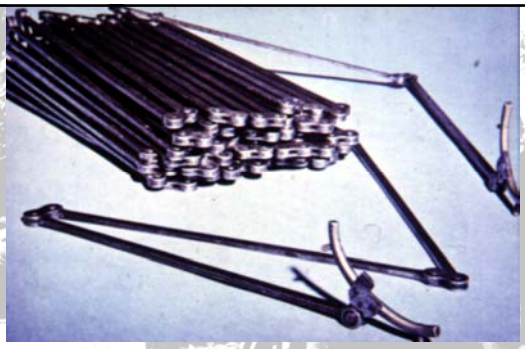
## The role of networks in changing survey teaching and practice in nineteenth century Britain and the British Empire

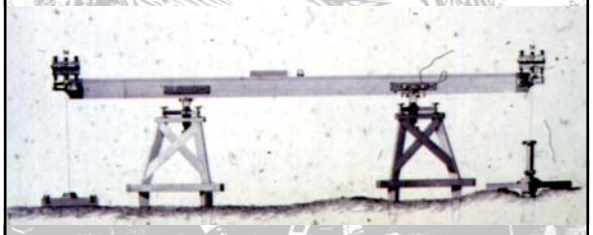
Or the fall and rise of the plane table

During the course of the 19th century there were few significant technical developments in surveying.

Any changes in survey practice in the course of the century were due to changes in ideas concerning accepted practice, or the imposition of working methods by key individuals who had the power or authority to impose their views.



Ramsden's Chain



Colby's compensating bars, first used on the Lough Foyle base in Ireland, they remained in use until the 1890s.


Lough Foyle base-line measurement in Ireland 1828

Distance measurement using catenary taping on the Caithness check base in Scotland

Chain survey in the Ordnance Survey, using the method of rectangular off-sets to survey detail. This was based on a 3rd order triangulation network, with triangles with side lengths of about 2,000 metres. The method was very time-consuming, but used very simple equipment.

Detail Survey in Austria 1783, but still in use in 1950

Plane table survey in the USA, late 19th century

Standard plane table (or Topo Board) with alidade and Indian Clinometer 1950s vintage

## So who decided which methods to use?

- Under Mudge, 1st Director of the OS, it was left to the discretion of the surveyor.
- Colby's System
  - Division of labour
  - Detail survey by chaining
  - An early example of quality management
  - No place for the plane table or traversing
  - The Colby System remained in force until 1897

## What was different in India?

- Three survey departments, one for each Presidency
- Ist survey school founded in 1783 – 50 years before something similar was founded in Britain
- Surveyors were expected to accomplish all aspects of their work, including most computations
- Surveying was a profession i.e. someone could expect to spend their entire career in survey work – in Britain it was just one aspect of a Royal Engineer's work

## What kind of training was needed for a surveyor in Britain and the colonies?

- 'Experts' were consulted
- Edward Sabine, the best connected expert of his age suggested:
  all instruments required in geodesical operations
  The transit, especially for longitude and latitude obs
  Repeating circles and repeating theodolites
  Reflecting circles and sextants
  Barometer obs
  Magnetical obs
- N.B. none of these is suitable for detail survey

## The impact of the lack of a professional body of surveyors in Britain

- Surveyors in Britain had no career path
- A posting to OS was seem as a temporary placement (Clarke was the exception)
- Career of Wilson as an example
- Crimean War the Army sails with no maps – role of Jervis
- 2nd South African War – OS officers recalled to regimental duties
- Nearly half a century of stagnation

## Survey in India

- High status, only the best candidates accepted
- A career – Andrew Waugh joined GTS in 1832, retired as Director of SoI in 1862
- The 'India method' including employment of native surveyors
- *The Manual of Surveying for India*, 1851 – revised, but not replaced until 1911 – included a memorandum on the use of the plane table

## What led to changes in Britain?

- First and foremost, the recognition that while OS methods were fine for Britain, they did not work in the Empire
- e.g. Conder and Kitchener – good control, poor detail
- How was Africa to be mapped? Problems with boundary surveys
- Role of the RGS
  *Hints to Travellers* and the introduction of survey instruction – the imposition of naval methods
- Markham, Holdich and survey training at the RGS – the use of networks to resist and make changes – the shift from Naval to SoI dominance

## What did Markham want taught?

- Use of the prismatic compass and plane table
- Use and adjustment of the sextant, transit theodolite and tacheometer
- Observations for finding time, azimuths, longitudes by Moon culminating stars, occulations of stars by the Moon, eclipses of Jupiter's satellites.
- Traverse surveying with transit theodolite and tacheometer
- Determination of heights and distances by trigonometry

## What Holdich wanted 1

- Methods of rapid base measurement for the extension of theodolite triangulation
- The use of the theodolite for determining
  Latitude
  Time
  Azimuth
  Longitude (Moon culminating stars)
  Ordinary triangulation, including heights
- The proper use of angle books and keeping records, as well as all the computations connected with the above

## What Holdich wanted 2

- The theory of longitude by Telegraph
- Barometric heighting
- The projection of plane table sheets for geographical purposes
- The use of the plane table for topography including the determination of compass error, the use of the clinometer etc

## Charles Close and the rise of the plane table

- Report of 1892 and the role of Dalton
- Ardagh in India
- Close posted to India and trained in India methods
- Irrawaddy survey
- 2nd South African War and the Survey of Orange River Colony
- Close appointed Instructor in Surveying in Chatham – reforms along Indian lines
- *Textbook of Topographical and Geographical Surveying* (1905)

## Conclusions

- For much of the 19th century survey training in Britain was inadequate
- It lacked a professional body of surveyors comparable to that in India
- Initial reform, when they came, were dominated by the Naval/explorer lobby and not suited to the needs of Empire
- The rising power of the 'Indian lobby' brought practice into line with India and Europe, and produced a body of surveyors equipped to meet the challenges of the 20th century