and undertook research in various fields, covering most of the leading petroleum technologies. He published widely. In 1970 he became Deputy Director General of the IFP, and in 1976 he was seconded to the French Commission for Atomic Energy. He returned to the IFP in 1982, and was made President and CEO in 1995. In 1990 he became an Officer of the Légion d’Honneur.

Jacquard had a major impact on oil science and technology, directly and indirectly through the IFP. The industry benefited from his many publications and licensed processes that he developed.

He was also active in the WPC. He was a member of the Scientific Programme Committee from 1967-1983, and Chairman from 1983-1991. He went on to serve as Senior Vice President of the WPC from 1991-1997.
not distributed equally. According to de Larderel, ‘Twenty per cent of the world uses 60% of the energy, and 2.8 billion people do not have access to energy sources’.

Over 300 papers and posters were presented, divided into four major programme blocks: upstream; natural gas, petrochemicals and transportation; downstream; and business management.

**Upstream**

Discussion in the Upstream programme block focused on finding new basins, reducing exploration and drilling costs, improving production rates and exploiting non-conventional petroleum resources. Keynote speeches were given by a diverse range of international participants, such as Sir John Browne (BP), HRH Prince Faisal Bin Turki Bin Abdul-Aziz Al-Saud (Saudi Arabia) and Olav Fjell (Statoil). Forums covered topics such as new petroleum provinces, non-conventional hydrocarbon production and deepwater production development options. The Review and Forecast papers considered remaining crude oil resources, new concepts in exploration data management and new environmental protection techniques for exploration and production.

Sir John Browne, Group Chief Executive of BP Amoco plc, gave a ‘New Agenda’ opening address. He stressed that the petroleum industry was not washed up and old-fashioned, but had been reshaped by changes that had fostered a new agenda of productivity, resulting in an exciting industry. Consolidations had made the industry more competitive. Growth in demand, particularly for natural gas, had spurred the development of cleaner products. Technological changes had introduced efficiencies. Globalisation, although incomplete, even in the energy sector, had increased the unrestricted flow of knowledge. However, globalisation brought with it a responsibility to tread sensitively in host countries. He said that productivity came from applying scientific advances over a complete span of activity, and that cost productivity went beyond the elimination of overheads so that reach and simplicity could be combined. He noted that these factors were driven by competition, which also stimulated progress and made performance visible. ‘Every advance is watched, monitored and copied,’ he said. ‘Technology in particular travels openly. There are few areas of proprietary knowledge. We have to earn our position every day.’

The Session was then addressed by HRH Prince Faisal Bin Turki Bin Abdul-Aziz Al-Saud, Adviser to the Ministry of Petroleum and Mineral Resources of Saudi Arabia. He said that major oil companies used to finance their investments from sales until the 1986 oil price crash, when companies were
forced to borrow heavily to finance investments. The 1998 price crash aggravated their problems. In contrast, OPEC countries financed their investment from internal sources, he noted. As international banks could not keep pace with the expansion of energy demand, a trend was developing for multinationals to seek closer cooperation with OPEC countries, including those of the Gulf.

In the opinion of Olav Fjell, Chairman and CEO of Statoil, business was motivated to be socially responsible mainly through long-term, educated self-interest, but could also have core values and a purpose beyond just profit. ‘Corporate social responsibility becomes a strategy for gaining competitive advantage,’ he said. Globalisation created opportunities and challenges. Companies must ensure that poorer countries were not marginalised, economic growth was not destabilising, and that living standards did not slip in the developed world.

**Natural gas, petrochemicals and transportation**

This part of the programme explored a diverse area of industry concerns, from integrating refinery and petrochemical processes to new concepts for increasing natural gas supply and linking natural gas to new markets. Forums ranged from non-conventional natural gas applications and gas transportation links to future business trends in the petrochemical industry. Review and Forecast papers looked at novel technologies and their role in shaping the petrochemical industry, GTL technology updates and new trends in pipeline technology.

There was a growing acknowledgement of natural gas as an environmentally-friendly, abundant and cost-efficient source of energy at the Congress. Technical achievements to improve its transmission and utilisation were underscored
by the speakers, including P. I. Bijur (Texaco), A. Bouhafs (Sonatrach), Linda Cook (Shell Gas and Power) Kochnev (Ministry of Fuel and Energy, of the Russian Federation), V. Chernomyrdin (Gazprom, Russia) and R. B. Peterson (President and CEO of Imperial Oil Ltd, Canada). Peterson delivered a lecture on *The Canadian petroleum experience: the power of diverse experience*. He emphasised the role of technology in Canada’s petroleum industry and said that this role would continue along with concern for the environment. Technological innovation allowed exploration and production in ever more remote areas and in deeper offshore venues. Technology enabled the industry to meet more stringent environmental demands.

**Downstream**

The focus of the Downstream programme was on linking vehicle and fuel technologies, fuelling global transportation and meeting environmental expectations. Forums comprised new fuels, lubricants and additives, technologies to upgrade heavy crude oils and optimising refineries by controlling emissions and energy consumption. Review and Forecast papers examined new concepts in catalysts and the opportunities for networking between the petroleum and automobile industries over issues of fuel quality and emissions control.

Speaking during the Plenary Session ‘Synthesising refinery and automotive strategies’, F. d’Adda, (Chairman and CEO of ENICHEM), said that refining needed to become more efficient and integrated with the petrochemical industry. He thought the refining industry had not changed in 25 years. Efficiency could be improved by the better recycling of feedstock and the use of emission gases to generate power.

Viable energy alternatives were years away, according to J. Hubbert (Daimler-Chrysler). The industry was developing fuel cells, and cars could be produced with a floor-mounted cell that left room for five passengers and luggage, but the infrastructure to support fuel cells was at least 10-15 years away (2010-2015). Pollution would be reduced dramatically by the development of sulphur-free fuels. More fuel-efficient engines would need to be developed to meet the challenge of reducing CO₂ emissions by 25% in the next five years.

According to Red Cavaney (President, API), car emissions had decreased by 70% since 1970, despite the doubling of miles driven. Product
quality and emissions control had improved through collaboration between the auto and oil industry, a long tradition. He thought the way to future improvement was less clear, as the two industries needed to balance environmental demands with the increasing requirement for individual transport.

**Business management**

The Business management programme examined the evolution of business rules that impact the petroleum industry. Topics in the Forum Section included operating in environmentally sensitive areas, developing partnerships to enhance and balance economic, environmental and societal needs, and people management in the restructured petroleum industry. Review and Forecast papers dissected the role of service companies in the petroleum business structure, public involvement in the decision-making process and the impact of information technology on the petroleum industry.

**FIRST WPC REGIONAL MEETING**

As agreed by the Permanent Council in Calgary, the WPC organised its first Regional Meeting in China before the Seventeenth Congress. The WPC Asia Regional Meeting was held in Shanghai, 17-20 September 2001, in parallel with the Shanghai International Petroleum and Petrochemical Exhibition.

Dr Wang Tao, Senior Vice President of WPC and former Minister in China’s Ministry of Petroleum, had taken the lead in bringing the event together to convey the opportunities in Asia’s petroleum industry and to promote mutual understanding, friendship and cooperation among Asian petroleum players.

In his opening address WPC President, Dr Eivald Røren, highlighted the theme of the meeting ‘Technology and cooperation – a fundamental strategy for Asia’s petroleum industry’. Dr Røren said that meeting society’s increasing demand for energy and strong environmental and social performance in the 21st century would be a decisive challenge for energy companies.

A host of senior governmental and petroleum industry officials addressed the issues and challenges facing the Asia-Pacific region. They analysed and reviewed the current situation and future development, and focused on some key issues facing Asia’s petroleum industry, including relations between the expanding national economies of Asian developing countries and their petroleum industries, how to solve the problem of shortages in resources caused by rapid economic development, the application of new technology for petroleum and petrochemical industrial development, reserves and environmental protection.
Liberalised global markets and accelerating technological changes meant major energy companies must take a greater role in financing their own long-term, complex projects, according to J. van der Veer (Group Managing Director, Royal Dutch/Shell Group). Shell regarded investing in such projects as its core business, although it did not rule out financing with other partners.

The corporate social responsibility of international companies was the theme of the Fourth Plenary. Dick Cheney (CEO, Halliburton), said that petroleum industry activity was enormously valuable to society and was carried out with regard for the triple bottom line of profit, society and the environment. Cheney thought that the challenge was to be proactive and part of the solution. For example, spending on environmental protection had soared from $700 million in 1970 to nearly $10 billion by 2000. The industry could contribute to infrastructure and improve the quality of life while pursuing development, and still minimise environmental impact.

The Indian Minister of Petroleum and Natural Gas, Shri Ram Naik, provided an overview of the Indian oil industry and its potential to cover a larger percentage of its own energy needs, while Ali Al-Naimi, Saudi Arabia’s Minister of Petroleum and Mineral Resources, identified four trends in the world oil outlook. He predicted that demand for fossil fuels would continue in line with global economic growth, with most of the increase in demand to come from developing countries, particularly those of Asia. The Gulf region and especially Saudi Arabia would remain the major supplier of oil and was well situated to provide Asia and the world with a sizable share of the increase in demand. The forth trend in world energy outlook was the increasing importance of environmental concerns and their incorporation into production and consumption decisions.

The Director of China’s State Development Planning Commission, Mr Zeng Peiyan, presented the new opportunities arising from the development of Western China’s hydrocarbon resources and summarised the region’s petroleum industry development in five aspects. Further oil and gas exploration should increase reserves in Western China and turn the region into a major driver for China’s oil and gas production. Secondly, technical and economic evaluations were to be raised and development costs lowered. Thirdly, the same emphasis would be placed on natural gas development as for oil, with further efforts being made to accelerate exploration and development of natural gas resources and to speed up construction of transmission pipelines and downstream projects. Fourthly, more effort would be made to facilitate technical progress and innovations. Fifthly, China would stick to the opening-up policy so as to capitalise on the markets and resources both at home and abroad. Further deregulation was expected to fuel the oil and gas industry development in Western China.

An overview of Indonesia’s energy resources was given by Surya Suryantoro, the representative of Purnomo Yusgiantoro, Minister of Energy and Mineral Resources. He went on to say that the country’s oil and gas industry was facing economic and technical challenges, such as drilling and operating in deep water areas, producing oil from more complicated reservoir structures and stimulating oil recovery from mature and even depleted fields.

From Russia, Alexei Mastepanov, the representative of Ivan Andreevich Matlashov, Senior Deputy Energy Minister, announced that West Siberia was expected to keep its position as the main gas-producing region in the country, albeit with a share declining to about 64% from 87%. He said that large-scale exploration of the hydrocarbon resources on the Siberian platform and Sakhalin shelf would boost reserves, and that East Siberia and the Far East regions should be linked to the unified gas supply system.
Stability, profitability and transparency. That’s what has attracted the whole world to Brazil.

Brazil has been achieving the trust of global investors from the oil and gas exploration and productive sector. Clear rules and a stable market, guaranteed by the Petroleum Law (1997), give the country the necessary credibility and keep a friendly environment for business. A proof of this is the 63 economic groups currently working in the Brazilian Upstream, half of which coming from 13 foreign countries. The ANP – National Agency of Petroleum, Natural Gas and Biofuels – has been working hard so that more and more investors believe in Brazil.

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The World Summit on Sustainable Development ran in Johannesburg at the same time as the Seventeenth Congress. Sustainability implies meeting the needs of the present without compromising the availability of resources for future generations. The idea of ‘sustainable development’ first evolved during the UN Conference on the Human Environment in Sweden in 1972. As part of the preparations for the Johannesburg Summit, UNEP invited 22 global industries to chronicle a decade of progress in sustainability in their sectors. The oil and gas industry was one of them. Its representative bodies, IPIECA (the International Petroleum Industry Environmental Conservation Association) and OGP (the International Association of Oil and Gas Producers) put together an exhaustive report which showed how 10 years of the application of innovative technology and improved management systems had helped to maintain security of supply within a framework of corporate social responsibility.
However, Brazil had taken an initiative on environmental concerns 70 years earlier. In 1931 a Federal Decree mandated that 5% of ethanol should be blended in gasoline sold in Brazil. This led to modern Brazil having the largest ethanol programme in the world.

The Seventeenth Congress took place in Rio de Janeiro, 1-5 September 2002. Exceptionally, it was held two years after the Sixteenth Congress following agreement with the International Gas Union (IGU) and the World Energy Council (WEC) to avoid clashes in the scheduling of the major global energy conferences. IGU would have the field clear for its World Gas Conference in 2003, WEC would have its World Energy Conference in 2004 and the Eighteenth World Petroleum Congress would take place in 2005, with each organisation then continuing on a triennial cycle.

The venue for the Seventeenth Congress was the enormous Riocentro – South America’s largest convention and exhibition complex – which also accommodated the concurrent Rio Oil & Gas Expo. The biennial Expo was a showcase of goods and services organised by the Brazilian Oil and Gas Institute. There were 850 exhibitors from 32 countries represented at the Expo, in 31,000 m² of exhibition space. It received 10,000 visitors per day. This made the Rio Oil & Gas Expo one of the four largest oil exhibitions in the world.

Social events of the Congress included the Opening Ceremony, a Brazilian night and a football game at Maracanã.

In many ways the Seventeenth Congress was innovative as it brought social and environmental issues to the fore. Social responsibility concepts and practices were integrated into the Congress. Special projects were designed that encompassed environmental conservation and local communities. There was a Social Responsibility Arena, which aimed to broaden the discussion on this issue. Thirty five non-governmental organisations (NGOs) and community leaders put forward their ideas and the themes that motivated them, and had the opportunity of discussing them with the industry.

A new initiative was the Excellence and Social Responsibility Awards which were conferred during the Congress. There were 78 submissions from around the world.

The criteria for the award on Technological Developments were as follows:

- Technological breakthroughs;
- Innovative applications of existing technologies;
- Cost effectiveness;
- Wide applicability for the petroleum industry; and
- Proved or clearly demonstrable and sustainable results (long term).
The award was won by Statoil, Norway, for its achievements in the underground storage of CO₂.

The criteria for the Award on Social Responsibility were as follows:

- Innovative and far-reaching health, safety and environment programmes;
- Development of mutually beneficial relations with communities;
- Feasibility;
- Wide applicability and reproducibility for the petroleum industry; and
- Proved or clearly demonstrable long-term results.

The winner in this category was Schlumberger Oilfield Services, USA for the Schlumberger Excellence in Educational Development (SEED) Program.

**WPC BUSINESS**

A new Constitution was approved at the Congress. The Council also voted on the Officers to be Members of the Executive Board jointly with host country representatives and the Director General, Dr Pierce Riemer, who had taken over from Paul Tempest in 1999.

**PAPERS PRESENTED**

There were eight Plenary Sessions and three official luncheons. The Plenary Speeches attract the most attention at the Congresses, and are more widely reported. However, in addition, over 300 papers were presented at the Congress. They were organised into four blocks covering exploration and production,

The Rio Oil & Gas Expo took place concurrently with the 17th WPC and Sinopec was one of many companies that took stands.
refining and downstream, gas/LNG and gas transportation, and sustainability and social and environmental issues.

**Sustainable development**

As already mentioned, the Seventeenth Congress coincided with the Johannesburg conference on sustainable development. The topic became a key theme at the Congress. Lew Watts (Director Africa and Latin America, Shell Gas and Power) gave a powerful presentation on “The energy playing field: is your business sustainable? Will you be allowed to play?” In his opinion: ‘Those that ignore sustainable development will not be allowed to operate. Those that embrace it will have a competitive advantage and will be contributing to the long-term sustainability of their companies, our industry as a whole and our planet’.

Egil Mykelbust (Chairman, Norsk Hydro) also tackled sustainable development, but from a slightly different angle. He flew in from the Johannesburg conference to address the Congress. He urged oil companies to seek a balance between business and social responsibilities in order to meet the challenges of globalisation and to sharpen their competitive edge. He said there was growing frustration in all quarters that targets set at the original Rio Summit of 1992 were not being met. In his words: 'The business case for sustainable development is emerging as a strategic and competitive issue within leading companies. Business potential for being recognised as part of the solution rather than part of the problem is improving ... our main challenge is to further enhance our credibility in society at large as a key player in making real the vision of sustainable development’.

Expansion of the definition of corporate social responsibility was noted by Mykelbust. ‘It has become increasingly important to understand and address the role of the company and its behaviour in a wider context than just economic growth. Growing public awareness and more forceful demands for greater transparency add a new dimension to the art of business management, as do the challenges that follow in the wake of globalisation’. The World Business Council for Sustainable Development provided this definition: ‘Corporate social responsibility is the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve quality of life’.
Another major theme at the Congress was the need for co-operation between the main energy producers and the view that this would help stability in the market, which, in turn, would benefit consumers as well as producers. This was the opinion expressed by Ali Rodríguez Araque (President of Petróleos de Venezuela, PdVSA) in his presentation ‘The global energy industry: an opportunity for co-operation, stability and investment’. He said that amid the enormous changes in the oil market, some encouraging progress was evident in the field of co-operation, prices and even the way the sector was viewed.

Araque thought that oil was bound to maintain its position of leadership in the world energy scenario. He showed some forecasts for the demand for hydrocarbons, rising from the 2002 level of 76 million b/d to 91 million b/d in 2010 to 106 million b/d by 2020. He said that ‘Venezuela’s role in the world energy market does not end with oil’. There were plans to develop the vast hydrocarbon reserves of Venezuela, the largest outside the Middle East, amounting to 77 billion barrels in 2002, not including the extra heavy crude deposit of the Orinoco Belt. ‘Production of this extra heavy crude has already begun and it has been improved for use in refineries in Venezuela and the USA to produce high quality products. The four projects under way account for a large undertaking by the private sector in which US companies, ExxonMobil, ConocoPhillips and ChevronTexaco, and TotalFinaElf are participating. These associations envisage a production level in excess of 600,000 b/d by 2006 with an investment calculated at $13 billion’.

**Working partnerships in Venezuela**

David O’Reilly, ChevronTexaco’s CEO, stressed the importance of partnerships in securing the future profitability of the oil and gas sector.

Euan Baird, President and CEO of Schlumberger, was the winner of the Dewhurst Award.
In addition, the potential opening up of the Venezuelan gas industry was much discussed at the Congress. Araque and David O’Reilly (CEO of ChevronTexaco) made it clear that the joint development of offshore gas resources was very much in prospect.

**Partnerships**

David O’Reilly stressed the importance of partnerships in securing the future profitability of the oil and gas sector. ‘Partnership, more and more, is a basic business principle that is central to any successful strategy’. He emphasised that hydrocarbons are a finite resource. And that the resources that do exist are increasingly concentrated in very few hands. Close to 75% of the world’s oil reserves are in seven countries and more than two-thirds are controlled by national oil companies with no equity access for international oil companies.

Partnership can be a pragmatic way to confront challenges that are too big and risks that are too complex for any one company. O’Reilly gave the example of the Caspian Pipeline. Three governments and 10 companies from six different countries worked together to build it. In the course of the project, more than 70% of expenditures, which came to nearly $2 billion, went to local companies. In Venezuela, the government and PdVSA actively sought the participation of international oil and gas companies to develop Plataforma Deltana, a major offshore gas opportunity.
The fifth Dewhurst Lecture

The WPC presented the Dewhurst Award to Euan Baird, President and CEO of Schlumberger, for outstanding leadership. Baird gave the Dewhurst Lecture on ‘A celebration of technological excellence’ which was one of the highlights of the Congress.

He thought that the oil industry needed to continue doing what it had already done so successfully for over 100 years. Namely, improving the energy efficiency of its products and reducing the environmental cost of finding and using them. For example, the industry has made huge improvements in its environmental performance through minimising its environmental footprint during exploration and development, reducing routine oil discharges offshore, and removing lead from gasoline. He thought that the gradual ‘decarbonisation’ of the industry’s products was leading the consumer to hydrogen-based fuel cell technologies.

SECOND WPC REGIONAL MEETING

Between the Rio and Johannesburg Congresses, the WPC organised a second Regional Meeting. The WPC Middle East Regional Meeting was held in Doha, Qatar, 8-11 December 2003, and 500 participants representing more than 40 countries attended. Around 50 technical papers were presented in six industry-specific sessions under the theme of ‘An Industry Committed to Excellence’.

The Regional Meeting was opened by HE Abdullah Bin Hamad Al-Attiyah, Qatar’s Second Deputy Prime Minister, Minister for Energy and Industry and Chairman of Qatar Petroleum. Also officiating at the meeting’s inauguration were HE Abdulrahman Bin Hamad Al-Attiyah, Secretary General of the Gulf Co-operation Council (GCC); Dr Pierce Riemer, WPC Director General; and Abdullah Salatt, Chairman of Qatar’s National Committee of the WPC.

HE Abdullah Bin Hamad Al-Attiyah stated in his opening remarks that the energy sector could attract capital as long as the policy and business environment was credible and predictable. Some of the important factors he cited were: the establishment of a comprehensive, fair and transparent sectoral framework and a system of enforcement; stamping out corruption; the application of international accounting standards; fair policy towards foreign capital; and enforcement of laws and contracts.

HE Abdulrahman Bin Hamad Al-Attiyah noted that the six members of the GCC (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE) held 45% of the world’s proven oil reserves. He outlined the principles of GCC oil and gas policy, its role in meeting rising energy demand and its
Baird covered the issue of climate change and gave his support for the idea of storing carbon in the oceans and underground. As he said, bypassing the atmosphere to accelerate the normal CO₂ sequestration cycle was the subject of much debate. In his opinion, probably the most straightforward proposal was to sequester CO₂ in depleted oil and gas reservoirs. Another attractive option was to bury CO₂ at sea. He concluded that: “There is a growing understanding in the oil and gas industry that a carbon-sensitive world offers opportunities as well as threats. If the accumulation of man-made CO₂ in the atmosphere is a global problem, the separation, compression, transport and storage of it elsewhere will become huge businesses. Who else has the technical expertise, financial strength and global management skills to help stabilise the composition of the earth’s atmosphere? Just as the massive deployment of new technology resolved concerns about oil supply in the 1970s, the oil and gas industry today has the unique capabilities and the motivation to solve the carbon problem.”

belief in international co-operation. He said the policy was based on a commitment to three guiding principles: free and open markets; security of supply; and cooperation between producers and consumers.

In a keynote address Saudi Aramco Senior Vice President Abd Allah Saif Al-Saif presented delegates with a global outlook, the challenges and opportunities facing the industry and a perspective on the Gulf region. He said the oil industry faced environmental, financial and technical challenges but oil would continue to be the world’s prime energy source.

This was the first-ever meeting of the WPC held in the Middle East and Dr Wang Tao, WPC Senior Vice President, summed up the importance of the event in his closing speech. “The Middle East, including the Gulf region, with its rich hydrocarbon resources, is the world’s major oil supplier,” he said. “The region has made great contributions to the development of the world economy and social progress. It is fascinating that with technical advancement, this region has witnessed the continuous addition of hydrocarbon reserves. This not only provides a solid resource base for the economic growth, social progress and improvement of people’s living standards in the region, but also enhances its position in the international community with the increasingly important role that it plays.”

A daily bulletin was produced during the event.

A highlight of the Doha event was the celebratory dinner to mark the WPC’s 70th anniversary and the close of the Regional Meeting. Dr Pierce Riemer, Director General, talked about how the WPC was formed in 1933 on the initiative of Thomas Dewhurst and how it had widened its remit over the years. In the 1970s and 1980s the WPC began to address environmental issues, which are now a major factor, as well as adding more topics on social responsibility, ethics and transparency. Attracting and retaining young people had also become an important issue for the WPC and the industry as a whole, which was going to be addressed at a special WPC Youth Forum the following year. Dr Riemer closed with the remarks: ‘A regional meeting held in-between WPC Congresses is a creative measure for better communication and co-operation among the international oil communities’.
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THE EIGHTEENTH CONGRESS,
Johannesburg, 2005

‘Shaping the energy future: partners in sustainable solutions’

The Eighteenth Congress was held in Johannesburg from 25-29 September 2005. Joining South Africa as co-hosts of the Congress were Algeria, Angola, Libya and Nigeria. The largest delegation from outside Africa came from the UK, which sent 294 people. Over 200 CEOs attended and there were 560 speakers, which set a record for the WPC. There were 270 stands at the exhibition run in conjunction with the Congress, and 400 exhibiting companies, making it one of the largest exhibitions held in Africa.

President Thabo Mbeki of South Africa attended the Opening Ceremony. The Ceremony was based around the prospects for a brighter future for Africa, and included other high-profile speakers such as Lindiwe Hendricks, South Africa’s Energy Minister. The importance of international co-operation as a way of finding solutions to the world’s energy crisis was also repeatedly emphasised. For example, Nigeria’s oil minister, Edmund Daukoru said the theme of the Congress ‘Shaping the Energy Future: Partners in Sustainable Solutions’ could not have come at a better time.

WPC BUSINESS

Dr Randy Gossen became the new President of the WPC. He said: ‘We, as the petroleum industry, have to find ways of producing oil in an economically viable, environmentally acceptable and socially responsible way. The big issue is around our reputation and credibility. The WPC can’t solve the world’s problems, but it can facilitate and catalyse dialogue between the industry and its various stakeholders’. The outgoing President, Dr Eivald Røren had a similar message: ‘Listen to the industry and listen to the public and provide a meeting place for both’.

Dr Randy Gossen is Vice President for Safety, Environment and Social Responsibility at Nexen, Canada. Before becoming President of the WPC he was Chairman of the Congress Programme Committee. Pedro Baridón was elected Senior Vice President. For the first time in the history of the WPC a woman was elected to the Executive Board – Mrs Hege Marie Norheim from Norway – who became Vice President in charge of Membership. Applications from Azerbaijan and Sierra Leone to join the WPC were approved, while Japan rejoined, bringing the total number of members to 65.
There were 100 competitors for the WPC Excellence Awards on Technological Development and Social Responsibility, four winners and five runners-up. The Social Awards were won by Statoil, for a community project based on substantial local participation in Alaska and Nexen for building a community of trust in zones of conflict. The Technical Awards were won by EnCana for a drilling-waste management system and Welltec for creating a new drilling technique.

**YOUTH INVOLVEMENT**

Also for the first time in the history of the WPC, special sessions were devoted to young professionals, and women were encouraged to take part more. The best young authors from the First WPC Youth Forum held in China in 2004 (see “The WPC: Leaving a Legacy”, pages 194-199) contributed to a Special Presentation of Youth Forum Papers of Excellence.

Energy industries in the developing and developed worlds were facing different problems in employing young people. However, the oil service companies’ more global approach to the problem seemed to be working. This emerged from a round table discussion on recruiting young people to the oil business. It found that in OECD countries the oil business was doing a reasonable job in recruiting university graduates, but was failing to encourage enough school leavers to study science at university. The problems were different in developing countries, where there were substantial numbers of technical university graduates joining the industry, but they tended to leave soon after due to a lack of opportunity to advance their careers. One possible remedy, already being followed by oil service companies, was to
bring qualified people in developing countries into their organisations, initially at the local level, but with the intention of deploying them later at an international level.

Seventy-five students from South Africa and elsewhere participated in the WPC Student Programme and received complimentary places at the Congress in exchange for their assistance with the running of it. The South African Organising Committee made the inclusion of young professionals and students a priority. Thus a further 100 students from South African universities were given sponsored places at the Congress. In addition, the Organising Committee set up a bursary with a portion of the funds raised from the Congress. The bursary provides financial assistance to disadvantaged young South Africans who wish to pursue a qualification in petroleum studies.

Finally, the Congress set up a unique Volunteers Programme for previously disadvantaged young people in Johannesburg. Some 130 unemployed youngsters benefited from the special skills development and training they were given in preparation for working at a major international event. The experience they gained enabled many of them to find employment after the Congress.

**SOCIAL RESPONSIBILITY SEMINAR**

By 2005 good governance and social responsibility had become more than mere concepts, and closely regulated the dialogue between the petroleum industry, government, NGOs and the local communities in any operating environment. The seminar featured presentations from industry and stakeholders on working with local communities. The Social Responsibility Arena highlighted long-term actions on environmental awareness, poverty alleviation and improving the lives of local communities, education and skills development, as well as health issues, particularly the prevention and management of HIV and malaria.

**PAPERS PRESENTED**

The Technical Programme was again organised in four blocks: upstream; downstream and petrochemicals; natural gas and renewables; and managing the industry. Each block had Plenary Speeches by high-profile business leaders, CEO-level Round Table Discussions, Review and Forecast Papers, Forums on key areas of industry interest and complementary Poster sessions. There were three themed lunches too, covering OPEC and the IEA, social responsibility and Africa. The seven Plenary keynote speeches were delivered on the themes of:

1. The African perspective;
2. The global oil perspective;
3. Partners for sustainability;
4. Natural gas in the global energy picture;
5. Renewables: a significant part of the solution;
6. Corporate governance: factors that influence the image of the industry; and
7. Oil and gas – sustainability of supply.
Country presentations

The African member countries of the WPC were invited to introduce their national petroleum industries. To reflect the impact of major consumer nations on the global petroleum industry, China and India were also invited to present special country presentations. A dedicated Africa session covered key topics relevant to the industry in the African continent, including exploration and production challenges, energy infrastructure and refining, the role of Africa in world resources and reserves, as well as corporate governance.

Africa’s leading producers of oil and gas outlined plans to attract huge amounts of investment into a range of energy projects. Nigeria, the continent’s largest oil producer, hoped to attract investments of $67 billion to its oil and gas industries by 2008 in a bid to accelerate upstream and downstream development, announced Funsho Kupolokun (Managing Director, Nigerian National Petroleum Corporation – NNPC).

Libya, which has the largest oil reserves in Africa, hoped to attract around $7 billion in upstream investment over the next 10 years and to add 20 billion barrels of oil equivalent to its reserves, according to Tarek Hassan Beck (Planning and IT Director, Libya’s National Oil Corporation). Angola, whose deep-water industry has boomed in recent years, will lift its oil production by 0.7 million b/d within the next few years, said Syanga Abilio (Vice President, Sonangol). Sipho Mkhize, Managing Director and CEO of PetroSA, South Africa, a leader in GTL developments, said Africa’s proved gas reserves could amount to as much as 18 trillion m³ by 2010, which would give the continent ‘great potential’ to establish a major GTL industry.

Supply and demand of oil and gas

As of 2005, oil and gas were still the main energy suppliers, responsible for 63% of all supply. Gas was thought likely to increase its share more than oil. Dr Adnan Shihab-Eldin (OPEC) and HE Ali Al-Naimi (Oil Minister, Saudi Arabia) informed the Congress that the resource base was ample to supply the growing demand for oil and gas. They thought that reserves must be established and produced. The level of investment required was estimated to be $200 billion per year. In the short term there was under capacity in the refining sector, in terms of quality and quantity, but it would be resolved, they thought. Growth would be strongest in developing countries.
HE Al-Naimi suggested that a complete study of all important bottlenecks in the global oil supply system should be undertaken, from demand to supply. Then recommendations could be made about the limiting factors in the system, to enable the delivery of products at reasonable prices. He thought the work should be carried out under the auspices of the International Energy Forum (IEF). In his opinion most of the current oil ‘deliverability difficulties’ were due to the downstream sector. He said that the upgrading of refinery capacity world-wide ‘had not kept pace with the growth in demand for high-quality, environmentally friendly transportation fuels’.

Rex Tillerson, (President, ExxonMobil) agreed that there was plenty of oil left and said that supply had not yet peaked. He referred to the US Geological Survey’s estimate of more than 2 trillion barrels of oil still to be recovered, twice what had been produced to date, and added that the figure was ‘probably on the low side’. He thought the world’s massive reserves of unconventional oil, estimated at more than 1 trillion barrels would be an important element of future supply.

Partnerships

One of the major issues addressed at the Congress was partnerships. The questions were – how do you deliver partnerships and what goes into a successful one, particularly in developing countries, where their indigenous natural resources are often the only source of national wealth? The challenge for the oil and gas industry is how best to develop such resources responsibly, while, at the same time, developing a sustainable infrastructure that will last long after the oil companies have gone.

Christophe de Margerie (Executive VP, Exploration and Production, Total) forcefully explained Total’s obligation to the African countries in which it operated. In his opinion partnerships were the key, not just with national oil companies (NOCs) but they should also include individuals from the local community and develop a sustainable SME (small- and medium-sized enterprises) sector that could help drive that area’s economic growth.

In addition to the effect large oil operations can have on entire economies, various companies, including BP, Shell, Schlumberger, Petrobras and Statoil, had policies of maximising local economic growth by using as many local employees, contractors, goods and services as possible.

Although not a legal requirement, guidelines for corporate behaviour existed and continued to be honed into universally-accepted standards. Several landmark programmes, bringing together governments, companies and NGOs, combined to provide a code of conduct, covering various areas of corporate social responsibility, to which many oil firms said they would adhere. They included the Extractive Industries Transparency Initiative (EITI) and the Voluntary Principles on Security and Human Rights.
Transparency

Allied to the partnership debate is the issue of transparency of operation, which was also widely discussed, particularly corruption. Several speakers made the point that accepting corruption as a normal part of doing business in the developing world only fed it, and resulted in further costs and deprived local communities of income derived from the exploitation of local natural resources and of the support infrastructure that is intrinsic to any development. The Congress embraced the subject of revenue transparency, aimed at eliminating corruption and financial malpractice from the petroleum industry.

Henry Parham (Co-ordinator, Publish What You Pay) said that one way for companies to free themselves from accusations of complicity with corrupt political regimes was to publish a breakdown of their accounts in all their countries of operation. The message was ‘Publish what you pay and publish what you receive’. Improving revenue transparency was recognised as an important area of corporate social responsibility because it is a necessary step in enabling countries to pay for social development programmes and general economic development.

Transparency was improving, encouraged by institutions such as the World Bank and the International Finance Corporation, which have said they would make revenue transparency a requirement for all funding of extractive-sector projects.

Environmental issues

Environmental concerns were a central part of the Congress. Christopher Flavin (President, Worldwatch Institute) presented the view that while renewables only accounted for 3% of world energy capacity, environmental pressures and rising costs could see the renewable sector enter an era of exponential growth.

Estimates by the IEA were that emissions of CO₂ from fossil fuels were about 25 bt annually in 2005, which could rise to 40 bt by 2030. There were a number of presentations tackling this issue. Both BP and EnCana led discussions on carbon capture and storage. EnCana described its operation in the Weyburn oil field of Saskatchewan where production levels have increased 35% since CO₂ injection commenced. Every day about 95 million ft³ (3 million m³) of CO₂ is injected, having been piped over 160 km from the USA. BP presented its plans for the North Sea Miller field CO₂ injection and power generation project.

Standards

Standards and best practice were another recurring theme. Two standards workshops were held, which illustrated the need and
The exhibition running in conjunction with the Congress was one of the largest held in Africa.

Saudi Arabia’s Minister of Petroleum and Mineral Resources, Ali Al-Naimi (centre), tours the exhibition hall.
appetite for standards and best practice guidelines throughout the industry, particularly from developing countries.

The WPC and others had focused for some time on a code of classification of reserves. This was reinforced under UN auspices (UN Framework Classification for Fossil and Mineral Resources). It was thought important that such a standard be employed universally by the industry, and preferably also by the international accounting standards community.

Natural gas
A number of speakers commented on the outstanding potential of Africa to develop its gas resources for a number of reasons. First, its gas reserves are larger than those of Western Europe and North America combined, and second the deregulation of gas markets across the world would open up opportunities for the continent. Total forecast that by 2015, West Africa would supply 1.8 trillion ft$^3$ (50 million m$^3$) per year of gas to the USA, amounting to one-third of its import needs, and another 1.2 trillion ft$^3$ (34 million m$^3$) per year to Europe.

According to John Gass (President of Chevron's global gas division), the natural gas business was at a ‘tipping point’ where it would shift from being an industry based on dedicated projects and long-term contracts, to being a global commodity market. He said that global energy demand was expected to grow by nearly 50% in the next 20 years, but that the real growth would occur in the gas sector, where demand would increase by 70% over the same period.

The Dewhurst Lecture
Lord Browne (BP) delivered the Dewhurst Lecture at Johannesburg. He reviewed the achievements of the industry over the past 35 years since he had joined it. Then he looked at how the industry was positioned to handle the challenges presented by rapid economic growth, environmental issues, significant growth of world trade and investment. He went on to highlight the massive levels of investment needed to be made by the industry in order to bring new supplies to market. He suggested that some $200 billion a year was needed in oilfield development alone, out of the IEA’s estimate of $560 billion a year required for the energy industry as a whole.

He referred to the low investment levels of the 1990s, which had since been left behind. For example, since 2000, around $50
billion a year had been invested in the upstream sector by the top five oil companies.

By 2000 it was broadly acknowledged that the current pricing issues were as much related to processing throughput as to supply inadequacies. Lord Browne discussed this issue, and pointed to the problems caused by differing specifications between regions of the world, and, therefore, the pressure this puts on an already tight market during crises such as Hurricane Katrina. In this example, minor product specification regulations were relaxed which enabled individual states to ease supply difficulties and restore order to the market in the wake of Katrina.

Lord Browne also reflected on the role of governments – on the one hand stating their importance in making sure investment incentives for industry are in place for example, but on the other hand stating that governments alone will not deliver energy security. That, he said, was down to the oil industry.

Hurricane Katrina was one of the strongest storms to hit the coast of the USA in the last hundred years. There were sustained winds of 125 mph, and minimum central pressure (920 mb), the third lowest on record at landfall which caused widespread devastation along the central Gulf Coast states of the USA.

Hurricane Katrina initially developed as a tropical depression in the southeastern Bahamas on 23 August 2005. As it moved towards the USA it strengthened to become a category 1 hurricane by the morning of 25 August. After entering the Gulf of Mexico, Katrina moved almost due west before turning northwest and then north. Katrina reached maximum windspeeds on the morning of 28 August of over 170 mph.

Hundreds of people lost their lives, mainly in Louisiana and Mississippi, and at one point more than 80% of New Orleans was under water.

The oil industry was severely disrupted too. It was estimated that oil production in the Gulf of Mexico was reduced by 1.4 million b/d (or 95% of daily Gulf production). The Gulf of Mexico oil infrastructure was seriously damaged, both onshore and offshore. Of the 4,000 Outer Continental Shelf oil and gas production facilities, 37 shallow water platforms were destroyed, though these made up only 1% of total Gulf production. More significantly, four large deep-water platforms, which accounted for about 10% of the pre-storm federal offshore Gulf oil production, suffered extensive damage, according to the US Minerals Management Service.

The government agency said these facilities could take up to six months to bring back on line. Some pipelines also suffered damage that took months to repair. One rig was pulled loose from its moorings and became wedged under a major bridge across the Mobile River, in southern Alabama.

The extensive casualty list and an insurance bill stretching into billions of dollars, raised questions about the adequacy of some platforms, rigs and pipelines working in the offshore province. However, the Gulf of Mexico already has among the world’s highest design values for storm variables, such as wind, wave and current.
Company Overview
Kenya Pipeline Company Limited (KPC) is a State Corporation wholly owned by the Government of Kenya under the Ministry of Energy. It was incorporated in 1973 under the Companies Act Cap 486. Its mandate is to transport, store and dispense petroleum products safely and efficiently, with utmost respect for the environment.

The Company serves the hinterland (Kenya, Tanzania, Southern Sudan, Rwanda, Burundi and Eastern Democratic Republic of Congo) through a multi-petroleum products pipeline from the port of Mombasa. The Company's operations are governed by and comply with stringent local and international safety, environmental and quality regulations such as OSHAS 18001, ISO 9001, NFPA, PI, the Factories and Coordination Act (EMCA, 1999).

Pipeline Network
The pipeline system consist of a 450 km 14-inch diameter pipeline from Mombasa to Nairobi (Line-1) commissioned in 1978 and a combination of an 8-inch and 6-inch diameter pipe running from Nairobi to Western Kenya (Line-2&3) commissioned in 1994. The total storage capacity for all KPC depots is 612,418m³.

Current and Future Petroleum Demand
The demand for petroleum products in Kenya and the neighbouring land-locked countries is expected to reach about 15.0 million m³ by 2030. In view of this, several projects have been lined up to ensure that the demand is met:
- Installation of new pumps at the existing four pumping stations along Line 1 (Mombada-Nairobi) to improve operation capacity of the pipeline.
- Construction of four additional pumping stations along the Mombasa – Nairobi pipeline (Line-1) is underway and is expected to be commissioned in March 2008. This will increase the flow rate from the current 440m³/hr to 880m³/hr.
- The Company is also constructing a parallel pipeline to the existing oil pipeline from Nairobi to Eldoret (Line-2) which is expected to provide an additional maximum flow rate of 656m³/hr. The existing pipeline system has flow rates of 220m³/hr.
- Construction of about 352-km cross-border pipeline extension from Eldoret to Kampala as a joint venture between Governments of Uganda and Kenya (through KPC) and a private investor, M/S Tamoil East Africa Limited. This project is expected to reduce traffic of petroleum tankers in the Eldoret to Kampala road resulting in significant reduction of fuel emissions and greenhouse gases.

Meeting E. Africa’s Petroleum Demand
While caring for the Environment
THE NINETEENTH CONGRESS, MADRID, 2008
‘A world in transition: delivering energy for sustainable growth’

The Nineteenth World Petroleum Congress will be the first for Spain and takes place in Madrid from 29 June to 3 July 2008. The King of Spain, HM Juan Carlos I de Borbón, has confirmed his participation as Head of the Honorary Committee and his personal attendance at the Congress. Highlights of the event include an Opening Ceremony with legendary tenor José Carreras and Sara Baras, Spain’s finest flamenco dancer, the Inaugural Session on the first day of the Congress and the Spanish Night, the traditional evening showcasing the host country’s music, culture and gastronomic delights.

The Congress will be complemented by the World Petroleum Exhibition, which will be held at the same venue – the Juan Carlos I Exhibition Centre or IFEMA in Madrid. Over 12,000 visitors are expected to view the stands of 500 exhibitors covering 30,000 m². Additional elements of the exhibition will include: the Global Business Opportunities Centre, the Media Village, the Poster Plaza and the Social Responsibility Global Village.

The 2008 World Expo in neighbouring Zaragoza will provide a great synergy with the Congress as it has the theme of water and sustainable development – also concerns of the petroleum industry – and will input expertise on water to the Congress during a Special Session.

Spain joined the WPC during the cycle of the Ninth Congress and is now hosting the 19th in Madrid.
Renato Bertani, Chairman of the Congress Programme Committee, outlined the new features in the programme for the 19th WPC: ‘High-level Plenaries from leading industry decision makers, interactive Round Tables and in-depth Forums and innovative Posters on a variety of industry aspects will address the status quo and the main challenges facing the sector. Best Practice Keynotes on the main issues in the upstream, downstream, natural gas and renewables sectors and management of the industry will add further to the quality of the programme. Key issues such as balancing the requirements of supply and demand, social and environmental responsibilities of the industry and ensuring the attraction and retention of the next generation of professionals will be addressed throughout the four days of the Congress’.

The Congress has already attracted a high level of decision makers from the industry including the CEOs of BP, CEPSA, ExxonMobil, Petrobras, Repsol YPF, Rosneft, Schlumberger, Shell and Total, the heads of international energy organisations such as OPEC and the IEA, as well as the heads of the UN Global Compact, Amnesty International and the UNFCCC.

Ministers from Canada, Cuba, Colombia, Iran, the Netherlands, Nigeria, Qatar, Russia, Venezuela and the UK have also confirmed their attendance at the Congress and will be hosting Ministerial Sessions focusing on their countries. Providing in-depth overviews and an update on the latest opportunities and potential for participation and investment, these Ministerial Sessions already promise to be one of the highlights of the event.

A key feature of the Congress is an extensive Youth Programme with a Youth Centre stand offering networking opportunities in the exhibition; a grants programme to enable students to attend the

![HM Juan Carlos I (fourth from left in the front row) is the Head of the Honorary Committee for the Madrid Congress.](image-url)
Congress; a Special Session asking CEOs and young people alike: ‘Does the industry need an image makeover’; a Student Programme whereby young people assist the chairs and speakers taking part in the Congress; and a Youth Party. Social Responsibility also takes a central role with a Global Village stand dedicated to demonstrating the industry’s commitment to social, community and environmental initiatives around the globe; a Special Session on Social Responsibility and Human Rights, to reflect on the 60th Anniversary of the Universal Declaration of Human Rights; and the WPC Excellence Award for Social Responsibility, which will be presented to the winner during the Congress.

**DEWHURST AWARD**

The World Petroleum Council has once again selected an outstanding individual to honour with the prestigious Dewhurst Award: HE Ali Al-Naimi, Saudi Arabia’s Minister of Petroleum and Mineral Resources.

Named for the WPC’s founder, Thomas Dewhurst, the Award is a tribute to him and to the person invited to deliver the Dewhurst Lecture as an acknowledgement and celebration of scientific and technological excellence in the petroleum industry. As one of the most inspirational leaders in the global oil and gas sector for many years, Ali Al-Naimi is a worthy recipient of the Dewhurst Award for the 19th World Petroleum Congress and has accepted the Council’s invitation to give the Dewhurst Lecture in Madrid in July 2008.

**75TH ANNIVERSARY OF THE WORLD PETROLEUM COUNCIL**

The 75th Anniversary of the World Petroleum Council falls in the same period as the Nineteenth Congress. With the First Congress held in July 1933, it is exactly 75 years later that the 19th Congress is taking place and the Spanish hosts are planning a celebration with all the National Committees of the WPC and special guests to commemorate the previous 18 Congresses and the 75 years since the very first meeting took place. Commemorative initiatives being planned throughout the year include the celebration during the 19th WPC, the publication of this Anniversary book, the production of a series of 75th Anniversary badges and commemorative items and a London-based event.
Commitment: our greatest source of energy

For this reason, in Repsol YPF we are carrying out a responsible and transparent project, which is committed to the community and sustainable development.

Because our goal is to progress and to continue innovating to bring you closer to tomorrow’s energy.
THE WPC: LEAVING A LEGACY

When hosting the triennial World Petroleum Congress, the intention is not only to promote the progress of the global oil and gas industry but to leave a positive affect on the local community of the host country and a long lasting legacy for its environment. The surplus of the event is designed to go towards funding the seeds of a country legacy project proposed by the Host and agreed with the WPC.

1994: NORWEGIAN PETROLEUM MUSEUM
The concept of leaving a legacy in the Host Country started in 1994 with the 14th World Petroleum Congress in Stavanger. The surplus funds of the Congress were put towards the creation and building of a state-of-the-art Petroleum Museum in Stavanger. The Norwegian Petroleum Museum was opened by HM King Harald V on 20 May 1999 and its unusual architecture has made it an exciting landmark in the port of Stavanger.

With a radical, modern architecture, built partly on land, partly in the sea from materials ranging from steel and grating to Norwegian granite, the Norwegian Petroleum Museum is the most ambitious museum ever built in Norway. With its many interactive, hands-on exhibits, it is intended to educate all those who would like to learn more about oil and gas and find out about the origins of, and developments in, the Norwegian petroleum industry. It also features the Petroscope, the Museum’s ‘well of knowledge’. This is a place where everyone, but particularly school children and young people, can delve deeper into the themes and subjects covered by the museum’s exhibitions. A full range of sources is available – from books and journals to videos, databases and multimedia programmes. Since its inception it has already received over half a million visitors, increasing their knowledge of the exploration, production and use of oil and gas.

1997: PUTTING YOUTH IN THE PICTURE, CHINA
The 15th World Petroleum Congress in Beijing adopted the issue of young people as a key aspect of its theme ‘Technology and Globalisation – Leading the Petroleum Industry into the 21st
Century’. The Congress acknowledged that young people will be the main force to drive future technological development and globalisation. To support their education and future involvement in the petroleum industry, the Chinese National Committee donated all the computer and video equipment worth $215,700 used for the Congress, to its Petroleum University after the close of the 15th WPC.

The Chinese organisers then took the issue of young people one step further and launched the 1st WPC Youth Forum in Beijing in October 2004. The Youth Forum attracted 541 young delegates from 19 countries around the world with its focus on ‘Youth and Innovation – the Future of the Petroleum Industry’. The Forum played an active role in implementing the WPC development strategy to attract more young people to WPC activities and the petroleum industry. It was fully financed by China’s state-owned companies – CNPC, SINOPEC, CNOOC and SINOCHEN, who were sponsoring many of the local and foreign students in order to enable them to attend the meeting and present papers on a wide variety of industry subjects. The presenters of the best papers at China’s WPC Youth Forum were honoured with a special session at the 18th WPC in South Africa.

2000: WPC MILLENNIUM SCHOLARSHIP PROGRAMME, CANADA

Chemical engineering student Christian Hamuli fled the Democratic Republic of Congo after his teenaged brother was murdered and rebels attacked his university.

Damon Ross, a fourth-year petroleum engineering student at the University of Alberta, spent part of summer 2006 living in a truck by a creek.
What do these two students have in common? Both are among the 200 students from across Canada receiving scholarships awards worth C$3,000 each year from the legacy created after Calgary hosted the 16th World Petroleum Congress in 2000. The Congress is long over, but the June 2000 event is still helping to create a legacy beyond the week long meetings and high-profile presentations.

Profits of C$4.2 million from the 16th WPC were used to endow a fund that gives scholarships to post-secondary students in several petroleum-related fields. The Canada Millennium Scholarship Foundation matched the amount dollar-for-dollar which created an endowment from the capital and the interest that provides approximately 200 scholarships annually, until 2009. By that time, approximately 1600 WPC millennium scholars will have received awards to assist them in completing their studies. These scholarships are designed as bursary programmes, and as such do not increase the students’ debts as they do not need to be repaid.

Calgary is known for its vital volunteer spirit and its citizens generate a special enthusiasm to support major events. It was no surprise then that 900 of them offered their time and provided valuable assistance to the Host organisers of the Congress. As well as helping facilitate the programme and special events, they helped with organising registrations, escorting people to sites, working with police and security agents, and providing interpretation services in 20 languages. In the end, volunteering pays back, as not only the award students benefited long term from the 16th WPC, but also more than 70 of the volunteers who were all offered employment within Canada’s oil and gas industry as a result of their activities during the Congress.

2002: A CONGRESS WITH A CONSCIENCE, RIO

The World Petroleum Congress in 2000 was the first to integrate the concept of sustainability throughout its event, instead of relegating it to a side position. The theme of the 17th Congress made that very clear: ‘The Petroleum Industry: Excellence and Responsibility in Serving Society’. The Organising Committee for Rio came up with a whole range of projects and activities to serve society with the event itself, leaving a legacy that would not cost the earth and enriching the experience of participants as well as the local community. NGOs joined the high-level speakers on the platform of the largest oil and gas congress worldwide and provided a balanced view of the petroleum industry’s effect and involvement in society and the environment, with environmental groups such as Greenpeace, Conservation International and the World Wildlife Fund invited to join the meetings.

The 17th WPC dedicated a special area to presenting social and environmental action programmes and projects. The Social Responsibility Arena, an unprecedented event for the triennial Congress, brought
together some 30 governmental, non-governmental and business organisations, including the Brazilian Nature Conservation Foundation, which supports public and private initiatives for conservation through environmental education, the International Conservation Institute of Brazil, which aims to protect biodiversity and ecosystems in Brazil and in 30 other countries, and the Pro-Natura Institute which encourages social and technological innovations for sustainable development through community and environmental projects. The United Nations Education, Science and Culture Organisation (UNESCO) was another participant, as well as The Blue Wave Movement Foundation, known in Portuguese as OndAzul. Created in 1990 by the composer and singer Gilberto Gil, the foundation manages more than 15 social and environmental projects with the main focus on the defence of water resources and associated ecosystems.

The Congress also took responsibility for the waste it generated. Event organisers estimated that, together, the Congress and the accompanying Rio Oil & Gas Expo 2002 generated a total of 16 metric tons of recyclable waste – plastic, aluminium, paper and glass. Official suppliers of the Congress materials were given strict environmental guidelines resulting in the use of recycled paper note pads and a vegetal leather kit, which was made of natural materials from Brazilian rubber trees. Recycled PET (polyethylene terephthalate) and PBT (polybutylene terephthalate) materials were used to make furniture for the event as well as the uniform t-shirts worn by the staff and volunteers of the Congress. Recycling also extended to the 31,000 m² exhibition, the largest ever in South America, where the carpets and the new stands built specifically for the 17th WPC were recycled after the event. All the proceeds of the various recycling activities were then passed on to a residents’ co-operative with 6,000 members located in the port area of Rio de Janeiro.

But the sustainability efforts did not stop there and an army of 250 volunteers collected 36 tons of refuse in 10 days in a special community effort to clean up the Corcovado area before the Congress, donating all proceeds to the refuse collectors, some of the poorest inhabitants of Rio. The Finlândia Public School also received a new lick of paint from the volunteers of the Congress.

With 10,000 professionals involved in the organisation of the 17th WPC, and about R$100 million ($35 million) in resources revenue received by the city, the Congress managed to leave a lasting impact on Rio de Janeiro’s communities and business tourism sector.

The surplus funds for the Congress of $2 million were used to set up the WPC Educational Fund in Brazil, which was further increased in 2005 with tax initiatives added by the Brazilian government.
2005: Social Responsibility in South Africa

The 18th World Petroleum Congress also chose a sustainability focus for the first ever WPC to be held in Africa: ‘Shaping the Energy Future: Partners in Sustainable Solutions’.

A social responsibility programme included Plenaries and keynote presentations as well as a special Social Responsibility Seminar alongside the Technical Programme of the Congress, which brought together industry, government and NGOs, to consider practical solutions and examples of successful cooperation.

Taking its cue from many of the key challenges faced in Africa and other emerging regions, the Social Responsibility Arena from Rio also featured in Johannesburg, highlighting long-term actions on environmental awareness, poverty alleviation and improving the lives of local communities, education and skills development, as well as health issues, particularly the prevention and management of HIV and malaria.

The Congress set up a unique volunteers programme for previously disadvantaged young people in Johannesburg. Some 130 unemployed youngsters benefited from the special skills development and training they were given in preparation for working at a major international event. The organisers paid for their expenses and set them up with bank accounts, a first for many of the young men and women who had never had one before. The experience in customer care and event organisation gained during the Congress enabled many of the youngsters to find employment after the event.

Young people were also involved in supporting the official Congress Programme, with 75 students from South Africa and around the globe actively participating in the WPC Student Programme and being given complimentary participation at the Congress in exchange for their assistance to the chairs and speakers of the Congress. Armed with their CVs in their hands, the students of petroleum related studies received access to key decision makers and leaders of their industry. The South African committee made the inclusion of young professionals and students one of its main priorities and a further 100 students from South African universities were given sponsored places at the Congress to ensure that young people about to enter the petroleum industry got as much exposure to the industry’s top professionals who were gathered there as possible.
‘Our commitment to the young emerging professionals goes beyond this; we want to leave behind a legacy we can be proud of once the congress is over. To this end, we are setting up a bursary with a portion of the funds raised from the congress,’ announced Sej Motau, the Chair of the South African Organising Committee, shortly before the Congress. Education was therefore made the focus of the 18th World Petroleum Congress Legacy Trust, set up by the South African National Committee with $1 million to provide financial assistance to needy young South Africans who wish to pursue a qualification in petroleum studies.

2008: PREPARING THE LEGACY, MADRID

The Host for the next World Petroleum Congress is already considering the long-term legacy they wish to leave behind once the 19th WPC is over. The selected theme ‘A World in Transition: Delivering Energy for Sustainable Growth’ provides the Spanish Committee with an excellent framework to plan the legacy for the Congress and the attached World Petroleum Exhibition. Key features will focus on the issues of youth and social responsibility, while the 2008 World Expo in neighbouring Zaragoza provides a great synergy with its focus on water and sustainable development, which are essential issues within the petroleum industry as well. The organisers are also making plans to address the carbon footprint that each of the delegates will leave behind when attending the event and are looking at ways to neutralise its effect for the coming generations.

WPC EXCELLENCE AWARDS

Every three years the World Petroleum Council bestows the WPC Excellence Awards in the categories of Technical Development and Social Responsibility. Recognising exceptional achievements in the oil and gas industry the Awards, created in 1933, are presented at a special ceremony during the triennial World Petroleum Congress.

The WPC Excellence Awards distinguish companies, institutions or any public or private organisation (not individuals) engaged in the oil and gas industry, for promoting or operating with high standards of excellence in the areas of technological development and social responsibility. A panel of independent judges selects two winners in each category, one from a large organisation and one from a small business. In addition two runners-up are recognised with highly commended awards within each category.

In the 75 years since the WPC was formed in 1933 the world has experienced vast changes in its energy production and consumption. Technical achievements have allowed oil and gas to be produced with greater efficiency, at lower cost and to create a range of products with a care for the environment. Whether it is drilling deeper, using new analytical techniques or producing cleaner fuels, the WPC Excellence Awards for technical development present some of the best achievements from the upstream or downstream sectors.

Our global industry is also leading the way in a number of social and environmental areas and we showcase the best of these initiatives in our Social Responsibility Award. By recognising partnerships between environmental issues, social responsibility and business, and encouraging a better understanding of the complex relationship between a clean environment, good business practice and a healthy economy, the Social Responsibility Award, and thus its recipient, reflects the world’s drive for a sustainable future.
WORLD PETROLEUM COUNCIL
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ACKNOWLEDGEMENTS AND OFFICERS

For the WPC:
Director General: Dr Pierce Riemer
Director of Communications: Ulrike von Lonski
Author of the WPC 75th Anniversary
Publication: Deborah Adams

For ISC:
Production Editor: Mark Blacklock
Copy & Picture Editor: Adrian Giddings
Publisher: Nigel Ruddin
Publications Director: Robert Miskin
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Research Executive: Harold Green
Office Manager: Kiira Mendenhall
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Printed by: Times Offset (M) Sdn Bhd

The WPC and ISC would like to express their thanks to all who helped in the production of this publication and their particular appreciation to Catherine Cosgrove and Liliana El-Minyawi of the Energy Institute; Dr Gisa Teßmer and Christa Jenka of the German Society for Petroleum and Coal Science and Technology (DGMK); Dr Dietmar Bleidick of the Historisches Archiv Aral; James Shaw of Nexen Inc.; Edouard de Guitaut and the staff of Petroleum Economist; and Ossama El-Buy of Qatar Petroleum.

Thanks are also due to the following companies, people and organisations for providing pictures. The credits are listed by article. Where the pictures for an article came from a variety of sources, the appropriate page numbers are given in brackets after each source.

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<tr>
<td>1933</td>
<td>J. Kewley (UK)</td>
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<td>1949 – 1951</td>
<td>M. Boldrini (Italy), P. Erculisse (Belgium), R. Navarre (France), F. M. Porter (USA), C. A. P. Southwell (UK)</td>
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<td>1951 – 1955</td>
<td>H. S. Gibson (UK), C. Perez de la Cova (Venezuela), M. S. Scheer (France), G. A. Tuyl Schuitemaker (Netherlands)</td>
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<td>1955 – 1959</td>
<td>H. S. Gibson (UK), G. A. Tuyl Schuitemaker (Netherlands), R. Navarre (France), C. Padovani (Italy)</td>
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<td>1959 – 1963</td>
<td>R. Navarre (France), C. Padovani (Italy), J. A. Beukers (Netherlands), G. Schlicht (Germany)</td>
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<td>1963 – 1967</td>
<td>F. Naficy (Iran), J. A. Beukers (Netherlands), W. J. Sweeney (USA)</td>
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<td>1967 – 1971</td>
<td>A. Demargne (France), S. Fujisaka (Japan), D. C. Ion (UK), B. Mascanzoni (Mexico)</td>
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<td>1975 – 1979</td>
<td>A. Demargne (France), D. C. Ion (UK), S. A. Orudjev (USSR), L. Plaz Bruzual (Venezuela)</td>
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<td>1979 – 1983</td>
<td>A. Lewis, Jr (USA), N. A. Maltsev (USSR), F. Naficy (Iran), A. A. Shunaib (Saudi Arabia)</td>
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<td>1983 – 1987</td>
<td>I. Antonica (Romania), A. Demargne (France), P. A. McKim (USA), A. M. Khalimov (USSR)</td>
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<td>1987 - 1991</td>
<td>R. Granier (France), V. I. Igrevsky (USSR), A. R. Martinez (Venezuela)</td>
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<td>1991 – 1994</td>
<td>C. M. Bechelli (Argentina), V. Y. Alekperov (USSR), N. A. White (UK)</td>
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<td>C. M. Bechelli (Argentina), Wang Tao (China), E. M. Q. Røren (Norway)</td>
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<td>1997 – 2000</td>
<td>Wang Tao (China) E. M. Q. Røren (Norway), C. J. Rederon (France)</td>
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<td>2000 – 2002</td>
<td>J. Toth (Hungary), P. N. Baridon (Uruguay), M. Laouadi (Algeria)</td>
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<td>2002 – 2005</td>
<td>R. Goldman (USA), R. G. Gossen (Canada), J. Toth (Hungary), P. N. Baridon (Uruguay),</td>
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<td>2005 –</td>
<td>R. Goldman (USA), R. T. Bertani (Brazil), Wu Yaowen (China), H. M. Norheim (Norway)</td>
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### TREASURERS OF THE WPC

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<th>Year</th>
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<tr>
<td>1951 – 1967</td>
<td>S. J. M. Auld</td>
<td>UK</td>
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<td>1983 – 1991</td>
<td>N. A. White</td>
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<tr>
<td>1994 – 1997</td>
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<td>UK</td>
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<tr>
<td>1999 –</td>
<td>P. W. F. Riemer</td>
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In 2002 this role became Vice President Finance

### SECRETARY/DIRECTOR-GENERAL OF WPC

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<tr>
<td>1932 – 1937</td>
<td>R. E. Stokes Rees, G. Sell (joint)</td>
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<td>1937 – 1939</td>
<td>S. J. Astbury</td>
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<td>1948 – 1973</td>
<td>D. A. Hough</td>
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<td>1973 – 1991</td>
<td>D. C. Payne</td>
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<td>1991 – 1999</td>
<td>L. P. Tempest</td>
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<td>1999 –</td>
<td>P. W. F. Riemer</td>
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