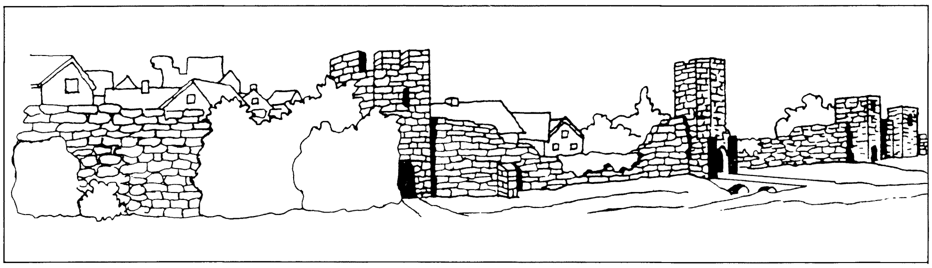
The walled town of Visby, on the Swedish island of Gotland, scene of the Second International Conference on Nucleus-Nucleus Collisions, held last summer.



CONFERENCE
Nuclear visions

Last summer, four hundred visitors of about 30 different nationalities descended on the ancient town of Visby on the Swedish island of Gotland for the Second International Conference on Nucleus-Nucleus Collisions.

The conference organizers, representing most Swedish universities and physics research institutes, had chosen to launch the conference in a surrounding of culture and history, far away from academic institutions. In his closing address, D. Scott of Michigan expressed the hope that the meeting would set a standard for future such conferences. Among other imaginative ideas, the conference fee included one week's use of a bicycle for countryside tours.

For the conference itself, sessions were organized not according to conventional topics like low, intermediate and high energy reactions, but along phenomena-related lines that brought listeners together instead of splitting them up. Examples were 'phase transitions', 'new facilities' and 'breaking nuclear matter into pieces'. This made for good participation. The concluding talk was turned into a round table session. Instead of one victim having to give a diplomatic account of everything, instead a few prominent physicists discussed the merits of different conference highlights.

The scientific success of the Visby conference was due to the interdisciplinary nature of heavy-ion research, something that was obvious at the first conference in this series, held at Michigan in 1982.

In his opening talk, D. Scott, chairman of the 1982 conference, fascinated his audience with the full story on what happens 'When Heavy Ions Collide', helped by a computer-generated cartoon.

The main theme of the conference turned out to be 'exotism' — new phenomena in nuclear matter under extreme conditions, and in particular as understood by phase transitions.

When looking for new phenomena it is necessary to have a fair understanding of how 'normal' nuclear matter behaves, and this is far from easy. A central question for creating exotic nuclear matter, such as quark-gluon plasma, or for understanding the mechanism behind supernovae explosions, is to what degree nuclei can be compressed. H.-G. Ritter, Berkeley, covered the celebrated data from the Plastic Ball and Streamer Chamber at the Bevalac, which establish the 'side-splash' of participating nucleons and 'bounce-off' of spectator fragments in heavy ion collisions at an energy of 250 MeV per nucleon (see July/August 1984 issue, page 243). The theoretical aspects were discussed by H. Stöcker, Michigan, and J. Cugnon, Liège. Most models seem to accept the data as the first signature of a compression of nuclear matter, but there are also efforts to explain the effect with a purely thermal equation of state for nuclear matter, with no separate compressional energy. More work is obviously needed before a reliable equation of state can be extrapolated into the unknown.

An understanding of how quarks and gluons react in normal nuclear matter is required to identify any possible plasma phase in future experiments at higher energies. M. A. Baldin, Dubna, reviewed the current knowledge of quark distributions in nuclei, and B. Andersson, Lund, reported on recent work to extend the popular string model of quark 'hadronization' to high energy heavy ion collisions.

There was no lack of reports on evidence for exotic nuclear matter, nor of theoretical speculations. Low energy experiments concentrate on creating and probing individual nuclei in extreme states. S. Bjørnholm, Niels Bohr Institute, reviewed pictures of the excited nucleus as a liquid and as a gas, and D. Boal, Vancouver, discussed the possibility of a mild phase transition between two such forms of nuclear matter.

There is also a special interest in high masses and high spins. The creation of giant nuclei in heavy ion collisions might open up new frontiers in physics, both by giving a new dimension to the study of nuclear forces, as discussed by S. Hofmann, GSI Darmstadt, and as a source of the supercritical electric fields necessary for vacuum decay, as reviewed by W. Greiner, Frankfurt. On the high spin side, there are new impressive data from Berkeley and Daresbury, presented by F. Stephens and J. Sharpey-Schafer, giving detailed nuclear spectra at spins as high as 40-50 units. I. Ragnarsson, Lund, discussed the possibility that this is a termination of the rotational band for some heavy nuclei at these high spin values. R. Broglia, Niels Bohr Institute, interpreted the new data as an indication that the spin-induced transition from a superfluid to a rigid rotation is not as abrupt as earlier believed. A rapidly spinning nucleus might therefore be a good place for studying the more general problem of smooth phase transitions.

Interesting things happen also at intermediate energies, and detailed analyses of various transitional phenomena, whether 'exotic' or not, will help to unify the rather scattered picture of nuclear matter in this energy region. One example was reported by J. Galin, Orsay, D. Guerreau, GANIL (Caen), and H. Nifenecker, Grenoble. In very recent experiments the energy interval of 27 to 44 MeV per nucleon has appeared as the region where the fusion peak in argon-tin reactions disappears completely, signalling a transition in the nuclear fragmentation mechanism. Another promising piece of fresh data, presented by W. Loveland, Corvallis, demonstrates that target fragments from 35 MeV per nucleon krypton-gold reactions are often similar to the projectile in both size and momentum; a correlation that seems hard to understand. A now well known phenomenon, first studied at CERN, that also needs a better understanding is the production of pions at 'subthreshold' energies — heavy ion velocities lower than those required in pure nucleon-nucleon reactions. H. Ströbele, GSI, discussed the possibility of similar investigations of sub-

Face (!) transitions when Visby Conference Chairman Ingvar Otterlund (left) collides with David Scott, who chaired the first meeting in the series, held at Michigan State University in 1982.

(Photo Gotlands Tidningar)

threshold kaon production by heavy ions.

When it comes to the much discussed transition to a quark-gluon plasma in heavy ion collisions, there is no clear experimental evidence at present, but the ambitious build-up of new experiments promises an interesting future. The programmes at Brookhaven and CERN were presented by T. Ludlam, Brookhaven, R. Stock, GSI, and H. J. Specht, Heidelberg. With the help of complicated detector systems these experiments will try to find any produced plasma. L. Van Hove, CERN, reviewed the possible experimental signals, as suggested by theorists in the field, and G. Baym, Urbana, explained the role of the quark-gluon soup in the early Universe. Our understanding of the present Universe needs a much deeper insight into the behaviour of quarks and gluons in unusual nuclear matter. Other heavy ion projects reported at Visby included the future storage ring CELSIUS in Uppsala (L. Westerberg), the Scandinavian multidetector system Nordball (B. Herskind), the powerful future machines at GSI, Darmstadt (P. Kienle), and the ambitious heavy ion programme at SATURNE (P. Radvanyi).

The Visby conference showed that there are three main sources of optimism in heavy ion physics. Firstly, the experiments have begun to highlight fundamental questions in particle, nuclear and astrophysics. Secondly, many of the problems are interdisciplinary, such as the relevance of quarks in nuclei or of particles and nuclei in astrophysics. Thirdly, many more heavy ion experiments are planned.

Those wanting to share the visions from Visby, or learn more about those newsy nuclei, could start with the conference proceedings, recently published in Nuclear Physics A.

From Sverker Fredriksson