The 12th International Dendritic Cell (DC) symposium (DC2012, www.DC2012.kr), organized by Ho-Youn Kim (President), Hyunah Lee (Secretary General), and Yong-Soo Bae (Scientific Program Organizer), was held from Sunday, October 7 to Thursday, October 11, 2012 at Daegu EXCO, approximately 300 km south of Seoul, Korea. It convened as a memorial symposium for Ralph Steinman. Ralph Steinman was awarded the 2011 Nobel Prize in Physiology and Medicine, but it was a posthumous award because he died just 3 days before the announcement. The International DC Symposium was founded by Ralph Steinman and his colleagues. The first meeting took place in Yamagata, Japan in 1990 (Ann Rev Immunol 30:1–22, 2012). Since the first meeting, Steinman, as a pioneer and a leader in the field of DC science, committed himself to building up this biennial international DC meeting. The 12th DC symposium was the first meeting without the presence of this inspiring leader.

Ten years ago, I (Bae) met Ralph Steinman at the 2002 Bamberg DC meeting. He asked me whether we were planning to invite the International DC Symposium to Korea. Two years later, at the 2004 Bruges meeting, he again encouraged us to extend an invitation from Korea. After a long internal discussion, the board of the Korean Association of Immunologists reached a consensus in April 2007 to hold the 2012 symposium in Korea. An organizing committee was temporarily created, with Ho-Youn Kim serving as President, and me (Bae) as scientific program organizer. The 12th DC symposium in Korea (DC2012) was officially announced at the 2008 Kobe Meeting and broadly advertised at the DC2010 Lugano Meeting, the 2011 Keystone Meeting and the 2011 LC meeting in Innsbruck. Kayo Inaba (Kyoto University, Japan) and Federica Sallusto (Institute for Research in Biomedicine, Switzerland) helped us tremendously in making the outline for DC2012. Through it all, Ralph Steinman was always there to give us detailed advice on the practical issues surrounding the basic meeting guidelines. However, he succumbed to pancreatic cancer 1 year before the DC2012 Meeting. The scientific program was largely outlined before he passed away, but the invitation of speakers was challenging. When he died, I applied for a sabbatical year to organize the meeting. I spent most of my sabbatical year organizing the scientific program. The program transformed from version 12 to its final 22nd version.

The DC2012 scientific program was designed to cover most recent issues in the DC science and immunology field, comprising five plenary sessions, eight symposia, four forums, three workshops, three poster sessions, and two satellite clinical sessions, along with two special Ralph Steinman memorial sessions during the opening and closing parts of the meeting. We had 53 invited speakers, 18 workshop speakers, 28 chairpersons, 429 posters leading to the registration of 967 DC scientists from 33 countries.
After the welcome addresses by President Kim and the mayor of Daegu Metropolitan City, Bum-Il Kim, Nikolaus Romani (Innsbruck Medical University, Austria) and Cheolho Cheong (McGill University, Canada) opened the conference with a documentary about Ralph Steinman using fragments of film that contained Ralph’s voice and memorable pictures, covering his family life, philosophy on DC science, and the story from the identification of DCs with Zanvil Cohn (1973) to his posthumous Nobel Prize (2011). The memorial continued with the first plenary speaker, Michel Nussenzweig (Rockefeller University, USA), Ralph’s first Ph.D student. Michel described his collaboration with Ralph as well as his current progress on the zDC project, entitled “Dendritic Cells: Past, Present, and Future.” The memorial session was followed by the opening ceremony (Fig. 1), welcome reception at the venue (Fig. 2), and the VIP dinner at Daegu Hyangkyo (Confucian Academy, a Korean educational institute in the previous several centuries; Fig. 3). For the following 4 days, the conference covered current issues in DC ontology and subset development, DCs and cancer, DCs and antigen presentation, DCs and infectious diseases, immune regulation, inflammation, pathogen recognition, autoimmunity, and hypersensitivity in association with DCs.

On day 2, the morning plenary speaker, Yong-Jun Liu (Baylor Institute for Immunology Research, USA), summarized his current findings on novel cytosolic dsDNA and dsRNA nucleic acid sensors in innate immune cells. In particular, he reported that a novel helicase, DHX33, senses dsRNA in the cytoplasm and activates the NLRP3 inflammasome. In Symposium 1, Development and Subset of DC, Caetano Reis e Sousa (London Research Institute, UK) showed an in vivo model for lineage tracing of DCs that allows definition of DC based on ontogenetic, rather than phenotypic, morphological, or functional, criteria. Steffen Jung (The Weizmann Institute of Science, Israel) presented monocyte fates in the inflamed colon. He showed infiltrating Ly6c<sup>hi</sup> monocytes gain tissue-context effector functions that render them pro-inflammatory responsive to bacterial products. Boris Reizis (Columbia University, USA) focused on the molecular mechanisms of lineage bifurcation between pDC and cDCs in development and homeostasis. He reported that pDCs are important for prevention of chronic viral infection and suggested that pDCs might be a therapeutic target for the treatment of chronic viral infection. Li Wu (Tsinghua University, China) reported novel micro-RNA-protein networks involved in regulating pDC activation. Florent Ginhoux (Singapore Immunology Network, Singapore) reported that adult Langerhans cells (LCs) have a dual origin: some are derived from the early embryonic yolk sac but they are predominantly derived from late fetal liver monocytes. In Symposium 2, DC and Cancer, Laurence Zitvogel (Institut Gustave Roussy, France) demonstrated that ATP released by dying tumor cells plays a dual role in the recruitment of myeloid cells into tumor beds and for the local differentiation of inflammatory CD11c<sup>-</sup>CD11b<sup>+</sup>Ly6<sup>Chigh</sup> DCs, which are crucial for the induction of antitumor immunity after chemotherapy. Chen Dong (MD Anderson Cancer Center,
prophylactic and therapeutic HIV vaccines. He showed clinical trial results of DCs loaded with HIV antigens and DC-targeting antigens via anti-DC receptor to develop HIV vaccines.

On day 3, plenary speaker Bali Pulendran (Emory University, USA) explained systems vaccinology, a novel approach for vaccine development. This technique would be useful to evaluate the efficacy or immunogenicity of untested vaccines by identifying early gene signatures that enable us to predict later immune responses in vaccinated subjects. In Symposium 4, Immune Regulation and DC, Shimon Sakaguchi (Osaka University, Japan) reported that stable Treg development requires both Foxp3 expression and genome-wide Treg-type CpG hypomethylation. Averil Ma (University of California at San Francisco, USA) demonstrated through DC-specific A20 knockout mice experiments that the ubiquitin-editing molecule A20 plays an important role in DC-mediated immune quiescence, which may control spontaneously developing autoimmune diseases like colitis, arthritis.
enthesitis, or inflammatory bowel disease. Tadatsugu Taniguchi (University of Tokyo, Japan) showed that activation of cytosolic RIG-I-like receptors selectively inhibits TLR-mediated IL-12 expression due to competitive binding of IRF3 to the IRF5 binding site on the Il12b promoter. Yasmine Belkaid (NIH, USA) described how the skin microbiota controls the local inflammatory milieu and tunes resident T-lymphocyte function to induce protective immunity against cutaneous pathogens, which are dependent on skin microbiota, but not gut microbiota. Symposium 5 covered Inflammation and DCs. Kenneth Murphy (Washington University, USA) was accidentally unable to attend the meeting due to fuel leaking problem during the flight. He safely returned to St. Louis, and his colleague Roxane Tussiwand (Washington University, USA) reported a Batf3-independent pathway of CD8α+ cDC development in Batf3−/− mice and described the molecular basis of compensatory Batf factors. Toshiaki Obteki (Tokyo Medical and Dental University, Japan) reported that MoDCs play an important role in immune system induction as well as in fine-tuning excessive immune system during infections to protect the host from self-injury. Jose A. Villadangos (The Walter and Eliza Hall Institute, Australia) demonstrated the antigen presenting functions of DC subtypes in CIITA transgenic mice, which have important implications for therapeutic DC vaccine design. Daniel Kaplan (University of Minnesota, USA) reported that LC-mediated antigen presentation is sufficient for antigen-specific Th17 generation in the presence of LC-derived IL-6, whereas langerin+ dDCs (required for the generation of CTL and Th1 cells) inhibit the ability of LCs and cDCs to promote Th17 responses.

Symposium 6 was headlined Pathogen recognition signaling and adjuvants. During a very interesting talk, Shizuo Akira (Osaka University, Japan) explained that RIG-I-like receptors (RLR) have an important role in poly I:C recognition in cDCs, leading to induce cDC death through a unique pathway involving lysosomal enzyme and IPS-1. Jie-Oh Lee (KAIST, Korea) presented on the structural biology of the Toll-like receptor family regarding ligand-recognition and activation mechanisms. Gregory Barton (University of California-Berkeley, USA) showed how the localization of endosomal TLRs is controlled as well as discussed the relevance of this regulation for self/non-self discrimination. Maria Rescigno (European Institute of Oncology, Italy) discussed DCs and bacterial handling in the intestine. She provided an overview of intestinal DC subsets. CD103+ conventional DCs become tolerogenic in the gut via their interaction with the local microenvironment and in particular, with epithelial cells. In Forum 2: Autoimmune disease (Psoriasis and SLE). Frank Nestle (King’s College London, UK) discussed skin-resident vitamin D3 inducible human DCs that are critical in tissue homeostasis and immunoregulation. He identified CD141+ dermal DCs that spontaneously secrete high levels of IL-10 and express the lymph node homing receptors CCR6 and CCR7. Virginia Pascual (Baylor Institute for Immunology Research, USA) focused on SLE, which is characterized by a breakdown of tolerance to nuclear antigens and the development of immune complexes that induce tissue damage. She stated that neutrophils and myeloid DCs from SLE patients efficiently
induce naïve B cell proliferation, isotype switch, and plasma cell differentiation.

On day 4, plenary speaker Federica Sallusto (Institute for Research in Biomedicine, Switzerland) reported two different types of pathogen-specific Th17 cells identified during in vitro priming of naïve T cells with two different types of pathogens (C. albicans or S. aureus): C. albicans-specific Th17 cells producing IL-17 and interferon-gamma (IFNγ), and S. aureus-specific Th17 cells producing IL-17 and IL-10 upon restimulation. She found that IL-1β is essential for C. albicans-induced IL-17/IFNγ-producing Th17 cell differentiation. Symposium 7 was entitled Dendritic Cells and Infectious Disease. Rafi Ahmed (Emory University, USA) explained the epigenetic regulation of PD-1 expression during CD8+ T cell differentiation by using human and murine systems of acute and chronic viral infections. Marco Colonna (Washington University School of Medicine, USA) presented data that IL-34 is a tissue-restricted ligand of CSF-1R required for LCs and microglia development. He showed keratinocytes and neurons were the main sources of IL-34. Matthew Collin (Newcastle University, UK) discussed human DC subsets in blood and tissues which are equivalent to those in mice. He showed the most prevalent genetic cause of DC deficiency is due to GATA-2 mutation. Michel Gilliet (Center Hospital University Vaudois, Switzerland) demonstrated that IL-26 regulates TLR9 activation in plasmacytoid DCs. He showed IL-26 released by Th17 cells forms complexes with extracellular DNA fragments, allowing their internalization into endosomal compartments and TLR9 activation in pDCs. To finish this symposium, Si-Yi Chen (University of Southern California, USA) presented the results of negative regulators of both cytokine receptor and TLR signaling as antigen presentation attenuators in controlling DC function. Teunis Geijtenbeek (Academic Medical Center, Netherlands) began his presentation with the C-type lectin receptors (CLRs) in infection and immunity in Forum 3 entitled Immunology in Infectious Diseases. He demonstrated that the molecular signaling pathways induced by CLRs such as DC-SIGN and dectin-1 regulate immunity to pathogens. Adolfo Garcia-Sastre (Mount Sinai School of Medicine, USA) showed that a role for tripartite motif proteins in regulating innate immune responses and pro-inflammatory cytokine secretion at multiple levels in response to viral infections. After the morning session on Wednesday, we visited Haeinsa temple located deep in the Gaya Mountains, 1 hour away from the Venue (Fig. 4). In particular, the meditation practice during the temple stay resulted in inner peace and stress-free feelings. In the evening, more than 300 participants joined the gala dinner, prepared in the venue square (Fig. 5). The Korean traditional music, dancing, and drumming performance entertained the people at the feast (Fig. 6).

On the last day, Miriam Merad (Mount Sinai School of Medicine, USA) started her plenary session with a general overview of DC subsets in the dermis, lungs and intestine in mice and humans. She discussed that granulocyte-macrophage colony-stimulating factor is essential for DC homeostasis in non-lymphoid tissue, whereas IL-34 secreted from keratinocytes is essential for LC homeostasis in the epidermis. Reinhold Förster (Hannover Medical School, Germany) opened Symposium 8 entitled DC Migration and Mucosal Immunology with imaging results of lymph node homing of DCs via afferent lymphatics. He showed that DCs enter the draining lymph node by directly penetrating the floor of the subcapsular sinus and directionally migrate into the T-cell-rich paracortex. DCs require CCR7 to leave the subcapsular sinus. Wenjun Ouyang (Genentech Inc., USA) demonstrated that IL-22 is mainly produced by innate lymphoid cells during the early stage of infection. Furthermore, IL-23 produced by DCs upon sensing C. rodentium infection is essential for IL-22 production. In addition, he discussed a novel factor produced in DCs that controls ROS production in a C. rodentium infection and EAE model. Björn Clausen (University of Medical Center Rotterdam, Netherlands) described in vivo models using DC-specific mouse mutants, such as IL-10R and TGF-BR, to analyze regulatory function and immune homeostasis. Hamida Hammad (University of Ghent, Belgium) spoke about crosstalk between epithelial cells and DCs in controlling immune responses to inhaled house dust mite (HDM) allergens. She showed mice lacking IL-1R in epithelial cells failed to mount Th2 immune responses and did not develop asthma upon HDM exposure. Allergic sensitization to HDM allergens was abolished in vivo when IL-1α was neutralized. Bart Lambrecht (VIB-Ugent, Belgium) opened Forum 4 entitled Lung (Asthma) and Mucosal Immunology describing lung DC subsets in asthma regulation. He showed inflammatory DCs and CD11b+ cDCs best present allergens, whereas CD103+ cDCs and pDCs are poor antigen presenting cells in terms of HDM allergen sensitization. Hiroshi Ohno (RIKEN Research Center for Allergy and Immunology, Japan) discussed the function and differentiation of M cells, which are a unique subset of intestinal epithelial cells specialized in mucosal antigen uptake. He demonstrated that glycoprotein 2, an M-cell-specific molecule, serves as an uptake receptor for type I piliated bacteria, including Salmonella spp and Escherichia coli.

In the closing memorial session, Kayo Inaba (Kyoto University, Japan) looked back upon the life of Ralph Steinman in association with his DC science. Jacques Banchereau (Hoffmann-La Roche Inc., USA) summarized the history of the International DC symposia, from the 1st meeting to the 12th. After President Kim awarded the prizes and travel awards, Matthew Albert (Pasteur Institute, France) advertised the DC2014 meeting (September 14–18, 2014) scheduled for Tours, France. DC2012 ended with the closing remarks of President Kim, wishing everyone safe trip home and looking forward to the next meeting (Fig. 7).

Summary

The 12th International DC symposium was held at Daegu EXCO in Korea for 5 days (October 7–11, 2012). The scientific program comprised five plenary sessions, eight symposia, four forums, three workshops, three poster sessions, and two satellite clinical trial sessions, as well as two special memorial sessions for Ralph Steinman. The symposium had 53 invited speakers, 18 workshop speakers, 28 chairs, and 429 posters. Over 900 DC
**Figure 4.** Haeinsa temple as a tour program, Wednesday afternoon, October 10, 2012.

**Figure 5.** Gala dinner in the venue square on Wednesday, October 10, 2012.
scientists and immunologists from all over the world took part in the symposium and made the meeting successful and exciting. During the symposium, social programs like the opening reception, tour program, and banquet provided enjoyable breaks from the tightly scheduled scientific program. The scientific program covered most of the current issues in the field of DC biology and related immunology. We apologize to workshop speakers and poster presenters whose findings are not mentioned here due to space limitations. The meeting was very productive and provided attendees with a better understanding of the recent progressions in the field of DC science. Nevertheless, many questions remain to be answered to remove the gaps between DC science and application of DCs to immunotherapy and fulfill the hope that DC vaccines will ultimately benefit patients with incurable diseases. On behalf of the organizing committee, we acknowledge and thank all participants and speakers. In addition, we give special thanks to financial supporters listed on the website (www.DC2012.kr).