THE HISTORY OF CHEMISTRY IN JAPAN AND AROUND THE WORLD - Focusing on Invention, Discovery, Commercialization, and the Founding of Major Companies -Big Trend Society in General Chemistry-related Developments of Japan Chemistry-related Developments of the World (France) Antoine Lavoisier, "the father of modern chemistry," Kaitai Shinsho ("New Book of Anatomy") discovered the law of conservation of mass. was published by Genpaku Sugita and Movement from alchemy to "chemistry" others. as an industry. (France) Nicholas Leblanc developed an industria US Declaration of process for producing sodium carbonate Independence (1776) (i.e. Leblanc process) (USA) DuPont was founded to manufacture gunpowder. (Germany) Friedrich Woehler succeeded in synthesizing urea. The world's first synthesis of an organic substance. Publishing of Seimi Kaiso, authored by Yoan Udagawa, begins (completed in 1847). The Rebellion of Heihachiro Oshio Japan's first book on chemistry. (UK) William Perkin synthesized Mauve, an aniline The first EXPO in London (1851) synthetic dye, for the first time in the world. Industrialization of coal chemistry Ponpe Seimisho, edited by Ryojun Matsumoto, was published. It was the first text of chemistry Yokohama Port was opened. based on taking notes from lectures given by Pompe van Meerdervoort, a Dutch naval surgeon. Kagaku Shinsho ("New Book on Chemistry"), a translated book by Komin Kawamoto, (UK) C. Williams separated the main ingredient of natural rubber was published. American Civil War (1861 - 1865) and named it "Isoprene." First book with "chemistry" in title. Seirenkata (a "refining laboratory") was started in Banshoshirabesho. (Place of origin: the Chemistry Department of the University of Tokyo) In 1865, Seirenkata was renamed "Kagakusho" (a "chemical laboratory"). (Germany) Bayer and Hoechst were established to manufacture dyestuffs. In 1865, BASF was established to manufacture dyestuffs and other chemicals. (Belgium) E. Solvay industrialized the ammonia-soda process (i.e. Solvay process). (Sweden) Alfred Nobel invented dynamite. (USA) Hyatt Brothers invented celluloid. The Meiji Restoration Koenraad Woulter Gratama, a Dutchman, gave an opening speech as vice principal of Suez Canal Osaka Seimikyoku, a chemistry school. was opened Education on chemistry began at Tokyo Kaisei School (now the University of Tokyo). Start of chemistry education: Chemistry education began with the lectures given by Gratama at (USA) Standard Oil was founded. Osaka Seimikyoku. Such famous scientists as Jokichi Takamine and Kikunae Ikeda graduated from the school, but it was closed in 1872, and was assimilated into Tokyo Kaisei School. (Germany) BASF commercially produced synthetic alizarin dyes. Osaka Zoheiryo (the Mint Bureau) started to manufacture sulfuric acid using a lead chamber Railway was opened between Shimbashi process for mint production and Yokohama. Introduction of inorganic chemical industry. (France/USA) Charles Friedel of France and James Crafts of the USA discovered the synthesis process of the benzene The University of Tokyo was established. derivatives (i.e. Friedel-Crafts reaction). The Chemical Society of Japan was established. (First chairman: Mitsuru Kuhara.) (Germany) Bayer succeeded in synthesizing indigo. Osaka Mint Bureau (now Japan Mint) started to manufacture Leblanc-process sodium carbonate and other chemicals. Bank of Japan was established. Introduction of soda industry. Komeisha (now Nippon Paint) developed paste paint from zinc oxide. Introduction of paint industry (France) Count H. Bernigaud de Chardonnet acquired a patent Japanese transfer from a Grand Council to manufacture artificial silk from nitrocellulose and, in 1891, he

produced it commercially

nitrogen in the air and carbide.

process artificial silk thread.

(commercial name: Bakelite).

Prize in Chemistry.

equipmen

The world's first synthetic resins.

commercial gas.

(Netherlands) Predecessor to Royal Dutch Shell was established.

(Germany) Emil Fischer discovered Fischer esterification. (Germany) Bayer discovered aspirin, a raw material for

(USA) Dow Chemical was established to manufacture bleach.

(France) Mr. and Mrs. Curie discovered polonium and radium.

(Germany) Adolf Frank and others produced lime nitrogen from

(UK) Courtaulds started a full-scale manufacture of viscose-

(Netherlands/UK) Royal Dutch of the Netherlands and Shell

experiment to directly synthesize nitrogen in the air to fixed

(Germany) Flitz Hoffmann of Bayer obtained a patent on

(France) Madame Curie was awarded the Nobel

butylrubber with the addition of polymerization of metylisoprene.

The world's first commercial production of synthetic rubber.

(USA) William M. Burton developed a thermal cracking process

for petroleum, a path to increased production of gasoline. (Germany) BASF started operation of a processing factory for

(Germany) Franz Guenter of BASF discovered potassium

(USA) Standard Oil produced IPA by using propylene from

(USA) Ivan Ostrominsky and others manufactured synthetic

(UK) ICI was established by merging four companies in alkali,

fertilizer, and dyestuff industries including Nobel, a gunpowder

rubber from butadiene using the emulsion polyerization

(Germany) IG Farben Industries was founded.

manufacturer, to compete against IG of Germany.

(USA) Goodrich manufactured polychlorovinyl and

World's first general-purpose plastics.

(Germany) IG commercialized polystyrene.

the ultra-high 2,400 atmospheric pressure. (Germany) IG developed "Buna S" of hot SBR.

and polyvinyl alcohol.

(later named "Teflon").

for phthalic anhydride

commercialized polychlorovinyl sheet and wall papers.

(UK) ICI discovered the synthesis process of polyethylene with

(USA) Wallace H. Carothers of DuPont succeeded in synthesizing

(USA) Theodore Lefort of Union Carbide developed a process

for direct oxidation of ethylene oxide and commercialized it. (USA) Roy Plunkett of DuPont invented polytetrafluoroethylene

(Germany) IG (Bayer) commercialized polyurethane resins.

(UK) ICI commercialized high-pressure process polyethylene.

(USA) Dow Chemical commercialized polychlorovinylidene.

(UK) John R. Whinfield and James T. Dickson of Calico Printers

succeeded in synthesizing and spinning polyethylene phthalate.

(USA) DuPont started production of polytetrafluoroethylene "Teflon."

(USA) Standard Oil New Jersey began production of butyl rubber.

(USA) GE produced full-scale silicone using direct synthesis

(USA) Dow Chemical started to manufacture high-impact

polystyrene (HIPS) and extruded polystyrene foam sheet. (USA) DuPont commercialized polyacrylonitrile fiber "Orlon" by

(W. Germany) Karl Ziegler created alkylaluminium from AlH3

(W. Germany) IG dissolved and divided into BASF, Hoechst,

(USA) Monsanto developed grafted-type ABS resins.

DMF solvent, a dry spinning process.

Bayer, and others.

polyamide synthetic fiber (nylon 66) for the first time. World's first general-purpose synthetic fiber.

World's first general-purpose synthetic rubber for tires.

diisopropylnaphthalenesulphonate in detergents.

World's first synthetic detergent.

World's first petrochemical product.

synthetic ammonium based on Haber-Bosch method.

Transport of the UK merged to form Royal Dutch Shell. (Germany) Fritz Haber and Karl Bosch succeeded in an

(USA) Leo Baekeland synthesized phenolic resins

(France) Air Liquide was established to manufacture

to a Cabinet system.

First Imperial Diet

Works was completed

capital.

Eiffel Tower was built at Paris Expo

Sino-Japanese War (1894 - 1895)

Government-managed Yawata Steel

First Nobel Prize Award Ceremony.

Russo-Japanese War (1904 - 1905)

In the US, the Ford Model T, a noted

automobile, was produced.

First World War (through 1918)

the general theory of relativity.

(Minimum age 12, 12-hour labor)

League of Nations was established

Great Kanto earthquake of 1923.

Emperor took over the throne

Taisho Emperor passed away and Showa

Charles Lindberg succeeded in a non-

stop flight across the Atlantic Ocean.

The Great Depression started.

Manchurian Incident occurred.

New Deal was started in the US.

Marco Polo Bridge Incident occurred and

Second Sino-Japanese war started.

Second World War (through 1945)

Asia-Pacific War (through 1945)

The Republic of Korea was formed.

People's Republic of China was formed.

refineries and the importation of crude oil.

GHQ permitted the resumption of petroleum

USSR closed down Berlin.

The Korean War outbroke.

Agency of Industrial Science and

Technology was established.

National Mobilization Law was

promulgated.

Battle of Midway.

Factory Law was enforced.

Albert Einstein of Germany advocated for

Industrial Bank of Japan was founded

for the purpose of introducing overseas

Oversea exchange of chemi 1859 1860 1861 1863 1866 1868

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1952

Shift to wartime regime: Production fiber and resins was promoted

of synthetic

Start of carbide/lime

nitrogen manufacturing

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Chemical imports v due to the war.
Toward domestic p

estic production

Production

underway

Chemical fertilizer industry started

Nagase Shoten (now Kao) launched Kao Sekken (Kao Soap). Tomijiro Kobayashi established T. Kobayashi & Co. (now Lion). Jokichi Takamine discovered digestive enzyme Taka-Diastase. Okinoyama Coal Mine (now Ube Industries) was established. Kotaro Shimomura succeeded in producing ammonium sulfate for fertilizers with ammonia from a by-product recovery coke oven. Jokichi Takamine succeeded in extracting adrenalin. Tokyo Gas started to distill coal tar.

Tokyo Jinzo Hiryo (now Nissan Chemical Industries) was founded. The following year,

Nippon Seimitsu Seizo (now Nissan Chemical Industries) was established and, in 1891

it started to produce chemical fertilizers (superphosphate of lime) domestically.

it started to manufacture Leblanc-process sodium carbonate in Onoda

Tsuchiya Rubber Co. succeeded in rubber heat vulcanizing.

Introduction of rubber processing industry.

Chemical fertilizer industry started. Nagase Shoten (now Kao) was founded

Tsuneichi Fujiyama succeeded in manufacturing carbide by the hydraulic power generation of Sankyozawa. (He later established Denki Kagaku Kogyo.) A path to electric chemistry/carbide (acetylene) chemistry. Takanobu Tanaka built a factory to manufacture celluloid. Introduction of plastic industry.

Asahi Glass was founded. Tomonori Nakano developed the Nakano-method mercury process electrolysis (i.e. electrolytic soda process). Sakai Celluloid and Japan Celluloid Artificial (now both Daicel) were established and started to manufacture celluloid in 1911.

Shitagau Noguchi established Nippon Chisso Hiryo K.K. (now Chisso)

Asahi Glass succeeded in the commercial production of sheet glass

Mitsui Mining started to manufacture ammonium sulfate in Omuta by tar distillation.

Rikou Majima determined the chemical structure of urushiol, a substance of lacquer.

Start of coal chemistry: Synthetic dyestuffs and ammonia were produced with ammonia and benzene

Sumitomo Fertilizer Manufacturing (now Sumitomo Chemical) was established, manufacturing

Yokohama Cable Manufacturing (now Furukawa Electric) and BF Goodrich established a joint-

Eight companies including Sakai Celluloid merged and established Dainippon Celluloid (now Daicel).

Synthetic ammonium industry: Synthetic ammonium is a symbolic product for modern chemistry.

Big-scale, high-pressure technology had become a start to the development of the process industry,

fertilizers from sulfer dioxide gas emitted by copper smelters. Origin of Sumitomo Chemical.

The government decided the soda industry, tar distillation industry, and electric chemistry

Kikunae Ikeda discovered monosodium glutamate. In 1909, he commercialized it as the seasoning "Ajinomoto".

by merging Sogi Electric and Nippon Carbide Shokai. Kawamura Ink Manufactory (now DIC) was founded.

Sankyo started to produce phenol resins

Introduction of synthetic resin industry

Mitsui Chemicals was founded.

industry were integral industries.

Chemical fiber industry started.

RIKEN was established.

Denki Kagaku Kogyo was established.

using the gas of coak oven.

(succeeded by what is now Sumitomo Bakelite).

using a "hand blown cylinder process" at its Kansai Plant.

Yuraseiko (now Honshu Chemical Industry) had built benzene distillation equipment and started to manufacture aniline for dyestuffs.

Nippon Kayaku Seizo (now Nippon Kayaku) was established,

Chika Kuroda determined the chemical structure of shikonine,

Japan's first electrolysis of soda manufacturing started.

Azuma Industries commercialized the process.

manufacturing explosives for industrial use.

a substance of natural violet pigment. Japan's first female chemist.

Kansai Paint was established.

Nippon Soda was established.

requiring the integration of power.

Toyo Rayon (now Toray) was established.

Kurashiki Kenshoku (now Kuraray) was established.

domestic technology (by Tokyo Kogyo Shikenjo).

Start of aluminam refining.

in the scale of 1.5 tons per day.

Yahagi Kogyo (now Toagosei) was founded.

Yasuzaburo Hara as the first chairman.

An era of synthetic fiber opened.

released the Frontier Orbital Theory.

for the first time in the world.

carbide-process vinyl chloride in Minamata.

Nippon Iodine (now Showa Denko) succeeded in producing

Fuji Photo Film (now Fujifilm Holdings) was established.

Toyo Soda Manufacturing (now Tosoh) was established.

established with Kyuhei Kobayashi as the first president.

Nippon Oil & Fats (now NOF Corp.) was established.

Nitto Boseki succeeded in commercilizaing glassfiber.

in synthesizing synthetic fiber vinylon (Synthesis No. 1).

Ichiro Sakurada laboratory of Kyoto Imperial University succeeded

Nippon Chisso Hiryo (now Chisso) commercialized polychlorovinyl

Chisso Hiryo (now Chisso) and renamed itself Sekisui Chemical.

Japan Chemical Industry Association was established with

Nippon Chisso Hiryo (now Chisso) started mass production of

Kyowa Hakko Kogyo (now Kyowa Hakko Kirin) was established.

Kurashiki Rayon (now Kuraray) began an integrated production of vinylon

Production of synthetic fiber: Unlike natural and recycled fibers, synthetic fibers enabled mass production, thereby supporting the mass consumption era.

Japan Gas Chemical (now Mitsubishi Gas Chemical) was established.

Kenichi Fukui, Teijiro Yonezawa, and Haruo Shingu of Kyoto University

Exploration of a new aspect to organic chemistry reaction theory.

Kanegafuchi Kagaku-Kogyo (now Kaneka) was established.

Osame Gosei Kagaku Kogyo (now Nippon Shokubai) was established and

it succeeded in commercializing phthalic anhydride for the first time in Japan.

Ube Industries was established by merging Okinoyama Coal Mine, for Ube Shinkawa Iron Works, Ube Cement Production, and Ube Nitrogen Industry.

Nippon Chemical Industries (now Mitsubishi Rayon) started production of MMA in Ohtake.

Sekisui Sangyo was established. In the following year, it had acquired Nara Plant of Nippon

Chemical Society (now Chemical Society of Japan) and Society of Chemical Industry merged

and started as the new Chemical Society of Japan, with Ichiro Ishikawa as the first president.

Toyo Rayon (now Toray) started to manufacture one-ton of nylon fiber per day in Shiga.

domestic metal aluminum with alunite for the first time in Japan.

Nippon Tar (now Mitsubishi Chemical Industries) was established jointly by

Mitsubishi Mining and Asahi Glass. This was the foundation for Mitsubishi Chemical.

The Society of Chemical Machinery (now The Society of Chemical Engineering) was

Teikoku Rayon (now Teijin) was established.

Nihon Soda Kogyo (now Tokuyama) was established.

Asahi Kenshoku (now Asahi Kasei) was established. Nippon Chisso Hiryo (now Chisso) started manufacturing ammonia using the Casale sythesis process in Nobeoka.

Nobuteru Mori established Nippon Iodine (now Showa Denko).

Shin-Etsu Nitrogen Fertilizer (now Shin-Etsu Chemical) was established

Nippon Gohsei succeeded in commercializing organic synthesized acetic acid.

Konishiroku (now Konica Minolta Holdings) was established and it launched the first photo films.

Showa Fertilizers (now Showa Denko) shifted technology to produce ammonia for Japan's first

Hodogaya Soda Works (now Hodogaya Chemical) was established.

Itsuzo Hata and Seita Kumura succeeded in spinning viscose-process rayon.

venture company Yokohama Rubber Manufacturing (now The Yokohama Rubber).

Edogawa Barium Industry (now Mitsubishi Gas Chemical) was established.

Big Trend Society in General Chemistry-related Developments of Japan Chemistry-related Developments of the World of Era Introduction of pational competional competion ammonia and for (W. Germany) Karl Ziegler succeeded in Tokyo Shibaura Electric (now Toshiba) and Shin-Etsu Chemical started full-scale production of 1953 synthesizing polyethylene in low pressure, silicone by direct process under 10 atmospheric pressures. Daikin Industries succeeded in domestic production of fluoro (Polytrifluoromonochloroethylene) resins. and foster It developed tetrafluoroethylene in 1955. (Italy) Giulio Natta succeeded in propylene polymerization with titanium Government determined "Outline of Fostering Petrochemical Industry". 1954 trichloride as the catalyst. This led to the production of polypropylene. (USA) Standard Oil Ohio developed production process for acrylonitrile (i.e. Sohio process). Formosa Plastics was established. Japan Exlan started to produce polyacrylonitrile fibers. 1956 Second Arab-Israeli conflict (Suez Crisis) Kanegafuchi Kagaku-Kogyo (now Kaneka) and others also started to produce the fibers. intern-ize (USA) Harcules Powder, (Italy) Montecaccini, Toyo Rayon (now Toray) and Teikoku Rayon (now Teijin) introduced technology 1957 and (W. Germany) Hoechst started to produce isotactic from IC of UK to manufacture polyethylene fibers and film. polypropylene independently. Maruzen Oil (now Cosmo Oil) produced SBA and MEK from exhausted gas of oil refinery. (Italy) ANIC produced emulsion polymerization SBR. Japan's first petrochemical product. Japan Synthetic Rubber (now JSR) was established. Mitsui Petrochemical Industries (now Mitsui Chemicals) Iwakuni and Introduction of full-scale industry Sumitomo Chemical Niihama started operation. 1958 (W. Germany) Bayer commercialized polycarbonate. Tokyo Tower was completed. Petrochemical products including polyethylene were produced domestically. Petrochemical era opened. Japan Petrochemical Industry Association was established with Kamesaburo Ikeda as first chairman. Start of petrochemical industry: Although starting behind Europe and the US, Economic boom (1958-61) it grew rapidly. With domestic production and the strengthening of international competitiveness as a goal, many industrial capitalists entered to compete. Nippon Oil (now JX Nippon Oil & Energy) Kawasaki and Mitsubishi Petrochemical (now petrochemical 1959 Mitsuibishi Chemical) Yokkaichi petrochemical complexes started operation. (Completed the (USA) DuPont started to produce polyacetal "Delrin". first stage of domestic petrochemical production.) Nippon Shokubai Kagaku Kogyo (now Nippon Shokubai) commercialized ethylene oxide with its own technology for the first time in Japan. Zeon domestically produced NBR, HSR, and SBR latex special synthetic rubber with the technology of Goodrich. Teijin produced polycarbonate domestically. (Netherlands) Shell manufactured SBR by solution polymerization Japan Synthetic Rubber (now JSR) started to produce general-purpose Campaign against the Japan-US Security 1960 synthetic rubber SBR with the technology of Goodyear. with litium catalist Organization of Petroleum Export Shin-Etsu Chemical started to produce high-purity silicon. (USA) DuPont launched aromatic polyamide "Aramid". Countries (OPEC) was established Liberal Democratic Party announced its Asahi-Dow (now Asahi Kasei) launched food wrapping film made of policy for rapid economic growth/income polyvinylidene chloride (PVDC). doubling. Toyo Koatsu Industries (now Mitsui Chemicals) and Dainippon Celluloid USSR succeeded in launching a manned 1961 (now Daicel) started to produce styrene acrylonitrile copolymer (SAN) independently in Japan spaceship for the first time. with their technology. (USA) Silent Spring, authored by Rachel L. Carson, was Successful first flight of Denki Kagaku Kogyo started to produce chloroprene rubber with its own technology, published. It pointed out the dangers of such chemicals as 1962 using the carbide acetylene process. DDT agrochemical for ecosystem. domestic airplane "YS-1" It led to environmental activity Mitsui Chemical Industry (now Mitsui Chemicals) domestically produced polypropyrene. Cuban Missile Crisis. Successful TV broadcast between Japan 1963 Toagosei Chemical Industry (now Toagosei) launched instant glue "Aron Alpha." and the US by communications satellite. Hamano Resin (now JSR) and Nitto Chemical Industry (now Mitsubishi Rayon) and others started to produce ABS resins. 1964 Kurashiki Rayon (now Kuraray) started to produce artificial leather "Clarino." Tokyo Olympic Games were held. (USA) GE developed polyphenyleneoxide (PPO) and Zeon commercialized butadiene extrusion process with 1965 Vietnam War (through 1975) DMF as solvent (GPB process). commercialized it in 1967 as modified PPE Economic boom (through 1970) Toyo Soda Manufacturing (now Tosoh) started to produce vinyl chloride Cultural Revolution in China (through 1977) 1966 (India) Reliance was established to develop into textile industry. monomers by oxychlorination process for the first time in Japan. chloride monomers by **Environmental Pollution Prevention Law** oxychlorination process was promulgated. Petrochemical Cooperation Round-Table Conference determined standards for newly-1967 Pollution issue: Environmental pollution established facilties for ethylene producing over 300,000 tons per year such as air and water pollution became a social issue around 1965. (USA) George H. Heilmeier and others of RCA produced a Ministry of Health and Welfare acknowledged mercury pollution incidents Toyo Koatsu Industries and Mitsui Chemical Industry merged and Mitsui Toatsu Chemicals display device using nematic liquid crystal. 1968 was formed. Movement to desk-top caluculators, word processors and in Minamata and Agano River as pollution other technologies. Toyo Ohka Kogyo started to manufacture photo resists for semiconductors. (W. Germany) Hoechst developed polyehtylene terephthalate 1970 Oji-Yuka Synthetic Paper (now Yupo Corp.) developed polyolefin synthetic paper. Osaka Expo was held. (PBT) resins. Nippon Shokubai Kagaku Kogyo (now Nippon Shokubai) commercialized acrylic acid with its 14 pollution-related bills were enacted own propyrene oxidation technology for the first time in Japan. into law at an extraordinary Diet session. Sakuji Ikeda and Hideki Shirakawa succeeded in synthesizing a polyacetylene film membrane 1971 by acetylene polymerization. Environment Agency was formed. Applied for the development of lithium-ion rechargeable battery and others. Nixon Shock: Yen moved to provisional Zeon started to produce polyisoprene by extraction process. floating exchange rate system. Toray started to produce polyacrylonitrile carbon fiber "Torayca." Japan Gas Chemical and Mitsubishi Edogawa Chemical merged to form Mitsubishi Gas Chemical. Sanyo Ethylene started operation in the Mizushima Petrochemical Complex. Club of Rome announced a "limitation of growth" with the Restoration of diplomatic ties between 1972 15 petrochemical complexes were all present. drying up of natural resources, including petroleum. Japan and China. Fourth Arab-Israeli conflict outbroke. First Oil First Oil Crisis Kuraray started to produce vinylalcohol ethylene copolymer resins "Eval". 1973 Crisis occurred with resulting confusion of shortage of commodities such as detergents. Law Concerning the Examination and Reguation of Manufacturing of Chemical Substances Issue of mercury-polluted fish and was proposed. nationwide protest by fishermen. The world's first law regulating chemical substances. Ministry of International Trade and Industry (now Ministry of Economy, Trade and Industry) was directed to make overall inspections of the 3,253 plants nationwide due to many occurrences of accidents at chemical factories. Government determined the conversion of the production process of caustic soda using mercury. Conversion of soda manufacturing process. (USA) Stanley N. Cohen and Herbert W. Boyer Asahi Chemical Industry (now Asahi Kasei) started to manufacture Bombing incident of Mitsubishi Heavy 1974 developed recombinant DNA technologies. Industry Bldg. occurred. hollow-fiber artificial kidneys. Introduction of biotechnology The first Summit Conference of the Asahi Chemical Industry (now Asahi Kasei) started commercial production 1975 Leading Industrialized Nations was held of caustic soda by ion-exchange membrane process electrolysis. (Rambouillet Summit) 1976 Saudi Basic Industries Corporation (SABIC) was established. 1977 Petrochemical Corporation of Singapore (PCS) was established. Sanyo Chemical Industries commercialized superabsorbent resins New Tokyo International Airport (Narita) 1978 (SAP) for the first time in the world. was opened 1979 The first East Asia Petrochemical Industry Conference was held. Second Oil Crisis occurred. Second Oil Crisis 1980 The Saudi Methanol (AR-RAZI) was established. Oil Crisis: The price of crude oil soared during the first crisis due to the fourth Arab-Kyodo Sakusan started to produce methanol-process acetic acid Israeli conflict. The second crisis was due for the first time in Japan. to the Iranian Revolution Prof. Kenichi Fukui of Kyoto University was awarded the Nobel Production of 1981 Prize in Chemistry. Japan's first awarding of the Nobel Prize in Chemistry. Honda America started to manufacture 1982 Joint sales company (by four companies) was established in vinyl chloride resins industry. passenger cars. Ministry of International Trade and Industry (now Ministry of Economy, Trade and Industry) decided to virtually liberalize importation of naphtha for petrochemical industry. Industrial Structure Council submitted a report on how the petrochemical industry should operate. Special Law for the Structural Expansion of petochemical st Special Law for the Structural of Specified Industries Nippon Unicar started to produce the US UCC-process 1983 China Petroleum and Chemical Corp. (SINOPEC) was established. Improvement of Specified Industries was straight-chain low density polyethylene. proposed and enforced. Mitsubishi Rayon commercialized isobutylene direct oxidation process MMA monomers for the first time in the world. Joint sales companies (four companies) were established in polyolefin industry. Production of straight-chain low density polyethylene (India) A subsidiary company of the US UCC had an accident Ube Ammonia Industry completed a coal gasification process 1984 regarding the leaking of poisonous gas in Bhopal, India. large-scale ammonia facility. Issue of risk communications was raised Kanegafuchi Kagaku-Kogyo (now Kaneka) developed and commercialized amorphous silicon solar cells. Conferece of Ministers and Governors by Direct oxidation process MMA (Canada) Canadian Chemical Producers' Association of the Group of Five Countries agreed to 1985 advocated Responsible Care. depreciate high dollars (i.e. Plaza Agreement) The completion of the conversion of production process of caustic soda and of the non-Bubble economy started 1986 Bubble economy mercury process. (through 1991) Dainippon Ink and Chemicals (now DIC) acquired the graphic arts materials division of the US Global development of the Japanese chemical companies occurs in full scale. 1988 Bridgestone acquired Firestone of the US. Conference of Environment Ministers on Global Warming Wall in Berlin was destroyed and the Cold 1989 Countermeasures was held and it was agreed to maintain the emission level of carbon dioxide at a certain level until 2000. Zeon and Japan Synthetic Rubber (now JSR) expanded the use of cyclic olefins transparent International Council of Chemical Industry Associations (ICCA) East and West Germanies were united. 1990 resins to materials for electronic information devices. was founded. Meeting of the Parties to the Montreal Protocol resolved the total abolishment of ozone-destroying substances (special freon and others) Club of Rome organized "Business Council for Sustainable United Soviet Socialist Republic ceased Development (BCSD)". 1991 Asahi Chemical Industry (now Asahi Kasei) developed practical lithium-ion rechargeable battery. to exist and the Commonwealth of Developed to an international stadardization of Independent States was formed. environmental management. The United Nations Conference on Environment and 1992 Development "Earth Summit" was held. Four chemical organizations held the first events of the Basic Environment Act was proposed and Earth Summit: Since the United Nations Conference on Environment 1993 "Dream Chemistry 21." enforced. and Development in 1972, the conference has been held every 10 Nichia Corp. succeeded in developing blue-light emitting diode vears by the UN. for the first time in the world. Mitsubishi Kasei and Mitsubishi Petrochemical merged to form (Netherlands) Akzo and (Sweden) Nobel merged to form Product Liability Act (PL Act) was Reorganization of the chemical industry accelerated 1994 AkzoNobel. Mitsubishi Chemical. proposed. Industry reorganization: De-industrialization due to high yen and globalization, caused by the closing of cold-war structure, prompted the chemical industry to consolidate. Business consolidation and The First Conference of the Parties to the UN Framework The World Trade Organization (WTO) was 1995 Japan Responsible Care Council was established. Conference on Climate Change (COP) was held. established. Our Stolen Future, authored by Theo Colborn and others, was Mitsui Petrochemical Industries and Mitsui Toatsu Chemicals merged 1997 The Asian Financial Crisis occurred. published. She mentioned about the dangers of chemicals as to form Mitsui Chemicals. endocrine disrupters. (Germany) Hoeckst and (France) Rhone-Poulenc merged and Pollutant Release and Transfer Register Law (PRTR Law) was proposed Aventis was formed. The chemical section of Hoechst was 1999 acquired by Celanese. All of the production processes of caustic soda were converted to the ion-exchange (USA) Exxon and Mobil merged to form ExxonMobil. membrane process (Netherlands) Shell and and polyolefin companies Japan Chemical Industry Association (JCIA) started its Long-range Research Initiative (LRI) (Elenac, Montell, and Targor) of Basell were merged and Basell 2000 regarding the effects of chemicals on human heath and the environment. JCIA coordinates with the chemical industry associations of Europe and the US (CEFIC, ACC) and ICCA. (France) Total Fina acquired Elf Aquitaine and Total Fina Elf was Hideki Shirakawa was awarded Nobel Prize in Chemistry for conductive polymer. formed. (Complete in 2003.) Ryoji Noyori was awarded the Nobel Prize in Chemistry for asymmetric synthesis of organic compound. Progress activity o 2001 China joined in the WTO. It is widely applied in the pharmaceutical and food industries. Koichi Tanaka was awarded Nobel Prize in Chemistry for biopolymers. (USA) Cargill Dow Polymers started to operate its big-scale facility 2002 ss in internation of chemical r He developed a device to measure the mass of protein. of polylactide-based biodegradable plastics "Nature Works." (Saudi Arabia) SABIC acquired the petrochemical business Roche of Switzerland acquired Chugai Pharmaceutical. of DSM of The Netherlands and advanced into the European market. World Summit on Sustainable Development was held. It was agreed to develop the Strategic Approach for International Chemical Management (SAICM). Kyoto Protocol, concerning prevention of **SAICM:** "It aims at minimizing the adverse effects on health and the environment by the manufacturing and use of chemicals by 2020." 2005 Sumitomo Chemical jointly established Petro Rabigh with Saudi Aramco. global warming, became effective. In Japan, through GPS/JIPS, the chemical industry with adequate Mitsubishi Chemical Holdings was formed with Mitsubishi Chemical and Mitsubishi Pharma management is handling risk assessment and information disclosure (now Tanabe Mitsubishi Pharma) under its umbrella. of many chemicals in the supply chain in general. In 2007, Mitsubishi Plastics and, in 2010, Mitsubishi Rayon were integrated under its umbrella. Yamanouchi Pharmaceutical and Fujisawa Pharmaceutical merged and Astellas Pharma was established. Daiichi-Sankyo, a joint holding company of Sankyo and Daiichi Pharmaceutical, was established and the two companies merged in 2007. The First International Conference on Chemical Management 2006 (ICCM-1) was held. (Saudi Arabia) SABIC acquired the engineering plastics 2007 business of GE of the US. The price of crude oil exceeded the 100 Osamu Shimomura was awarded Nobel Prize in Chemistry for green fluorescent protein. dollar mark of West Texas Intermediate The discovery was made from Aequorea victoria and the protein is used as a tool for medical 2008 (Netherlands) AkzoNobel merged ICI of the UK. (WTI) for the first time at New York Mercantile Exchange. Eiichi Negishi and Akira Suzuki were awarded Nobel Prize in Chemistry for palladium-catalyzed cross coupling reaction in organic synthesis. 2010 An epoch-making process for efficiently synthesizing carbon to carbon. Mitsubishi Chemical and Asahi Kasei Chemicals jointly established Nishi Nippon Ethylene for 2011 The Great East Japan Earthquake. unified operation of Mizushima Ethylene Center. Japan Chemical Industry Association