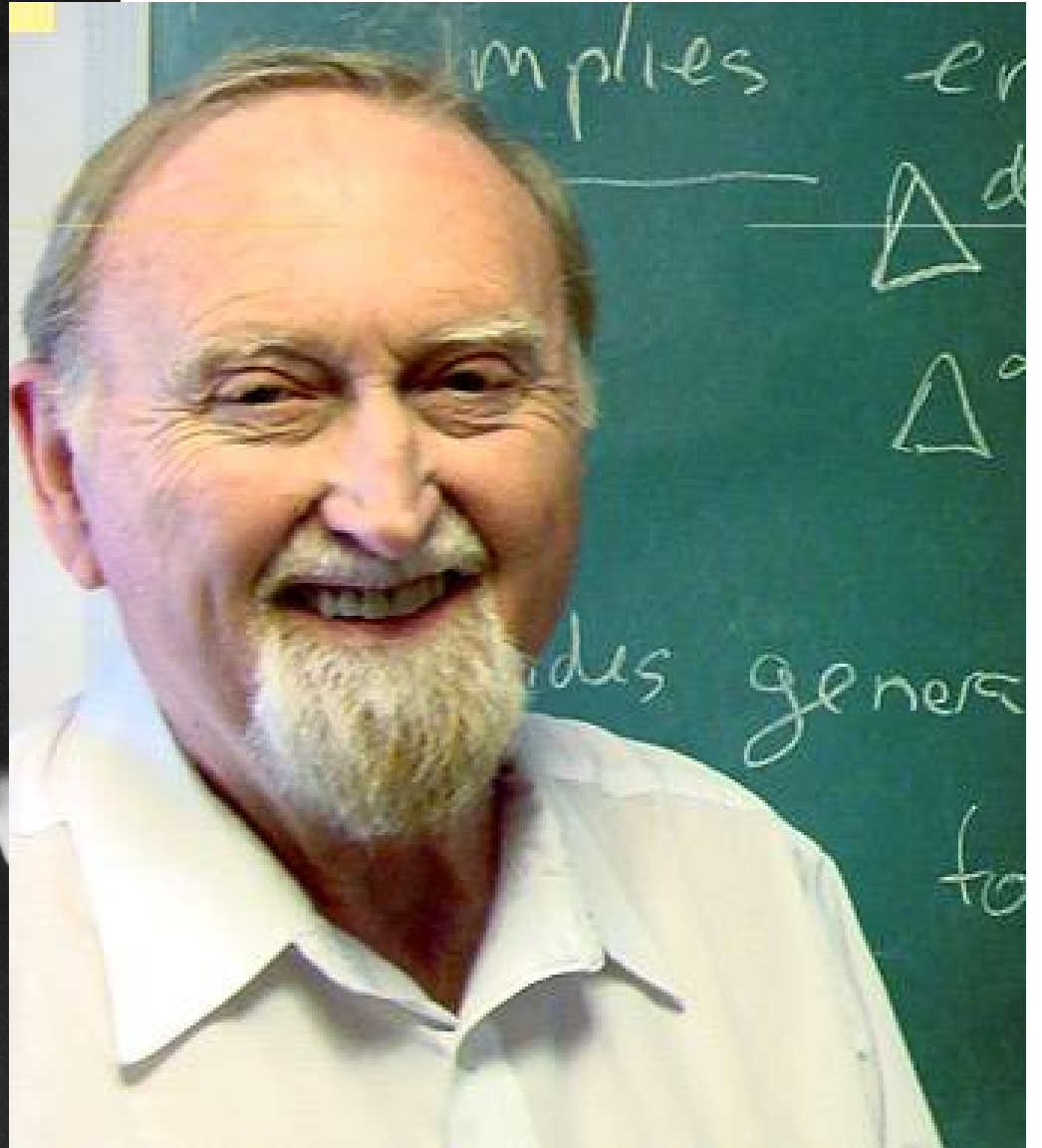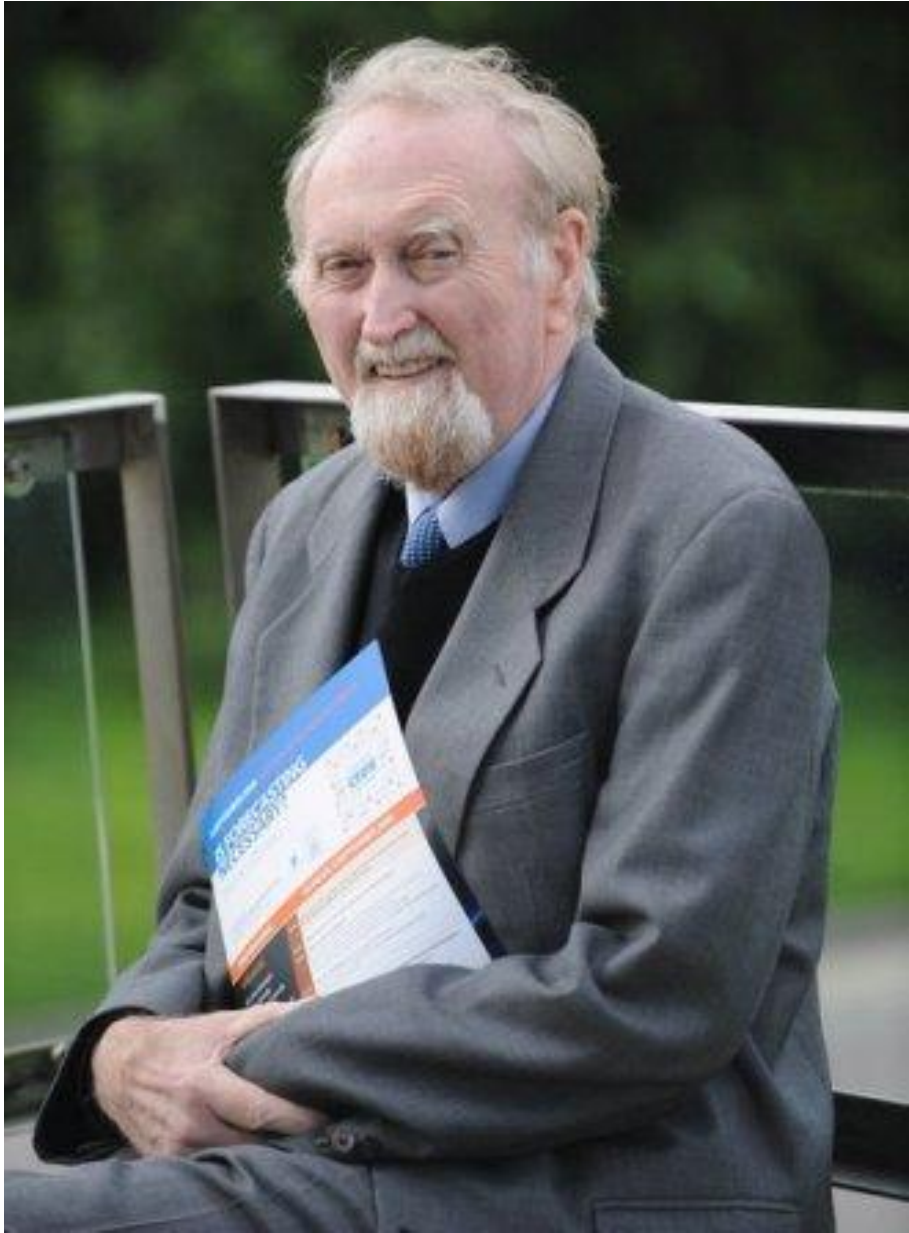# In Memoriam

Sir Clive W.J. Granger

**In Memory of Sir Clive W.J. Granger
Retrospective and Directions for Future Research
Econometrics Society & American Economic Association Special Session
Atlanta, January 2010**

Organized by Xiaohong Chen and Norman R. Swanson. Session participants: Jim Stock, Norman R. Swanson, Halbert White and Mark Watson

Speech slides and notes from Norman R. Swanson

'Nobel Laureates in Economics'

- **Sir Clive W. J. Granger (b. 1934) Econometrician**
  Nobel Memorial Prize in Economic Sciences
  Fellow of the American Academy of Arts and Sciences
  Knight Bachelor of the British Empire
  Adviser: Harry Pitt

- **Sir Harry Raymond Pitt (b. 1914) Mathematician**
  Fellow of the Royal Society
  Knight Bachelor of the British Empire
  Adviser: G.H. Hardy

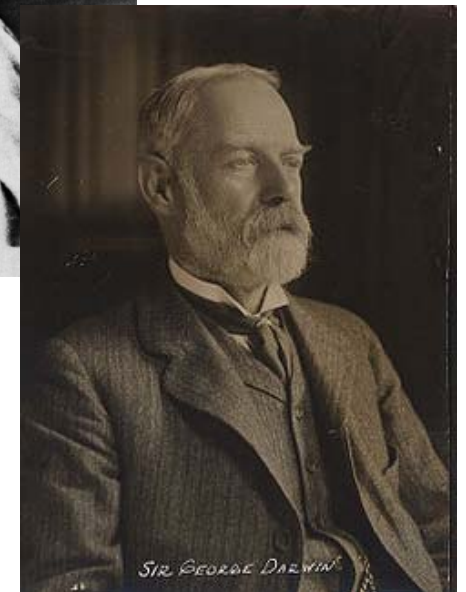- **Godfrey Harold Hardy (b. 1877) Pure Mathematician**
  Fellow of the Royal Society
  President of the London Mathematical Society
  Copley Medal of the Royal Society of London
  Adviser: E.T. Whittaker

- **Sir Edmond T. Whittaker (b. 1873) Mathematician**
  Knight Bachelor of the British Empire
  President of the Royal Astronomical Society
  Copley Medal of the Royal Society of London
  Adviser: George Darwin

Sir George H. Darwin (b. 1845) Mathematician, Astronomer
Fellow of the Royal Society
Knight Bachelor of the British Empire
Copley Medal of the Royal Society of London

- *Between 1911 and 1954 approx. 12 Copley medals were awarded in mathematics and mathematical physics, and Clive's ancestors accounted for a quarter of these. Other recipients included Einstein, Planck, Bohr, Lorentz, and Dirac.*

- *How is it that great men tend to find great men and help them to mature and reach even loftier pinnacles? Is it possible that it's due to luck?*

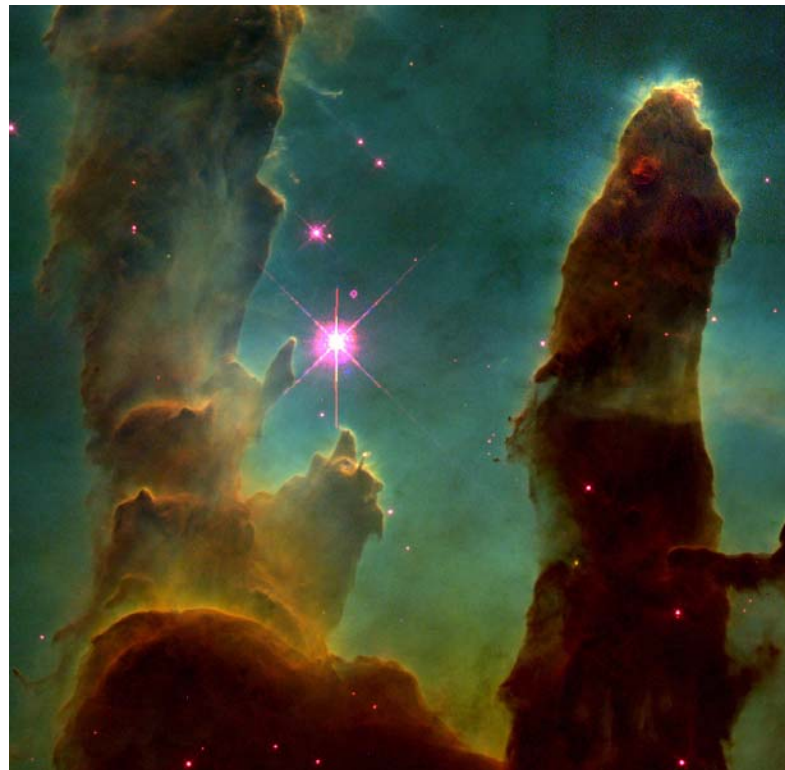- *Clive stated that his career was largely due to 10 lucky breaks.*

I think luck matters, too, but in Clive's case the idea that skill breeds luck seem oh so much more appropriate.

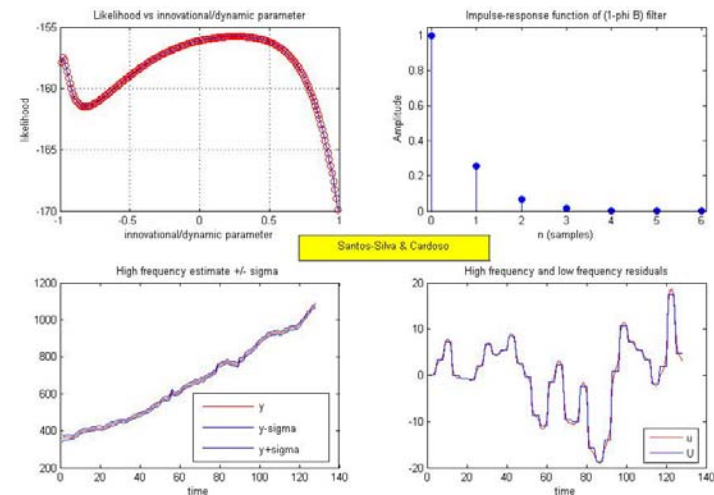*He was brilliant, stood directly upon the shoulders brilliant men, and took it one notch higher.*

He defined and directed an entire field in the discipline of economics for 50 years …
and counting …

Clive carried out research in so many areas, and not just the areas we all know and love in economics, but also physics and hydrology. This is a testament to the how broadly he transcended the breadth of his academic ancestors; he not only contributed to every topic in time series analysis of the day, but he was instrumental in launching all of the new topics that continue to face front and fore today, as well as redirecting and reinventing many extant topics of research.

- Spectral Analysis of Economic Time Series
- Seasonality in Time Series
- Long Memory
- Financial Econometrics
- Memory Properties of Financial V
- Models of Financial Time Series
- Nonlinearity and Nonlinear Models
- Time Series Methodology
- Invertibility
- Policy Model Evaluation
- Common Factors
- Nonstationary Variable Decomposition
- Causality
- Prediction Methodology including
- Forecast Combination
- Forecast Loss, Cost, and Error Functi
- Forecasting White Noise
- Forecast Accuracy Testing
- Integration and Cointegration
- Long Memory

- *Gentle giant of a man*
- *Warm, friendly*
- *A great man*
- *One of the nicest people I ever met*
- *Research giant and great teacher*
- *Spirit of openness and kindness*
- *Profound kindness and humility*
- *Generous*
- *Exceptional*
- *Inspiring*
- *Extraordinary*
- *Brilliant*
- *Genius*

The inimitable pure academic, mentor, and friend.

Do not start too high on the ladder, move to a good but not top university, work hard, have a few good ideas, choose good collaborators (I had over eighty in my career), attract some excellent students, wait twenty years or so, and then retire. It worked for Rob and I.

Sir Granger's Academic Ancestry and Speech Notes

Sir Clive William John Granger (b. 1934) Econometrician
Nobel Memorial Prize in Economic Sciences
Fellow of the American Academy of Arts and Sciences
Knight Bachelor of the British Empire

Breakthroughs in Fourier analysis, Statistical Testing Theory, Causality, Forecasting, Model Specification and Analysis, Nonstationarity, Cointegration, Long-Memory, Financial Econometrics, and almost every field in Time Series Analysis

Ph.D. awarded in 1959 from Nottingham University for thesis on Testing for Non-stationarity under Harry Pitt. Around this point, spent year in Princeton working under Oscar Morgenstern, leading to his famous book with Michio Hatanaka entitled "**Spectral Analysis of Economic Time Series**" and early work on financial econometrics, a new field of study.

Sir Harry Raymond Pitt (b. 1914) Mathematician
Fellow of the Royal Society
Knight Bachelor of the British Empire

Breakthroughs in the development of alberian and tauberian theorems dealing with infitinte series, summability and limits. Key efforts spurred by work of Norbert Wiener, among others, see e.g. "*On absolutely convergent Fourier-Stieltjes transforms*" Harry Pitt and Norbert Wiener, 1938. Wiener's work on continuous time processes underpins modern financial econometrics, the field that Clive essentially began, and his work on partial sums underpins much of unit root asymptotics.

Ph.D. awarded in 1938 from Cambridge University for thesis on General Tauberean Theorems under G.H. Hardy.

Godfrey Harold Hardy (b. 1877) Pure Mathematician
Fellow of the Royal Society
President of the London Mathematical Society
Copley Medal of the Royal Society of London

Breakthroughs in number theory and mathematical analysis (including tauberian theorems with J.E. Littlewood), including the Hardy-Ramanujan asymptotic formula, applied in quantum physics (e.g. see Niels Bohr) and to derive thermodynamic functions of non-interacting Bose-Einstein systems. Credited with being the father of the early 20th century reform of British mathematics that brought rigor to the field. Discovered Srinivasa Ramanujan and brought him to Cambridge. Even now, formulae from Ramanujan are newly being rediscovered, for example for use in modern String theory of the variety pioneered by physicists at Princeton, where Clive first did his pioneering early work on Fourier analysis and financial econometrics.

Hardy once told Bertrand Russell "If I could prove by logic that you would die in five minutes, I should be sorry you were going to die, but my sorrow would be very much mitigated by pleasure in the proof".

M.A. awarded in 1903 from Cambridge University (with major influence stated as being the famous Frenchman *Marie Ennemond Camille Jordan (b. 1838) Mathematician)*, under Edmond T. Whitaker

Sir Edmond Taylor Whittaker (b. 1873) Mathematician and Celestial Mechanics
Knight Bachelor of the British Empire
President of the Royal Astronomical Society
Copley Medal of the Royal Society of London

Credited with many discoveries in numerical analysis. In the theory of partial differential equations developed a general solution to the Laplace equation in three dimensions. Also worked in celestial mechanics decades before Clive's first paper, which happened to be in astronomy on sunspots was published (see "A statistical model for sunspot activity", Clive W.J. Granger, 1957).

Ph.D. awarded in 1895 from Cambridge University under George H. Darwin.

Sir George Howard Darwin (b. 1845) Mathematician, Astronomer
Fellow of the Royal Society
Knight Bachelor of the British Empire
President of the Edinburgh Mathematical Society
Copley Medal of the Royal Society of London

Studied the three body problem, and in particular tidal forces involving the sun, moon and earth and formulated the fission theory of the formation of the moon. Was the first to apply mathematical techniques to study the evolution of the Sun-Earth-Moon system. Second son of Emma Wedgwood and Charles Darwin.

Between 1911 and 1954 approximately 12 Copley medals were awarded in mathematics and mathematical physics, and Clive's ancestors accounted for a quarter of these. Other recipients included Einstein, Planck, Bohr and Lorentz.

How is it that great men tend to find great men and help them to mature and reach even loftier pinnacles? Certainly seems it cannot be luck!

Still, Clive in an autobiography stated that his career has largely been determined by 10 lucky breaks. I tend to think that luck always matters, and perhaps Clive did too, but in Clive's case the idea that skill breeds luck seems oh so much more appropriate. He was brilliant, stood directly upon the shoulders of brilliant men, and in every sense took it one notch higher, really defining and directing an entire field in the discipline of economics for 50 years … and counting …

Clive's secret to success, as elicited by Oscar Jorda – good taste in research. My interpretation of that, you need to know what matters.

When I asked Clive what matters 15 or 20 years ago, he said that we spend too much time on point prediction and evaluation of accuracy measures such as mean square forecast error, and that we would do well to focus on distributions – dozens of papers published at good journals have appeared since, on everything from evaluation of distributional features such as autocorrelation, skew and kurtosis, to model selection based on distributional accuracy comparison. When I asked him around the same time if real-time data mattered, he said that's a "whole new can of worms", and likewise the field has recently blossomed. I think that Clive knew what mattered already around 1960 – when many were trying to figure out how to efficiently estimate models and simultaneous sets of equations, as Clive was already thinking about long memory in financial time series, and nonstationarity in economic variables. Shortly thereafter, he decided that prediction was a key to applied time series analysis, and numerous additional strands of research spun off from that realization.

Clive carried out research in so many areas, and not just the areas we all know and love in economics, but also physics and hydrology. This is a testament to the how broadly he transcended the breadth of his academic ancestors; he not only contributed to every topic in time series analysis of the day, but he was instrumental in launching all of the new topics that continue to face front and fore today, as well as redirecting and reinventing many extant topics of research including:

Spectral Analysis of Economic Time Series

Seasonality in Time Series

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Financial Econometrics including
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Time Series Methodology
       Invertibility
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       Common Factors
       Nonstationary Variable Decomposition

Causality

Prediction Methodology
       Forecast Combination
       Forecast Loss, Cost, and Error Functions
       Forecasting White Noise
       Forecast Accuracy Testing

Integration and Cointegration

Overall, Clive cared about what mattered, and certainly not just to him, but more importantly to others. He often said that his goal was to provide results that could be usefully used by others, results that mattered in the real-word. The catch is that he knew what mattered to others, sometimes even more than they knew themselves it seemed, judging by how his ideas always percolated into the mainstream.

One example was his famous paper on nonstationarity with Paul Newbold, which met with some small amount of shock and perhaps disbelief, until later on those same academics ran their own simulations and experiments, and proved their own theorems, justifying as crucially correct all inferences Clive had made on the topic in his 1974 paper and others before and after.

Clive's penchant for research carried over into his love of teaching and advising students.

He was the ultimate advisor, which I can attest to as I was one of the dozens of students who had the luck to be one of his advisees. Clive gave incredibly to his students, both in terms of his time and his brilliance. He met all students weekly, and would answer any question, ranging from when the best time was for body surfing at the beach to whether or not chaos theory was likely to yield advances in the area of time series forecasting.

As a student and later a co-author, I was always sure that whatever I asked him, regardless of how deeply into the area he had personally delved, he would provide an answer that could not be bettered. Perhaps this was due to his uncanny ability to see through to the essence of a problem, regardless of its complexity. It always amazed me that he could tell whether a proof was correct within a few seconds, simply, it seemed, by looking at the statement of the proof. I guess that that goes along with his innate sense of knowing what mattered.

He was the variety of advisor who said, when you meekly approached him asking if he might consider you as an advisee. "OK – sure, how about you consider one of the following topics." When I went to him, he gave me a choice of two topics, and assigned probabilities of success along with probabilities that the topics would provide a high value pay-off. Of course, choosing a topic that Clive suggested was always a pretty good idea, for pretty obvious reasons! Clive even wrote a great many of the first papers of each of his students. Really, all a student had to do was jump aboard for the ride. Clive always wrote precisely, and the papers stood as they were, after one go on his pad of paper, generally. He felt that long papers were not useful, better to state an idea clearly, briefly and concisely – not unlike as is often done in physics, for example.

In truth, it's really difficult for me to put into words the love and respect that we as students felt for Clive. On the remembrance site at UCSD economics, many have commented, though, and to a one, they said the same thing, but using each different words. Quotes include:

Gentle gain of a man

Warm, friendly

A great man

One of the nicest people I ever met

Research giant and great teacher

Spirit of openness and kindness

Profound kindness and humility

Generous

Exceptional

Inspiring

Extraordinary

Brilliant

Genius

My view: All of these are correct; for me Clive was *the inimitable pure academic, mentor, and friend.*

Clive's ever modest autobiographical recipe for success:

Do not start too high on the ladder, move to a good but not top university, work hard, have a few good ideas, choose good collaborators (I had over eighty in my career), attract some excellent students, wait twenty years or so, and then retire. It worked for Rob and I.