International Conference on Nonlinear Dynamics
(New York)

An International Conference on Nonlinear Dynamics was held in New York from December 17–21, 1979, under auspices of the New York Academy of Sciences. Its organizer was Robert H. G. Helleman (The La Jolla Institute, California).

All sessions were held at the Barbizon–Plaza Hotel Theatre in Manhattan just next the southern part of Central Park so to speak in a heart of New York city. The conference was attended by many scientists of host country but many came from abroad too (totally about 400–500 participants).

No parallel sessions were held during this conference so every body could follow a whole programme running since morning till evening time without problems. It was very appreciated one can say.

A scientific conference programme was deviding into six sessions (one session-one day, except two sessions on last day):

1. Turbulence (O. Lanford III, G. Ahlers, D. Ruelle, H. L. Swinney, J. P. Gollub, K. E. Heikes, P. C. Martin, R. Kraichnan – as speakers)
2. Ergodic and Integrable Behavior (J. Moser, E. Trubowitz, M. Kac, A. Katok, J. M. Greene, H. Rüssmann, M. A. Lieberman, Ya. G. Sinai, J. L. Lebowitz, O. I. Bogoyavlenskii)
3. Physics and Chemistry (J. A. Krumhansl, R. A. Marcus, J. Ford, M. U. Berry, M. N. Rosenbluth, H. Grad, M. Month, B. B. Mandelbrot)
4. Chaotic Maps and Flows (S. Smale, R. M. May, E. N. Lorenz, S. Newhouse, J. Yorke, E. A. Spiegel, M. Brin, M. Shub, M. J. Feigenbaum, P. Collet, J. Guckenheimer, M. Misiurewicz)
5. Chemical and Fully Developed Turbulence (V. Frish, E. Siggia, C. Vidal, N. Kopell, M. Malek-Mansour)
6. Strange Attractors (Y. Ueda – the only speaker from Japan, P. J. Holmes, G. Iooss, M. Wojtkowski – presented by M. Misiurewicz)

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Looking on the schedule above one can see the problems of very wide spectrum were treated during the conference as those in conservative and dissipative dynamical systems from a unified point of view of ergodic (chaotic) kinds of behavior. To do this many sorts of systems were taken into considerations as those of physics, chemistry, and biology. A striking common feature of some kind of universality behavior for such nonlinear systems can be described only by some sophisticated mathematics. (It seemed the conference to be a little bit pushed to mathematics from this point of view.)

Although many presentations sounded to be a review of previous results one could find freshly new ones during the conference. But we can mention only very briefly some of them here.

Strikingly new results, in author's opinion, were those of E. N. Lorenz and M. Feigenbaum's findings about a way to turbulence. Lorenz has introduced a new notion of semiperiodicity* and showed that there is semiperiodicity, e.g., for the iteration of quadaratic mapping $X_{n+1} = \frac{1}{2} X_n^2 - a$ for some band of a as well as for his model of forced dissipative hydrodynamical systems – so called Lorenz model. So in light of this we have a new step on the route to turbulence – semiperiodicity. A transition from quasiperiodicity to semiperiodicity is handling by so called reverse bifurcation (Lorenz). From semiperiodicity a system is evolving directly to chaos. M. Feigenbaum presented a general theory for the fluctuation spectrum of the onset of turbulence mainly based on his previous universality theory [1]. The results so obtained are in an excellent agreement with new experimental results of A. Libchaber and J. Maurer. Even, Lorenz found some universal constants for semi-periodicity in analogy to those of Feigenbaum's universality theory.

Besides an interesting proposal was made by S. Smale on reviving the ergodic hypothesis of Boltzmann and Birkhoff. It seems one possibility to do this is by introducing a dissipation / forcing term into Hamilton's equations of physics. The problem then arises of finding a non-hamiltonian perturbation of a given hamiltonian system to produce ϵ-dense ergodic attractor.

We have many numerical indications to prove the presence of strange attractors (SA)

*A sequence X_0, X_1, X_2, ... generated by iterating a mapping is called semiperiodic of period N if, for $0 \leqslant k \leqslant N$, the sequences X_k, X_{k+N}, X_{k+2N}, ... are aperiodic and their ranges are disjoint but the ranges of X_k, X_{k+m}, X_{k+2m}, ... overlap for $0 \leqslant k \leqslant m$ when $m > N$.

in dissipative dynamical systems but one is faced with two fundamental and largely unsolved problems:

1. How does one prove SA exist?
2. Once one has SA, how does one understand the structure of the orbits it contains?

as was pointed out by Newhouse. He also pronounced some conjectures alone this line:

A) Homoclinicity $\not\Rightarrow$ an existence of SA
B) Transverse homoclinicity $\Rightarrow$ SA would exist?
C) Creation of transversal homoclinicity $\Rightarrow$ an existence of SA

An interesting result about the existence of SA for a simplified Hénon map: $f(x, y) = (1+y-a|x|, bx)$, now so called Lozi map, was proved by M. MIsiurewicz.

By construction of appropriate Markov partitions for the Lorentz gas as well as using of his previous results on billiards Ya. G. Sinai was able to prove some ergodic and kinetic properties for this dynamical system.

It is impossible to mention many other interesting communications here. The author is aware of possible subjectivism of his choice.

Let us add that "Informal communications" (15 minutes talks on new results mostly presented by young people) took place for two evenings during the conference.

Besides participants could enjoy some social events too such as "cocktail party" at City College sponsored by C. C. N. Y. (on 18^{th}), "conference dinner" where E. W. Montroll spoke on "Three hundred years of irregular motion" (on 19^{th}) and finally to attend "Wine and cheese party" sponsored by the New York Academy of Sciences (on 20^{th}).

To close one can say the conference brought together many scientists interesting in nonlinear dynamics problems and was held in a very friendly atmosphere with an open discussion on almost every problem presented there. So I think the conference has been very successful in a scientific as well as social sense.

Note that the above mentioned results as well as another talks given at this conference will be published as Proceedings of New York Academy of Sciences probably this year.

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[1] M. Feigenbaum, The Onset Spectrum of Turbulence, Phys. Lett. 74A, 6 (1979), 375