

12th Accident Compensation Seminar 2009 Rising to the Challenge

Melbourne 22nd – 24th November 2009



Institute of Actuaries of Australia

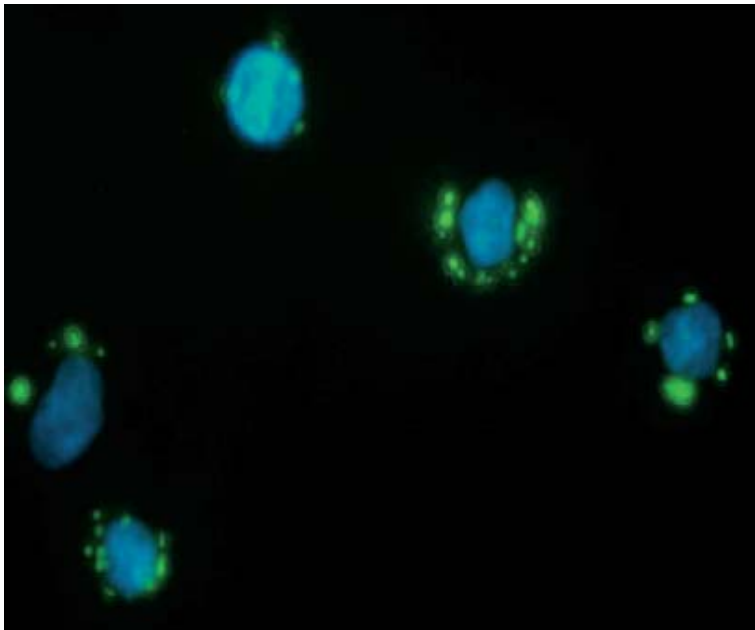


Nanomaterials, regulation and hazard:- are liability insurers condemned to repeat the past?

Andrew Richards

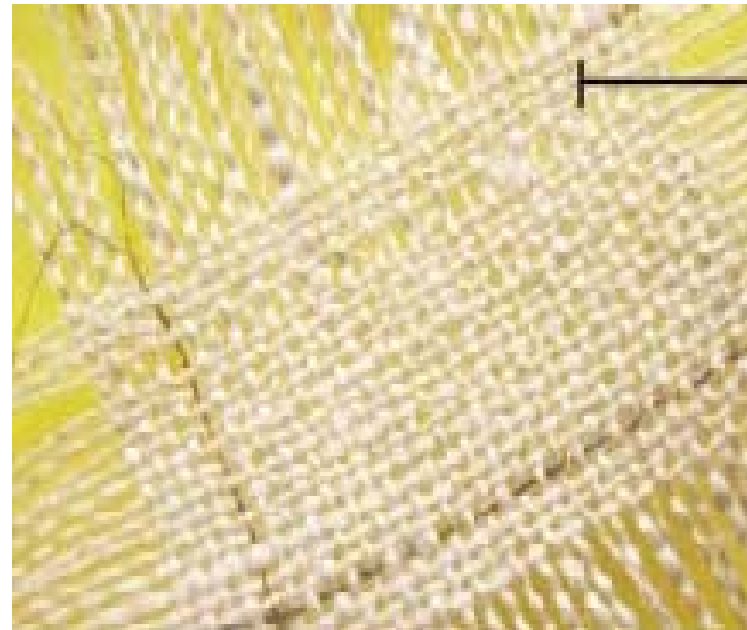


Manufactured Nanomaterials (MNs)



Nanoparticles for drug and gene delivery

Photo credit: James F Leary, University of Texas



Nanofibre super capacitors embedded into textile fabric

Project URL: <http://www.ces.clemson.edu/ssnems/ntc.htm>
<http://www.ntcresearch.org/pdf-rpts/anrp03/m03-cl07s-a3.pdf>

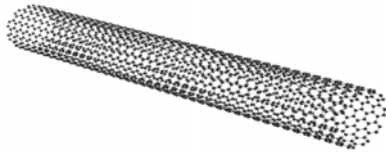


Why are MNs special?

- **Surface area-to-mass ratio**
 - **Surface electronic structure**
 - **Composition**
 - **Shape**
- **unexpected physical-chemical properties
(functionality)**



Carbon nanotubes (CNTs)



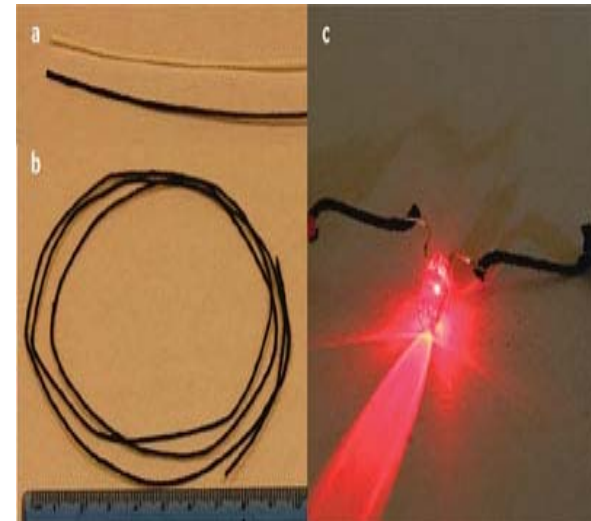
Single-walled carbon nanotubes (SWCNT)



Multi-walled carbon nanotubes (MWCNT)

CNT fibres:

- **strength-to-weight >> steel**
- **extremely stiff and durable**
- **good conductor**





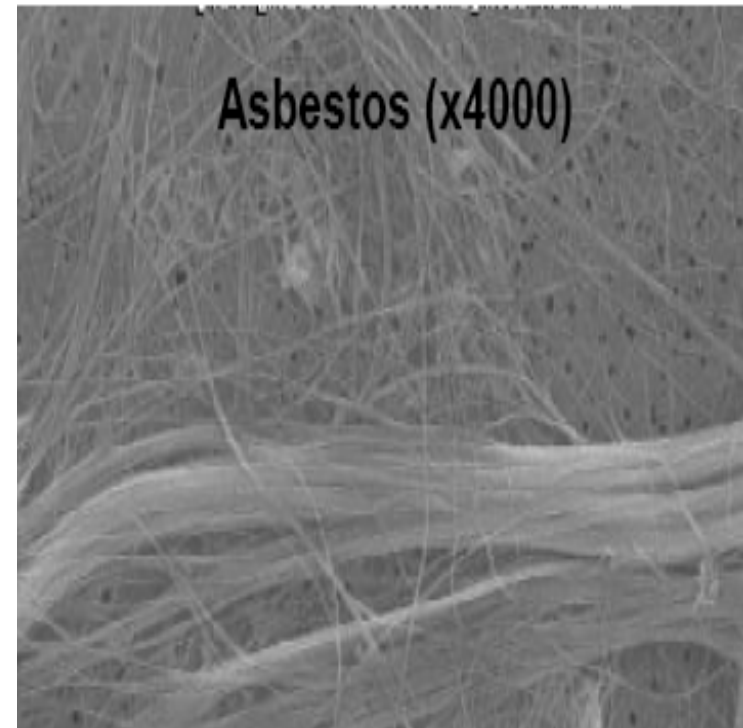
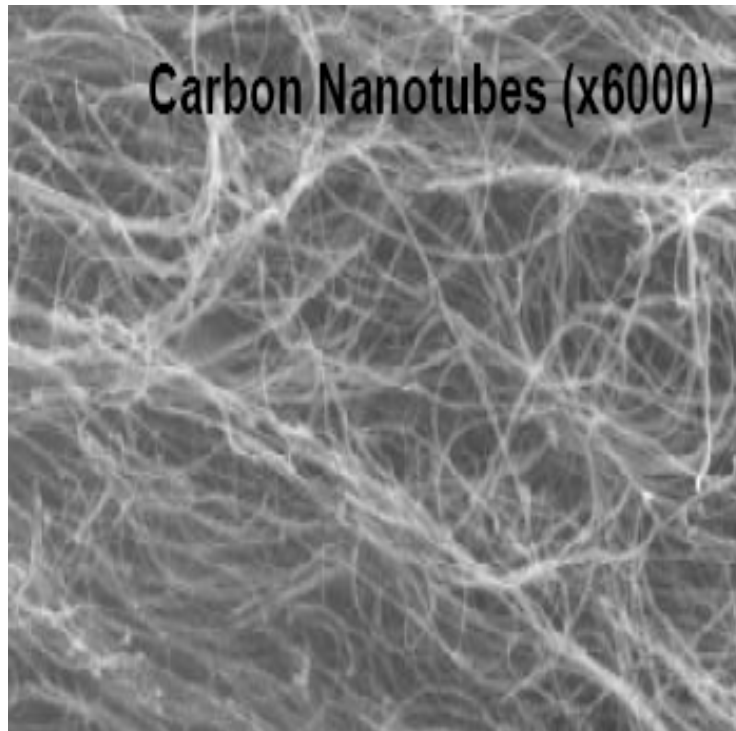
Current regulatory paradigm for MNs

Considered ‘equivalent’ to the bulk parent chemical for registration:

- **No additional safety data required**
- **Same use restrictions, OHS precautions etc.**
- **No inventory for MNs produced/ used/ supplied**



Do CNTs that look like asbestos behave like asbestos?



Source: http://ec.europa.eu/health/ph_risk/documents/ev_20081002_co03_en.pdf?bcsi_scan_F246D99C5E000224=0&bcsi_scan_filename=ev_20081002_co03_en.pdf



Two key studies

- 1. Poland C, Duffin R, *et. al.* (2008)
Nature Nanotechnology 3: 423-42**
- 2. Takagi A, Hirose A, *et. al.* (2008)
J.Toxicol. Sci. 33(1):105-116**

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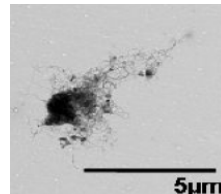
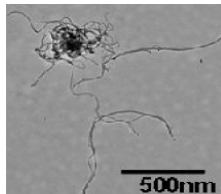
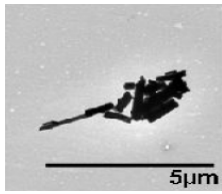


Short fibres

Short Fibre
Amosite
SFA

NanoTubes -
tangled
NT tang1

NanoTubes -
tangled
NT tang2

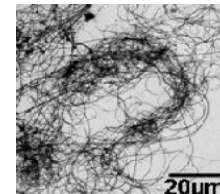
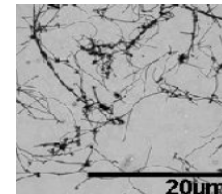
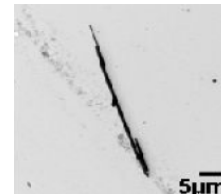


Long fibres

Long Fibre
Amosite
LFA

Nanotubes -
long 1
NT long1

Nanotube:
long 2
NT long2



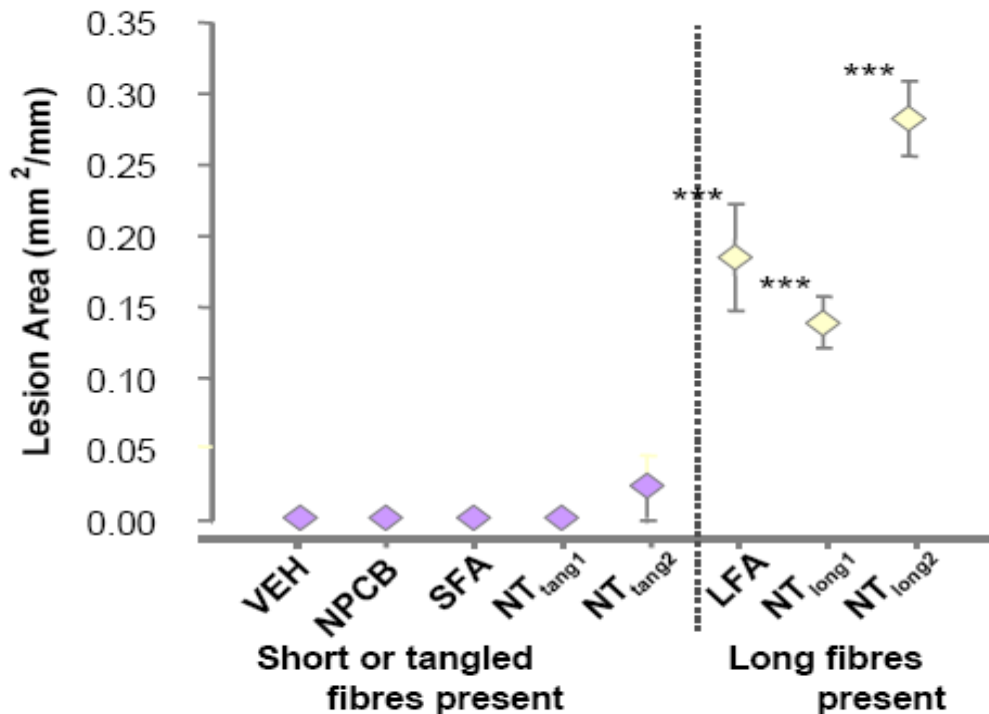
Suspension of each
material instilled into
mouse abdominal cavity

- (1) Acute inflammation
- (2) Potential for scarring (fibrosis)



Confirmed potential for fibrosis

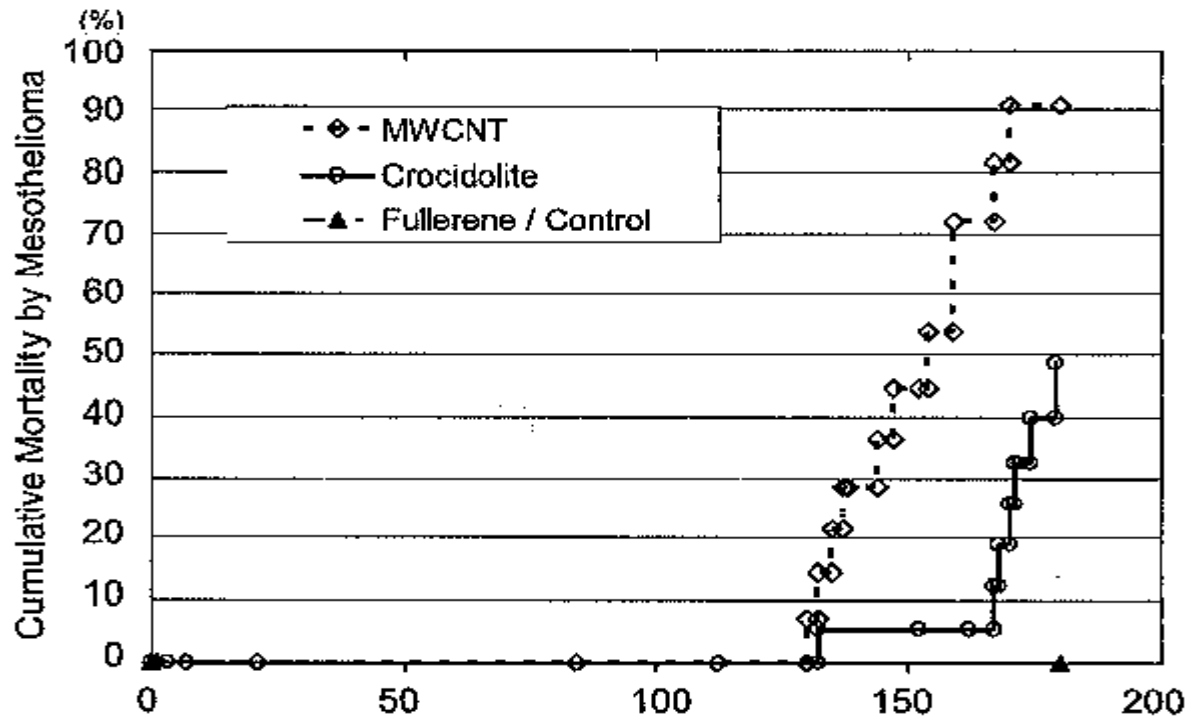
Generation of granulomas:



*** $P < 0.001$ vs. vehicle control



(2) Takagi *et. al.* 2008

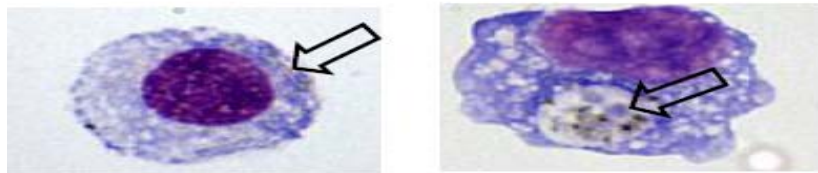
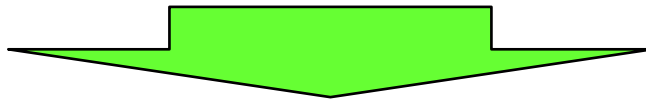
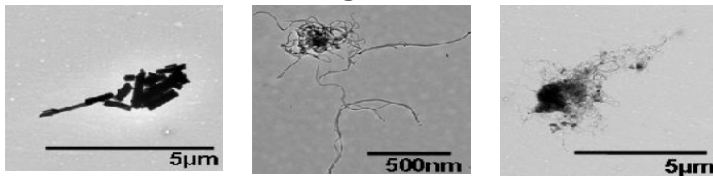


Conclusion: causative link between MWCNT and mesothelioma is established



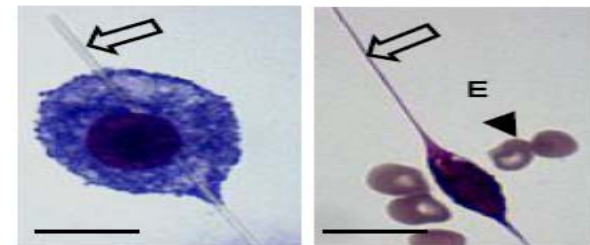
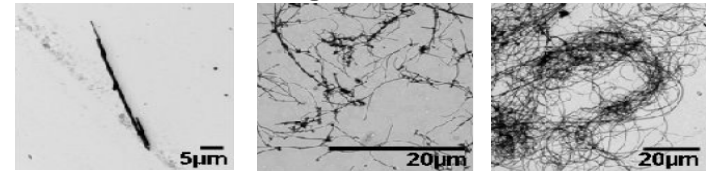
Proposed disease mechanism

Short/ tangled fibres



Cleared

Long fibres



PRO-INFLAMMATORY



Global CNT Production

	Production	Price (ton qty)
Pre-2007	<10 tonnes/yr	>\$1000/kg (US)
2009	>100 tonnes/yr	<\$100/kg
~ 2012	1000's tonnes/yr	\$10-\$20/kg

CNT volume-pricing dynamic shifting to a high volume-low margin material → diverse consumer product and manufacturing uses



CNT raw materials

Powder/ dust


Yarn

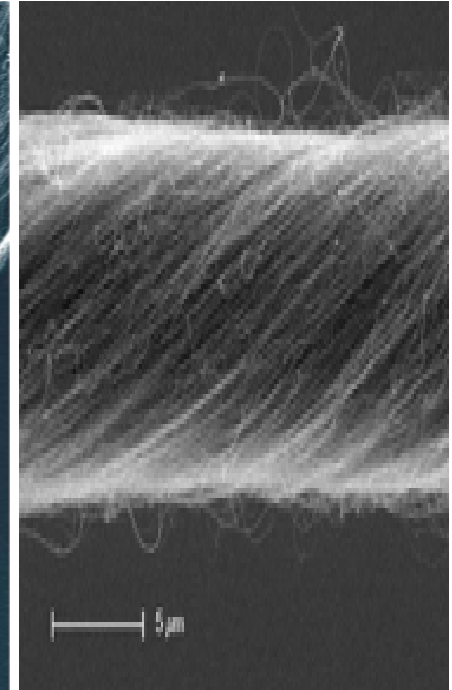
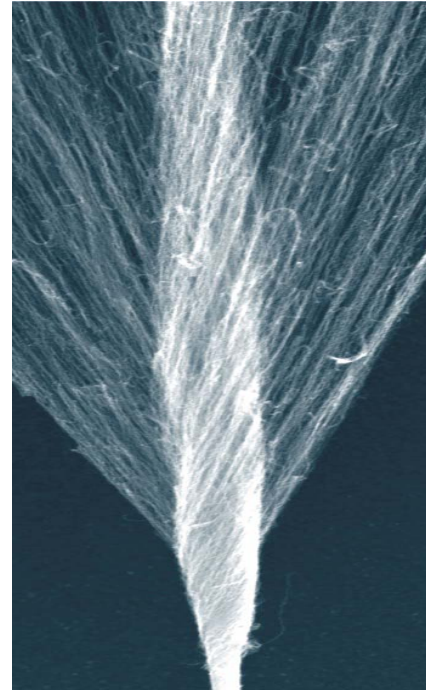
<http://www.cheaptubesinc.com/industrialgrademwnts.htm>

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Sales@cheaptubes.com

IGCNTs SSA : >110m ² /g	<i>A TEM image of our Industrial Grade Multi Walled (IGCNTs) 90wt% 20-40nm OD</i>
IGCNTs Bulk density: 0.07 g/cm ³	
IGCNTs True density: ~2.1 g/cm ³	
Industrial Grade Carbon Nanotubes -IGCNTs- >50nm OD Specifications	
IGCNTs Purity : 90wt%	
IGCNTs OD : 50-80nm	
IGCNTs ID : 5-10nm	
IGCNTs Length : 10-20um	<i>A TEM image of our Industrial Grade Carbon Nanotubes (IGCNTs) 90wt% 20-40nm OD</i>
IGCNTs SSA : >40m ² /g	
IGCNTs Bulk density: 0.05 g/cm ³	
IGCNTs True density: ~2.1 g/cm ³	



<http://www.cheaptubesinc.com/industrialgrademwnts.htm#ixzz0XFjWbCnB>

<http://www.csiro.au/files/files/p55a.pdf>
<http://www.csiro.au/science/Carbon-Nanotube-Yarn.html>

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CNT Production

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Advances in Nanotechnology - News from Industry and Academia - Jobs & Conferences



CNano Technology Commissions World's Largest Carbon Nanotube Manufacturing Plant With a Capacity of 500 Tons per Year

SANTA CLARA, CA, Jun 23, 2009 (MARKETWIRE via COMTEX) – CNano Technology (CNano) announced today at NT09: Tenth International Conference on the Science and Application of Nanotubes, that it has successfully scaled up its manufacturing technology to reach the world's largest production capacity of 500 tons per year for multiple wall carbon nanotubes. The carbon nanotube products are already in evaluation with selected customers in several markets that include electronics, automotive and energy storage.

"This manufacturing capability is an important milestone in the drive to meet current and future customer supply demands. The production line validates our technology at a much larger scale while providing a reliable large volume supply source for customers utilizing the unique properties of carbon nanotubes in their products," said Xindi Wu,

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<http://www2.marketwire.com/mw/emailprcntct?id=80AC454B401996F8>



Insurance risk

- **Workers' Compensation; related employer liability covers**
- **Product and public liability: product recall; clean-up/ removal costs; legal costs/ awards**
- **Business interruption cover – closure around removal of fittings containing CNTs (eg. textiles, painted surfaces)**



Historical Perspective

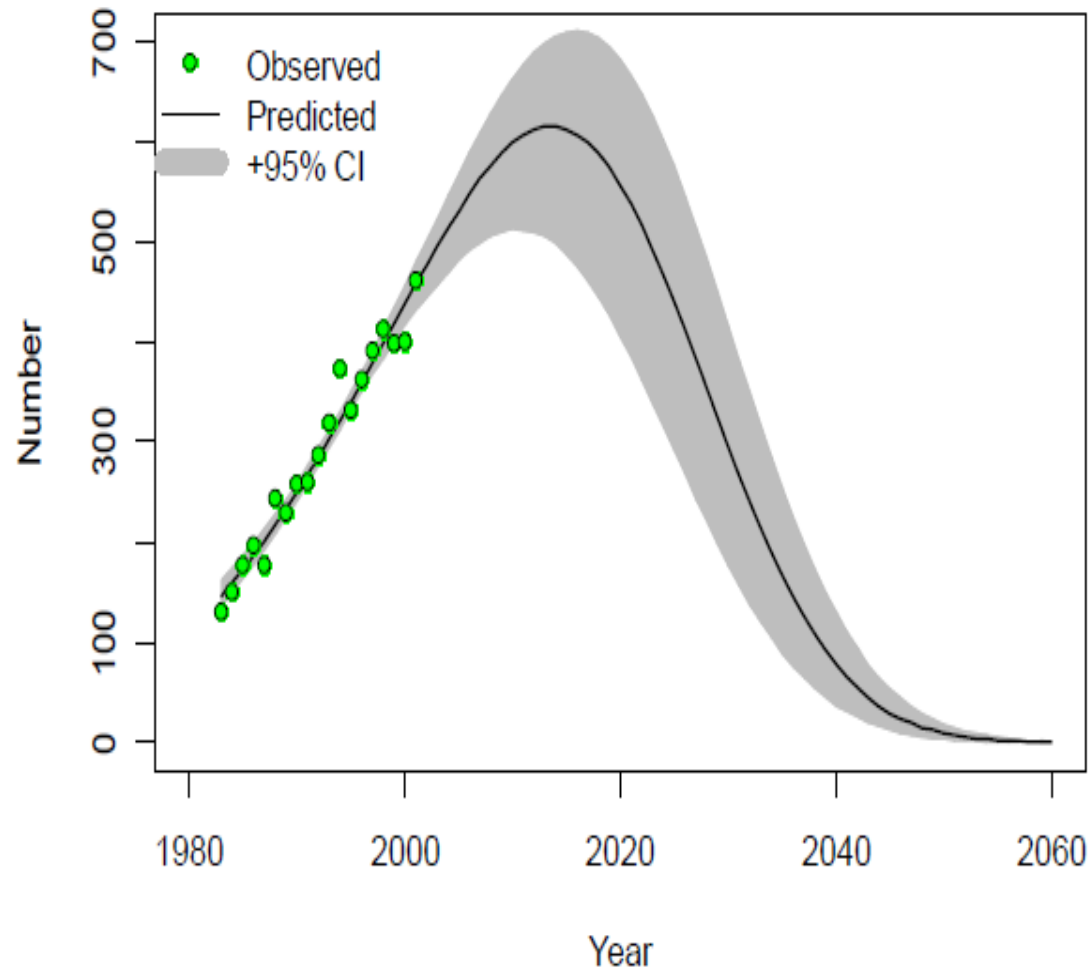


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Actuarial projections for
mesothelioma:
an epidemiological perspective

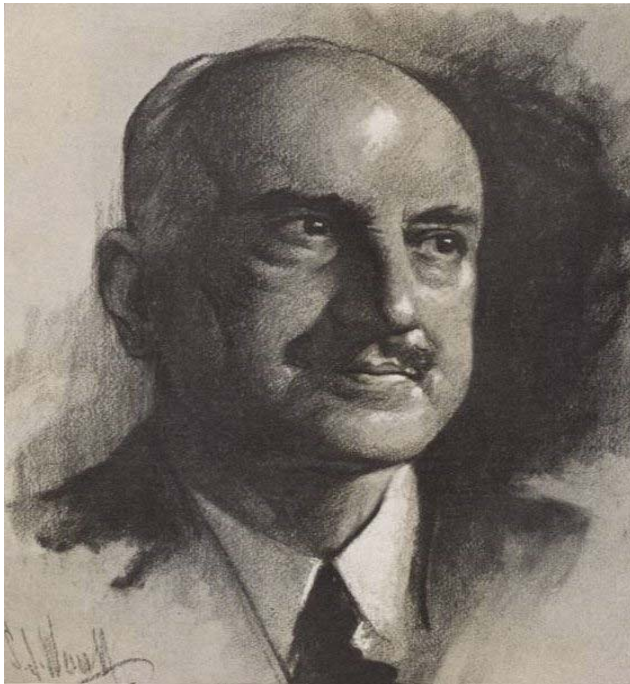
Prepared by Mark Clements, Geoffrey Berry
and Jill Shi

Presented to the Institute of Actuaries of Australia
Xth Accident Compensation Seminar 1-4 April 2007
Grand Hyatt Melbourne, Australia





Law of Repetitive Consequences



George Santayana
1863 - 1952

**“Those who cannot
remember the past are
condemned to repeat it”**

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Thankyou. Questions?