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ISIAQ NEWSLETTER

July 2012

Letter from ISIAQ President Pawel Wargocki

Welcome to ISIAQ,

It is a great pleasure to welcome all new members of ISIAQ who joined our Society by joining the Healthy Buildings 2012 conference in Brisbane. ISIAQ is an international, independent, multidisciplinary, scientific, non-profit organization whose purpose is to support the creation of healthy, comfortable and productive indoor environments. I hope that you will contribute to this mission.

As members of the Society you are entitled to several benefits. You will soon receive the copy of Indoor Air, the premier journal in our field, and you will regularly receive the Newsletter. You can also participate in the congresses which are organized by the Society, our flagship congress Indoor Air which will be held next time in Hong Kong in 2014 and our Healthy Building conferences which from 2015 will have regional/topical focus. You can also enjoy the reduced fees by joining the congresses which are co-organized by ISIAQ or co-sponsored by ISIAQ.

Already next year in August ISIAQ will co-organize the congress in Basel, Switzerland together with two societies dealing with exposure analysis, International Society for Environmental Epidemiology (ISEE) and International Society of Exposure Science (ISES). The title of the congress is Environment and Health – bridging south, east, north and west. We will also co-sponsor ASHRAE IAQ 2013 congress in Vancouver in October on

Environmental Health in Low Energy Buildings. Finally we are in the process of securing reduced fees for ISIAQ members joining CLIMA 2013 congress in July in Prague, next year. These congresses will increase outreach of the Society to the disciplines which are closely related to indoor air such as exposure and epidemiology, and also will provide possibility of transforming the science of indoor air into practice. I warmly invite all members to use this opportunity to join these meetings at reduced prize and enjoy possibility of enlarging their networks and gaining new insights and knowledge from other disciplines which are related to indoor air field.

As new members you can also join our Scientific and Technical Committees (STCs). This is a very important activity of the Society which we hope will soon bring many fruits in form of tutorials, guidelines and perhaps policy papers. You can read about STCs and generally about ISIAQ at our home page: www.isiaq.org. (continued on page 2)

Healthy Buildings 2012

More than 525 researchers, practitioners, policy makers and others from 39 countries on five continents gathered in Brisbane for ISIAQ's 12th Healthy Buildings conference. Japan, with 77 participants, had the largest delegation followed closely by host Australia. There was representation from regional neighbour countries Korea and China, and more than 40 representatives from the USA. The conference dinner took place at a Koala bear preserve where participants could have their photo taken holding an adorable, live Koala bear. Participants enjoyed the mild Australian winter weather and a well-run technical conference.

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Besides the above, you can enjoy possibility of communicating with nearly 1,000 members on the issues related to indoor air sciences. This is an unique opportunity to, as a minimum, find potential partners in your research, fill-in post-doctoral and Ph.D. positions, exchange ideas and experiences and find solutions to indoor air problems related with your work and research. You can communicate with other members by starting discussions on our home page under forums. We have also a profile on Facebook and consider creating profiles on other social and professional networks to intensify and increase communication between members.

I am particularly happy to welcome many young people, students who join indoor air quality community and are interested in indoor air sciences. I invite you to use the unique opportunity to communicate with other students around the world and improve your research. Your representative on the Board of Directors of ISIAQ, Jelle Lavarge, will be more than happy to receive feedback and good ideas from you on what can be made to further improve student-student and student-teacher communication within the Society.

Last but not least I would like to thank all our Members for the continuing support, active participation in the activities of the Society and joining our congresses. The Society is composed of members and you as members create the Society. Therefore I welcome bottom-up initiatives of members which the Board of Directors will certainly endorse.

At this time it is my great pleasure to introduce the new Board of Directors which took the office during the Healthy Buildings 2012 congress in Brisbane

Pawel Wargocki, President, 2 yr term
Carl Gustaf Bornehag, Treasurer, 2 yr term
Anne Hyvärinen, Secretary, 2 yr term
David Cheong, VP Research, 4 yr term
Andrea Ferro, at-large position, 4 yr term
Carl Grimes, VP Practice, 4 yr term
Chris Chao, at large position, 4 yr term
Glenn Morrison, VP Policy, President elect, 4 yr total term
William Nazaroff, Academy President position on BoD, 2 yr term

Richard Shaughnessy, Past President (non-voting)
Yuguo Li, President of IA 2014 (non-voting)
Jelle Lavarge, student representative (non-voting)

Geo Clausen, Trustee
Kwok Wai Tham, Trustee

You are all welcome to contact the Board in the matters important for the Society.

I want to wish all our Members great and relaxing summer.

Pawel Wargocki

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Abstracts

William W Nazaroff - Open Access Musings

Scientific journals serve three main functions. First, they are a primary means of communicating research results. Second, through the peer review process, they improve the quality of what is communicated. Third, they constitute a permanent record of created knowledge, permitting future scholars to build on prior accomplishments.

In recent history, the scientific journal system has depended on publishers for the technology to print and distribute physical issues to individual subscribers and libraries. Advances in computing and communication technology have revolutionized scientific publishing. One remarkable change is improved access to scientific literature. For example, working at a major research university provides electronic access to a phenomenal range of journals. I rarely visit a library now, although I use library services almost daily. Even from home, I can access journal collections through a proxy server and download a PDF copy of a research article within minutes of identifying it.

S. Batterman, J.-Y. Chin, C. Jia, C. Godwin, E. Parker, T. Robins, P. Max and T. Lewis - Sources, concentrations, and risks of naphthalene in indoor and outdoor air

Abstract Naphthalene is a ubiquitous pollutant, and very high concentrations are sometimes encountered indoors when this chemical is used as a pest repellent or deodorant. This study describes the distribution and sources of vapor-phase naphthalene concentrations in four communities in southeast Michigan, USA. Outdoors, naphthalene was measured in the communities and at a near-road site. Indoors, naphthalene levels were characterized in 288 suburban and urban homes. The median outdoor concentration was $0.15 \mu\text{g}/\text{m}^3$, and a modest contribution from rush-hour traffic was noted. The median indoor long-term concentration was $0.89 \mu\text{g}/\text{m}^3$, but concentrations were extremely skewed and 14% of homes exceeded $3 \mu\text{g}/\text{m}^3$, the chronic reference concentration for non-cancer effects, 8% exceeded $10 \mu\text{g}/\text{m}^3$, and levels reached $200 \mu\text{g}/\text{m}^3$. The typical excess individual lifetime cancer risk was about 10–4 and reached 10–2 in some homes. Important sources include naphthalene's use as a pest repellent and deodorant, migration from attached garages and, to lesser extents, cigarette smoke and vehicle emissions. Excessive use as a repellent caused the highest concentrations. Naphthalene presents high risks in a subset of homes, and policies and actions to reduce exposures, for example, sales bans or restrictions, improved labeling, and consumer education, should be considered.

Practical Implications Long-term average concentrations of naphthalene in most homes fell into the $0.2\text{--}1.7 \mu\text{g}/\text{m}^3$ range reported as representative in earlier studies. The highly skewed distribution of concentrations results in a subset of homes with elevated concentrations and health risks that greatly exceed US EPA and World Health Organization (WHO) guidelines. The most important indoor source is the use of naphthalene as a pest repellent or deodorant; secondary sources include presence of an attached garage, cigarette smoking, and outdoor sources. House-to-house variation was large, reflecting differences among the residences and naphthalene use practices. Stronger policies and educational efforts are needed to eliminate or modify indoor usage practices of this chemical.

J. A. Björklund, U. Sellström, C. A. de Wit, M. Aune, S. Lignell and P. O. Darnerud - Comparisons of polybrominated diphenyl ether and hexabromocyclododecane concentrations in dust collected with two sampling methods and matched breast milk samples

Abstract Household dust from 19 Swedish homes was collected using two different sampling methods: from the occupant's own home vacuum cleaner after insertion of a new bag and using a researcher-collected method where settled house dust was collected from surfaces above floor level. The samples were analyzed for 16 polybrominated diphenyl ether (PBDE) congeners and total hexabromocyclododecane (HBCD). Significant correlations ($r = 0.60$ – 0.65 , Spearman $r = 0.47$ – 0.54 , $P < 0.05$) were found between matched dust samples collected with the two sampling methods for Σ OctaBDE and Σ DecaBDE but not for Σ PentaBDE or HBCD. Statistically significantly higher concentrations of all PBDE congeners were found in the researcher-collected dust than in the home vacuum cleaner bag dust (VCBD). For HBCD, however, the concentrations were significantly higher in the home VCBD samples. Analysis of the bags themselves indicated no or very low levels of PBDEs and HBCD. This indicates that there may be specific HBCD sources to the floor and/or that it may be present in the vacuum cleaners themselves. The BDE-47 concentrations in matched pairs of VCBD and breast milk samples were significantly correlated ($r = 0.514$, $P = 0.029$), indicating that one possible exposure route for this congener may be via dust ingestion.

Practical Implications The statistically significant correlations found for several individual polybrominated diphenyl ether (PBDE) congeners, Σ OctaBDE and Σ DecaBDE between the two dust sampling methods in this study indicate that the same indoor sources contaminate both types of dust or that common processes govern the distribution of these compounds in the indoor environment. Therefore, either method is adequate for screening Σ OctaBDE and Σ DecaBDE in dust. The high variability seen between dust samples confirms results seen in other studies. For hexabromocyclododecane (HBCD), divergent results in the two dust types indicate differences in contamination sources to the floor than to above-floor surfaces. Thus, it is still unclear which dust sampling method is most relevant for HBCD as well as for Σ PentaBDE in dust and, further, which is most relevant for determining human exposure to PBDEs and HBCD.

T. Salthammer, E. Uhde, A. Omelan, A. Lüdecke and H.-J. Moriske - Estimating human indoor exposure to elemental mercury from broken compact fluorescent lamps (CFLs)

Abstract The 2008 EU regulation, which prohibits conventional incandescent light bulbs, is to be implemented in phases, completing in 2012. One of the possible substitutes is the compact fluorescent lamp (CFL), which, however, does contain up to 5 mg of mercury in its elemental or amalgamated form. The question arises as to the possible exposure of individuals to mercury as a result of lamp breakage during operation or when disconnected from the power supply. Therefore, an apparatus was built to shatter CFLs and drop the shards onto glycol-modified polyethylene terephthalate, a carpeted floor, or laminate floor under defined climatic parameters and operating conditions. Six CFLs of different types and mercury content were studied. After the breakage of a common CFL containing liquid mercury, concentrations up to 8000 ng/m^3 were reached in the chamber. Much lower peak values were obtained with amalgam-type lamps (414 ng/m^3) or with lamps with a shatter-proof coating (60 ng/m^3). It was found that ventilation can considerably reduce the indoor air concentration within 20 min. Acute health effects would only be expected if the mercury is not removed immediately. Careful collection and disposal of the lamp fragments would also prevent dwellers from the risk of long-term exposure.

Practical Implications After accidental breakage of a compact fluorescent lamp (CFL) indoors, dwellers could be exposed to high mercury concentrations. From the results of our studies in test chambers and real rooms using different lamp types and scenarios, it was possible to estimate the possible human uptake of mercury by inhalation. Immediate action is important to reduce indoor mercury concentrations to a minimum level. The first step is to maximize ventilation followed by careful collection of spilled mercury.

M. Carteret, J.-F. Pauwels and B. Hanoune - Emission factors of gaseous pollutants from recent kerosene space heaters and fuels available in France in 2010

Abstract Laboratory measurements of the gaseous emission factors (EF) from two recent kerosene space heaters (wick and injector) with five different fuels have been conducted in an 8-m³ environmental chamber. The two heaters tested were found to emit mainly CO₂, CO, NO, NO₂, and some volatile organic compounds (VOCs). NO₂ is continuously emitted during use, with an EF of 100–450 µg per g of consumed fuel. CO is normally emitted mainly during the first minutes of use (up to 3 mg/g). Formaldehyde and benzene EFs were quantified at 15 and 16 µg/g respectively, for the wick heater. Some other VOCs, such as 1,3-butadiene, were detected with lower EFs. We demonstrated the unsuitability of a ‘biofuel’ containing fatty acid methyl esters for use with the wick heater, and that the accumulation of soot on the same heater, whatever the fuel, leads to a dramatic increase in the CO EF, up to 16 mg/g, which could be responsible for chronic and acute CO intoxications.

Practical Implications Our results show that in spite of new technologies and emission standards for unvented kerosene space heaters, as well as for the fuels, the use of these heaters in indoor environments still leads to NO_x levels in excess of current health recommendations. Whereas injection heaters generate more nitrogen oxides than wick heaters, prolonged use of the latter leads to a soot buildup, concomitant with high CO emissions, which could be responsible for acute and chronic intoxications. The use of a biofuel in a wick heater is also of concern. Maintenance of the heaters and adequate ventilation of the room during use of kerosene space heaters are therefore of prime importance to reduce personal exposure.

D. H. Bennett, W. Fisk, M. G. Apte, X. Wu, A. Trout, D. Faulkner and D. Sullivan - Ventilation, temperature, and HVAC characteristics in small and medium commercial buildings in California

Abstract This field study of 37 small and medium commercial buildings throughout California obtained information on ventilation rate, temperature, and heating, ventilating, and air-conditioning (HVAC) system characteristics. The study included seven retail establishments; five restaurants; eight offices; two each of gas stations, hair salons, healthcare facilities, grocery stores, dental offices, and fitness centers; and five other buildings. Fourteen (38%) of the buildings either could not or did not provide outdoor air through the HVAC system. The air exchange rate averaged 1.6 (s.d. = 1.7) exchanges per hour and was similar between buildings with and without outdoor air supplied through the HVAC system, indicating that some buildings have significant leakage or ventilation through open windows and doors. Not all buildings had sufficient air exchange to meet ASHRAE 62.1 Standards, including buildings used for fitness centers, hair salons, offices, and retail establishments. The majority of the time, buildings were within the ASHRAE temperature comfort range. Offices were frequently overcooled in the summer. All of the buildings had filters, but over half the buildings had a filter with a minimum efficiency reporting value rating of 4 or lower, which are not very effective for removing fine particles.

Practical Implications Most U.S. commercial buildings (96%) are small- to medium-sized, using nearly 18% of the country’s energy, and sheltering a large population daily. Little is known about the ventilation systems in these buildings. This study found a wide variety of ventilation conditions, with many buildings failing to meet relevant ventilation standards. Regulators may want to consider implementing more complete building inspections at commissioning and point of sale.

L.-Z. Zhang, X.-R. Zhang, Q.-Z. Miao and L.-X. Pei - Selective permeation of moisture and VOCs through polymer membranes used in total heat exchangers for indoor air ventilation

Abstract Fresh air ventilation is central to indoor environmental control. Total heat exchangers can be key equipment for energy conservation in ventilation. Membranes have been used for total heat exchangers for more than a decade. Much effort has been spent to achieve water vapor permeability of various membranes; however, relatively little attention has been paid to the selectivity of moisture compared with volatile organic compounds (VOCs) through such membranes. In this investigation, the most commonly used membranes, both hydrophilic and hydrophobic ones, are tested for their permeability for moisture and five VOCs (acetic acid, formaldehyde, acetaldehyde, toluene, and ethane). The selectivity of moisture vs. VOCs in these membranes is then evaluated. With a solution-diffusion model, the solubility and diffusivity of moisture and VOCs in these membranes are calculated. The resulting data could provide some reference for future material selection.

Practical Implications Total heat exchangers are important equipment for fresh air ventilation with energy conservation. However, their implications for indoor air quality in terms of volatile organic compound permeation have not been known. The data in this article help us to clarify the impacts on indoor VOC levels of membrane-based heat exchangers. Guidelines for material selection can be obtained for future use total heat exchangers for building ventilation.

B. Sahlberg, D. Norbäck, G. Wieslander, T. Gislason and C. Janson - Onset of mucosal, dermal, and general symptoms in relation to biomarkers and exposures in the dwelling: a cohort study from 1992 to 2002

Abstract We examined the associations between biomarkers of allergy and inflammation, indoor environment in dwellings, and incidence and remission of symptoms included in the sick building syndrome (SBS) and changes in the home environment of 452 adults who were followed from 1992 to 2002 within the Uppsala part of the European Community Respiratory Health Survey (ECRHS). The 10-year incidence (onset) of general, mucosal, and dermal symptoms was 8.5%, 12.7%, and 6.8%, respectively. Dampness or indoor molds at baseline was a predictor of incidence of general (relative risk [RR] = 1.98), mucosal (RR = 2.28), and dermal symptoms (RR = 1.91). Women had higher incidence of general (RR = 1.74) and mucosal symptoms (RR = 1.71). Indoor painting increased the incidence of general symptoms (RR = 1.62). Bronchial responsiveness (BR), eosinophil counts in blood, total IgE and eosinophilic cationic protein (ECP) in serum at baseline were predictors of incidence of SBS. At follow-up, BR, total IgE, and C-reactive protein (CRP) were associated with increased incidence of SBS. Moreover, subjects with doctor-diagnosed asthma at baseline had a higher incidence of general (RR = 1.65) and mucosal symptoms (RR = 1.97). In conclusion, female gender, dampness or indoor molds, indoor painting, and biomarkers of allergy and inflammation were associated with a higher incidence of SBS symptoms, in particular mucosal symptoms.

Practical Implications The focus in Sweden on indoor environment issues over the last few decades has resulted in improvements in dwellings, and reduced tobacco smoking, which could be beneficial for public health. Reducing dampness and molds in the dwelling place is another important way of reducing occurrence of SBS symptoms in the general adult population. The association between the incidence of SBS symptoms and clinical biomarkers of allergy and inflammation suggests a common etiology between inflammatory diseases, including asthma, rhinitis, and SBS. Lastly, good agreement between self-reported and clinically diagnosed atopy indicates that questionnaire data on atopy can be used in epidemiological studies.

J. Qian, D. Hospodsky, N. Yamamoto, W. W. Nazaroff and J. Peccia - Size-resolved emission rates of airborne bacteria and fungi in an occupied classroom

Abstract The role of human occupancy as a source of indoor biological aerosols is poorly understood. Size-resolved concentrations of total and biological particles in indoor air were quantified in a classroom under occupied and vacant conditions. Per-occupant emission rates were estimated through a mass-balance modeling approach, and the microbial diversity of indoor and outdoor air during occupancy was determined via rDNA gene sequence analysis. Significant increases of total particle mass and bacterial genome concentrations were observed during the occupied period compared to the vacant case. These increases varied in magnitude with the particle size and ranged from 3 to 68 times for total mass, 12–2700 times for bacterial genomes, and 1.5–5.2 times for fungal genomes. Emission rates per person-hour because of occupancy were 31 mg, 37×10^6 genome copies, and 7.3×10^6 genome copies for total particle mass, bacteria, and fungi, respectively. Of the bacterial emissions, ~18% are from taxa that are closely associated with the human skin microbiome. This analysis provides size-resolved, per person-hour emission rates for these biological particles and illustrates the extent to which being in an occupied room results in exposure to bacteria that are associated with previous or current human occupants.

Practical Implications Presented here are the first size-resolved, per person emission rate estimates of bacterial and fungal genomes for a common occupied indoor space. The marked differences observed between total particle and bacterial size distributions suggest that size-dependent aerosol models that use total particles as a surrogate for microbial particles incorrectly assess the fate of and human exposure to airborne bacteria. The strong signal of human microbiota in airborne particulate matter in an occupied setting demonstrates that the aerosol route can be a source of exposure to microorganisms emitted from the skin, hair, nostrils, and mouths of other occupants.

In memoriam Helmut Knöppel

Helmut Knöppel was born in Essen, Germany, on August 17, 1934. After studies in Physics Helmut earned a Doctor in Sciences from Friedrich-Wilhelm University in Bonn, Germany, in 1965. Fascinated by the idea of common European research, he moved to Ispra in Northern Italy, to work with the relatively newly created research center established there within the framework of EURATOM, the European Atomic Energy Community. Over the years, this research center developed into what is now known as the European Commission's Joint Research Centre Ispra (JRC).

From the beginning of his work in Ispra, Helmut was interested in environmental problems. His first years were devoted to solve water pollution problems. At that time, he was one of the few who had started using gas chromatography/mass spectrometry in environmental analysis, a technique that was then only emerging. He then began dealing with outdoor air pollution. While continuing this work and developing his laboratory to meet new standards, Helmut introduced indoor air quality (IAQ) as a new research topic for the JRC. His work at JRC persuaded him very early that cooperation of countries was essential in promoting the strength of European scientific research. Consequently, he also looked for ways to create such European cooperation in the IAQ field. He succeeded in persuading colleagues at the European Commission in Brussels to support a European activity devoted to the study of IAQ problems. Helmut then organized a few preparatory meetings with a small group of scientists from different countries to prepare what was to become project COST 613 'Indoor Air Quality and its Impact on Man'. This project was run within the framework of COST, the European Cooperation in Science in Technology created in the early 1970s, and was the starting point of the well-known European Concerted Action (ECA) with the same title. Helmut, together with his colleagues at JRC, was instrumental in providing both the scientific and financial support of the many meetings of the Steering Committee and its Working Groups. Since beginning their work, these groups prepared 27 consensus reports covering the width and breadth of IAQ issues from specific indoor pollution sources to risk management policies. Over the years, the JRC-ECA Steering Committee involved highly qualified IAQ experts who, under Helmut's guidance and inspiration, brainstormed and established the framework for what would become the future for IAQ research and the beginning of modern IAQ risk management in Europe. The reports issued by the Steering Committee expressed the common view of European experts and, in their prenormative character, laid the scientific grounds for decision-makers in Brussels. From the late 1980s until his retirement in 1999, Helmut worked tirelessly organizing numerous European and international expert meetings and conference sessions to promote and discuss the findings contained in these reports. (*continued on next page*)

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While these network-creating activities had mostly a management character, Helmut did not neglect his own scientific work. A milestone was the construction, in the 1990s of one of the few European large-scale experimental chambers, the

Indoortron, to study the emissions from indoor products, especially building materials and products. The results obtained in this work became essential elements of European standard methods for emissions testing for building materials.

Helmut was one of the founding members of ISIAQ, and in fact a number of the founding members, as well as presidents of early Indoor Air Conferences, came from the ECA Steering Committee.

Helmut was a cultivated scientist and gentleman who radiated knowledge, honesty, and kindness. For many, he became even more: a friend.

Helmut Knöppel died in Augsburg, Germany, on April 20, 2012. We are grateful to him for everything he has done for the IAQ community. We will always remember and respect him. His death is a loss to the IAQ sciences and the whole IAQ community.

His friends

Send us your news to fill this space in the next ISIAQ Newsletter

Tell your ISIAQ Colleagues what you are doing! Send us news about your latest publication, grant or project.

Has your government adopted a new law or regulation that would be of interest to your ISIAQ colleagues around the world? Send us a brief summary or send a link to a web site where we can learn about it.

About ISIAQ

With more than 800 members from more than 45 countries, ISIAQ is an international, independent, multidisciplinary, scientific, non-profit organization whose purpose is to support the creation of healthy, comfortable and productive indoor environments. We strongly believe this is achievable by advancing the science and technology of indoor air quality and climate as it relates to indoor environmental design, construction, operation and maintenance, air quality measurement and health sciences.

As a Society, our major role is to facilitate international and interdisciplinary communication and information exchange by publishing and fostering publication on indoor air quality and climate. We organize, sponsor and support initiatives such as meetings, conferences, and seminars on indoor air quality and climate; and we develop, adapt and maintain guidelines for the improvement of indoor air quality and climate.

ISIAQ's journal, *Indoor Air*, published six times per year, is the most respected and widely-cited source of scientific information relevant to building scientists and professionals. Our two major international conferences -- the Indoor Air 'xx and the Healthy Buildings 'xx conference series -- set the standard for high quality scientific information and its application to making healthy buildings. We also cooperate with government and other agencies and societies with interests in the indoor environment and climate.

To find out more about us, visit our website: <http://isiaq.org>

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Corporate Memberships are available

If your organization is involved in indoor air science, policy, or practice, a corporate membership in ISIAQ will place you in the limelight with the international indoor air community.

- ISIAQ reaches more than 45 countries around the world.

- ISIAQ's conferences, considered the most important in the field, have been attended by more than 4,000 individuals.

- The official Society journal, *Indoor Air*, is respected by scientists and policy-makers as the most reliable way to keep up with the latest scientific findings in the field.

To learn more about the benefits of corporate membership in ISIAQ, visit the membership page on our web site and click on the [corporate membership link](#).

Corporate Members

