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# **New Zealand Nuclear Test Veterans Study**

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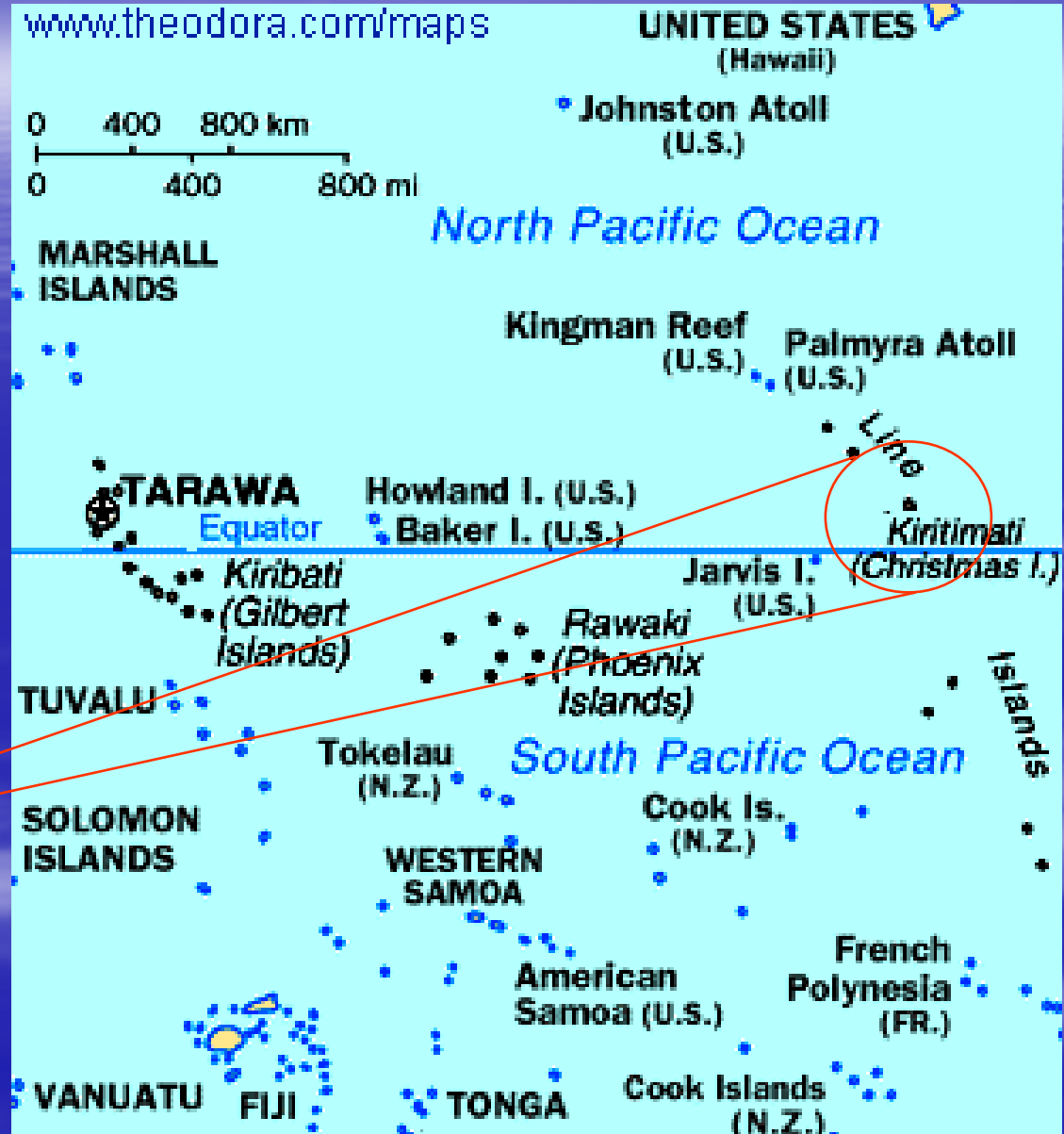


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# Location of Christmas Island



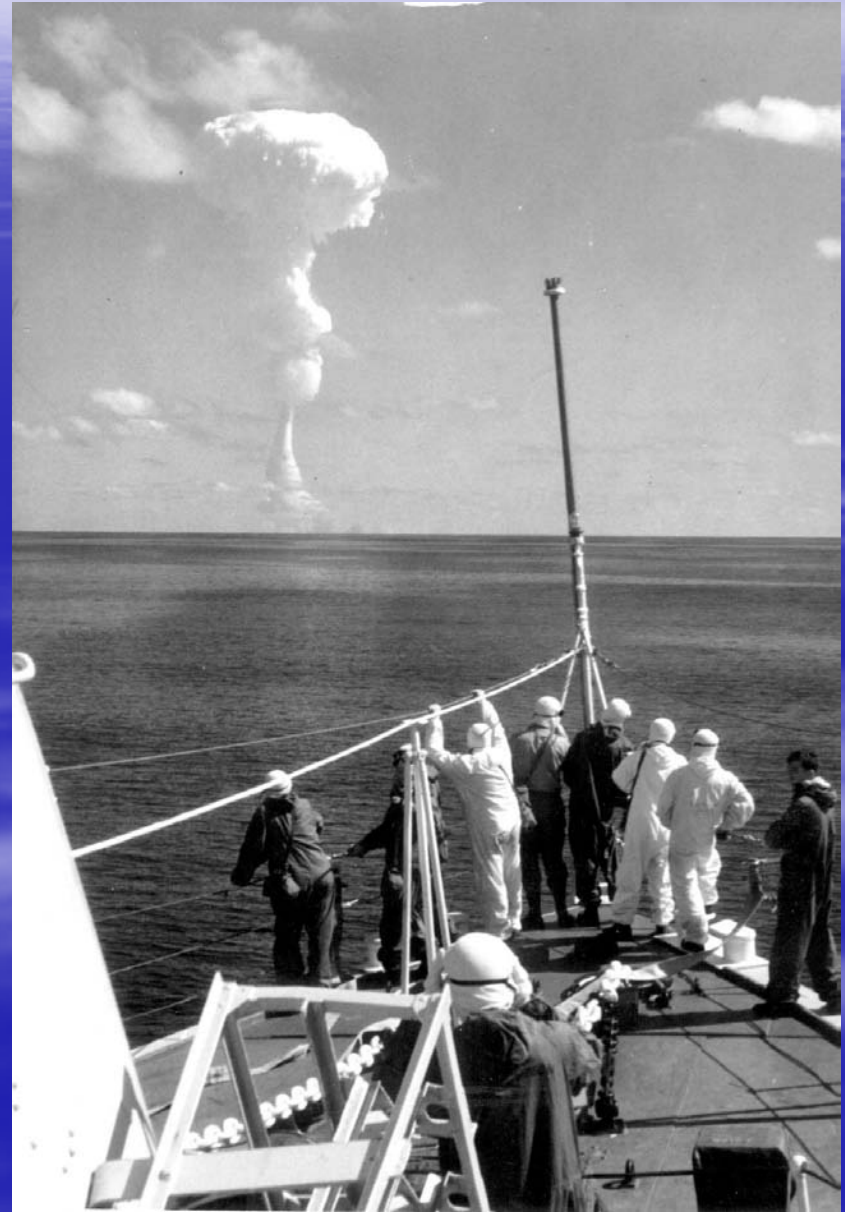
## United Kingdom nuclear weapons test in the Pacific 1957-1958 in which RNZN ships Participated

Operation	Date	Island	Height	Yield Range	Distance from ground zero in nautical miles	
					Pukaki	Rotoiti
Grapple 1	15/05/1957	Malden	2400m	Megaton	50	150
2	31/05/1957	Malden	2300m	Megaton	50	150
3	19/06/1957	Malden	2300m	Megaton	150	50
Grapple X	08/11/1957	Christmas	2250m	Megaton	132	60
Grapple Y	28/04/1958	Christmas	2350m	Megaton	80	-
Grapple Z1	22/08/1958	Christmas	450m	Kiloton	28	-
Z2	02/09/1958	Christmas	2850m	Megaton	35	-
Z3	11/09/1958	Christmas	2650m	Megaton	35	-
Z4	23/09/1958	Christmas	450m	Kiloton	20	-

**Source: Crawford (1989)**



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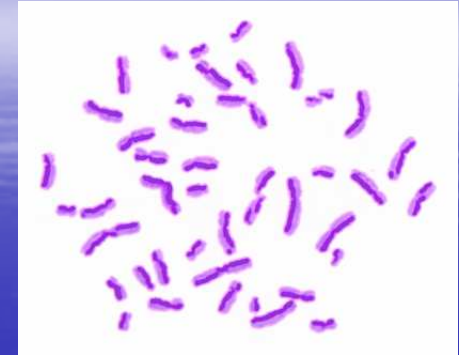


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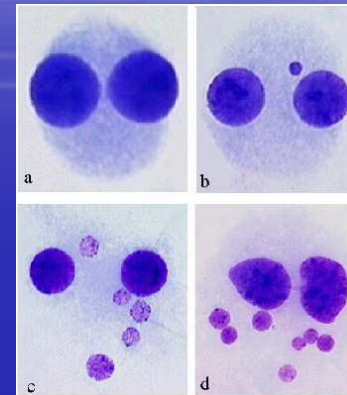


# Five assays were conducted:

## 1. Sister Chromatid Exchange (SCE)



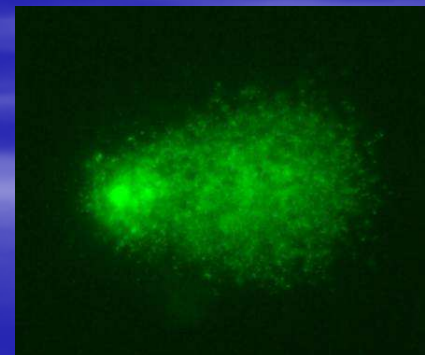
## 2. Micronucleus Assay (MN)



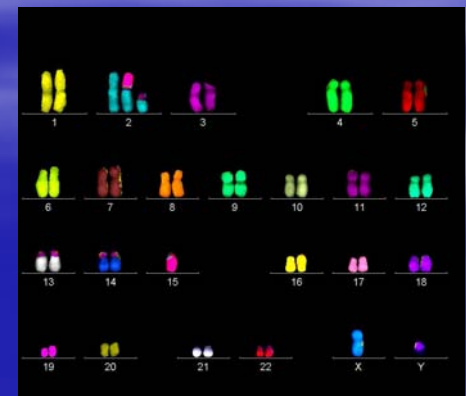
## 3. G2 Assay



## 4. COMET Assay

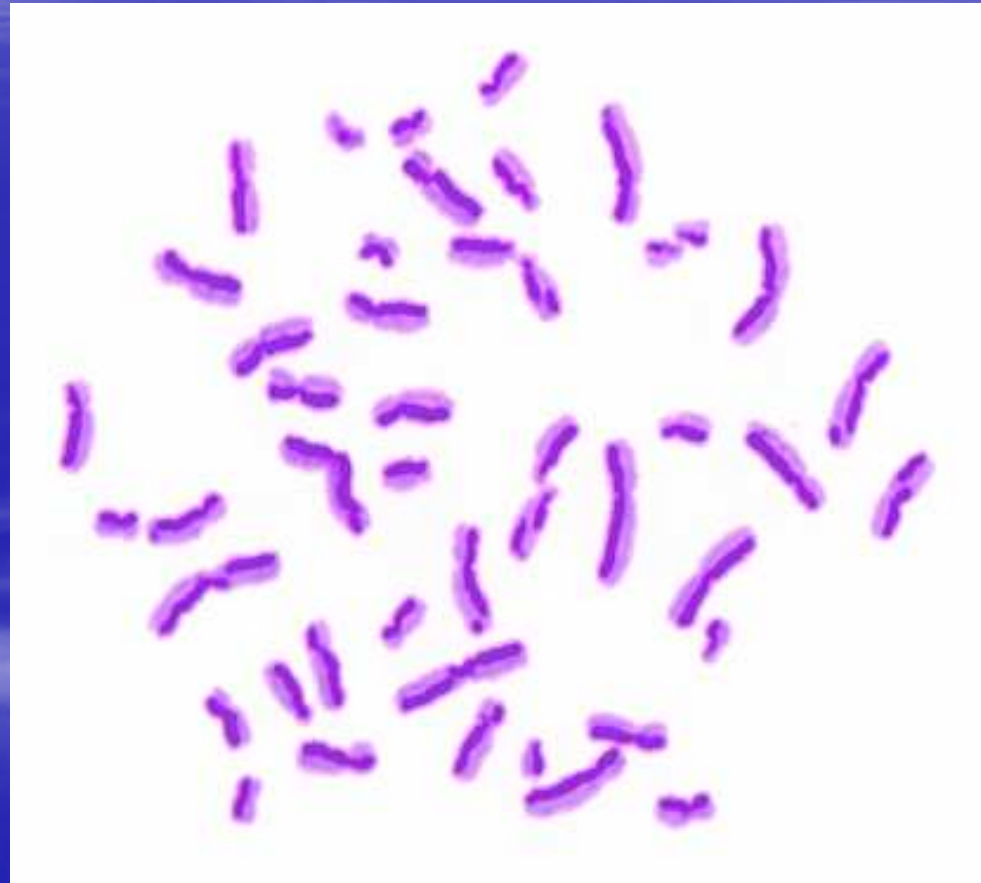


## 5. mFISH



## **Sister Chromatid Exchange (SCE)**

- **Established biomonitoring technique for clastogenicity**
- **Strong correlation between elevated SCE frequency and ill health**





# SCE Study

**The control group scored a mean of 11.07 SCEs/cell (SD=4.08) from a total of 2057 cells.**

**The veteran group scored a mean of 11.88 SCEs/cell (SD=4.42) from a total of 1635 cells.**

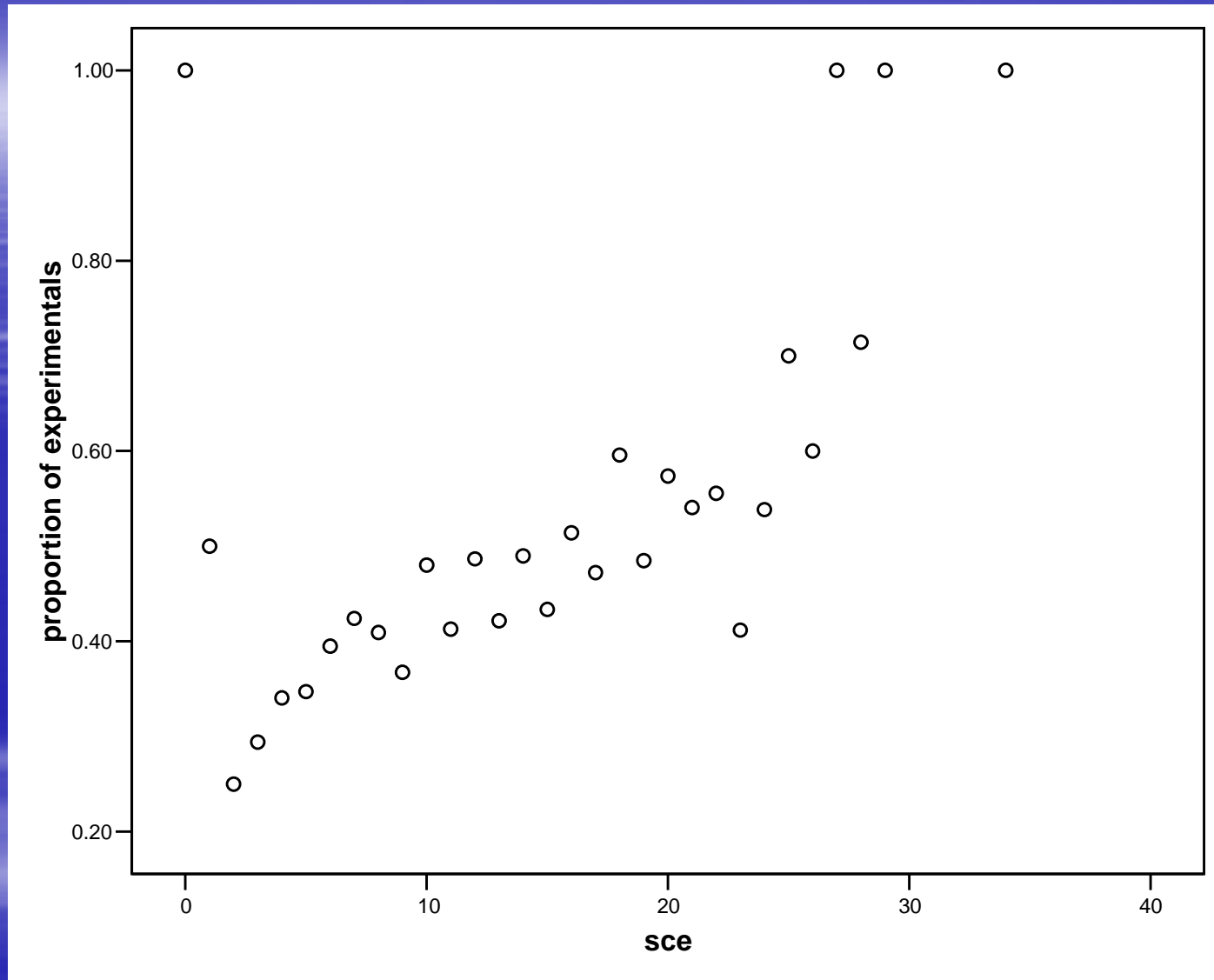
**The range of SCEs was 2 - 28 for the controls and from 1- 34 for the veterans.**

**A t-test showed that the mean SCE is significantly higher for the veterans than the controls.**

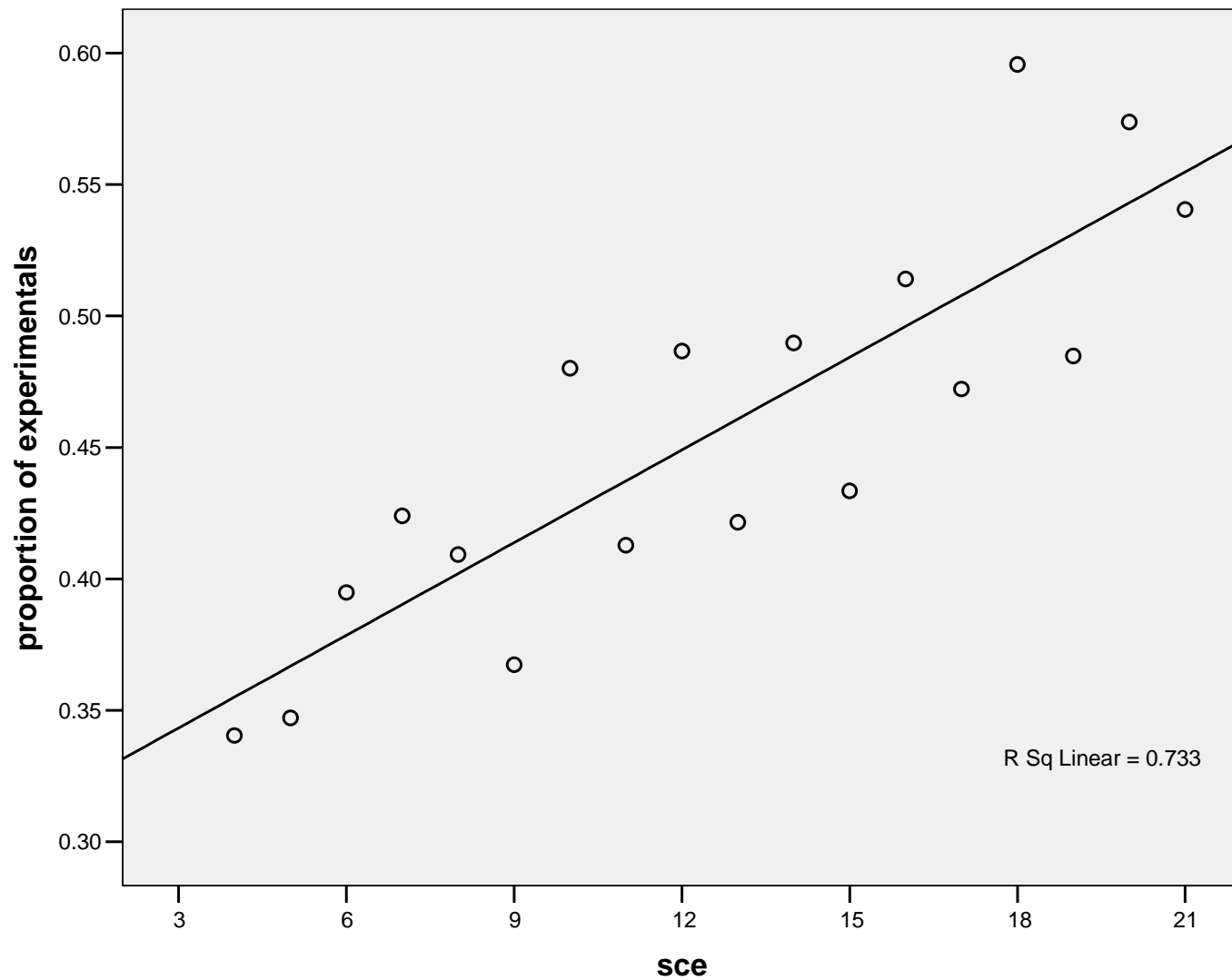
$$t = 5.741, df = 3365, p < 0.001$$

**A non-parametric (Kruskal-Wallis) test was also performed because the data distributions are not normal. This also showed a highly significant difference between the veterans and the controls.**

$$p = 0.018$$



**Graph showing proportion of experimentals compared to controls against SCE frequency**



**There are proportionately more experimentals and less controls at higher levels of damage.**

<b>GROUP</b>	<b>No. of HFCs with SCE &gt;19 over total number of cells scored</b>
<b>Experimental</b>  <b>Observed Count:</b> <b>Expected count:</b>	<b>98/1683 (5.82%)</b> <b>76.1/1633</b>
<b>Control</b>  <b>Observed Count:</b> <b>Expected count:</b>	<b>74/2057 (3.59%)</b> <b>95.9/2057</b>

The proportion of High Frequency Cells (HFCs) at the 95th percentile in both the experimentals and controls was also calculated.

The 95th percentile was at SCE = 19, thus HFCs were defined as those cells with an SCE frequency >19.

Table shows a cross-tabulation of HFCs against the experimentals and controls.

**The proportion of HFCs is higher in the experimentals (5.82%) than in the controls (3.59%).**

**A Pearson chi-square test ( $X^2 = 11.836$ ,  $df = 1$ ) shows that the difference is significant ( $p = 0.001$ ).**

**The experimentals have more than expected high-frequency cells.**



**A t-test between the experimentals and the controls for the major covariates showed no significant difference in the means for:**

**age**

**current cigarette smoking**

**alcohol consumption**

**tea/coffee intake**

**medical X-ray dosage**

# Summary of Sister Chromatid Exchange Assay

- A significantly higher frequency of SCEs was observed in a sample group of NZ nuclear test veterans compared to a non-exposed control group, but the effect size is small.
- Elevated SCE frequency in a target group is an accepted indicator of clastogenicity



## Summary of SCE assay (cont.)

- We conclude that those men who took part in Operation Grapple have incurred a small but nonetheless significant measure of genetic damage as shown by the SCE assay.
- We do not exclude the possibility that some other factor influenced the results, but we have not been able to detect it.

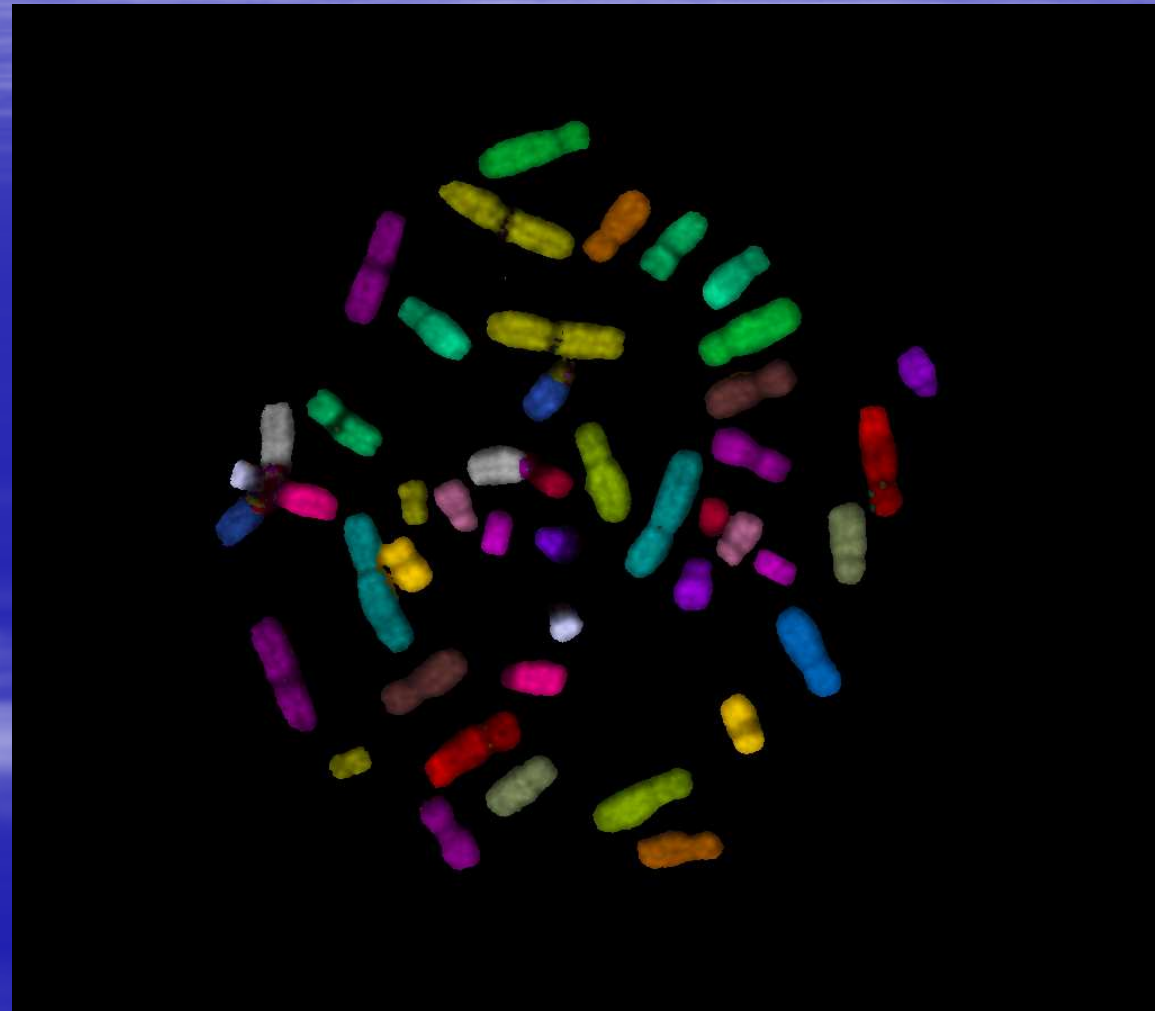
# mFISH

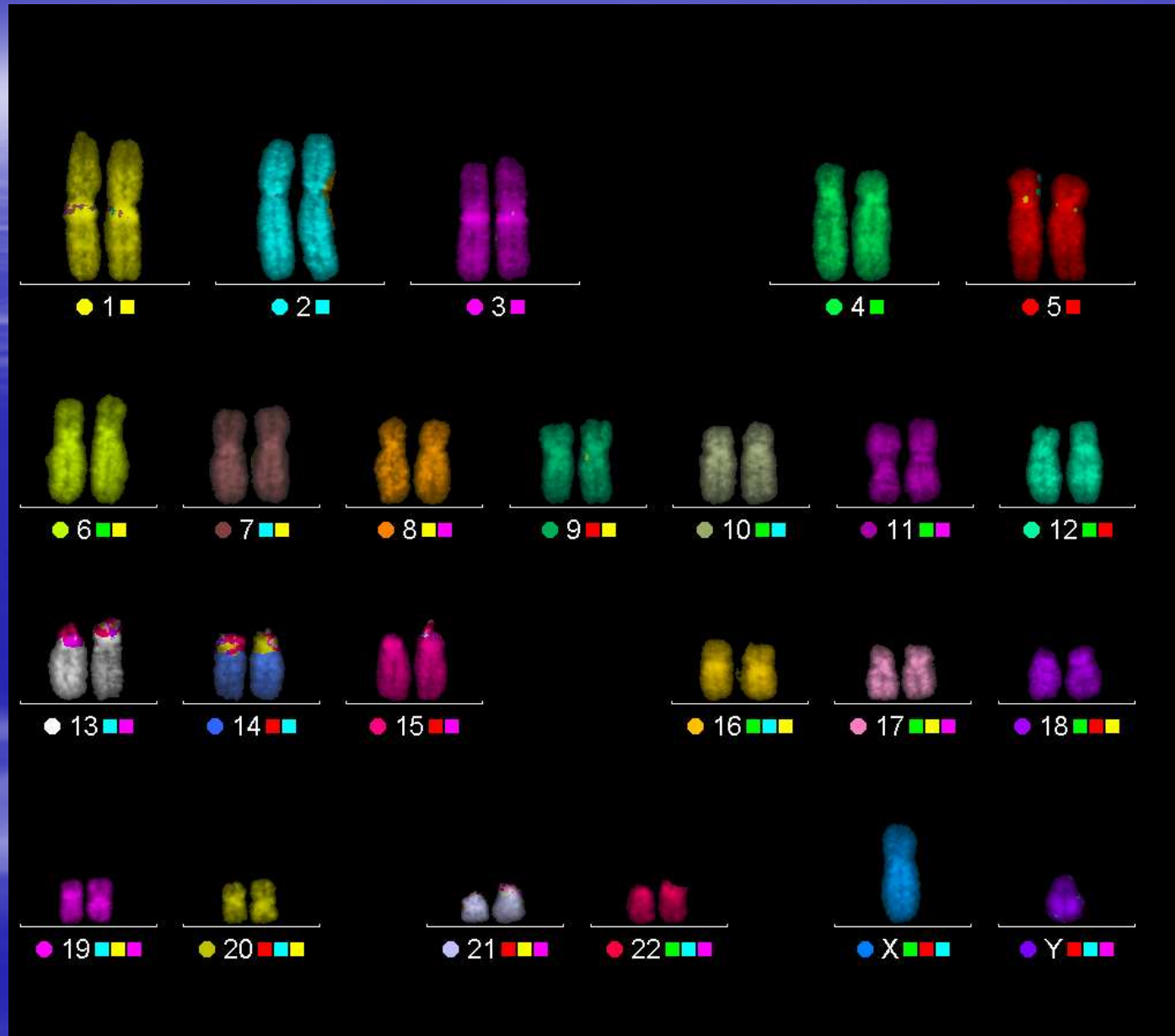
## Multicolour Fluorescent *In Situ* Hybridization

Very powerful test for  
detecting radiation damage

It is used to score number  
of translocations between  
chromosomes

Can be used to estimate  
amount of past exposure  
to radiation

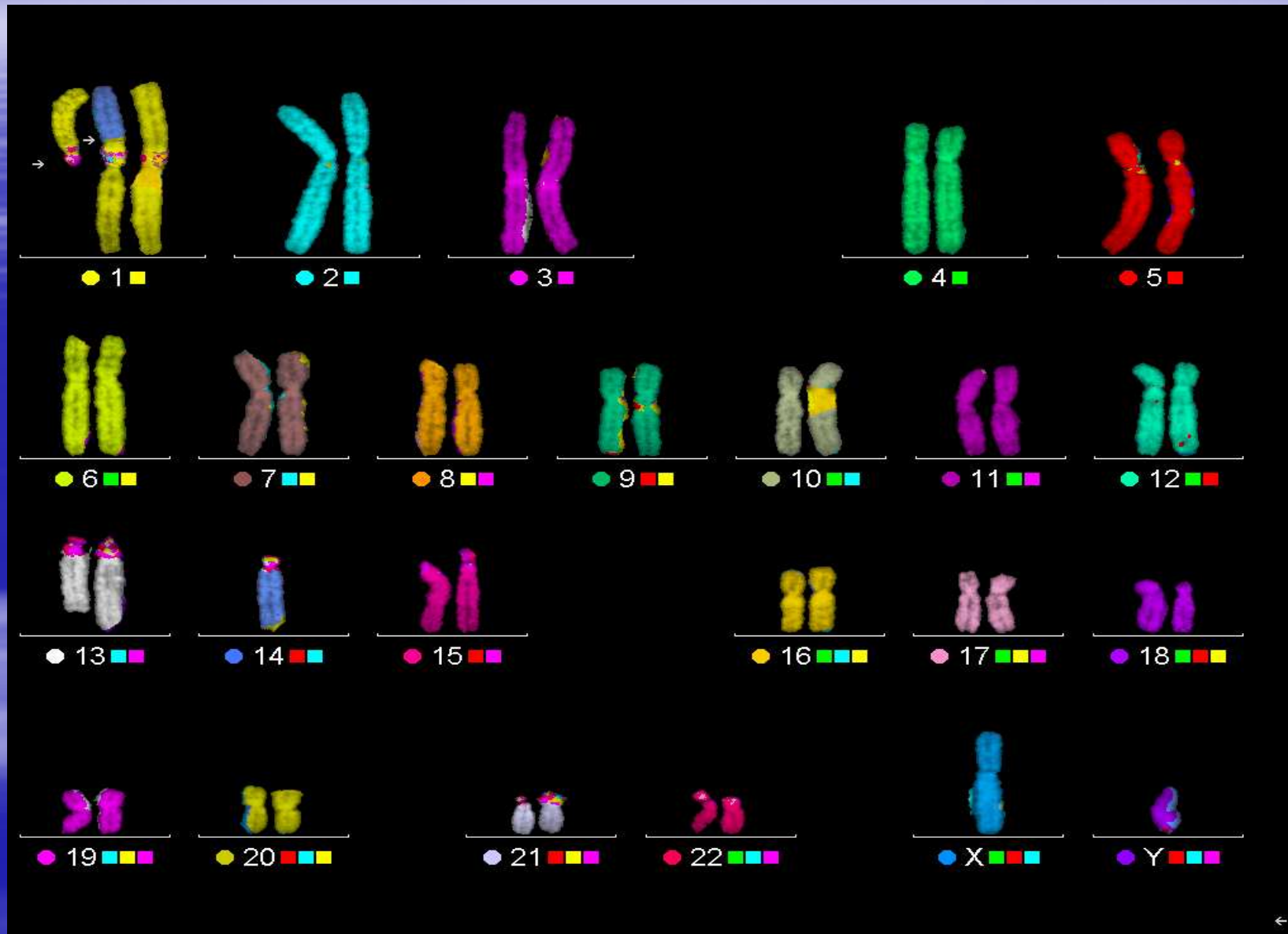


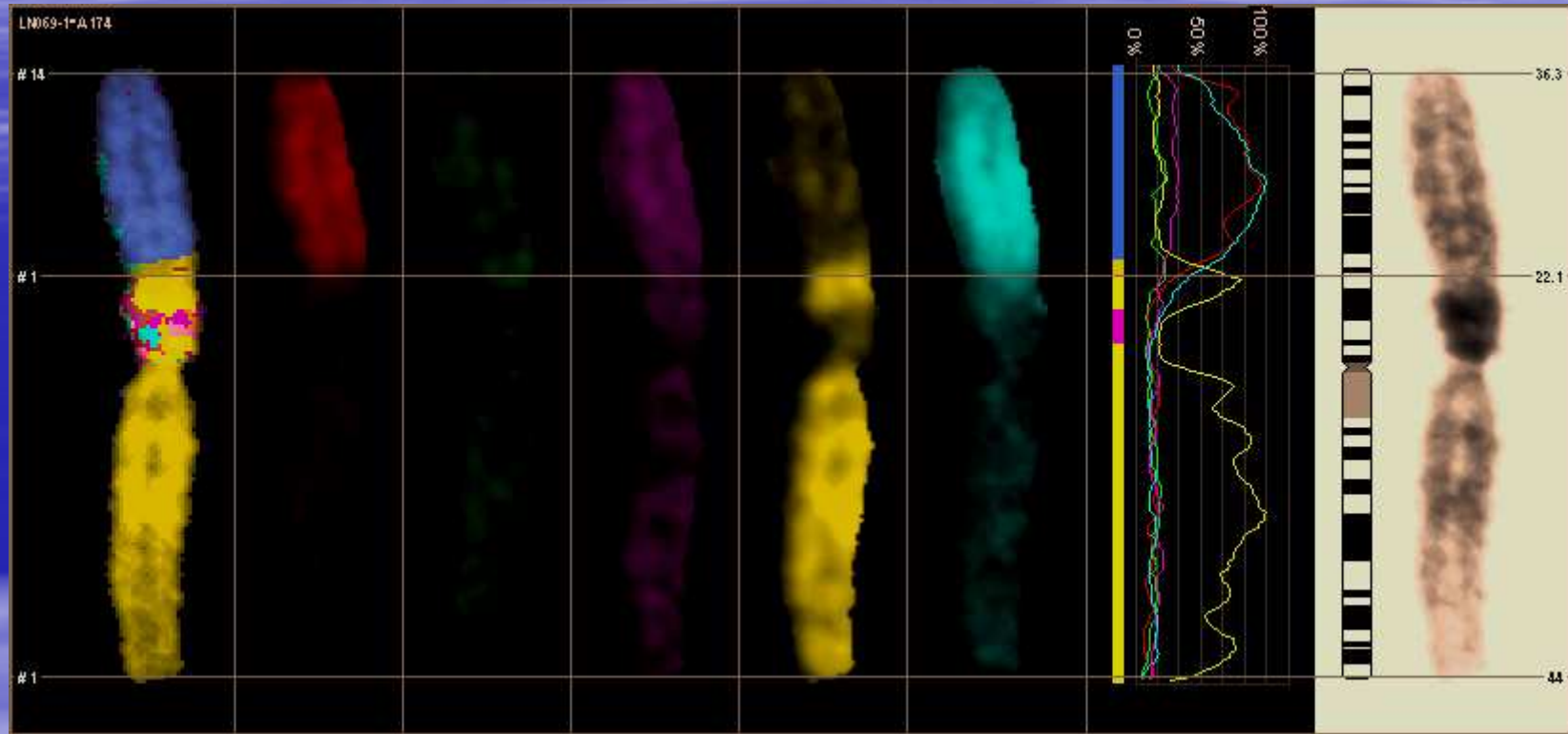




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# Progress of mFISH

- Completed 45 veterans and 15 controls
- Results are so far under an embargo until all participants are analyzed
- “Watch this space”

# **New Zealand Nuclear Test Veterans Study**

**Institute of Molecular BioSciences**

**Massey University**

**Palmerston North**

**New Zealand**

## **Researchers:**

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